United States Department of the Interior
U.S. FISH AND WILDLIFE SERVICE
Fairbanks Fish and Wildlife Field Office
101 12th Avenue, Room 110
Fairbanks, Alaska 99701

September 18, 2013

Janet Post
Regulatory Specialist
U.S. Army Corps of Engineers
District Office
Elmendorf Air Force Base, AK 99506

Re: Biological Opinion for 2013 modifications to UIC's Barrow Camp

This document transmits the U.S. Fish and Wildlife Service's (Service) revised Biological Opinion (BO) on a proposal by UMIAQ, LLC., on behalf of Ukpeagvik Inupiat Corporation (UIC) to modify an existing 60-person housing camp near Barrow, Alaska. The Service previously consulted on this project in a BO dated April 16, 2012, however re-initiation is necessary because the project description and timing have changed. The Service's April, 2012 *not likely to adversely affect* determination for polar bears (*Ursus maritimus*) remains valid because changes to the proposed action would not increase project effects on polar bears. However the proposed placement of additional gravel infrastructure may increase project impacts to listed eiders.

Therefore, this BO describes effects of the proposed modifications on listed spectacled (*Somateria fischeri*) and Alaska-breeding Steller's eiders (*Polysticta stelleri*), pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). The Service has determined that the proposed action *may adversely affect* listed spectacled and Alaska-breeding Steller's eiders. Following review of the status and environmental baseline of listed eiders, and analysis of potential effects of the proposed action to these species, the Service has concluded the proposed action *is not likely to jeopardize* the continued existence of spectacled or Alaska-breeding Steller's eiders.

A complete administrative record of this consultation is on file at the Fairbanks Fish and Wildlife Field Office, 101 12th Avenue, Fairbanks, Alaska, 99701. If you have comments or concerns regarding this BO, please contact Ted Swem, Endangered Species Branch Chief, Fairbanks Fish and Wildlife Field Office at (907) 456-0441.

Sincerely,

Ted Swem

Ted Swem
Branch Chief
Endangered Species

BIOLOGICAL OPINION

for

BARROW CAMP: 2013 PROJECT MODIFICATIONS

Consultation with
U.S. Army Corps of Engineers
Alaska District
Anchorage, Alaska

Prepared by:
Fairbanks Fish and Wildlife Field Office
U.S. Fish and Wildlife Service
101 12th Ave, Room 110
Fairbanks, AK 99701

September 18, 2013

Table of Contents

List of Figures

List of Tables

1. INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) revised Biological Opinion (BO) on a proposal by UMIAQ, LLC., on behalf of Ukpeagvik Inupiat Corporation (UIC) to modify an existing 60-person housing camp near Barrow, Alaska. Because the project will impact waters of the United States, UIC has requested a section 404 permit from the U.S. Army Corps of Engineers (USACE). The Service previously consulted on this project in a BO dated April 16, 2012, however, re-initiation is necessary because the project description and timing have changed. The Service's April, 2012 *not likely to adversely affect* determination for polar bears (*Ursus maritimus*) remains valid because changes to the proposed action would not increase project effects on polar bears. However the proposed placement of additional gravel infrastructure may increase project impacts to listed eiders.

Therefore, this BO describes effects of the proposed modifications on listed spectacled (*Somateria fischeri*) and Alaska-breeding Steller's eiders (*Polysticta stelleri*), pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). We used information in the permit application provided to the USACE; project-specific communications with the applicant and USACE; other Service documents; and published and unpublished literature to develop this BO.

Section 7(a)(2) of the ESA states that Federal agencies must ensure that their activities are not likely to:

- Jeopardize the continued existence of any listed species, or
- Result in the destruction or adverse modification of designated critical habitat.

The Service has determined that the proposed action *may adversely affect* listed spectacled and Alaska-breeding Steller's eiders. Following review of the status and environmental baseline of listed eiders, and analysis of potential effects of the proposed action to these species, the Service has concluded the proposed action *is not likely to jeopardize* the continued existence of spectacled or Alaska-breeding Steller's eiders.

If you have comments or concerns regarding this BO, please contact Ted Swem, Endangered Species Branch Chief, Fairbanks Fish and Wildlife Field Office at (907) 456-0441.

2. DESCRIPTION OF THE PROPOSED ACTION

Project Description

Proposed modifications include construction of a 2.87 acre pad for additional housing and an associated 1.78 acre access road adjacent to the existing 60-person camp (Figure 2.1). The proposed pad would require approximately 22,000 cubic yards of fill material and provide space for housing 100 people with associated support structures for waste water, potable water, a generator, fuel tank, equipment storage, and vehicle parking. Additional communication towers are not planned, however if a tower were necessary it would be free-standing without guy wires.

The access road would require approximately 7,800 cubic yards of fill material and all gravel would be sourced from the existing Barrow material pit. The proposed work is scheduled to begin in the fall of 2013 with an estimated completion date of December 20, 2013.

Mitigation Measures

Conservations measures that UIC plans to implement to reduce potential impacts from project modifications to listed species and other wildlife are listed below:

- Construction activities would not occur on undisturbed tundra from June 1 through August 10 to avoid impacts to nesting migratory birds;
- Powerlines would be buried and no overhead powerlines are planned;
- Exterior lighting would be hooded to minimize outward radiating light; and
- UMIAQ will follow a project specific Polar Bear Conflict Avoidance Plan which provides:
  - Procedures for early detection of bears, and avoidance of close encounters;
  - Procedures for minimizing bear attractants; and
  - Procedures for responding safely to bear encounters.

Action Area

The area is approximately 0.7 mi (1.13 km) south of Barrow, Alaska (Figure 2.2) east of the intersection between Nunavak and Emaiksoun roads. It includes the existing housing pad as well as proposed pad and road additions. The action area also includes the area within which listed eiders may be affected by disturbance associated with the proposed action. This zone of influence is assumed to be 200 m.

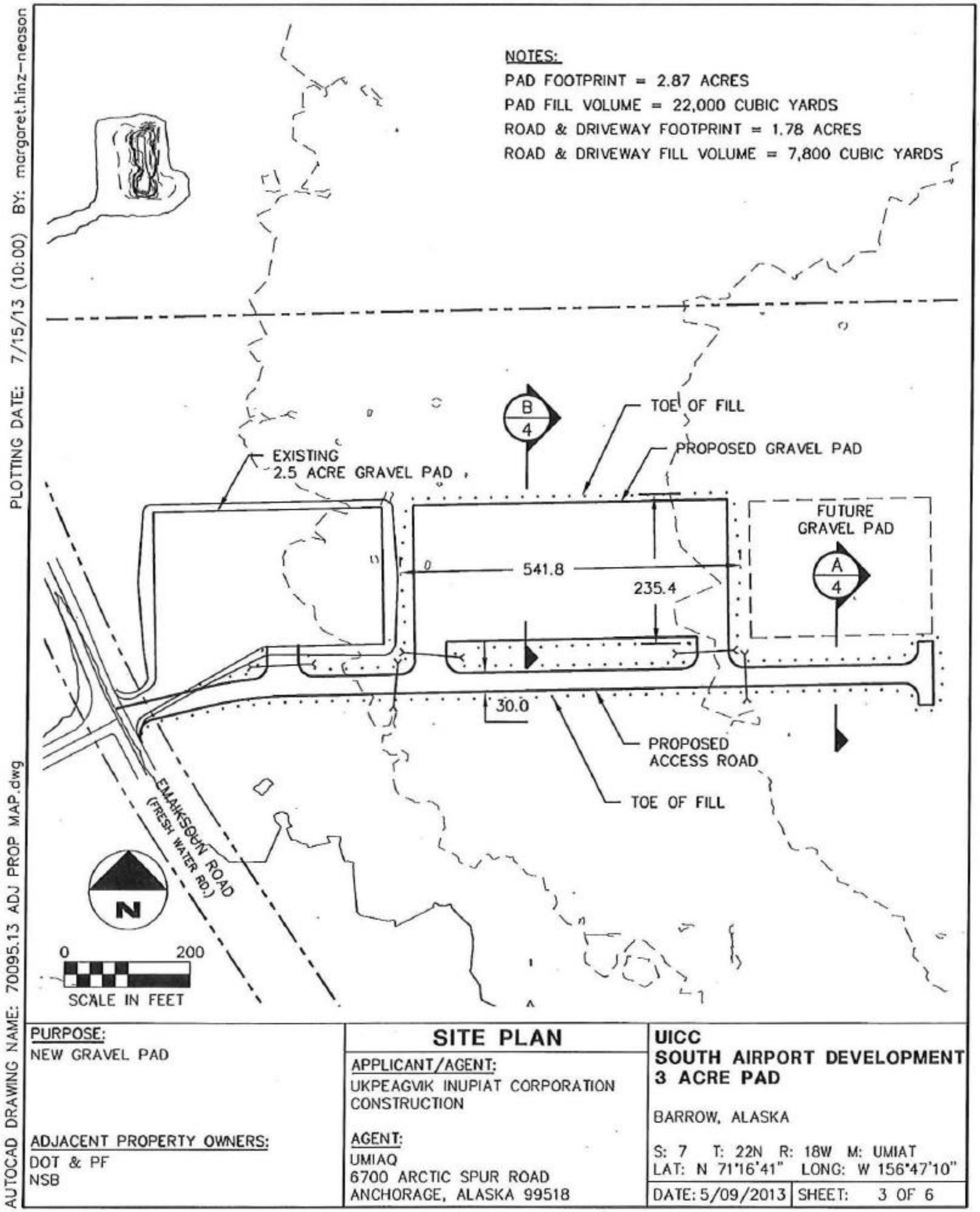


Figure 2.1. Proposed gravel pad (center) and associated access road adjacent to an existing (far left) camp pad on Emaiksoun Road south of Barrow, Alaska.

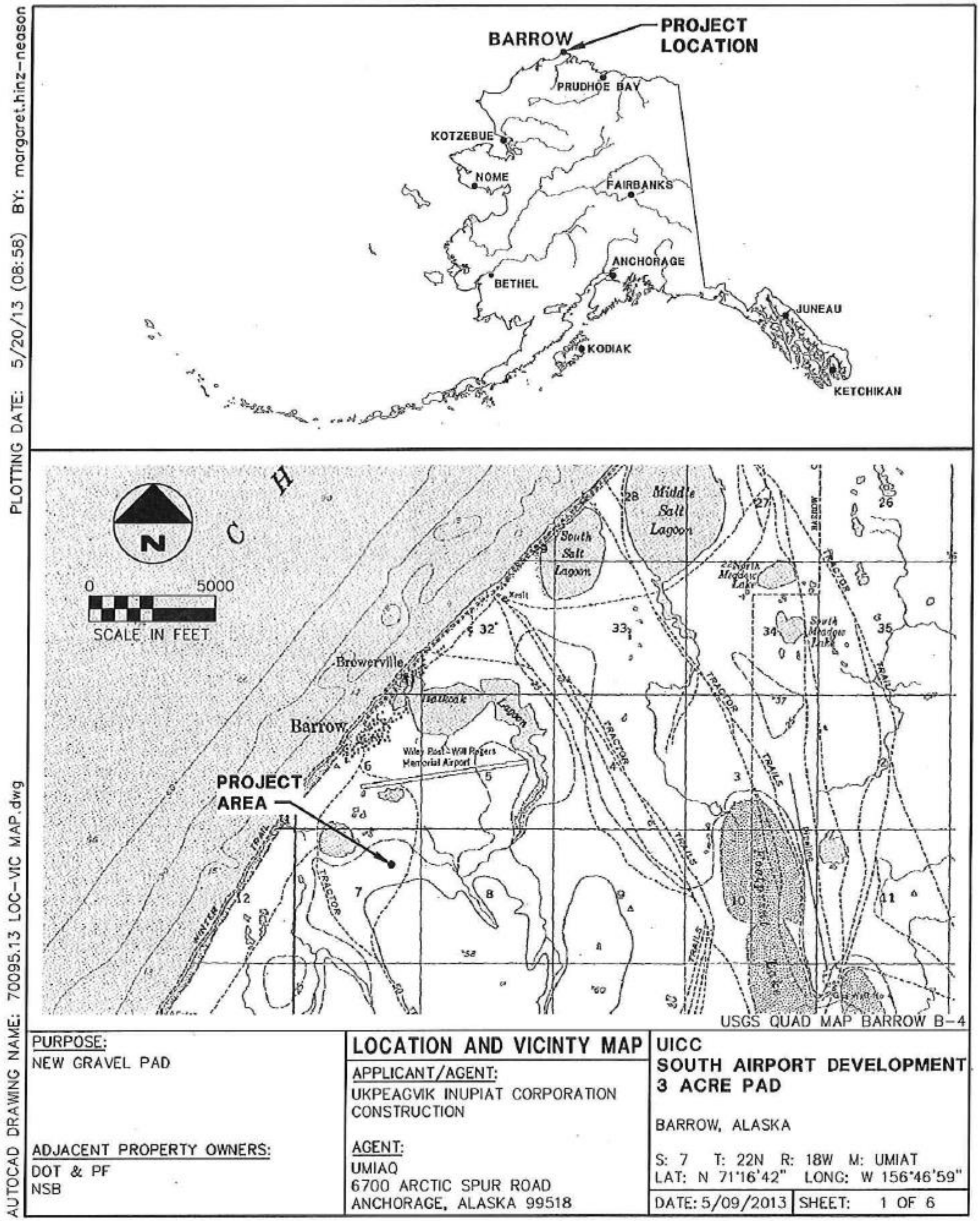


Figure 2.2. Location of the proposed project on Emaiksoun Road south of Barrow, Alaska.

3. STATUS OF THE SPECIES

This section presents biological and ecological information relevant to the BO. Appropriate information on species' life history, habitat and distribution, and other factors necessary for their survival is included as background for subsequent sections.

Spectacled eider

Spectacled eiders (Figure 3.1A) were listed as threatened throughout their range on May 10, 1993 (USFWS 1993) based on indications of steep declines in the two Alaska-breeding populations. There are three primary spectacled eider populations, corresponding to breeding grounds on Alaska's North Slope, the Yukon–Kuskokwim Delta (YK-delta), and northern Russia. The YK-delta population declined 96% between the early 1970s and 1992 (Stehn et al. 1993). Data from the Prudhoe Bay oil fields (Warnock and Troy 1992) and information from Native elders at Wainwright, Alaska (R. Suydam, pers. comm. in USFWS 1996) suggested concurrent localized declines on the North Slope, although data for the entire North Slope breeding population were not available. Spectacled eiders molt in several discrete areas (Figure 3.1B) during late summer and fall, with birds from different populations and genders apparently favoring different molting areas (Petersen et al. 1999). All three spectacled eider populations overwinter in openings in pack ice of the central Bering Sea, south of St. Lawrence Island (Petersen et al. 1999; Figure 3.2), where they remain until March–April (Lovvorn et al. 2003).

Life History

Breeding – In Alaska, spectacled eiders breed primarily on the North Slope (ACP) and the YK-delta. On the ACP, spectacled eiders breed north of a line connecting the mouth of the Utukok River to a point on the Shaviovik River about 24 km (15 mi) inland from its mouth, with breeding density varying across the ACP (Figure 3.2). Although spectacled eiders historically occurred throughout the coastal zone of the YK-delta, they currently breed primarily in the central coast zone within about 15 km (9 mi) of the coast from Kigigak Island north to Kokechik Bay (USFWS 1996). However, sightings on the YK-delta have also occurred both north and south of this area during the breeding season (R. Platte, USFWS, pers. comm. 1997).

Spectacled eiders arrive on the ACP breeding grounds in late May to early June. Numbers of breeding pairs peak in mid-June and decline 4–5 days later when males begin to depart from the breeding grounds (Smith et al. 1994, Anderson and Cooper 1994, Anderson et al. 1995, Bart and Earnst 2005). Mean clutch size reported from studies on the Colville River Delta was 4.3 (Bart and Earnst 2005). Spectacled eider clutch size near Barrow has averaged 3.2–4.1, with clutches of up to eight eggs reported (Quakenbush et al. 1995, Safine 2011). Incubation lasts 20–25 days (Kondratev and Zadorina 1992, Harwood and Moran 1993, Moran and Harwood 1994, Moran 1995), and hatching occurs from mid- to late July (Warnock and Troy 1992).

Nest initiation on Kigigak Island on the YK-delta occurs from mid-May to mid-June (Lake 2007). Incubation lasts approximately 24 days (Dau 1974). Mean spectacled eider clutch size is higher on the YK-delta compared to the ACP. Mean annual clutch size ranged from 3.8–5.4 in coastal areas of the YK-delta (1985–2011; Fischer at al. 2011), and 4.0–5.5 on Kigigak Island (1992–2011; Gabrielson and Graff 2011), with clutches of up to eight eggs reported (Lake 2007).

On the breeding grounds, spectacled eiders feed on mollusks, insect larvae (craneflies, caddisflies, and midges), small freshwater crustaceans, and plants and seeds (Kondratev and Zadorina 1992) in shallow freshwater or brackish ponds, or on flooded tundra. Ducklings fledge approximately 50 days after hatch, when females with broods move from freshwater to marine habitat prior to fall migration.

Survivorship – Nest success is highly variable and thought to be primarily influenced by predators, including gulls (*Larus* spp.), jaegers (*Stercorarius* spp.), and red (*Vulpes vulpes*) and arctic foxes (*Alopex lagopus*). In arctic Russia, apparent nest success was estimated to be < 2% in 1994 and 27% in 1995; low nest success was attributed to predation (Pearce et al. 1998). Apparent nest success in 1991 and 1993–1995 in the Kuparuk and Prudhoe Bay oil fields on the ACP was also low, varying from 25–40% (Warnock and Troy 1992, Anderson et al. 1998). On Kigigak Island in the YK-delta, nest survival probability ranged from 0.06–0.92 from 1992–2007 (Lake 2007); nest success tended to be higher in years with low fox numbers or activity (i.e., no denning) or when foxes were eliminated from the island prior to the nesting season. Bowman et al. (2002) also reported high variation in nest success (20–95%) of spectacled eiders on the YK-delta, depending on year and location.

(A)

(B)

Figure 3.1. (A) Male and female spectacled eiders in breeding plumage. (B) Distribution of spectacled eiders. Molting areas (green) are used July –October. Wintering areas (yellow) are used October –April. The full extent of molting and wintering areas is not yet known and may extend beyond the boundaries shown.

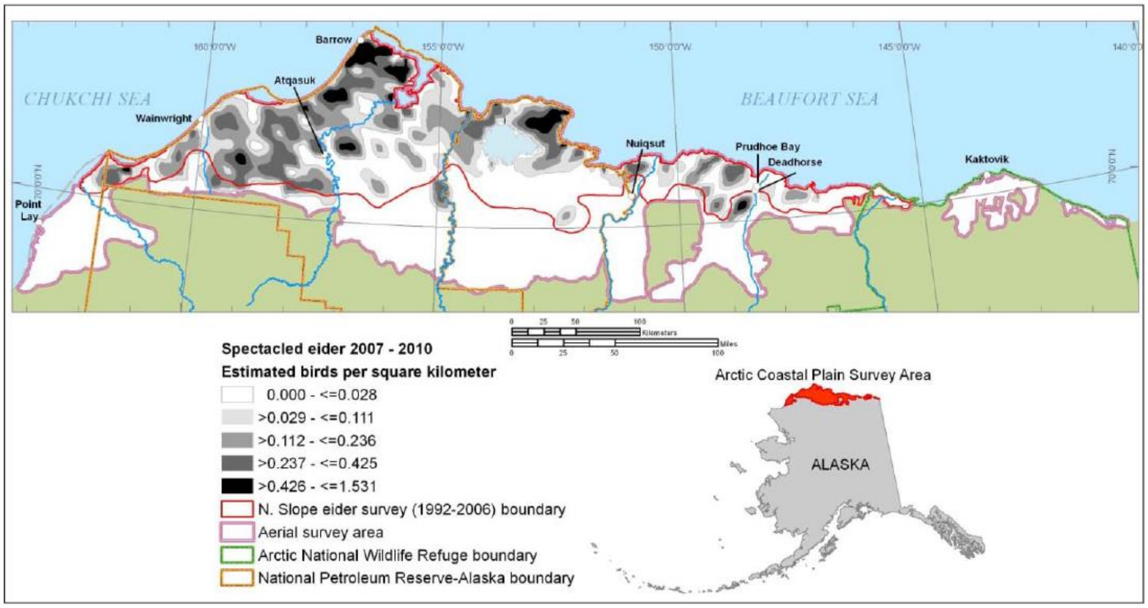


Figure 3.2. Density distribution of spectacled eiders observed on aerial transects sampling 57,336 km^2 of wetland tundra on the North Slope of Alaska during early to mid-June, 2007–2010 (Larned et al. 2011).

Available data indicate egg hatchability is high for spectacled eiders nesting on the ACP, in arctic Russia, and at inland sites on the YK-delta, but considerably lower in the coastal region of the YK-delta. Spectacled eider eggs that are addled or that do not hatch are very rare in the Prudhoe Bay area (Declan Troy, TERA, pers. comm. 1997), and Esler et al. (1995) found very few addled eggs on the Indigirka River Delta in Arctic Russia. Additionally, from 1969 to 1973 at an inland site on the Yukon Delta National Wildlife Refuge, only 0.8% of spectacled eider eggs were addled or infertile (Dau 1974). In contrast, 24% of all nests monitored in a coastal region of the YK-delta during the early to mid-1990s contained inviable eggs and ~10% of eggs in successful nests did not hatch due to either embryonic mortality or infertility (Grand and Flint 1997). This relatively high occurrence of inviable eggs near the coast of the YK-delta may have been related to exposure to contaminants (Grand and Flint 1997). It is unknown whether hatchability of eggs in this region has improved with decreased use of lead shot in the region and gradual settling of existing lead pellets (Flint and Schamber 2010) in coastal YK-delta wetlands.

Recruitment rate (the percentage of young eiders that hatch, fledge, and survive to sexual maturity) of spectacled eiders is poorly known (USFWS 1999) because there is limited data on juvenile survival. In a coastal region of the YK-delta, duckling survival to 30 days averaged 34%, with 74% of this mortality occurring in the first 10 days, while survival of adult females during the first 30 days post hatch was 93% (Flint and Grand 1997).

Fall migration and molting – As with many other sea ducks, spectacled eiders spend the 8–10 month non-breeding season at sea. Satellite telemetry and aerial surveys led to the identification of spectacled eider migrating, molting, and wintering areas. These studies are summarized in Petersen et al. (1995 and 1999) and Larned et al. (1995). Results of more recent satellite telemetry research (2008–2011) are consistent with earlier studies (Matt Sexson, USGS, pers. comm.). Phenology, spring migration and breeding, including arrival, nest initiation, hatch, and fledging, is 3–4 weeks earlier in western Alaska (YK-delta) than northern Alaska (ACP); however, phenology of fall migration is similar between areas. Individuals depart breeding areas July–September, depending on breeding status and success, and molt in September–October (Matt Sexson, USGS, pers. comm.).

Males generally depart breeding areas on the ACP when females begin incubation in late June (Anderson and Cooper 1994, Bart and Earnst 2005). Use of the Beaufort Sea by departing males is variable. Some appear to move directly to the Chukchi Sea over land, while the majority move rapidly (average travel of 1.75 days), over nearshore waters from breeding grounds to the Chukchi Sea (TERA 2002). Of 14 males implanted with satellite transmitters, only four spent an extended period of time (11–30 days) in the Beaufort Sea (TERA 2002). Males appeared to prefer areas near large river deltas such as the Colville River where open water is more prevalent in early summer when much of the Beaufort Sea is still frozen. Most adult males marked with satellite transmitters in northern and western Alaska in a recent satellite telemetry study migrated to northern Russia to molt (USGS, unpublished data). Results from this study also suggest that male eiders likely follow coast lines but also migrate straight across the northern Bering and Chukchi seas en route to northern Russia (Matt Sexson, USGS, pers. comm.).

Females generally depart the breeding grounds later, when more of the Beaufort Sea is ice-free, allowing more extensive use of the area. Females spent an average of two weeks in the Beaufort Sea (range 6-30 days) with the western Beaufort Sea the most heavily used (TERA 2002). Females also appeared to migrate through the Beaufort Sea an average of 10 km further offshore than males (Petersen et al. 1999). The greater use of the Beaufort Sea and offshore areas by females was attributed to the greater availability of open water when females depart the area (Petersen et al. 1999, TERA 2002). Recent telemetry data indicate that molt migration of failed/non-breeding females from the Colville River Delta through the Beaufort Sea is relatively rapid, 2 weeks, compared to 2–3 months spent in the Chukchi Sea (Matt Sexson, USGS, pers. comm.).

Spectacled eiders use specific molting areas from July to late October/early November. Larned et al. (1995) and Petersen et al. (1999) found spectacled eiders' show strong preference for specific molting locations, and concluded that spectacled eiders molt in four discrete areas (Table 3.1). Females generally used molting areas nearest their breeding grounds. All marked females from the YK-delta molted in nearby Norton Sound, while females from the North Slope molted in Ledyard Bay, along the Russian coast, and near St. Lawrence Island. Males did not show strong molting site fidelity; males from all three breeding areas molted in Ledyard Bay, Mechigmenskiy Bay, and the Indigirka/Kolyma River Delta. Males reached molting areas first, beginning in late June, and remained through mid-October. Non-breeding females, and those that nested but failed, arrived at molting areas in late July, while successfully-breeding females and young of the year reached molting areas in late August through late September and remained through October. Fledged juveniles marked on the Colville River Delta usually staged in the Beaufort Sea near the delta for 2–3 weeks before migrating to the Chukchi Sea.

Table 3.1. Important staging and molting areas for female and male spectacled eiders from each breeding population.

Population and Sex	Known Major Staging/Molting Areas
Arctic Russia Males	Northwest of Medvezhni (Bear) Island group
	Mechigmenskiy Bay
	Ledyard Bay
Arctic Russia Females	unknown
North Slope Males	Ledyard Bay
	Northwest of Medvezhni (Bear) Island group
	Mechigmenskiy Bay
North Slope Females	Ledyard Bay
	Mechigmenskiy Bay
	West of St. Lawrence Island
YK-delta Males	Mechigmenskiy Bay Northeastern Norton Sound
YK-delta Females	Northeastern Norton Sound

Avian molt is energetically demanding, especially for species such as spectacled eiders that complete molt in a few weeks. Molting birds require adequate food resources, and apparently benthic community of Ledyard Bay (Feder et al. 1989, 1994a, 1994b) provides this for spectacled eiders. Large concentrations of spectacled eiders molt in Ledyard Bay using this food resource; aerial surveys on 4 days in different years counted 200 to 33,192 molting spectacled eiders in Ledyard Bay (Petersen et al. 1999; Larned et al. 1995).

Wintering – Spectacled eiders generally depart molting areas in late October/early November (Matt Sexson, USGS, pers. comm.), migrating offshore in the Chukchi and Bering seas to a single wintering area in pack-ice lead complexes south/southwest of St. Lawrence Island (Figure 3.1B). In this relatively shallow area, > 300,000 spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 230 ft (70 m) to eat bivalves, other mollusks, and crustaceans (Cottam 1939, Petersen et al. 1998, Lovvorn et al. 2003, Petersen and Douglas 2004).

Spring migration – Recent information indicates spectacled eiders likely make extensive use of the eastern Chukchi spring lead system between departure from the wintering area in March and April and arrival on the North Slope in mid-May or early June. Limited spring observations in the eastern Chukchi Sea have documented dozens to several hundred common eiders (*Somateria mollissima)* and spectacled eiders in spring leads and several miles offshore in relatively small openings in rotting sea ice (W. Larned, USFWS; J. Lovvorn, University of Wyoming, pers. comm.). Woodby and Divoky (1982) documented large numbers of king (*Somateria spectabilis*) and common eiders using the eastern Chukchi lead system, advancing in pulses during days of favorable following winds, and concluded that an open lead is probably requisite for spring eider passage in this region. Preliminary results from an ongoing satellite telemetry study conducted by the USGS Alaska Science Center (Figure 3.3; USGS, unpublished data) suggest that spectacled eiders also use the lead system during spring migration.

Adequate foraging opportunities and nutrition during spring migration are critical to spectacled eider productivity. Like most sea ducks, female spectacled eiders do not feed substantially on the breeding grounds, but produce and incubate eggs while living primarily off body reserves

(Korschgen 1977, Drent and Daan 1980, Parker and Holm 1990). Clutch size, a measure of reproductive potential, was positively correlated with body condition and reserves obtained prior to arrival at breeding areas (Coulson 1984, Raveling 1979, Parker and Holm 1990). Body reserves must be maintained from winter or acquired during the 4-8 weeks (Lovvorn et al. 2003) of spring staging, and Petersen and Flint (2002) suggest common eider productivity on the western Beaufort Sea coast is influenced by conditions encountered in May to early June during migration through the Chukchi Sea (including Ledyard Bay). Common eider female body mass increased 20% during the 4-6 weeks prior to egg laying (Gorman and Milne 1971, Milne 1976, Korschgen 1977, Parker and Holm 1990). For spectacled eiders, average female body weight in late March in the Bering Sea was 1,550 ± 35 g (n = 12), and slightly (but not significantly) more upon arrival at breeding sites (1,623 ± 46 g, n = 11; Lovvorn et al. 2003), suggesting that spectacled eiders maintain or enhance their physiological condition during spring staging.

Abundance and trends

The most recent rangewide estimate of abundance of spectacled eiders was 369,122 (364,190–374,054 90% CI), obtained by aerial surveys of the known wintering area in the Bering Sea in late winter 2010 (Larned et al. 2012). Comparison of point estimates between 1997 and 2010 indicate an average of 353,051 spectacled eiders (344,147-361956 90% CI) in the global population over that 14-year period (Larned et al. 2012).

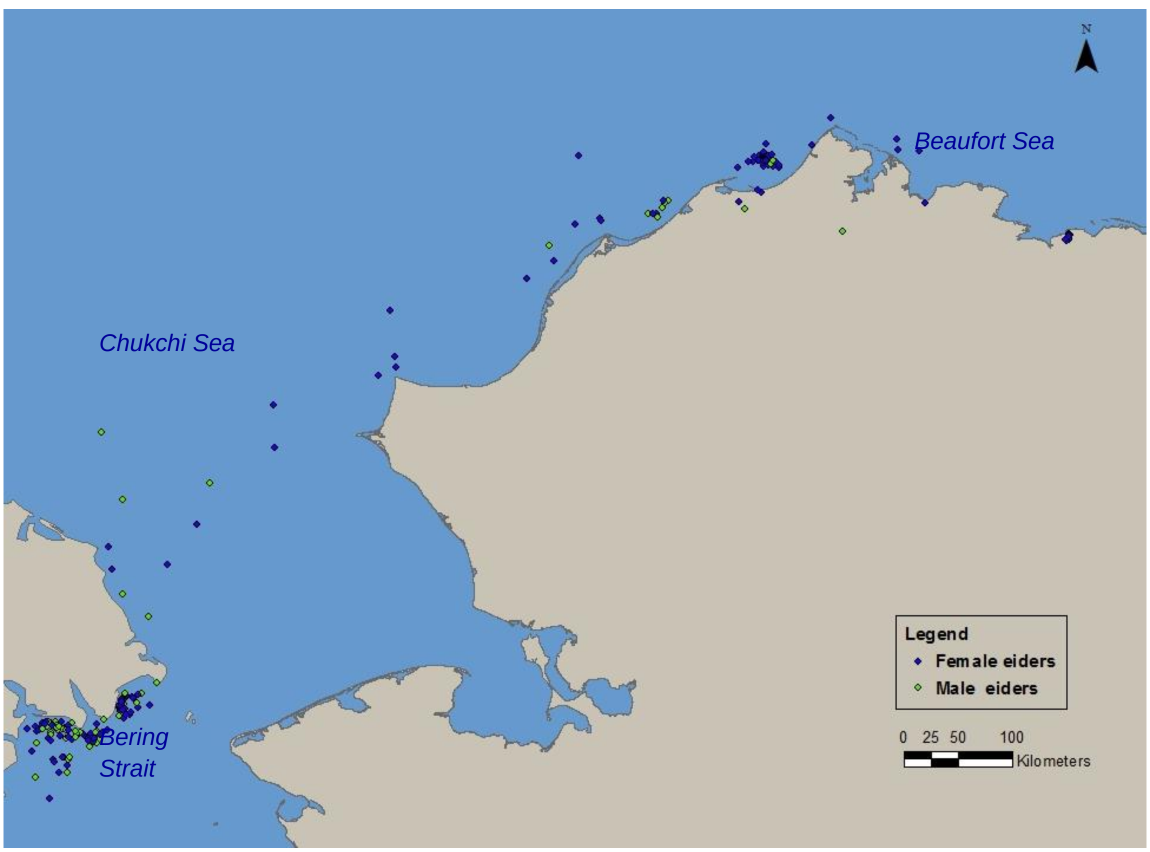


Figure 3.3. Spectacled eider satellite telemetry locations for 12 female and 7 male spectacled eiders in the eastern Chukchi Sea from 1 April – 15 June 2010 and 1 April – 15 June 2011. Additional locations from the northern coast of Russia are not shown.

Eiders were tagged on the North Slope during the 2009 and 2010 breeding seasons. Data provided by Matt Sexson, USGS Alaska Science Center (USGS, unpublished).

Population indices for North Slope-breeding spectacled eiders prior to 1992 are unavailable. However, Warnock and Troy (1992) documented an 80% decline in spectacled eider abundance from 1981 to 1991 in the Prudhoe Bay area. Since 1992, the Service has conducted annual aerial surveys for breeding spectacled eiders on the ACP. The 2010 population index based on these aerial surveys was 6,286 birds (95% CI, 4,877–7,695; unadjusted for detection probability), which is 4% lower than the 18-year mean (Larned et al 2011). In 2010, the index growth rate was significantly negative for both the long-term (0.987; 95% CI, 0.974–0.999) and most recent 10 years (0.974; 95% CI, 0.950–0.999; Larned et al. 2011). Stehn et al. (2006) developed a North Slope-breeding population estimate of 12,916 (95% CI, 10,942–14,890) based on the 2002–2006 ACP aerial index for spectacled eiders and relationships between ground and aerial surveys on the YK-delta. If the same methods are applied to the 2007–2010 ACP aerial index reported in Larned et al. (2011), the resulting adjusted population estimate for North Slope-breeding spectacled eiders is 11,254 (8,338–14,167, 95% CI).

The YK-delta spectacled eider population is thought to have declined by about 96% from the 1970s to 1992 (Stehn et al. 1993). Evidence of the dramatic decline in spectacled eider nesting on the YK-delta was corroborated by Ely et al. (1994), who found a 79% decline in eider nesting near the Kashunuk River between 1969 and 1992. Aerial and ground survey data indicated that spectacled eiders declined 9–14% per year from 1985–1992 (Stehn et al. 1993). Further, from the early 1970s to the early 1990s, the number of pairs on the YK-delta declined from 48,000 to 2,000, apparently stabilizing at that low level (Stehn et al. 1993). Before 1972, an estimated 47,700–70,000 pairs of spectacled eiders nested on the YK-delta in average to good years (Dau and Kistchinski 1977).

Fischer et al. (2011) used combined annual ground-based and aerial survey data to estimate the number of nests and eggs of spectacled eiders on the coastal area of the YK-delta in 2011 and evaluate long-term trends in the YK-delta breeding population from 1985 to 2011. In a given year, the estimated number of nests reflects the minimum number of breeding pairs in the population and does not include non-nesting individuals or nests that were destroyed or abandoned (Fischer et al. 2011). The total number of nests in 2011 was estimated at 3,608 (SE 448) spectacled eiders nests on the YK-delta, the second lowest estimate over the past 10 years. The average population growth rate based on these surveys was 1.049 (90% CI = 0.994–1.105) in 2002–2011 and 1.003 (90% CI = 0.991–1.015) in 1985–2011 (Fischer et al. 2011). Log-linear regression based solely on the long-term YK-delta aerial survey data indicate positive population growth rates of 1.073 (90% CI = 1.046–1.100) in 2001–2010 and 1.070 (90% CI = 1.058–1.081) in 1988–2010 (Platte and Stehn 2011).

Spectacled eider recovery criteria

The Spectacled Eider Recovery Plan (USFWS 1996) presents research and management priorities with the objective of recovery and delisting so that protection under the ESA is no longer required. Although the cause or causes of the spectacled eider population decline is/are not known, factors that affect adult survival are likely to be the most influential on population growth rate. These include lead poisoning from ingested spent shotgun pellets, which may have contributed to the rapid decline observed in the YK-delta (Franson et al. 1995, Grand et al. 1998), and other factors such as habitat loss, increased nest predation, over harvest, and disturbance and collisions caused by human infrastructure. Under the Recovery Plan, the species will be considered recovered when each of the three recognized populations (YK-delta, North Slope of Alaska, and Arctic Russia): 1) is stable or increasing over 10 or more years and the minimum estimated population size is at least 6,000 breeding pairs, or 2) number at least 10,000 breeding pairs over 3 or more years, or 3) number at least 25,000 breeding pairs in one year. Spectacled eiders do not currently meet these recovery criteria.

Steller's Eider

The Steller's eider is a small sea duck with circumpolar distribution and the sole member of the genus *Polysticta*. Males are in breeding plumage (Figure 3.4) from early winter through mid-summer (Figure 3.4). Females are dark mottled brown with a white-bordered blue wing speculum. Juveniles are dark mottled brown until fall of their second year, when they acquire breeding plumage.

Figure 3.4. Male and female Steller's eiders in breeding plumage.

Steller's eiders are divided into Atlantic and Pacific populations; the Pacific population is further subdivided into the Russia-breeding and Alaska-breeding populations. The Alaska-breeding population of Steller's eiders was listed as threatened on July 11, 1997 based on:

- Substantial contraction of the species' breeding range on the ACP and Y-K Delta;
  - Steller's eiders on the North Slope historically occurred east to the Canada border (Brooks 1915), but have not been observed on the eastern North Slope in recent decades (USFWS 2002).

- Only 10 Steller's eider nests have been recorded on the Y-K Delta since 1970 (Hollmen et al. 2007).
- Reduced numbers breeding in Alaska; and
- Resulting vulnerability of the remaining Alaska-breeding population to extirpation (USFWS 1997).

In Alaska, Steller's eiders breed almost exclusively on the ACP and winter, along with the majority of the Russia-breeding population, in south-central Alaska (Figure 3.5). Periodic non-breeding of Steller's eiders coupled with low nesting and fledging success, has resulted in very low productivity (Quakenbush et al. 2004). In 2001, the Service designated 2,830 mi^2 (7,330 km^2) of critical habitat for the Alaska-breeding population of Steller's eiders, including historical breeding areas on the Y-K Delta, a molting and staging area in the Kuskokwim Shoals, and marine molting areas at Seal Islands, Nelson Lagoon, and Izembek Lagoon (USFWS 2001). No critical habitat for Steller's eiders has been designated on the ACP.

Life History

Breeding – Steller's eiders arrive in small flocks of breeding pairs on the ACP in early June. Nesting on the ACP is concentrated in tundra wetlands near Barrow, AK (Figure 3.6) and occurs at lower densities elsewhere on the ACP from Wainwright east to the Sagavanirktok River (Quakenbush et al. 2002). Long-term studies of Steller's eider breeding ecology near Barrow indicate periodic non-breeding by the entire local population. From 1991-2010, Steller's eiders nests were detected in 12 of 20 years (Safine 2011). Periodic non-breeding by Steller's eiders near Barrow seems to correspond to fluctuations in lemming populations and risk of nest predation (Quakenbush et al. 2004). During years of peak abundance, lemmings are a primary food source for predators including jaegers, owls, and foxes (Pitelka et al. 1955*a*, Pitelka et al. 1955*b*, MacLean et al. 1974, Larter 1998, Quakenbush et al. 2004). It is hypothesized that Steller's eiders and other ground-nesting birds increase reproductive effort during lemming peaks because predators preferentially select (prey-switch) for hyper-abundant lemmings and nests are less likely to be depredated. (Roselaar 1979, Summers 1986, Dhondt 1987, and Quakenbush et al. 2004). Furthermore, during high lemming abundance, Steller's eider nest survival (the probability of at least one duckling hatching) has been reported as a function of distance from nests of jaegers and snowy owls (Quakenbush et al. 2004). These avian predators aggressively defend their nests against other predators and this defense likely indirectly imparts protection to Steller's eiders nesting nearby.

Steller's eiders initiate nesting in the first half of June and nests are commonly located on the rims of polygons and troughs (Quakenbush et al. 2000, 2004). Mean clutch size at Barrow was 5.4 ± 1.6 SD (range = 1–8) over 5 nesting years between 1992 and 1999 (Quakenbush et al. 2004). Breeding males depart following onset of incubation by the female. Nest survival is affected by predation levels, and averaged 0.23 (±0.09, standard error [SE]) from 1991–2004 before fox control was implemented near Barrow and 0.47 (±0.08 SE) from 2005–2012 during years with fox control (USFWS, unpublished data). Steller's eider nest failure has been attributed to depredation by jaegers (*Stercorarius* spp.), common ravens (*Corvus corax*), arctic fox (*Alopex lagopus*), glaucous gulls (*Larus hyperboreus*), and in at least one instance, polar bears (Quakenbush et al. 1995, Rojek 2008, Safine 2011, Safine 2012).

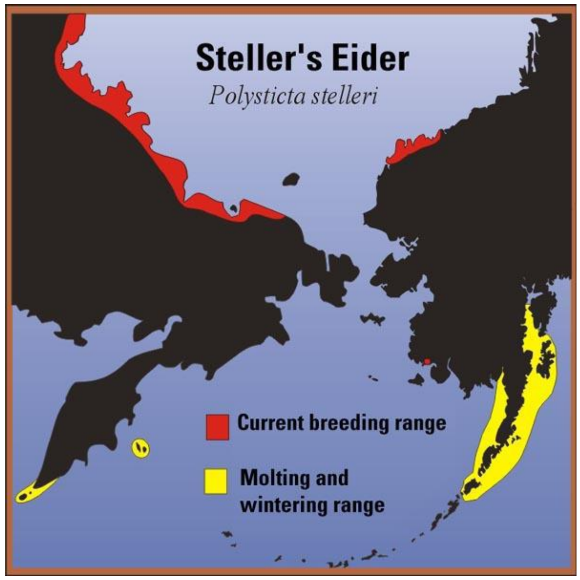


Figure 3.5. Steller's eider distribution in the Bering, Chukchi, and Beaufort seas.

Hatching occurs from mid-July through early August, after which hens move their broods to adjacent ponds with emergent vegetation dominated by *Carex* spp. and *Arctophila fulva* (Quakenbush et al. 2000, Rojek 2006, 2007, and 2008). In these brood-rearing ponds, hens with ducklings feed on aquatic insect larvae and freshwater crustaceans. In general, broods remain within 0.7 km of their nests (Quakenbush et al. 2004); although, movements of up to 3.5 km from nests have been documented (Rojek 2006 and 2007). Large distance movements from hatch sites may be a response to drying of wetlands that would normally have been used for brood-rearing (Rojek 2006). Fledging occurs 32–37 days post hatch (Obritschkewitsch et al. 2001, Quakenbush et al. 2004, Rojek 2006 and 2007).

Information on breeding site fidelity of Steller's eiders is limited. However, ongoing research at Barrow has documented some cases of site fidelity in nesting Steller's eiders. Since the mid-1990s, six banded birds that nested near Barrow were recaptured in subsequent years again nesting near Barrow. Time between capture events ranged from 1 to 12 years and distance between nests ranged from 0.1 to 6.3 km (USFWS, unpublished data).

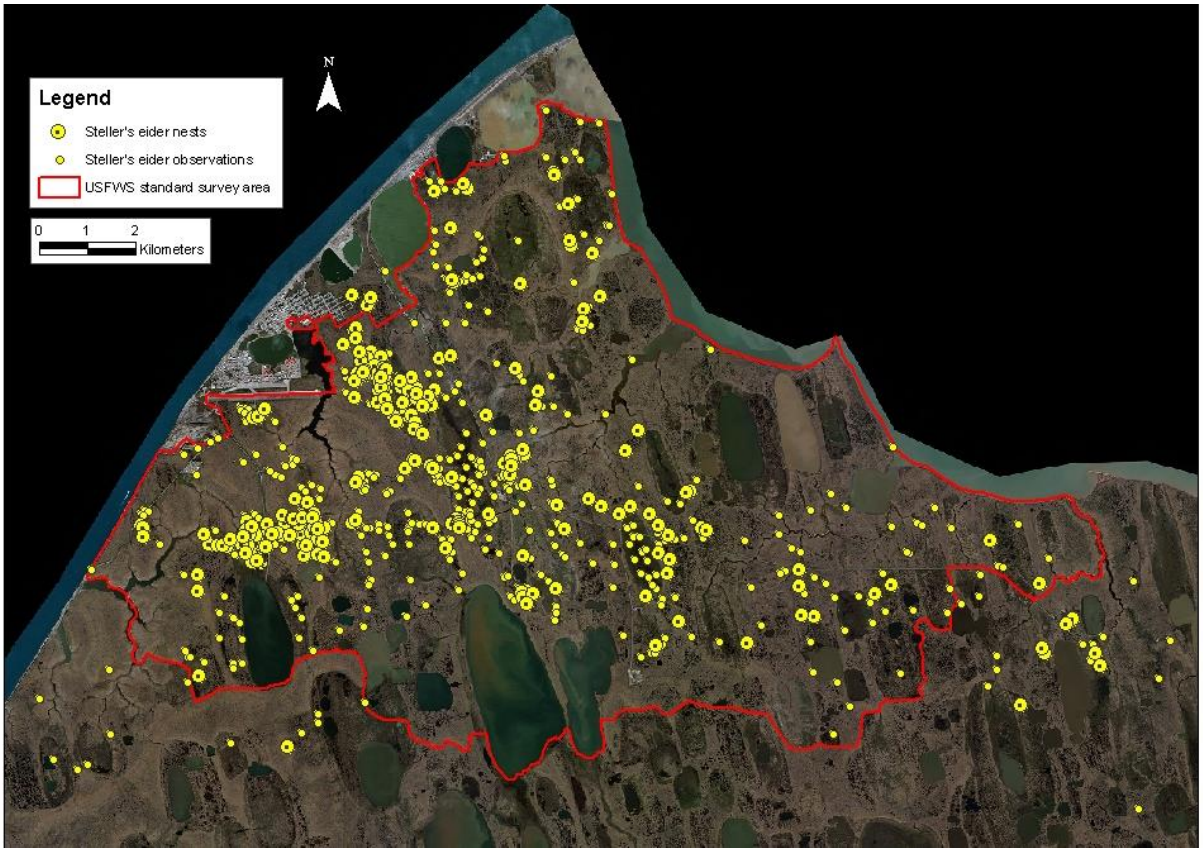


Figure 3.6. Steller's eider nest locations (1991–2010) and breeding pair observations (1999–2010). The red border represents the standard annual survey area. This survey is expanded beyond the standard area in some years.

Localized movements – Timing of departure from the breeding grounds near Barrow differs between sexes and between breeding and non-breeding years. In breeding years, male Steller's eiders typically leave the breeding grounds in late June to early July after females begin incubating (Obritschkewitsch et al. 2001, Quakenbush et al. 1995, Rojek 2006 and 2007). Females with fledged broods depart the breeding grounds in late August and mid-September to rest and forage in freshwater and marine habitat near the Barrow spit prior to fall migration along the Chukchi coast. Females with broods are often observed near the channel that connects North Salt Lagoon and Elson Lagoon (J. Bacon, NSBDWM, pers. comm.). In 2008, 10–30 Steller's eider adult females and juveniles were observed staging daily in Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the Chukchi Sea from late August to mid-September (USFWS, unpublished data).

Before fall migration in breeding and non-breeding years, some Steller's eiders rest and forage in in coastal waters near Barrow including Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the vicinity of Pigniq (Duck Camp; Figure 3.7). In breeding years, these flocks are primarily composed of males that remain in the area until the second week of July, while in non-breeding years, flocks are composed of both sexes and depart earlier than in nesting years (J. Bacon, North Slope Borough Department of Wildlife Management [NSBDWM], pers. comm.).

Safine (2012) investigated post-hatch movements of 10 Steller's eider hens with VHF transmitters in 2011. Most (8 of 10) females successfully reared broods to fledging. From late August through early September, females and fledged juveniles were observed in nearshore waters of the Chukchi and Beaufort seas from Point Barrow south along the coast approximately 18 km. During this period, marked Steller's eiders and broods frequented areas traditionally used for subsistence waterfowl hunting (e.g., Duck Camp; Figure 3.7).

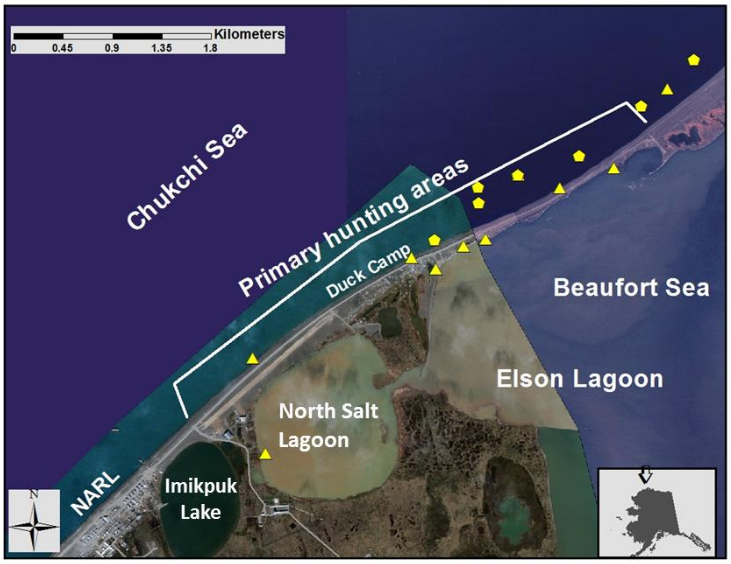


Figure 3.7. Some post-breeding and pre-migration staging areas for Steller's eiders near Barrow, Alaska. Locations of Steller's eider hens with successfully-fledged (triangles) and failed broods (pentagons) from mid-August to early September 2011.

Wing molt – Following departure from the breeding grounds, Steller's eiders migrate to southwest Alaska where they undergo complete flightless molt for about 3 weeks. Preferred molting areas are shallow with extensive eelgrass (*Zostera marina*) beds and intertidal mud and sand flats where Steller's eiders forage on bivalve mollusks and amphipods (Petersen 1980, 1981; Metzner 1993).

The Russia- and Alaska-breeding populations both molt in southwest Alaska, and banding studies found at least some individuals had a high degree of molting site fidelity in subsequent years (Flint et al. 2000). Primary molting areas include the north side of the Alaska Peninsula (Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands; Gill et al. 1981, Petersen 1981, Metzner 1993) as well as the Kuskoskwim Shoals in northern Kuskokwim Bay (Martin et al. *in prep*). Larned (2005) also reported > 2,000 eiders molting in lower Cook Inlet near the Douglas River Delta, and smaller numbers of molting Steller's have been reported around islands in the Bering Sea, along the coast of Bristol Bay, and in smaller lagoons along the Alaska Peninsula (e.g., Dick and Dick 1971; Petersen and Sigman 1977; Wilk et al. 1986; Dau 1987; Petersen et al. 1991).

Winter distribution – After molt, many Pacific-wintering Steller's eiders disperse throughout the Aleutian Islands, Alaskan Peninsula, and western Gulf of Alaska including Kodiak Island and lower Cook Inlet (Figure 3.8; Larned 2000a, Martin et al. *in prep*), although thousands may remain in molting lagoons unless freezing conditions force departure (USFWS 2002). The Service estimates the Alaska-breeding population comprises only ~ 1% of the Pacific-wintering population of Steller's eiders. Wintering Steller's eiders usually occur in shallow waters (< 10 m deep), within 400 m of shore or in shallow waters further offshore (USFWS 2002). However, Martin et al. (*in prep*) reported substantial use of habitats > 10 m deep during mid-winter, although this use may reflect nocturnal rest periods or shifts in availability of food resources (Martin et al. *in prep*).

Spring migration – During spring migration, thousands of Steller's eiders stage in estuaries along the north coast of the Alaska Peninsula and, in particular, at Kuskokwim Shoals in late May (Figure 3.8; Larned 2007, Martin et al. *in prep*). Larned (1998) concluded that Steller's eiders show strong site fidelity to specific areas[1] during migration, where they congregate in large numbers to feed before continuing northward.

[1] Several areas receive consistent use by Steller's eiders during spring migration, including Bechevin Bay, Morzhovoi Bay, Izembek Lagoon, Nelson Lagoon/Port Moller Complex, Cape Seniavin, Seal Islands, Port Heiden, Cinder River State Critical Habitat Area, Ugashik Bay, Egegik Bay, Kulukak Bay, Togiak Bay, Nanwak Bay, Kuskokwim Bay, Goodnews Bay, and the south side of Nunivak Island (Larned 1998, Larned 2000a, Larned 2000b, Larned et al. 1993).

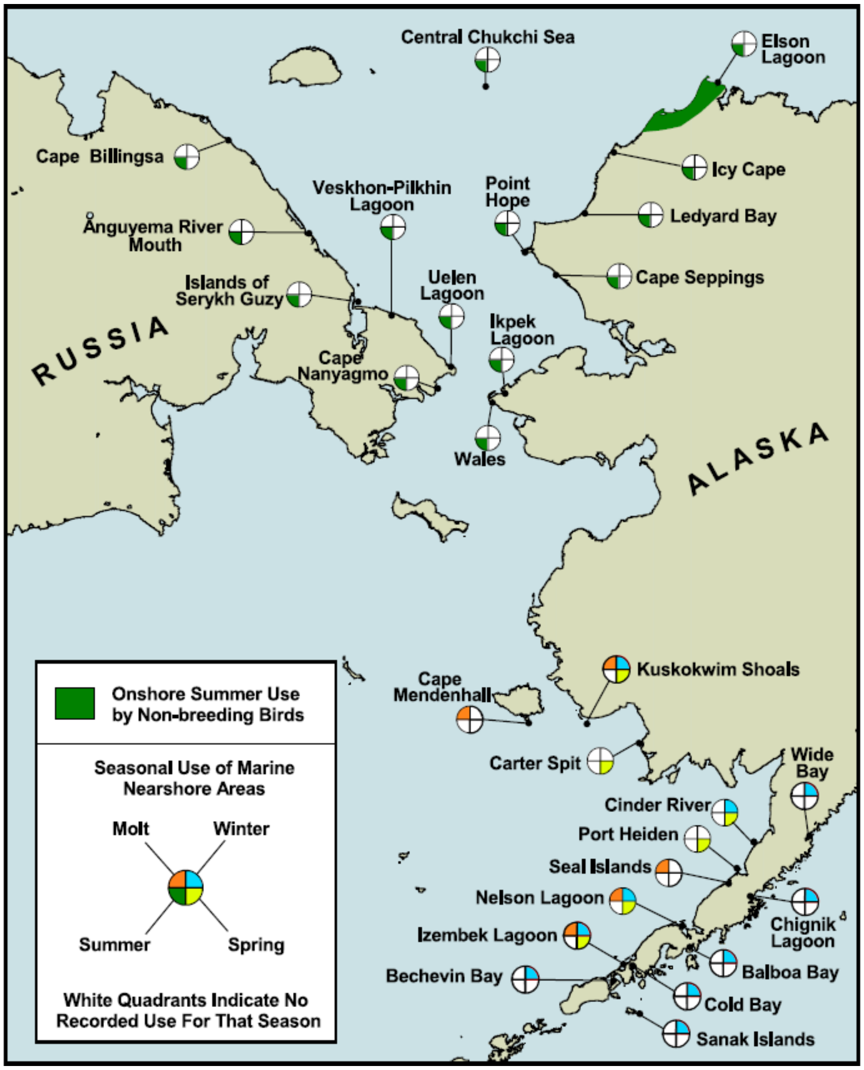


Figure 3.8. Distribution of Alaska-breeding Steller's eiders during the non-breeding season, based on locations of 13 birds implanted with satellite transmitters in Barrow, Alaska, during June 2000 and June 2001. Marked locations include all those at which a bird remained for at least three days. Onshore summer use areas comprise locations of birds that departed Barrow, apparently without attempting to breed in 2001 (USFWS 2002).

Spring migration usually includes movements along the coast, although some Steller's eiders may make straight line crossings of water bodies such as Bristol Bay (W. Larned, USFWS, pers. comm. 2000). Despite numerous aerial surveys, Steller's eiders have not been observed during migratory flights (W. Larned, USFWS, pers. comm. 2000). Steller's eiders likely use spring leads for feeding and resting as they move northward, although there is little information on distribution or habitat use after departure from spring staging areas.

Migration patterns relative to breeding origin – Information is limited on migratory movements of Steller's eiders in relation to breeding origin, and it remains unclear where the Russia- and Alaska-breeding populations converge and diverge during their molt and spring migrations.

Martin et al. (*unpublished data*) attached satellite transmitters to 14 Steller's eiders near Barrow in 2000 and 2001. Despite the limited sample, there was disproportionately high use of Kuskokwim Shoals by Alaska-breeding Steller's eiders during wing molt compared to the Pacific population as a whole. However, Martin et al. (*in prep*) did not find Alaska-breeding Steller's eiders to preferentially use specific wintering areas. A later study marked Steller's eiders wintering near Kodiak Island, Alaska and followed birds through the subsequent spring (n = 24) and fall molt (n = 16) migrations from 2004–2006 (Rosenberg et al. 2011). Most birds marked near Kodiak Island migrated to eastern arctic Russia prior to the nesting period and none were relocated on land or in nearshore waters north of the Yukon River Delta in Alaska (Rosenberg et al. 2011).

Alaska-breeding population abundance and trends – Stehn and Platte (2009) evaluated Steller's eider population and trends from three aerial surveys on the ACP:

- USFWS ACP survey
  - 1989–2006 (Mallek et al. 2007)
  - 2007–2008 (new ACP survey design; Larned et al. 2008, 2009)
- USFWS North Slope eider (NSE) survey
  - 1992–2006 (Larned et al. 2009)
  - 2007–2008 (NSE strata of new ACP survey; Larned et al. 2008, 2009)
  - Barrow Triangle (ABR) survey, 1999–2007 (ABR, Inc.; Obrishkewitsch et al. 2008)

In 2007, the ACP and NSE surveys were combined under a single ACP survey design. Previously, surveys differed in spatial extent, timing, sampling intensity, and duration, and consequently, produced different estimates of population size and trend for Steller's eiders. These estimates, including results from previous analyses of the ACP and NSE survey data (Mallek et al. 2007, Larned et al. 2009), are summarized in Table 3.2. Most observations of Steller's eider from both surveys occurred within the boundaries of the NSE survey (Figure 3.9).

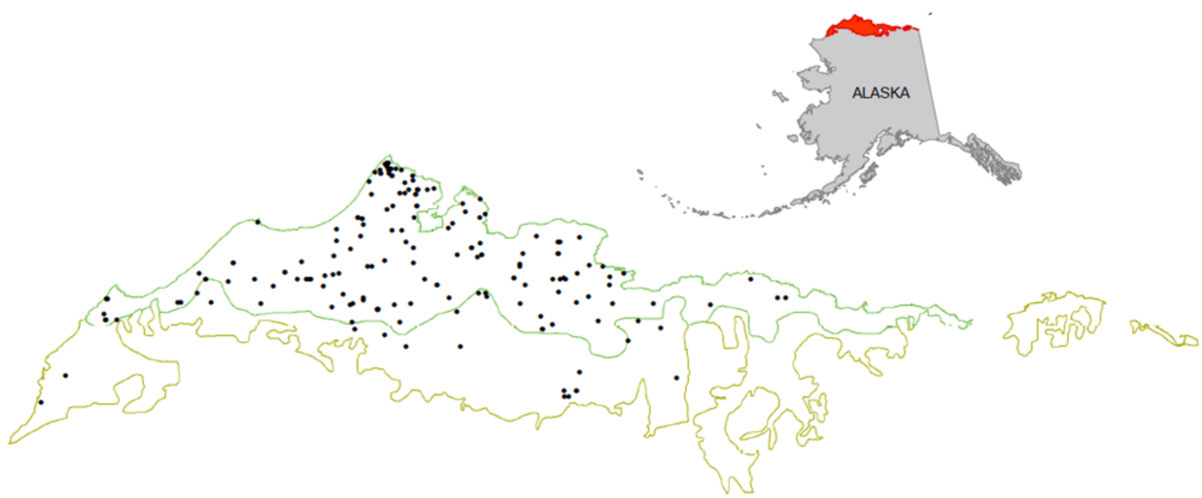


Figure 3.9. All Steller's eider sightings from the Arctic Coastal Plain (ACP) survey (1989–2008) and the North Slope eider (NSE) survey (1992–2006). The ACP survey encompasses

the entire area shown (61,645 km^2); the NSE includes only the northern portion outlined in green (30,465 km^2; modified from Stehn and Platte 2009).

Following assessment of potential biases inherent in both surveys, Stehn and Platte (2009) identified a subset of the NSE survey data (1993–2008) that were determined to be "least confounded by changes in survey timing and observers." Based on this subset, the average population index[2] for Steller's eiders on the ACP was 173 (90% CI 88–258) with an estimated growth rate of 1.011 (90% CI 0.857–1.193). Average population size of Steller's eiders breeding on the ACP was estimated at 576 (292–859, 90% CI; Stehn and Platte 2009) assuming a detection probability of 30%[3]. Currently, this analysis provides the best available estimate of the Alaska-breeding Steller's eider population size and growth rate for the ACP. Note that these estimates are based on relatively few actual observations of Steller's eiders with none detected in some years.

The annual Barrow Triangle (ABR) survey provides more intensive coverage (50%, 1999–2004; 25–50%, 2005–2010) of the northern portion of the ACP. This survey has been conducted since 1999 over a 2,757 km^2 area south of Barrow (Figure 3.10) to compliment ground surveys closer to Barrow. Estimated Steller's eider density for the ABR survey area ranges from <0.01–0.03 birds/km^2 in non-nesting years to 0.03–0.08 birds/km^2 in nesting years. The estimated average population index for Steller's eiders within the Barrow Triangle was 99.6 (90% CI 55.5–143.7; Stehn and Platte 2009) with an estimated growth rate of 0.934 (90% CI 0.686–1.272). If we assume the same 30% detection probability applied to NSE estimates, average population size of Steller's eiders breeding in the Barrow Triangle area would be 332 (185–479, 90% CI).

Breeding population near Barrow, Alaska – The tundra surrounding Barrow supports the only significant concentration of Steller's eiders nesting in North America. Barrow is the northernmost community on the ACP and standardized ground surveys for eiders have been conducted near Barrow since 1999 (Figure 3.6; Rojek 2008). Counts of males are the most reliable indicator of Steller's eider presence because females are cryptic and often go undetected in counts. The greatest concentrations of Steller's eiders observed during Barrow ground surveys occurred in 1999 and 2008 with 135 and 114 males respectively (Table 3.2; Safine 2011). Total nests found (both viable[4] and post-failure) ranged from 0–78 between 1991 and 2011, while the number of viable nests ranged from 0–27. Steller's eider nests were found in 14 of 22 years (64%) between 1991 and 2012 (Safine 2013).

[2] Geographically extrapolated total Steller's eiders derived from NSE survey counts.
[3] Detection probability of 30% with a visibility correction factor of 3.33 was selected based on evaluation of estimates for similar species and habitats (Stehn and Platte 2009).
[4] A nest is considered viable if it contains at least one viable egg.

Table 3.2. Steller's eider males, nests, and pair densities recorded during ground-based and aerial surveys conducted near Barrow, Alaska 1999–2012 (modified from Safine 2013).

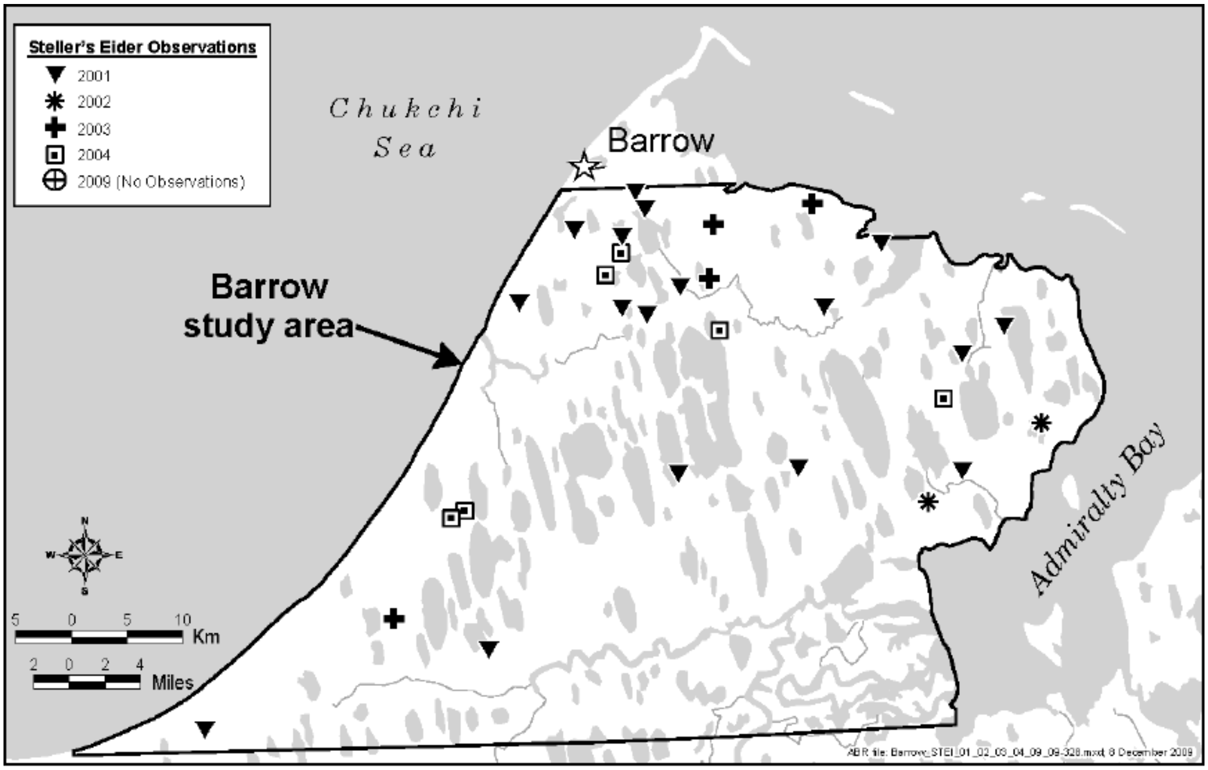
	Overall ground-based survey area			Standard Ground-based Survey Area[a]		Aerial survey of Barrow Triangle		
Year	Area (km^2)	Males counted	Pair density (males/km^2)	Males counted	Pair density (males/km^2)	Males counted	Pair density (males/km^2)[b]	Nests found near Barrow
1999	172	135	0.78	132	0.98	56	0.04	36
2000	136	58	0.43	58	0.43	55	0.04	23
2001	178	22	0.12	22	0.16	22	0.02	0
2002	192	1	<0.01	0	0	2	<0.01	0
2003	192	10	0.05	9	0.07	4	<0.01	0
2004	192	10	0.05	9	0.07	6	<0.01	0
2005	192	91	0.47	84	0.62	31	0.02	21
2006	191	61	0.32	54	0.40	24	0.02	16
2007	136	12	0.09	12	0.09	12	0.02	12
2008	166	114	0.69	105	0.78	24	0.02	28
2009	170	6	0.04	6	0.04	0	0	0
2010	176	18	0.10	17	0.13	4	0.01	2
2011	180	69	0.38	59	0.44	10	0.01	27
2012	176	61	0.35	55	0.41	37	0.03	19

[a]Standard area (the area covered in all years) is ~134 km^2 (2008 – 2010) and ~135 km^2 in previous years.
[b]Actual area covered by aerial survey (50% coverage) was ~1408 km^2 in 1999 and ~1363 km^2 in 2000 – 2006 and 2008. Coverage was 25% in 2007 and 2010 (~682 km^2) and 27% in 2009 (~736 km^2). Pair density calculations are half the bird density calculations reported in ABR, Inc.'s annual reports (Obritschkewitsch and Ritchie 2011).

Steller's Eider Recovery Criteria

The Steller's Eider Recovery Plan (USFWS 2002) presents research and management priorities that are re-evaluated and adjusted periodically, with the objective of recovery and delisting so that protection under the ESA is no longer required. When the Alaska-breeding population was listed as threatened, factors causing the decline were unknown, although possible causes identified were increased predation, overhunting, ingestion of spent lead shot in wetlands, and habitat loss from development. Since listing, other potential threats have been identified, including exposure to other contaminants, disturbance caused during scientific research, and climate change, but causes of decline and obstacles to recovery remain poorly understood.

Criteria used to determine when species are recovered are often based on historical abundance and distribution, or on the population size required to ensure that extinction risk, based on population modeling, is tolerably low. For Steller's eiders, information on historical abundance is lacking, and demographic parameters needed for accurate population modeling are poorly understood. Therefore, the Recovery Plan for Steller's Eiders (USFWS 2002) establishes interim recovery criteria based on extinction risk, with the assumption that numeric population goals will be developed as demographic parameters become better understood. Under the Recovery Plan, the Alaska-breeding population would be considered for delisting from threatened status if it has ≤ 1% probability of extinction in the next 100 years, and each of the northern and western subpopulations are stable or increasing and have ≤ 10% probability of extinction in 100 years.



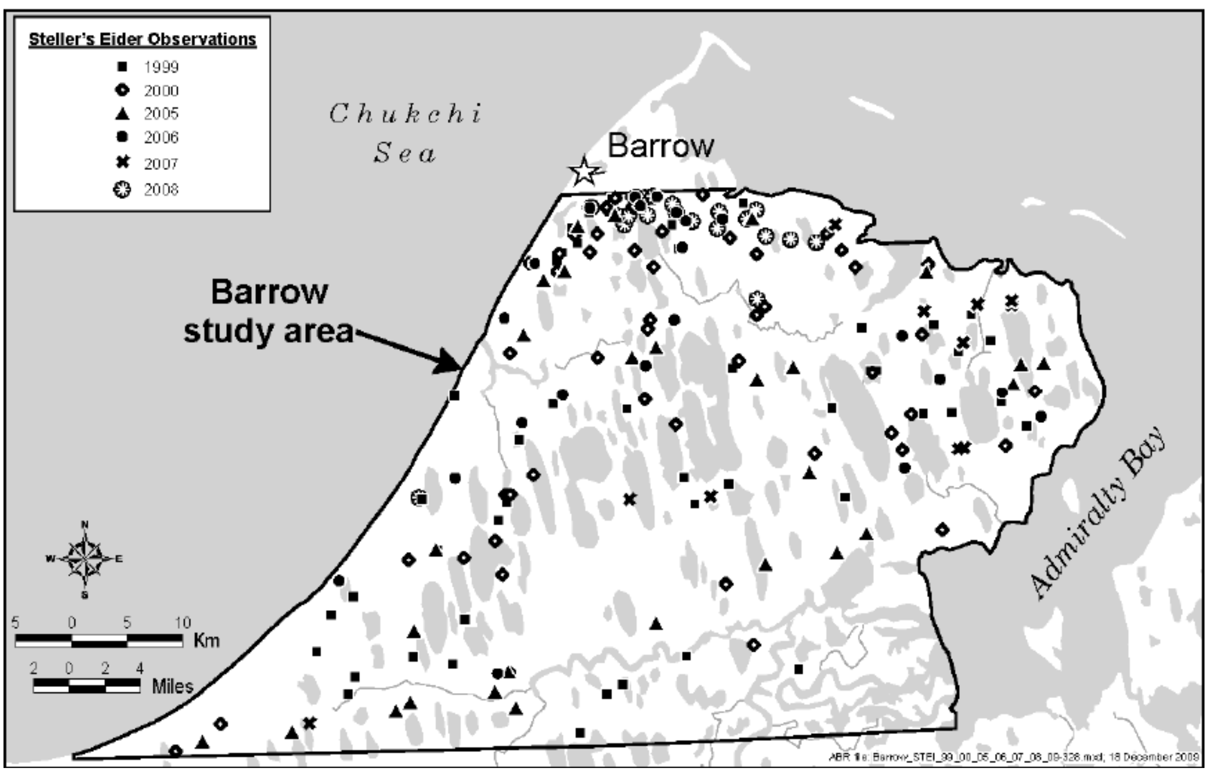


Figure 3.10. Locations of Steller's Eiders observed by ABR, Inc. during aerial surveys in non-breeding (top) and breeding years (bottom) near Barrow, Alaska, June 1999–2009 (Obritschkewitsch and Ritchie 2011).

4. ENVIRONMENTAL BASELINE

The environmental baseline provides an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, their habitat, and ecosystem in the action area.

Status of listed eiders in the action area

Although density of nesting spectacled eiders varies across much of the ACP (Figure 3.2), they regularly breed near Barrow. Breeding Steller's eiders concentrate in tundra wetlands surrounding Barrow (Figure 4.1), and occur at very low densities elsewhere on the ACP (Larned et al. 2010). In the action area, both species arrive between late May and early June and may remain as late as mid-October. The channel at the south end of Middle Salt Lagoon is one of the first open-water areas available when eiders arrive in early June, and frequently functions as a staging area until terrestrial and freshwater habitats are snow-free. Multiple observations of spectacled eider breeding pairs in wetland complexes south of the action area suggest they may nest in the area (Figure 4.1). In addition, numerous observations of Steller's eider breeding pairs and some nests have occurred within the action area (Figure 4.1). Broods of both species may forage in the action area during late summer and early fall. Factors that may have contributed to the current status of spectacled and Steller's eiders in the action area include, but are not limited to, environmental contaminants, increased predator populations, incidental harvest, and habitat loss through development and disturbance. Recovery efforts for both species are underway in portions of the action area.

Environmental contaminants

Deposition of lead shot in tundra wetlands and shallow marine habitat where eiders forage is considered a threat to spectacled and Steller's eiders. Lead poisoning of spectacled eiders has been documented on the Y-K Delta (Franson et al. 1995, Grand et al. 1998) and in Steller's eiders on the ACP (Trust et al. 1997; Service unpublished data). Steller's eider hens nesting near Barrow in 1999 had blood-lead concentrations suggesting exposure to lead (>0.2 ppm lead), and six of seven individuals had blood-lead concentrations indicating poisoning (>0.6 ppm lead). Subsequent isotope analysis confirmed lead in the Steller's eider blood was of lead shot origin, rather than a natural source (Matz, USFWS, unpublished data). Waterfowl hunting with lead shot is prohibited in Alaska, and for all birds on the North Slope. Although the Service reports use of lead shot appears to be declining residual lead shot will presumably be present in the environment, and available to waterfowl, for some unknown period into the future.

Other contaminants, including petroleum hydrocarbons from local sources or globally distributed heavy metals, may also affect listed eiders. For example, spectacled eiders wintering near St. Lawrence Island exhibited high concentrations of metals as well as subtle biochemical changes (Trust et al. 2000). Additionally, spectacled eiders breeding and staging on the Colville River Delta may have experienced a variety of exposure to petroleum hydrocarbons, heavy metals, and other contaminants from nearby industrial development. However, risk of contaminant exposure and potential affects to listed eiders in the action area are unknown.

Increased predator populations
Poor breeding success of Steller's eiders near Barrow has been partially attributed to high predation rates (Obritschkewitsch et al. 2001). Predator and scavenger populations have likely increased near villages and industrial infrastructure on the ACP in recent decades (Eberhardt et al. 1983, Day 1998, Powell and Bakensto 2009). Reduced fox trapping, anthropogenic food sources in villages, and an increase in availability of nesting/denning sites at human-built structures may have resulted in increased numbers of arctic foxes (*Vulpes lagopus*), common ravens (*Corvus corax*), and glaucous gulls (*Larus hyperboreus*) in developed areas of the ACP (Day 1998). For example, ravens are highly efficient egg predators (Day 1998), and have been observed depredating Steller's eider nests near Barrow (Quakenbush et al. 2004). Ravens also appear to have expanded their breeding range on the ACP by using manmade structures for nest sites (Day 1998). Therefore, as the number of structures and anthropogenic attractants associated with development increase, reproductive success of listed spectacled and Steller's eiders may decrease.

Incidental harvest
Although local knowledge suggests spectacled and Steller's eiders were not specifically targeted for subsistence, an unknown level of incidental harvest of both species occurred across the North Slope prior to listing spectacled and Steller's eiders under the ESA (Braund et al. 1993). All harvest of spectacled and Steller's eiders was closed in 1991 by Alaska State regulations and Service policy, and outreach efforts have been conducted by the North Slope Borough, BLM, and Service to encourage compliance. However, annual harvest data indicate that at least some listed eiders continue to be incidentally taken during subsistence activities on the North Slope. Ongoing efforts to help subsistence users avoid incidental harvest are being implemented in North Slope villages, particularly at Barrow, where the greatest perceived risk to Steller's eiders is expected due to their relatively high concentrations and occupancy of areas commonly used for hunting. Annual intra-service consultations are conducted for the Migratory Bird Subsistence Hunting Regulations, and although estimates are imprecise, harvest of all migratory bird species, including listed eiders, are reported annually.

Habitat loss
Destruction or modification of listed eider nesting habitat on the North Slope has been limited, and is not believed to have contributed substantially to population declines of spectacled or Steller's eiders. However, increased development and disturbance in recent decades has impacted listed eiders through loss of nesting habitat.

The human population of Barrow is increasing, and population growth is projected to continue at approximately 2% per annum until at least the middle of this century (BLM 2007). Assuming community infrastructure grows at roughly the same pace, the Barrow footprint could cover approximately 3,600 acres (14.6 km^2) by the 2040s (BLM 2007). In addition, oil and gas development has progressed westward across the ACP towards the National Petroleum Reserve – Alaska (NPR-A) and given industry interest in NPR-A, expressed in lease sales, seismic surveys, and exploratory wells, westward expansion of industrial development is likely to continue. However, potential effects of predicted community and industry expansion on listed eiders is difficult to predict.

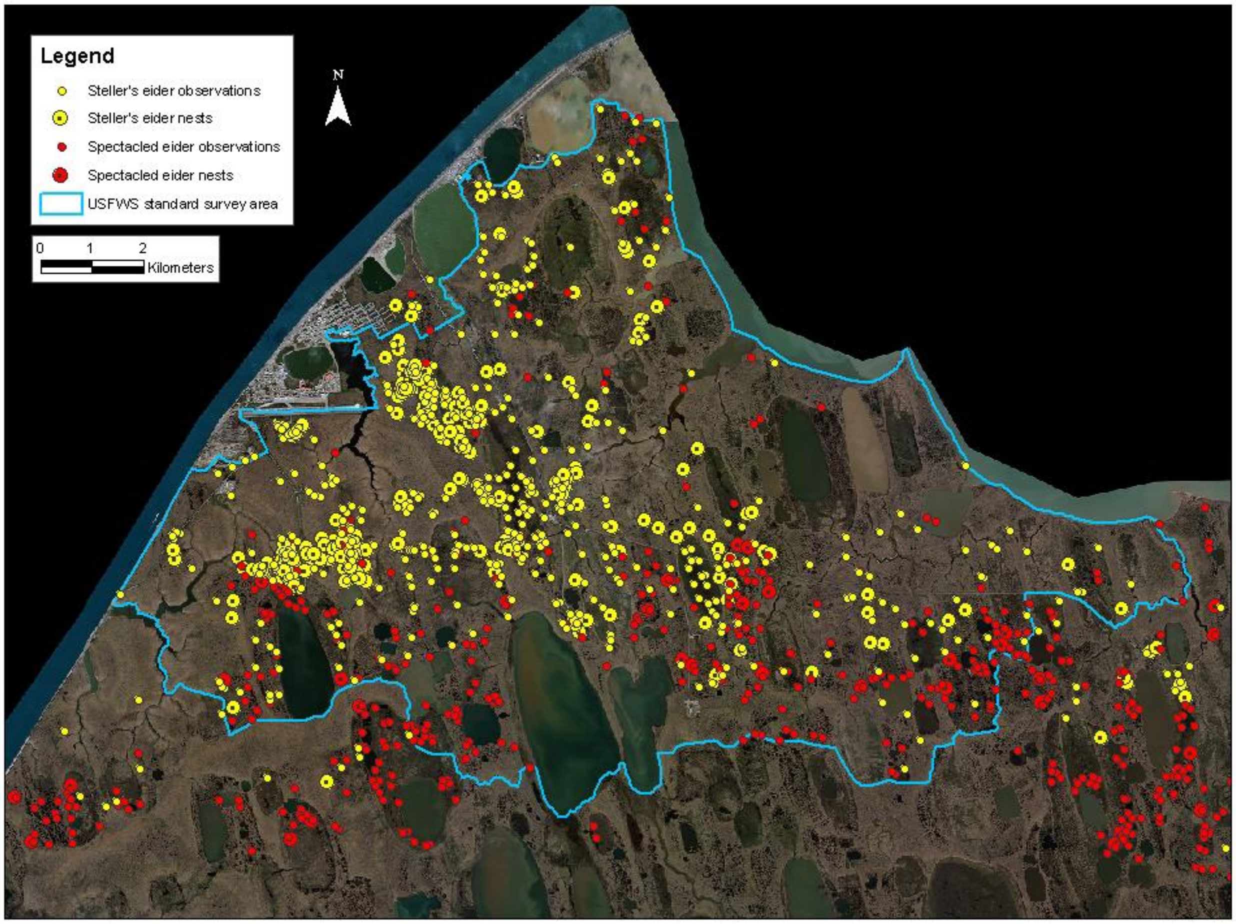


Figure 4.1. Observations of Steller's eiders and spectacled eiders during USFWS breeding pair and nest foot surveys at Barrow, AK (1999–2010; Steller's eider nest locations 1991–2010).

Research
Field-based scientific research has also increased on the ACP in response to interest in climate change and its effects on Arctic ecosystems. While some activities have no impact on listed eiders (e.g., project timing occurs when eiders are absent, or employs remote sensing tools), on-tundra activities and remote aircraft landings may disturb listed eiders. Many of these activities are considered in intra-Service consultations, or under a programmatic consultation with the BLM for summer activities in NPR-A.

Regional activities requiring formal section 7 consultation
Activities in the vicinity of Barrow, Alaska that required formal section 7 consultation, and associated estimated incidental take of listed eiders, is presented in Table 4.1. The table illustrates the number and diversity of actions that have required consultation in the region. We believe these consultations have overestimated, probably substantially, actual take. Take occurs over the life of a project, and in most cases is in the form of potential loss of eggs/ducklings, which we expect to have substantially lower population-level effects compared to adult mortality (for further discussion see *Effects of the Action on Listed Species*). Further, these estimates are predicated upon several conservative (i.e., more protective) assumptions.

Table 4.1. Activities near Barrow, Alaska that have required formal Section 7 consultation and the amount of incidental take authorized.

Project Name	**Impact Type**	**Estimated Incidental Take**
Barrow Airport Expansion (2006)	Habitat loss	14 spectacled eider eggs/ducklings 29 Steller's eider eggs/ducklings
Barrow Hospital (2004 & 2007)	Habitat loss	2 spectacled eider eggs/ducklings 17 Steller's eider eggs/ducklings
Barrow Landfill (2003)	Habitat loss	1 spectacled eider nest/ year 1 Steller's eider nest/year
Barrow Artificial Egg Incubation	Removal of eggs for captive breeding program	Maximum of 24 Steller's eider eggs
Barrow Tundra Manipulation Experiment (2005)	Habitat loss Collisions	2 spectacled eider eggs/ducklings 1 Steller's eider eggs/ducklings 2 adult spectacled eiders 2 adult Steller's eiders
Barrow Global Climate Change Research Facility, Phase I & II (2005 & 2007)	Habitat loss Collisions	6 spectacled eider eggs/ducklings 25 Steller's eider eggs/ducklings 1 adult spectacled eider 1 adult Steller's eider
Barrow Wastewater Treatment Facility (2005)	Habitat loss	3 Steller's eider eggs/ducklings 3 spectacled eider eggs/ducklings
ABR Avian Research/USFWS Intra-Service Consultation	Disturbance	5 spectacled eider eggs/ducklings
Intra-service on Subsistence Hunting Regulations 2007	No estimate of incidental take provided	
Intra-service on Subsistence Hunting Regulations 2008	No estimate of incidental take provided	
NOAA National Weather Service Office in Barrow	Habitat loss Disturbance Collision	< 4 spectacled eider eggs/ducklings < 10 Steller's eider eggs/ducklings 1 adult Steller's eider
Intra-service on Subsistence Hunting Regulations 2009	No estimate of incidental take provided	
Intra-Service on Section 10 permit for USGS 2009 telemetry study	Loss of Production Capture/surgery	130 spectacled eider eggs/ducklings 4 adult spectacled eiders
Intra-Service, Migratory Bird 2010 Subsistence Hunting Regulations	No estimate of incidental take provided	
Intra-Service, Section 10 permit for USFWS eider survey work at Barrow (2010)	Disturbance Capture/handling	≤ 3 Steller's or spectacled eider clutches- lethal ≤ 90 pairs + 60 hens, Steller's eider -non-lethal ≤ 60 pairs + 60 hens, spectacled eider ≤ 1 Steller's eider or spectacled eider adult (lethal take) ≤ 7 ducklings Steller's eider or spectacled eider (lethal take) ≤ 30 Steller's eider or spectacled eider hens (nonlethal take) ≤ 40 Steller's eider or spectacled eider ducklings (nonlethal take)
Intra-Service, Section 10 permit for ABR Inc.'s eider survey work on the North Slope and at Cook Inlet (2010)	Disturbance	≤ 35 spectacled eider eggs/ducklings
Intra-Service, Migratory Bird 2011 Subsistence Hunting Regulations	Shooting	≤ 4 adult Steller's eiders (lethal take) ≤ 400 adult spectacled eiders (lethal take)

Barrow Gas Fields Well Drilling Program, 2011	Loss of production	≤ 20 spectacled eider eggs/ducklings ≤ 22 Steller's eider eggs/ducklings
Intra-Service, Section 10 permit for ABR Inc.'s eider survey work on the North Slope and at Cook Inlet (2011)	Disturbance	≤ 20 spectacled eider eggs/ducklings
Intra-Service, Alaska Region Migratory Bird Management, 2011 Shorebird Breeding Ecology Studies, Barrow, Alaska	No estimate of incidental take provided	
Intra-Service, Section 10 permit for USFWS eider survey work at Barrow (2011)	Disturbance Capture/handling/	≤ 4 Steller's and 4 spectacled eider clutches- (lethal take) ≤ 90 Steller's and 60 spectacled eider pairs (nonlethal take; pre-nesting monitoring) ≤ 60 Steller's and 60 spectacled eider hens (nonlethal take; nest monitoring) ≤ 20 Steller's and 20 spectacled eider hens (nonlethal take) ≤ 40 Steller's or spectacled eider ducklings (nonlethal take) ≤ 1 Steller's eider or spectacled eider adult (lethal take) ≤ 2 Steller's or spectacled eider ducklings (lethal take)
Intra-Service, Migratory Bird 2012 Subsistence Hunting Regulations	Shooting	4 adult Steller's eiders (lethal take) 400 adult spectacled eiders (lethal take)
Barrow 60-man Camp Facility (2012)	Habitat Loss	6 Steller's eider eggs/ducklings 4 spectacled eider eggs/ducklings
Barrow Roads Improvement Project (2012)	Habitat Loss	121 Steller's eider eggs/ducklings 16 spectacled eider eggs/ducklings
Intra-Service, Section 10 permit for USFWS eider survey work, lemming studies, and fox control at Barrow (2012)	Disturbance Capture/handling/	≤ 4 Steller's and 4 spectacled eider clutches (lethal take) ≤ 90 Steller's and 60 spectacled eider pairs (nonlethal take; pre-nesting monitoring) ≤ 60 Steller's and 60 spectacled eider hens (nonlethal take; nest monitoring) ≤ 20 Steller's and 20 spectacled eider hens (nonlethal take) ≤ 40 Steller's or spectacled eider ducklings (nonlethal take) ≤ 1 Steller's eider or spectacled eider adult (lethal take) ≤ 7 Steller's or spectacled eider ducklings (lethal take)
Intra-Service, Section 10 permit for USFWS eider survey work, lemming studies, and fox control at Barrow (2013)	Disturbance Capture/handling/	≤ 4 Steller's and 4 spectacled eider clutches (lethal take) ≤ 90 Steller's and 60 spectacled eider pairs (nonlethal take; pre-nesting monitoring) ≤ 60 Steller's and 60 spectacled eider hens (nonlethal take; nest monitoring) ≤ 20 Steller's and 20 spectacled eider hens (nonlethal take) ≤ 40 Steller's or spectacled eider ducklings (nonlethal take) ≤ 1 Steller's eider or spectacled eider adult (lethal take) ≤ 7 Steller's or spectacled eider ducklings (lethal take)

Climate change
High latitude regions, such as Alaska's North Slope, are thought to be especially sensitive to effects of climate change (Quinlan et al. 2005, Schindler and Smol 2006, Smol et al. 2005). While climate change will likely affect individual organisms and communities it is difficult to predict with certainty how these effects will manifest. Biological, climatological, and hydrologic components of the ecosystem are interlinked and operate on varied spatial, temporal, and organizational scales with feedback between each component (Hinzman et al. 2005).

There are a wide variety of changes occurring across the circumpolar Arctic. Arctic landscapes are dominated by freshwater wetlands (Quinlan et al. 2005), which listed eiders depend on for forage and brood rearing. As permafrost thaws, some water bodies are draining (Smith et al. 2005, Oechel et al. 1995), or drying due to increased evaporation and evapotranspiration during prolonged ice-free periods (Schindler and Smol 2006, and Smol and Douglas 2007). In addition, productivity of some lakes and ponds is increasing in correlation with elevated nutrient inputs from thawing soil (Quinlan et al. 2005, Smol et al. 2005, Hinzman et al. 2005, and Chapin et al. 1995) and other changes in water chemistry or temperature are altering algal and invertebrate communities, which form the basis of the Arctic food web (Smol et al. 2005, Quinlan et al. 2005).

With reduced summer sea ice coverage, the frequency and magnitude of coastal storm surges has increased. During these events, coastal lakes and low lying wetlands are often breached, altering soil/water chemistry as well as floral and faunal communities (USGS 2006). When coupled with softer, semi-thawed permafrost, reductions in sea ice have significantly increased coastal erosion rates (USGS 2006), which may reduce available coastal tundra habitat over time.

Changes in precipitation patterns, air and soil temperatures, and water chemistry are also affecting terrestrial communities (Hinzman et al. 2005, Prowse et al. 2006, Chapin et al. 1995), and the range of some boreal vegetation species is expanding northward (Callaghan et al. 2004). Climate-induced shifts in distributions of predators, parasites, and disease vectors may also have significant effects on listed and un-listed species. Climate change may also cause mismatched phenology between listed eider migration, development of tundra wetland invertebrate stocks, fluctuation of small mammal populations, and corresponding abundance of predators (Callaghan et al. 2004, Quakenbush and Suydam 1999).

While the impacts of climate change are on-going and the ultimate effects on listed eiders within the action area are unclear, species with small populations are more vulnerable to the impacts of environmental change (Crick 2004). Some species may adapt and thrive under changing environmental conditions, while others decline or suffer reduced biological fitness.

5. EFFECTS OF THE ACTION ON LISTED SPECIES

This section of the BO provides an analysis of the effects of the action on listed species and, where appropriate, critical habitat. Both direct effects (effects immediately attributable to the action) and indirect effects (effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur) are considered. Interrelated and interdependent effects of the action are also discussed.

Our analyses of the effects of the action on species listed under the ESA include consideration of ongoing and projected changes in climate. The terms “climate” and “climate change” are defined by the Intergovernmental Panel on Climate Change (IPCC). “Climate” refers to the mean and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods also may be used (IPCC 2007). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007). Various types of changes in climate can have direct or indirect effects on species. These effects may be positive, neutral, or negative and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Effects to listed eiders

Adverse effects to spectacled and Steller’s eiders could occur through collisions with structures, increased predator populations, and long-term habitat loss; each of these factors is evaluated below.

Collisions with structures

Migratory birds suffer considerable mortality from collisions with man-made structures (Manville 2004). Birds are particularly at risk of collision when visibility is impaired by darkness or inclement weather (Weir 1976). There is also evidence that lights on structures increase collision risk (Reed et al. 1985, Russell 2005, numerous authors cited by Manville 2000). Anderson and Murphy (1988) monitored flight behavior of 25 migratory species near a 12.5 km power line in the Lisburn area (southern Prudhoe Bay oil fields) during 1986 and 1987. They witnessed four non-lethal collisions and detected 31 mortalities, including eiders. Results indicated that strike rate was related to flight behavior, in particular altitude. Johnson and Richardson (1982) in their study of migratory behavior along the Beaufort Sea coast, reported that 88% of eiders flew below an estimated altitude of 10 m (32 ft) and well over half flew below 5 m (16 ft). This tendency to fly near the ground puts eiders at risk of striking even relatively low objects in their path.

Eiders migrating east during spring and west during summer/fall would be at risk of colliding with the UIC Barrow Camp structures. These structures include the light poles, buildings, and potential free-standing communication tower. However, we expect most eiders to remain offshore during spring migration because they are thought to follow open water leads in pack ice during their spring migration to breeding grounds (Woodby and Divoky 1982, Johnson and Richardson 1982, Oppel et al. 2009, M. Sexson, USGS, pers. comm.). During post-breeding migration in summer and fall, we anticipate that male eiders would have the greatest collision risk in the action area.

Satellite telemetry studies from the eastern ACP indicated that male spectacled eiders depart early in summer and generally remain close to shore, sometimes moving overland, during westward migration (TERA 2002; see also Petersen et al. 1999). However, we anticipate listed eider collision risk with UIC Barrow Camp structures from mid-May through late July would be greatly reduced by the visibility of structures during 24 hours of daylight in the project area. When females and juveniles migrate during late summer/fall, shorter daylight and frequent foggy weather conditions could increase collision risk. Longer nights increase the duration that eiders are vulnerable to collisions with unseen structures, and may compound susceptibility to attraction and disorientation from project lighting. However, we anticipate sea ducks, including listed eiders, would be more likely to migrate over open water in the Chukchi Sea (Petersen et al. 1999, TERA 2002), thereby generally avoiding inland UIC Barrow Camp structures. We also expect collision risk with project lighting would be further reduced by design features which shield outward-radiating light and minimize potential disorienting effects to eiders. Finally, the applicant plans to bury powerlines, which eliminates risk of collision with overhead lines.

In summary, we anticipate the likelihood of collisions of listed eiders with proposed UIC Barrow Camp structures would be very low because 1) good visibility of project structures in late-spring and early summer due to extended daylight likely reduces collision risk; 2) migrating eiders tend to fly offshore thereby avoiding inland structures during late summer and fall when darkness increases collision risk; 3) facility lighting would be designed to reduce the potential for attracting or disorienting eiders in flight; and 4) no overhead lines are planned.

Increased predator populations

Predator and scavenger populations have likely increased near villages and industrial infrastructure on the ACP (Eberhardt et al. 1983, Day 1998, Powell and Bakensto 2009). Reduced fox trapping, anthropogenic food sources near villages, and an increase in availability of nesting/denning sites on man-made structures may have resulted in increased numbers of arctic foxes (*Vulpes lagopus*), common ravens (*Corvus corax*), and glaucous gulls (*Larus hyperboreus*) in developed areas of the ACP (Day 1998). Although ravens did not historically nest on the ACP, particularly along the coast in recent years multiple raven pairs have established territories and nest annually on communication towers or other structures near Barrow.

Ravens were observed depredating 5 Steller’s eider nests near Barrow between 1991 and 1999 and are capable of displacing female Steller's eiders and removing whole eggs from a nest (Quakenbush et al. 1995, 2004). A raven was also documented depredating a Steller’s eider nest during camera-monitoring work in 2007 (Rojek 2008). Although ravens are known to be highly efficient egg predators, estimating the effects of predators on listed eider production in the action area is extremely difficult. We expect structures associated with proposed camp facilities would increase the number of potential nesting and perching sites for ravens and increase availability of anthropogenic food resources for predators in the project area. However, management of raven nest sites and proper waste management and disposal policies would reduce potential increases in predator productivity and depredation of listed eider nests. Provided these management policies are implemented, we anticipate adverse effects to listed eiders from increased predator populations would be minimized.

Long-term habitat loss
Permanent habitat loss will result from placement of gravel for the additional 2.67 acre pad and 1.78 acre access road. We also anticipate that indirect habitat loss via disturbance will occur within a 200-m (656.17-ft) zone of influence surrounding the proposed development from increased on-pad activities and vehicle traffic. The two principal mechanisms through which disturbance can adversely affect eiders on their breeding grounds are:

1. Displacing adults and/or broods from preferred habitats during pre-nesting, nesting, brood rearing, and migration; and
2. Displacing females from nests, exposing eggs or small young to inclement weather or predators.

Loss of production
In the discussion below, we provide an assessment of potential loss of listed eider production resulting from the proposed action. This assessment uses estimates of spectacled eider density on the ACP from waterfowl breeding population survey data in the region (Larned et al. 2011), and average density of Steller's eider breeding pairs within the Service's standard survey area 1999–2012 (Safine 2013). These estimates were developed at a coarse regional scale and are not site or habitat-specific; however, they reflect the best available data on the density of breeding eiders in the action area. Distribution on a local scale may vary based on the availability of preferred habitats.

Habitat loss could occur through direct or indirect effects. Direct loss of habitat would occur by placement of gravel onto approximately 4.65 acres (0.019 km^2) of tundra wetlands during installation of the proposed pad and access road. Indirect habitat loss may occur through displacement of eiders from the surrounding area affected by disturbance. Assuming this affect may extend over roughly 200 m, the area encompassed by the zone of influence, or the area of total habitat loss, is estimated to be 58.69 acres (0.24 km^2). This estimate is likely conservative (i.e., biased high) because fewer eiders may nest in the area given the proximity to existing infrastructure and human disturbance.

Spectacled eiders
Spectacled eider density polygons constructed from data collected during the 2007–2010 waterfowl breeding population survey of the ACP (Larned et al. 2011) provide our best estimate of spectacled eider nest density in the action area. Estimated spectacled eider density in the action area ranged from 0.237 to 1.531 birds/km^2 (Larned et al. 2011). To estimate the potential number of spectacled eider pairs displaced by the proposed action per year, we multiplied the median estimated density in the action area (0.88 birds/km^2) by the estimated affected footprint (0.24 km^2). We assume the estimated number of pairs displaced is equivalent to the number of nests or broods that may be affected. We also assume that spectacled eiders will be present and attempt to nest annually in the action area. Finally, we assume that displaced pairs will not move and successfully nest elsewhere, which is an unproven and conservative assumption. The potential loss of production in terms of numbers of eggs or ducklings lost was based on an average clutch size of 3.9 for spectacled eiders in northern Alaska (Petersen et al. 2000, Bart and Earnst 2005, Johnson et al. 2008). Applying these assumptions and this logic, we estimate the

proposed action would preclude initiation or success of 5 spectacled eider nests over an estimated 50-year project life:

$$0.88 \text{ birds/km}^2 \times 0.5 \text{ nests/pair} \times 0.24 \text{ km}^2 = 0.10 \text{ nests annually}$$

$$0.10 \text{ nests annually} \times 50 \text{ years} = 5.25 \text{ spectacled eider nests}$$

Loss of eggs is of much lower significance for survival and recovery of the species than the death of an adult bird. For example, when nest success, fledging success, over-winter survival, and annual survival are taken in context, we estimate only 1-7 out of every 100 spectacled eiders hatched on the Y-K Delta would enter the breeding population (Grand and Flint 1997, Flint et al. 2000, Grand et al. 1998, and Flint pers. comm.). Similarly, we would expect only a small proportion of spectacled eider eggs or ducklings hatched on the North Slope to achieve reproductive potential.

Based on an average clutch size of 3.9 eggs for spectacled eiders (Petersen et al. 2000, Bart and Earnst 2005, Johnson et al. 2008), we estimate up to 21 eggs could be lost due to nest abandonment.

$$5.25 \text{ nests} \times 3.9 \text{ eggs per nest} = 20.5 \text{ eggs lost}$$

Because the most recent population estimate for North Slope-breeding spectacled eiders is 11,254 (8,338–14,167, 95% CI), we would not anticipate population level effects from the loss of 21 eggs from 5 nests as a result of disturbance associated with the proposed camp and road additions.

Steller's eiders

We estimated the potential number of Steller's eider nests lost by multiplying the average density of breeding pairs within the USFWS standard survey area 1999–2012 (Safine 2013; 0.262 breeding pairs/km^2) by the extent of the affected area (0.24 km^2). Therefore, the mean number of nests affected annually by the proposed project would be:

$$0.262 \text{ pairs/km}^2 \times 0.5 \text{ nest/pair} \times 0.24 \text{ km}^2 = 0.03 \text{ nests annually}$$

Based on the number of potential Steller's eider nests lost annually, we estimate approximately 2 nests may be lost over an assumed 50-year project life (0.03 nests/year × 50 years = 1.56 nests). We estimated the potential number of eggs or ducklings lost over the project life as the product of an average clutch size of 8 for Steller's eiders near Barrow, and the number of affected nests, resulting in an estimated loss of production of 13 Steller's eider eggs or ducklings (1.56 nests × 8 eggs/nest = 12.46 eggs). Given low nest survival and fledging success, only a small proportion of Steller's eider eggs or ducklings would be expected to recruit into the breeding population. Therefore, we would not anticipate population-level effects from the loss of 13 eggs from 2 abandoned Steller's eider nests over a 50-year project life.

6. CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this BO. Future federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. When analyzing cumulative effects of a proposed action, it is important to define both the spatial (geographic), and temporal (time) boundaries. Within these boundaries, the types of actions that are reasonably foreseeable are considered.

Future development by the State of Alaska or the North Slope Borough may occur in the area through developments like improved roads, transportation facilities, utilities or other infrastructure. However, the entire action area, and the undeveloped lands surrounding are wetlands, and are therefore subject to Section 404 permitting requirements by the USACE. This permitting process would serve as a federal nexus, and hence trigger a review of any major state or borough construction project in the area.

7. CONCLUSION

Regulations (51 CFR 19958) that implement section 7(a)(2) of the ESA define “jeopardize the continued existence of” as “to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.”

Listed eiders

In evaluating the impacts of the proposed project to spectacled eiders, the Service identified direct and indirect adverse effects that could result from habitat loss and disturbance. Using methods explained in the *Effects of the Action* section, the Service estimates the loss of up to 21 spectacled eider eggs from 5 nests and 13 Steller’s eider eggs from 2 nests. However, we expect this loss of production will not have a significant effect at the population level because only a small proportion of listed eider eggs or ducklings on the North Slope would eventually survive to recruit into the breeding populations.

Given that the potential loss in production from the proposed action is an extremely small proportion of the estimated North Slope-breeding population of spectacled (10,942–14,890, 95% CI; Stehn et al. 2006) and Steller’s eiders (292–859, 90% CI; Stehn and Platte 2009), and this loss would be distributed across approximately 50 years, we believe the loss of production that may result from the proposed project will not significantly affect the likelihood of survival and recovery of spectacled or Alaska-breeding Steller’s eiders. After reviewing the current status of the species, the environmental baseline, and effects of the proposed action, the Service concludes that the proposed action is *not likely to jeopardize the continued existence* of the spectacled or Steller’s eider by reducing appreciably the likelihood of survival and recovery in the wild by reducing reproduction, numbers, or distribution of these species.

Future consultation
This BO's determination of non-jeopardy is based on the assumption that the USACE and their agents will consult with the Service on future activities related to the UIC Barrow Camp that are not evaluated in this document.

In addition to listed eiders, the area affected by the UIC Barrow Camp may now or hereafter contain plants, animals, or their habitats determined to be threatened or endangered. The Service, through future consultation may recommend alternatives to future developments within the project area to prevent activity that will contribute to a need to list such a species or their habitat. The Service may require alternatives to proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of designated or proposed critical habitat. The Federal action agencies should not authorize any activity that may affect such species or critical habitat until it completes its obligations under applicable requirements of the ESA as amended (16 U.S.C. 1531 et seq.), including completion of any required procedure for conference or consultation.

8. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or attempt to engage in any such conduct. "Harm" is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. "Harass" is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action, is not considered a prohibited taking provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement (ITS).

USACE has a continuing duty to regulate the activity covered by this ITS. If USACE (1) fails to assume and implement the terms and conditions or (2) fails to require any applicant to adhere to the terms and conditions of the ITS through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse.

Listed eiders
As described in *Effects of the Action*, the activities described and assessed in this BO may adversely affect listed eiders through direct and indirect long-term habitat loss. Long-term habitat loss would occur directly from placement of gravel fill and indirectly through disturbance associated with on-pad activities and vehicle traffic. Methods used to estimate loss of listed eider production resulting from long-term habitat loss are described in the *Effects of the Action* section. Based on these estimates of loss of listed eider production, the Service anticipates the

loss of production of 5 abandoned spectacled eider nests with eggs and 2 Steller's eider nest with eggs as a result of the proposed action through long-term direct and indirect habitat loss.

While the incidental take statement provided in this consultation satisfies the requirements of the ESA, it does not constitute an exemption from the prohibitions of take of listed migratory birds under the more restrictive provisions of the Migratory Bird Treaty Act. However, the Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703–712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668–668d), if such take is in compliance with the terms and conditions specified herein.

9. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to use their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. We recommend the following actions be implemented:

1. While collisions between listed eiders and project structures are not anticipated, the Service recommends reporting all sea duck collisions to the Endangered Species Branch, Fairbanks Fish and Wildlife Field Office to improve our understanding of collision risks to eiders in the project area. Contact Shannon Torrence at 907-455-1871 for information on how to report bird collisions.

2. In order to better understand common raven activity in the vicinity human developments, the Service recommends reporting any raven nests to the Endangered Species Branch, Fairbanks Fish and Wildlife Field Office as soon as they are discovered.

10. REINITIATION NOTICE

This concludes formal consultation for modifications to the Barrow Camp Project. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

1. The amount or extent of incidental take for spectacled eiders is exceeded;
    a. More than 21 spectacled eider eggs or ducklings taken over the life of the project; and
    b. More than 13 Steller's eider eggs or ducklings taken over the life of the project;
2. New information reveals effects of the action agency that may affect listed species in a manner or to an extent not considered in this opinion;
3. The agency action is subsequently modified in a manner that causes an effect to listed species or critical habitat not considered in this opinion; or
4. A new species is listed or critical habitat is designated that may be affected by the action.

11. LITERATURE CITED

Anderson, B. and B. Cooper. 1994. Distribution and abundance of spectacled eiders in the Kuparuk and Milne Point oilfields, Alaska, 1993. Unpublished report prepared for ARCO Alaska, Inc., and the Kuparuk River Unit, Anchorage, Alaska by ABR, Inc., Fairbanks, Alaska, and BBN Systems and Technologies Corp., Canoga Park, CA. 71 pp.

Anderson B.A. and S.M. Murphy 1988. Lisburn terrestrial monitoring program 1986 and 1987: The effects of the Lisburn powerline on birds. Final report by ABR Inc. for ARCO Alaska. 60pp.

Anderson, B., R. Ritchie, A. Stickney, and A. Wildman. 1998. Avian studies in the Kuparuk oilfield, Alaska, 1998. Unpublished report for ARCO Alaska, Inc. and the Kuparuk River Unit, Anchorage, Alaska. 28 pp.

Anderson B., A.A. Stickney, R.J. Ritchie, and B.A. Cooper. 1995. Avian studies in the Kuparuk Oilfield, Alaska, 1994. Unpublished report for ARCO Alaska, Inc. and the Kuparuk River Unit, Anchorage, Alaska.

Bart, J. and S.L. Earnst. 2005. Breeding ecology of spectacled eiders *Somateria fischeri* in Northern Alaska. Wildfowl 55:85–100.

BLM. 2007. Northeast National Petroleum Reserve–Alaska Draft Supplemental Integrated Activity Plan / Environmental Impact Statement. August 2007. U.S. Department of Interior, Bureau of Land Management, Anchorage, Alaska. Four Volumes + Appendices.

Bowman, T., J. Fischer, R. Stehn, and G. Walters. 2002. Population size and production of geese and eiders nesting on the Yukon-Kuskokwim Delta, Alaska in 2002. Field report. U.S. Fish and Wildlife Service, Waterfowl Management Branch. Anchorage, AK. 22pp.

Braund, S. 1993. North Slope subsistence study Barrow 1987, 1988, 1989. Submitted to U.S. Department of Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. OCS Study MMS 91-0086, Technical Report No. 149. 234 pp. + appendices.

Brooks, W. 1915. Notes on birds from east Siberia and Arctic Alaska. Bulletin of the Museum of Comparative Zoology 59:359–413.

Callaghan, T.V., L.O. Björn, Y. Chernov, T. Chapain, T.R. Christensen, B. Huntley, R.A. Ims, M. Johansson, D. Jolly, S. Jonasson, N. Matveyeva, N. Panikov, W. Oechel, G. Shaver, J. Elster, H. Henttonen, K. Laine, K. Taulavuori, E. Taulavuori, and C. Zöckler. 2004. Biodiversity, distributions and adaptations of Arctic species in the context of environmental change. Ambio 33:404–417.

Chapin, F.S, G.R. Shaver, A.E. Giblin, K.J. Nadelhoffer, and J.A. Laundre. 1995. Responses of Arctic tundra to experimental and observed changes in climate. Ecology 76:694–711.

Cottam, C. 1939. Food habits of North American diving ducks. USDA Technical Bulletin 643, Washington, D.C.

Coulson, J.C. 1984. The population dynamics of the Eider Duck *Somateria mollissima* and evidence of extensive non-breeding by adult ducks. Ibis 126:525–543.

Crick, H.Q.P. 2004. The impact of climate change on birds. Ibis 146:48–56.

Dau, C.P. 1974. Nesting biology of the spectacled eider, *Somateria fischeri* (Brandt), on the Yukon–Kuskokwim Delta, Alaska. University of Alaska, Fairbanks, Alaska. M.S. thesis. 72 pp.

Dau, C.P. 1987. Birds in nearshore waters of the Yukon–Kuskokwim Delta, Alaska. Murrelet 68:12–23.

Dau, C.P., and S.A. Kistchinski. 1977. Seasonal movements and distribution of the spectacled eider. Wildfowl. 28:65–75.

Day, R.H. 1998. Predator populations and predation intensity on tundra-nesting birds in relation to human development. Report prepared by ABR Inc., for Northern Alaska Ecological Services, U.S. Fish and Wildlife Service, Fairbanks, Alaska. 106 pp.

Dhondt, A. A. 1987. Cycle of lemmings and geese: A comment on the hypothesis of Roselaar and Summers. Bird Study 34:151-154.

Dick, M.H. and L.S. Dick. 1971. The natural history of Cape Pierce and Nanvak Bay, Cape Newenham National Wildlife Refuge, Alaska. U.S. Fish and Wildlife Service. Unpublished report. Bethel, Alaska. 77 pp.

Drent, R. and S. Daan. 1980. The prudent parent: energetic adjustments in breeding biology. Ardea 68:225–252.

Eberhardt, L.E., R.A. Garrott, and W.C. Hanson. 1983. Winter movements of Arctic foxes, *Alopex lagopus*, in a Petroleum Development Area. The Canadian Field-Naturalist 97:66–70.

Ely, C.R., C.P. Dau, and C.A. Babcock. 1994. Decline in population of Spectacled Eiders nesting on the Yukon–Kuskokwim Delta, Alaska. Northwestern Naturalist 75:81–87.

Esler D., J.M. Pearce, J. Hodges, and M.R. Petersen. 1995. Distribution, abundance and nesting ecology of spectacled eiders on the Indigirka River Delta, Russia. Unpublished progress report. National Biological Survey, Alaska Science Center. 12 pp.

Feder, H.M., A.S. Naidu, J.M. Hameedi, S.C. Jewett, and W.R. Johnson. 1989. The Chukchi Sea Continental Shelf: Benthos–Environmental Interactions. Final Report. NOAA–Ocean Assessment Division, Anchorage, Alaska. 294 pp.

Feder, H.M., N.R. Foster, S.C. Jewett, T.J. Weingartner, and R. Baxter. 1994a. Mollusks in the Northeastern Chukchi Sea. Arctic 47(2): 145–163.

Feder, H.M., A.S. Naidu, S.C. Jewett, J.M. Hameedi, W.R. Johnson, and T.E. Whitledge. 1994b. The northeastern Chukchi Sea: benthos–environmental interactions. Marine Ecology Progress Series 111:171–190.

Fischer, J.B., R.A. Stehn, and G. Walters. 2011. Nest population size and potential production of geese and spectacled eiders on the Yukon–Kuskokwim Delta, Alaska, 1985–2011. Unpublished Report. U.S. Fish and Wildlife. Service, Anchorage, Alaska. 43 pp.

Flint, P.L and J.B. Grand. 1997. Survival of spectacled eider adult females and ducklings during brood rearing. Journal of Wildlife Management 61:217–221.

Flint, P.L., J.B. Grand, J.A. Morse, and T.F. Fondell. 2000. Late summer survival of adult female and juvenile spectacled eiders on the Yukon–Kuskokwim Delta, Alaska. Waterbirds 23:292–297.

Flint, P.L and J.L. Schamber. 2010. Long-term persistence of spent lead shot in tundra wetlands. Journal of Wildlife Management 74:148–151.

Franson, J., M.R. Petersen, C. Meteyer, and M. Smith. 1995. Lead poisoning of spectacled eiders (*Somateria fischeri*) and of a common eider (*Somateria mollissima*) in Alaska. Journal of Wildlife Diseases 31:268–271.

Gabrielson, M. and N. Graff. 2011 Monitoring of Nesting Spectacled Eiders on Kigigak Island, Yukon Delta NWR, 2011. Unpublished report. U.S. Fish and Wildlife Service, Yukon Delta National Wildlife Refuge, Bethel, Alaska 99559. 16 pp.

Gill, R.E., M.R. Petersen, and P.D. Jorgensen. 1981. Birds of Northcentral Alaska Peninsula, 1978–80. Arctic 34:286–306.

Gorman, M.L. and H. Milne. 1971. Seasonal changes in adrenal steroid tissue of the common eider *Somateria mollissima* and its relation to organic metabolism in normal and oil polluted birds. Ibis 133:218–228.

Grand, J.B. and P.L. Flint. 1997. Productivity of nesting spectacled eiders on the Lower Kashunuk River, Alaska. The Condor 99:926–932.

Grand, J.B., P.L. Flint, and M.R. Petersen. 1998. Effect of lead poisoning on spectacled eiders survival rates. Journal of Wildlife Management 62:1103–1109.

Harwood, C. and T. Moran. 1993. Productivity, brood survival, and mortality factors for spectacled eiders on Kigigak Island, Yukon Delta NWR, Alaska, 1992. Unpublished report prepared for U.S. Fish and Wildlife Service, Bethel, Alaska. 11pp + Appendix.

Hinzman, L.D., N.D. Bettez, W.R. Bolton, F.S. Chpin, M.B. Dyurgerov, C.L. Fastie, B. Griffith, R.D. Hollister, A. Hope, H.P. Huntington, A.M. Jensen, G.J. Jia, T. Jorgenson, D.L. Kane, D.R. Klien, G. Kofinas, A.H. Lynch, A.H. Lloyd, A.D. McGuire, F.E. Nelson, W.C. Oechel, T.E. Osterkamp, C.H. Racine, V.E. Romanovsky, R.S. Stone, D.A. Stow, M. Strum, C.E.

Tweedie, G.L. Vourlitis, M.D. Walker, D.A. Walker, P.J. Webber, J.M. Welker, K.S. Winklet, K. Yoshikawa. 2005. Evidence and implications of recent climate change in northern Alaska and other arctic regions. Climatic Change 72: 251–298.

Hollmen T, T Swem, B McCaffery, S Atkinson; sections by H Cline, J Grand, and D Safine. 2007. Draft Steller's eider reintroduction plan: feasibility analysis. U.S. Fish and Wildlife Service, Fairbanks, Alaska.

IPCC. 2007. Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K., and A. Reisinger (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

Johnson, C.B, J.P. Parrett, and P.E. Seiser. 2008. Spectacled eider monitoring at the CD–3 development, 2007. Annual report for ConocoPhillips Alaska, Inc., and Anadarko Petroleum Corporation, Anchorage, by ABR, Inc., Fairbanks, Alaska. 43 pp.

Johnson, R. and W. Richardson. 1982. Waterbird migration near the Yukon and Alaska coast of the Beaufort Sea: II. Molt migration of seaducks in summer. Arctic 35: 291–301.

Kondratev, A. and L. Zadorina. 1992. Comparative ecology of the king eider *Somateria spectabilis* and spectacled eider *Somateria fischeri* on the Chaun tundra. Zool. Zhur. 71:99–108. (in Russian; translation by J. Pearce, National Biological Survey, Anchorage, Alaska).

Korschgen, C.E. 1977. Breeding stress of female eiders in Maine. Journal of Wildlife Management 41:360–373.

Lake, B. C. 2007. Nesting Ecology of Spectacled and Common Eiders on Kigigak Island, Yukon Delta NWR, Alaska, 2007. Unpublished report. U.S. Fish and Wildlife Service, Yukon Delta National Wildlife Refuge, Bethel, Alaska 99559. 18 pp.

Larned, W., G.R. Balogh, and M.R. Petersen. 1995. Distribution and abundance of spectacled eiders (*Somateria fischeri*) in Ledyard Bay, Alaska, September 1995. Unpublished progress report, U.S. Fish and Wildlife Service, Anchorage, Alaska. 11 pp.

Larned, W.W. 1998. Steller's eider spring migration surveys, 1998. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larned, W.W. 2000a. Aerial surveys of Steller's eiders and other water birds and marine mammals in southwest Alaska areas proposed for navigation improvements by the U.S. Army Corps of Engineers, Alaska. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larned, W.W. 2000b. Steller's eider spring migration surveys, 2000. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larned, W.W. 2005. Aerial survey of lower Cook Inlet to locate molting flocks of Steller's eiders and mergansers. Trip report, 14 September 2005. U.S. Fish and Wildlife Service, Soldotna, Alaska. 9 pp.

Larned, W.W. 2007. Steller's eider spring migration surveys southwest Alaska, 2007. Unpublished report, U.S. Fish and Wildlife Service, Anchorage, Alaska. 26 pp.

Larned, W. W., R. Stehn, and R. Platte. 2008. Waterfowl breeding population survey, Arctic Coastal Plain, Alaska 2007. U. S. Fish and Wildlife Service, Division of Migratory Bird Management. Anchorage, Alaska. 44pp.

Larned, W.W., R. Platte and R. Stehn. 2009. Waterfowl breeding population survey, Arctic Coastal Plain, Alaska, 2008. Unpublished report, U.S. Fish and Wildlife Service, Anchorage, Alaska. 42 pp.

Larned, W., R. Stehn, and R. Platte. 2010. Waterfowl breeding population survey Arctic Coastal Plain, Alaska 2009. Unpublished report. U.S. Fish and Wildlife Service, Anchorage, AK. 42 pp.

Larned, W., R. Stehn, and R. Platte. 2011. Waterfowl breeding population survey Arctic Coastal Plain, Alaska 2010. Unpublished report. U.S. Fish and Wildlife Service, Anchorage, AK. 52 pp.

Larned, W., K. Bollinger, and R. Stehn. 2012. Late winter population and distribution of spectacled eiders (*Somateria fischeri*) in the Bering Sea, 2009 and 2010. Unpublished report. U.S. Fish and Wildlife Service, Anchorage, AK. 25 pp.

Larned, W.W., B Butler, G Balogh. 1993. Progress report: Steller's eider spring migration surveys southwest Alaska, 1993. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larter, N.C. 1998. Collared lemming abundance diet and morphometrics on Banks Island, 1993-1996. Manuscript report, Department of Resources, Wildlife, and Economic Development. Government of the Northwest Territories, Inuvik, N.W.T. 21pp.

Lovvorn, J.R., S.E. Richman, J.M. Grebmeier, and L.W. Cooper. 2003. Diet and body condition of spectacled eiders wintering in the pack ice of the Bering Sea. Polar Biology 26:259–267.

MacLean, S.F. Jr., Fitzgerald, B.M., and Pitelka, F.A. 1974. Population cycles in arctic lemmings: winter reproduction and predation by weasels. 6: 1-12.

Mallek, E.J., R. Platte and R. Stehn. 2007. Aerial breeding pair surveys of the Arctic Coastal Plain of Alaska, 2006. Unpublished report, U.S. Fish and Wildlife Service, Fairbanks, Alaska.

Manville, A.M., II. 2000. The ABCs of avoiding bird collisions at communication towers: the next steps. Proceedings of the Avian Interactions Workshop, December 2, 1999, Charleston, SC. Electric Power Research Institute. 15pp.

Manville, A.M., II. 2004. Bird Strikes and electrocutions at power lines, communication towers, and wind turbines; State of the art and state of the science – next steps towards mitigation. Proceedings 3rd International Partners in Flight Conference, March 20–24, 2002, Asilomar Conference Grounds, CA. USDA Forest Service General Technical Report PSW-GTR-191. 25pp.

Martin, P.D., T. Obritschkewitsch, and D.C. Douglas. *in prep.* Distribution and movements of Steller's eiders in the non–breeding period.

Metzner, K.A. 1993. Ecological strategies of wintering Steller's eiders on Izembeck Lagoon and Cold Bay, Alaska. M.S. Thesis, University of Missouri, Columbia, MO. 193 pp.

Milne, H. 1976. Body weights and carcass composition of the common eider. Wildfowl 27:115–122.

Moran, T. 1995. Nesting ecology of spectacled eiders on Kigigak Island, Yukon Delta NWR, Alaska, 1994. Unpublished report prepared for U.S. Fish and Wildlife Service, Bethel, Alaska. 8pp + appendix.

Moran, T. and C. Harwood. 1994. Nesting ecology, brood survival, and movements of spectacled eiders on Kigigak Island, Yukon Delta NWR, Alaska, 1993. Unpublished report prepared for U.S. Fish and Wildlife Service, Bethel, Alaska. 33 pp + appendix.

Obritschkewitsch, T., P. Martin, and R. Suydam. 2001. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 1999–2000. Northern Ecological Services, U.S. Fish and Wildlife Service, Technical Report NAES–TR–01–04, Fairbanks, Alaska pp 113.

Obrischkewitsch, T. and R. J. Ritchie. 2011. Steller's eider surveys near Barrow, Alaska, 2010. Final Report. ABR, Inc., Fairbanks, Alaska. 13 pp.

Obrischkewitsch, T., R. J. Ritchie, and J. King. 2008. Steller's eider surveys near Barrow, Alaska, 2007. Final Report. ABR, Inc., Fairbanks, Alaska. 17 pp.

Oechel, W.C., G.L. Vourlitis, S.J. Hastings, and S.A. Bochkarev. 1995. Change in Arctic CO_2 flux over two decades: Effects of climate change at Barrow, Alaska. Ecological Adaptations 5(3):846–855.

Oppel, S., D.L. Dickson, and A.N. Powell. 2009. International importance of the eastern Chukchi Sea as a staging area for migrating king eiders. Polar Biology 32:775–783.

Parker, H. and H. Holm. 1990. Pattern of nutrient and energy expenditure in female Common eiders nesting in the high arctic. Auk 107:660–668.

Pearce, J.M., D. Esler and A.G. Degtyarev. 1998. Birds of the Indigirka River Delta, Russia: historical and biogeographic comparisons. Arctic 51:361–370.

Petersen, M.R. and D. Douglas. 2004. Winter ecology of spectacled eiders: environmental characteristics and population change. Condor 106:79–94.

Petersen, M.R. 1980. Observations of wing-feather molt and summer feeding ecology of Steller's eiders at Nelson Lagoon, Alaska. Wildfowl 31:99–106.

Petersen, M.R. 1981. Populations, feeding ecology and molt of Steller's eiders. Condor 83:256–262.

Petersen, M., D. Douglas, and D. Mulcahy. 1995. Use of implanted satellite transmitters to locate spectacled eiders at sea. Condor 97: 276–278.

Petersen, M.R. and P.L. Flint. 2002. Population structure of pacific common eiders breeding in Alaska. Condor 104:780–787.

Petersen, M.R., J.B. Grand, and C.P. Dau. 2000. Spectacled Eider (*Somateria fischeri*). *In* A. Poole and F. Gill, editors. The Birds of North America, No. 547. The Birds of North America, Inc., Philadelphia, PA.

Petersen, M.R., W.W. Larned, and D.C. Douglas. 1999. At-sea distribution of spectacled eiders: a 120-year-old mystery resolved. The Auk 116(4):1009–1020.

Petersen, M.R., J.F. Piatt, and K.A. Trust. 1998. Foods of Spectacled Eiders *Somateria fischeri* in the Bering Sea, Alaska. Wildfowl 49:124–128.

Petersen, M.R. and M.J. Sigman. 1977. Field studies at Cape Pierce, Alaska 1976. Pages 633–693 in Environmental Assessment of the Alaskan Continental Shelf, Annual Reports of Principal Investigators, Vol. 4. NOAA, Boulder, Colorado.

Petersen, M.R., D.N. Weir, and M.H. Dick. 1991. Birds of the Kilbuck and Ahklun Mountain Region, Alaska. North American Fauna No. 76. 158 pp.

Pitelka, F. A., Tomich, Q., and Treichel, G.W. 1955a. Breeding behavior of jaegers and owls near Barrow, AK. The Condor 57: 3-18.

Pitelka, F. A., Tomich, Q., and Treichel, G.W. 1955b. Ecological relations of jaegers and owls as lemming predators near Barrow, Alaska. Ecological Monographs 25: 85-117.

Platte, R.M. and R.A. Stehn. 2011. Abundance and trend of waterbirds on Alaska's Yukon–Kuskokwim Delta coast based on 1988 to 2010 aerial surveys. Unpublished report, U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. April 29, 2011. 43 pp.

Powell, A.N. and S. Backensto. 2009. Common ravens (Corvus corax) nesting on Alaska's North Slope Oil Fields. Final Report to CMI, Minerals Management Service OCS Study 2009-007, Alaska. 41 pp.

Prowse, T.D., F.J. Wrona, J.D. Reist, J.E. Hobbie, L.M.J. Lévesque, and W.F. Vincent. 2006. General features of the Arctic relevant to climate change in freshwater ecosystems. Ambio 35:330–338.

Quakenbush, L.T. and R.S. Suydam. 1999. Periodic non–breeding of Steller's eiders near Barrow, Alaska, with speculation on possible causes. Pages 34–40 *in* R.I. Goudie, M.R. Petersen, and G.J. Robertson , editors. Behavior and ecology of sea ducks. Occasional Paper Number 100. Canadian Wildlife Service, Ottawa.

Quakenbush, L.T., R.S. Suydam, K.M. Fluetsch, & C.L. Donaldson. 1995. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 1991–1994. Ecological Services Fairbanks, AK, U.S. Fish & Wildlife Service, Technical Report NAES-TR-95-03. 53 pp.

Quakenbush, L. T., R. Suydam, and T. Obritschkewitsch. 2000. Habitat use by Steller's eiders during the breeding season near Barrow, Alaska, 1991–1996. Unpublished report, U.S. Fish and Wildlife Service, Fairbanks AK.

Quakenbush, L.T., R.H. Day, B.A. Anderson, F.A. Pitelka, and B.J. McCaffery. 2002. Historical and present breeding season distribution of Steller's eiders in Alaska. Western Birds 33:99–120.

Quakenbush , L., R. Suydam, T. Obritschkewitsch, and M. Deering. 2004. Breeding biology of Steller's eiders (*Polysticta stelleri*) near Barrow, Alaska, 1991–1999. Arctic 57:166–182.

Quinlan, R., M.V. Douglas, and J.P. Smol. 2005. Food web changes in arctic ecosystems related to climate warming. Global Change Biology 11:1381–1386.

Raveling, D.G. 1979. The annual cycle of body composition of Canada Geese with special reference to control of reproduction. Auk 96:234–252.

Reed, J.R., J.L. Sincock, and J.P. Hailman. 1985. Light attraction in endangered procellariiform birds: reduction by shielding upward radiation. Auk 102: 377–383.

Rojek, N.A. 2006. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 2005. Technical report for U.S. Fish & Wildlife Service, Fairbanks, Alaska. 61 pp.

Rojek, N.A. 2007. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 2006. Technical report for U.S. Fish & Wildlife Service, Fairbanks, Alaska. 53 pp.

Rojek, N.A. 2008. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 2007. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, Alaska. Technical Report. 44 pp.

Roselaar, C. S. 1979. Fluctuaties in aantallen Krombedstrandlopers *Calidris ferruginea*. Watervogles 4:202-210.

Rosenberg, D.A., M.J. Petrula, D. Zwiefelhofer, T. Holmen, D.D. Hill, and J.L. Schamber. 2011. Seasonal movements and distribution of Pacific Steller's eiders (*Polysticta stelleri*). Final Report. Alaska Department of Fish and Game, Division of Wildlife Conservation, Anchorage, Alaska. 44 pp.

Russell, R. W. 2005. Interactions between migrating birds and offshore oil and gas platforms in the northern Gulf of Mexico: final report. U.S. Department of the Interior, Minerals

Management Service (MMS), Gulf of Mexico Outer Continental Shelf (OCS) Region, OCS Study MMS 2005-009, New Orleans, Louisiana, USA.

Safine, D.E. 2011. Breeding ecology of Steller's and spectacled eiders nesting near Barrow, Alaska, 2008–2010. U.S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, Alaska. Technical Report. 66 pp.

Safine, D. E. 2012. Breeding ecology of Steller's and spectacled eiders nesting near Barrow, Alaska, 2011. U. S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, Alaska. Technical Report. 65 pp.

Safine, D. E. 2013. Breeding ecology of Steller's and spectacled eiders nesting near Barrow, Alaska, 2012. U. S. Fish and Wildlife Service, Fairbanks Fish and Wildlife Field Office, Fairbanks, Alaska. Technical Report. 64 pp.

Schindler, D.W., and J.P. Smol. 2006. Cumulative effects of climate warming and other human activities on freshwaters of arctic and subarctic North America. Ambio 35:160–168.

Smith, L., L. Byrne, C. Johnson, and A. Stickney. 1994. Wildlife studies on the Colville River Delta, Alaska, 1993. Unpublished report prepared for ARCO Alaska, Inc., Anchorage, Alaska. 58 pp.

Smith, L.C., Y. Sheng, G.M. MacDonald, and L.D. Hinzman. 2005. Disappearing Arctic lakes. Science 308:1429.

Smol, J.P. and M.S.V. Douglas. 2007. Crossing the final ecological threshold in high Arctic ponds. Proceedings of the National Academy of Sciences 104:12395–12397.

Smol, J.P., A.P. Wolfe, H.J.B. Birks, M.S.V. Douglas, V.J. Jones, A. Korhola, R. Pienitzi, K. Rühland, S. Sorvari, D. Antoniades, S.J. Brooks, M.A. Fallu, M. Hughes, B.E. Keatley, T.E. Laing, N. Michelutti, L. Nazarova, M. Nyman, A.M. Patterson, B. Perren, R. Quinlan, M. Rautio, E. Saulier–Talbot, S. Siitonen, N. Solovieva, and J. Weckström. 2005. Climate–driven regime shifts in the biological communities of arctic lakes. Proceedings of the National Academy of Science 102:4397–4402.

Stehn, R., C. Dau, B. Conant, and W. Butler. 1993. Decline of spectacled eiders nesting in western Alaska. Arctic 46: 264–277.

Stehn, R., W. Larned, R. Platte, J. Fischer, and T. Bowman. 2006. Spectacled eider status and trend in Alaska. U.S. Fish and Wildlife Service, Anchorage, Alaska. Unpublished Report. 17 pp.

Stehn, R., and R. Platte. 2009. Steller's eider distribution, abundance, and trend on the Arctic Coastal Plain, Alaska, 1989–2008. Unpublished report for the U.S. Fish and Wildlife Service, Anchorage, Alaska. 35pp.

Summers, R. W. 1986. Breeding production of dark-bellied brant geese *Branta bernicla bernicla* in relation to lemming cycles. Bird Study 33: 105-108.

TERA (Troy Ecological Research Associates). 2002. Spectacled eider movements in the Beaufort Sea: Distribution and timing of use. Report for BP Alaska Inc., Anchorage, Alaska and Bureau of Land Management, Fairbanks, Alaska. 17 pp.

Trust, K.A., J.F. Cochrane, and J.H. Stout. 1997. Environmental contaminants in three eider species from Alaska and Arctic Russia. Technical Report WAES-TR-97-03. U.S. Fish and Wildlife Service, Anchorage, Alaska. 44 pp.

Trust, K., K.T. Rummel, A.M. Scheuhammer, I.L. Brisbin, Jr., and M.G. Hooper. 2000. Contaminant exposure and biomarker responses in spectacled eiders (*Somateria fischeri*) from St. Lawrence Island, Alaska. Archives of Environmental Contamination and Toxicology 38:107-113.

USFWS. 1993. Final rule to list the Spectacled Eider as threatened. U.S. Fish and Wildlife Service. May 10, 1993. Federal Register 58(88):27474–27480.

USFWS. 1996. Spectacled Eider Recovery Plan.. Prepared for Region 7, U.S. Fish and Wildlife Service, Anchorage, Alaska. 100 pp + Appendices.

USFWS. 1997. Endangered and threatened wildlife and plants; Threatened status for the Alaska breeding population of the Steller's eider. Final rule. Published 11 July 1997 by the U.S. Fish and Wildlife Service. Federal Register 62(112):31748–31757.

USFWS. 1999. Population status and trends of sea ducks in Alaska. Migratory Bird Management, Anchorage, Alaska.

USFWS. 2001. Endangered and Threatened Wildlife and Plants; Final determination of critical habitat for the Alaska–breeding population of the Steller's eider. Final rule. Published 2 February 2001 by the U.S. Fish and Wildlife Service. Federal Register 66(23):8849–8884.

USFWS. 2002. Steller's Eider Recovery Plan. Fairbanks, Alaska. 27 pp.

USGS. 2006. Biological response to ecological change along the Arctic Coastal Plain. Progress Report, August 2006, Alaska Science Center, Anchorage, United States Geological Survey. 10pp.

Warnock, N. and D. Troy. 1992. Distribution and abundance of spectacled eiders at Prudhoe Bay, Alaska: 1991. Unpublished report prepared for BP Exploration (Alaska) Inc., Environmental and Regulatory Affairs Department, Anchorage, Alaska, by Troy Ecological Research Associates (TERA), Anchorage, Alaska. 20 pp.

Wilk, R.J., K.I. Wilk, R.C. Kuntz, II. 1986. Abundance, age composition and observations of emperor geese in Cinder lagoon, Alaska Peninsula, 17 September–10 October 1986. Unpublished report. U.S. Fish and Wildlife Service, King Salmon, Alaska. 41 pp.

Weir, R. 1976. Annotated bibliography of bird kills at man-made obstacles: a review of the state of the art and solutions. Unpublished report prepared for Department of Fisheries & Environment, Canadian Wildlife Service-Ontario Region.

Woodby, D.A. and G.J. Divoky. 1982. Spring migration of eiders and other waterbirds at Point Barrow, Alaska. Arctic 35: 403–410.