INTRA-SERVICE BIOLOGICAL OPINION

for

Alaska Region Migratory Bird Management's

2013-2014 Shorebird Breeding Ecology Studies,

Barrow, Alaska

1. INTRODUCTION

This document is the U.S. Fish and Wildlife Service's (USFWS) final Biological Opinion (BO) on a proposal by the USFWS Alaska Region Migratory Bird Management (MBM) office to conduct shorebird research in the vicinity of Barrow, AK during the summers of 2013 and 2014. This BO describes the effects of these actions on Alaska-breeding Steller's eider (*Polysticta stelleri*), spectacled eider (*Somateria fischeri*) and polar bear (*Ursus maritimus*), as pursuant to section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.).

This BO describes the effects of these actions on Steller's eiders (*Polysticta stelleri*), spectacled eiders (*Somateria fischeri*), and polar bears (*Ursus maritimus*) 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 a project description provided by the MBM on May 10, 2013, communications on the same project from previous years, USFWS documents, published and unpublished literature, and other sources of information to develop this BO.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 the proposed action may affect but is not likely to adversely affect polar bears.

After reviewing the status and environmental baseline of listed eiders and analysis of the potential effects of the Proposed Action to these species, the Service concludes the Proposed Action is likely to adversely affect Alaska-breeding Steller's eiders and spectacled eiders but is not likely to jeopardize the continued existence of either species.

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

The proposed action includes shorebird breeding ecology studies and related activities that will be conducted near Barrow, Alaska in the summers of 2013-2014. The objectives of these studies are to: 1) serve as a Tier II site within the Arctic portion of the Program for Regional and International Shorebird Monitoring North American shorebird monitoring program designed to assess the status and trends of shorebird populations; 2) compare data collected in 2003–2014 with historical shorebird breeding ecology data collected from the study area in the 1950s through early 1980s, and again in the 1990s;

and 3) address other specific aspects of the breeding and behavioral ecology of shorebird species, including studies on population structure and migratory connectivity, molting, paternity, contaminants sampling, egg fertility, egg volume, and avian health. Proposed activities involve collecting of demographic data on all shorebird species breeding within six permanent study plots as well as some off-plot research activities.

Proposed activities will occur from approximately late May, 2013 through 1 August 2014. The field crew consists of 6 full-time staff plus 1–3 others rotating in for a week or two at a time. There will be no field camps. The field crew will be housed in Barrow and access shorebird study plots and the surrounding tundra by driving ATVs along Cakeeater and Gasline roads and walking from roads to plots. The field crew will follow Polar Bear Interaction Guidelines (Appendix A) developed in cooperation with the USFWS Alaska Region Marine Mammals Management Office to minimize risks associated with potential encounters with polar bears.

The following description of proposed activities is copied directly from that provided by MBM:

> "Breeding shorebirds will be monitored at Barrow, Alaska, on six 600 x 600 m plots (Figure 1). A grid of wooden stakes is located every 50 m to facilitate orientation within plots. We systematically search for nests using single-person area searches and two-person rope drags. In area searches, surveyors walked in a "w" path within each 50 m^2 quadrat to ensure complete coverage of the area, but also relied on following individual birds displaying nest attendance behaviors, and occasionally on accidentally flushing incubating birds. Surveyors spend 4 hours on a plot every day with one day off per week during the month of June. In most cases, surveyors cover less than half the plot in a given day, and daily plot maps are made so surveyors can cover areas missed previously. In rope dragging, two people pull a 35 m rope throughout the plots to flush incubating birds. Rope-draggers systematically cover every portion of the plot by following rows of stakes. We typically rope drag each plot only once per season – normally near the end of June. Prior area search and rope drag efforts are described in Table 1. Once a nest is found, the location is noted in a GPS and the status of the nest is determined (i.e., laying or incubating). For nests found during incubation, two eggs are floated to determine an estimated hatch date (Liebezeit et al. 2007). For nests found during laying, nests are revisited until four eggs are likely to be in the nest (based on a single egg being laid per day) to determine final clutch size. All eggs are measured (length and width) at the time a nest is determined to be complete (i.e., when nests have four eggs or when a nest no longer gains eggs – e.g., the rare three egg nest). Nest locations are noted in the field by placing a Popsicle stick 1 meter and 5 meters north of the nest, and a blue flag 10 meters north of the nest. Alignment of the flag and sticks allow the nest to be relocated quickly. Each nest is visited every 5 days during incubation for estimating daily survival rates, then bi-daily or daily (once stars are on seen on the outside of eggs) within 4 days of predicted hatch date to assess hatching success. During early nest monitoring, observers minimize disturbance to a nest by simply recording

whether an adult flushes or is incubating. These visits entail simply walking by the nest. During late nest monitoring (i.e., within 4 days of expected hatch), observers note the number and condition (i.e., signs of hatching) of eggs, and note the color band combinations of adults that are unknown (assuming the adults stay near the nest). At hatch, most chicks are banded with USGS metal bands and a single cohort color band to allow estimates of natal philopatry to be made. For a few species (Dunlin and Long-billed Dowitchers), we also collect blood from the chicks to ascertain paternity or for stable isotope analysis.

"Additional visits will be made to the nest to capture adults and mark them. Adults will be captured using bow nets, which require an initial setting of the trap, placement of a pull cord to set the trap off, and after waiting about 30 minutes, firing the trap and revisiting the nest to remove the bird and trap. Uni-parental incubators (i.e., phalaropes; Pectoral, Buff-breasted, and White-rumped sandpipers) require 1 revisit to the nest, and bi-parental incubators (other species) require two visits. To avoid nest desertion, we generally wait 8-10 days into incubation before capturing birds (about 1/3 of the duration of incubation). The only exception to this is birds with geolocators; here birds are recaptured as soon as possible since retrieving the geolocators is of paramount importance.

"We also search for nests and banded birds away from the plots as needed to conduct other studies on migration ecology, renesting, contaminant exposure, avian health, stable isotopes, landscape and climate change effects on shorebirds, and for relocating birds equipped with geolocators. Nest search and banding off the regularly monitored plots is not systematic as it varies by year (primarily by the graduate student project on-going), and although is much lower than on plots has not been quantified.

"In 2013-2014, we will have three studies that require additional off-plot work. The first is a migratory connectivity study that will require the recapture of American Golden-plovers equipped with light-level geolocators. Most of these birds were initially captured on or very near our plots. Because adults of these species occasionally shift their territories, we will spend time conducting area searches and rope-dragging around the plots to locate missing birds (i.e., ones that were not on their old territories). The second study is to capture 29 Semipalmated Sandpipers and equip them with geolocators. Because geolocators may impact survival rates, we will capture birds at nests located outside but near our plots. This work is likely to take place by the road near the new landfill and northwest of plot 2 (see Figure 1). The third study is being conducted by Kristen Grond, a PhD student at Kansas State University, who is investigating immuno-competence and gut microbiota in shorebirds. She will rely primarily on shorebirds captured on our plots but will also likely search for Dunlin and Red Phalarope nests near Freshwater Lake. She will also equip adults and young with radio transmitters so she can track them during the first 16 days of development and collect fecal samples from chicks periodically. Broods typically remain within 1-3 km of their nest sites but could move farther distances."

Minimizing disturbance to nesting Steller's and spectacled eiders

To minimize disturbance to breeding Steller's and spectacled eiders, the following measures (which were used in 2012) will be implemented in 2013 and 2014 by the shorebird ecology field crew:

- If a listed eider nest is found during shorebird ecology field activities, staff will record GPS coordinates and retreat to a distance of ≥100 m if the nest is found within a shorebird plot and ≥200 m if the nest is found outside the plots. Staff will report the nest observation to the USFWS eider ecology program lead, David Safine, or his designee, as soon as practicable on the day the nest is found.

- The shorebird field crew will maintain a distance of ≥100 m of known active nests within a shorebird plot and ≥200 m of known active nests outside the plots. Within-plot activities may occur ≥100 m from nests located outside the plot. Nests will be considered active unless the USFWS eider ecology crew confirms failure of the nest.

- The shorebird field crew will move to and maintain a ≥100-m distance from young eider broods that are detected during research activities to minimize the risk of fragmenting young broods or separating hens from ducklings, which would increase the predation risk to the ducklings.

- Both the shorebird ecology and eider ecology field crews will maintain communications regarding the status of eider nests in the Barrow area. The shorebird ecology program lead will develop, in coordination with the eider ecology program lead and before the 2012 fieldwork commences, a procedure describing how nest location and status information is exchanged between the eider and shorebird crews and a procedure for the shorebird crew to follow when they discover a listed eider nest.

Action Area

The action area is that area in which the direct and indirect effects of the proposed action may occur. For activities that occur in the six permanent shorebird nest search plots (Figure 2.1), the area directly affected by the proposed project is the combined footprint of the plots (0.6 km × 0.6 km × 6 plots= 2.16 km^2). The area indirectly affected by the proposed activities is delineated by a zone of influence surrounding each plot and on either side of the walking route traveled from the road to the plot. This zone of influence is assumed to be 200 m wide. We estimate the combined affected area encompasses approximately 5.79 km^2 of tundra, including both the plots and their surrounding zone of influence. Because off-plot activities occur at variable locations within walking distance of the Barrow road system, delineating the spatial extent of off-plot activities is difficult. For the purposes of this BO, we estimate the area potentially affected by off-plot work to be equivalent to the USFWS standard survey area for eider ecology studies near Barrow, 135 km^2, recognizing that proposed activities would affect only a small portion of this area.

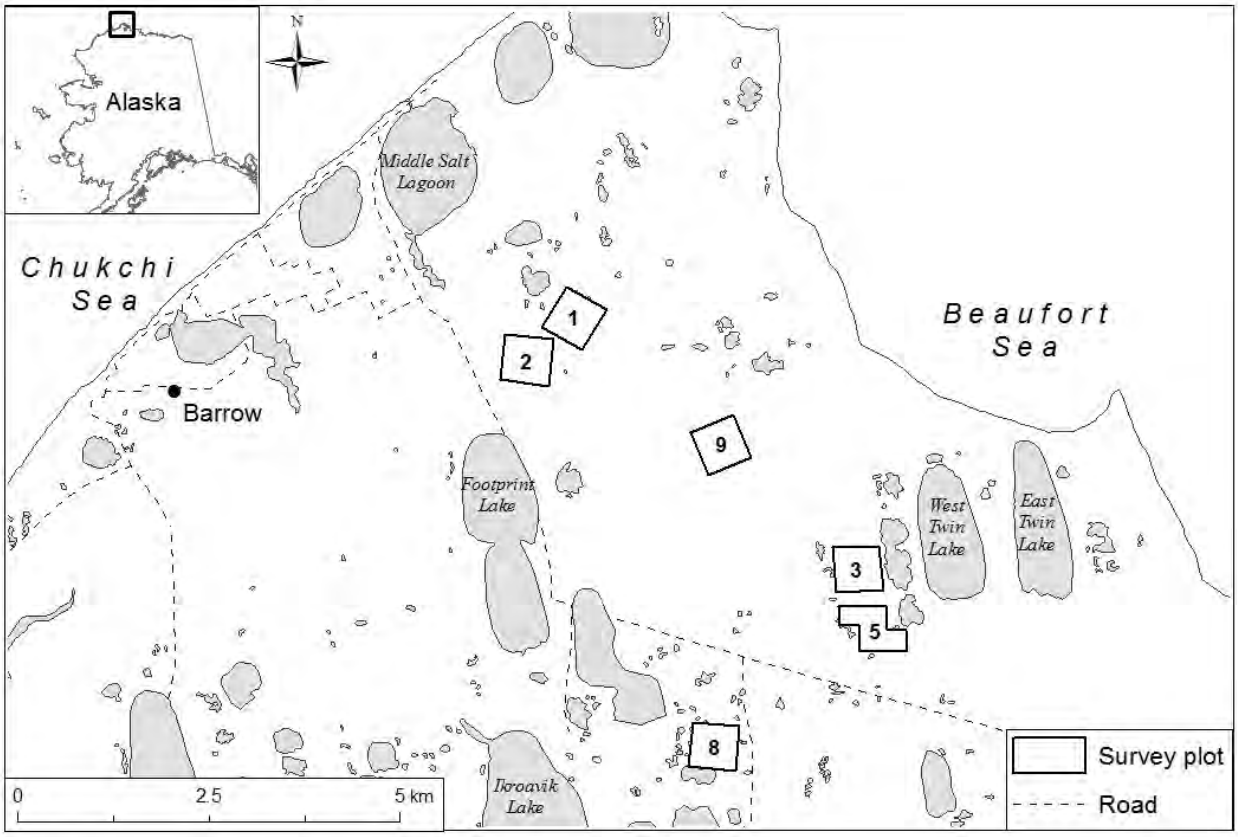

Figure 2.1. Locations of six plots used for studying shorebirds in 2012. Map provided by Rick Lanctot, Migratory Bird Management).

3. EFFECT DETERMINATIONS FOR POLAR BEARS

Polar Bears

Polar bears do not regularly occur on the tundra near Barrow during summer, but the possibility of encountering a polar bear exists. To minimize the risk of negative human–bear interactions and respond to potential encounters with polar bears, MBM will follow Polar Bear Interaction Guidelines (Appendix A) developed in cooperation with the USFWS Alaska Region Marine Mammals Management Office. Implementation of these guidelines should reduce the risk of polar bear–human interactions. Based on the low probability of a human–polar bear interaction in the study area and the implementation Polar Bear Interaction Guidelines, we expect that effects to polar bears will be insignificant and conclude the project is *not likely to adversely affect polar bears.*

Polar bears are widely distributed throughout the Arctic where the sea is ice-covered for large portions of the year. Sea ice provides a platform for hunting, feeding, breeding, denning, resting, and long-distance movement. Polar bears primarily hunt ringed seals, which also depend on sea ice for their survival, but they also consume other marine

mammals (USFWS 2008a). Female polar bears excavate maternal dens in snow drifts in areas with suitable topographic relief in terrestrial habitats as well as on pack ice. While dens do occur in the region, there are no historic observations within the Action Area and females will not be denning during the period in which field studies will occur. In Alaska, non-denning polar bears usually occur on sea ice, but may occupy onshore habitats during the open-water period in late summer and early fall (reviewed in Schliebe et al. 2008). Non-denning bears are known to occasionally travel through the Action Area. We expect most transient bears would move quickly through the area; however, potential encounters with polar bears during field activities could result in harassment, injury, or killing of bears and pose a risk to human safety. Field crews will follow Polar Bear Interaction Guidelines (Appendix A) developed in cooperation with the USFWS Alaska Region Marine Mammals Management Office to reduce potential adverse effects to polar bears associated with negative polar bear–human interactions by managing food and other wastes that may attract bears to the project site and supporting early detection and appropriate responses by field personnel if polar bears do enter the area. The Service has determined effects to denning polar bears would not occur based on project timing and effects to non-denning bears would be insignificant because transient polar bears are likely to experience only minor and short-lived effects associated with disturbance from field crews and minimization measures are in place to reduce further potential adverse effects should a polar bear enter the oilfields. Accordingly, we conclude the proposed action is not likely to adversely affect polar bears.

3. STATUS OF THE SPECIES

This section presents biological and ecological information relevant to formation of the BO. Appropriate information on the species' life history, habitat and distribution, and other factors necessary for their survival is included for analysis in later sections.

Our analyses of the status of the species listed under the ESA, and how they may be affected by the proposed action as well as other previous and ongoing actions within the action area, 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, p. 78). 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, p. 78). 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, pp. 8–14, 18–19). In our analyses, we use our expert judgment to weigh relevant information, including uncertainty, in our consideration of various aspects of climate change.

Steller's Eider

The Steller's eider is a sea duck with a circumpolar distribution and the sole member of the genus *Polysticta*. The Steller's eider is the smallest of the four eider species, weighing approximately 700–800 g (1.5–1.8 lb). Males are in breeding plumage (Figure 3.1) from early winter through mid-summer. During late summer and fall, males molt to dark brown with a white-bordered blue wing speculum. Following replacement of flight feathers in the fall, males re-acquire breeding plumage, which lasts through the next summer. Females are dark mottled brown with a white-bordered blue wing speculum year round. Juveniles are dark mottled brown until fall of their second year, when they acquire breeding plumage.

Figure 3.1. Male and female Steller's eiders in breeding plumage.

Steller's eiders are divided into Atlantic and Pacific populations; the Pacific population is further divided into the Russia-breeding population, which nests along the Russian eastern arctic coastal plain, and the Alaska-breeding population. The Alaska breeding population of the Steller's eider was listed as threatened on July 11, 1997 based on substantial contraction of the species' breeding range on the Arctic Coastal Plain (ACP) and on the Yukon–Kuskokwim Delta (YKD) in Alaska, reduced numbers of Steller's eiders breeding in Alaska, and the resulting vulnerability of the remaining breeding population to extirpation (USFWS 1997). In Alaska, Steller's eiders breed almost exclusively on the Arctic Coastal Plain (ACP) and molt and winter, along with the majority of the Russia-breeding population, in southcentral Alaska (Figure 3.2). Periodic non-breeding of the entire population of Steller's eiders breeding near Barrow, AK, the species' primary breeding grounds, coupled with low nesting and fledging success, has resulted in very low productivity (Quakenbush et al. 2004) and may make the population particularly vulnerable to extirpation. 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 at historic breeding areas on the YKD, a molting and staging area in the Kuskokwim Shoals, and

molting areas in marine waters 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 ecology – Steller's eiders arrive in small flocks of breeding pairs on the ACP[1] in early June. Nesting on the ACP is concentrated in tundra wetlands near Barrow, AK (Figure 3.3) 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 breeding population. Since 1991, Steller's eiders nests were detected in 12 of 20 study years (1991–2010; Safine 2011). Periodic non-breeding by Steller's eiders near Barrow seems to be associated with fluctuations in lemming populations and related breeding patterns in pomarine jaegers (*Stercorarius pomarinus*) and snowy owls (*Nyctea scandiaca*) (Quakenbush et al. 2004). In years with high lemming abundance, Quakenbush et al. (2004) reported that Steller's eider nesting success was a function of a nest's distance from pomarine jaeger and snowy owl nests. These avian predators nest only in years of high lemming abundance and defend their nests aggressively against arctic foxes. By nesting within jaeger and owl territories, Steller's eiders may benefit from protection against arctic foxes even at the expense of occasional partial nest depredation by the avian predators themselves (Quakenbush et al. 2002, Quakenbush et al. 2004). Steller's eiders may also benefit from the increased availability of alternative prey for both arctic foxes and avian predators in high lemming years (Quakenbush et al. 2004).

Steller's eiders initiate nesting in the first half of June (Quakenbush et al. 2004). Nests are preferentially located on the rims of low-center polygons, low polygons, and high-center polygons (Quakenbush et al. 2000). Mean clutch size at Barrow was 5.4 ± 1.6 SD (range = 1–8) over 5 nesting years in 1992–1999 (Quakenbush et al. 2004). Males leave the nests with the onset of incubation. Nest survival (the probability a nest will hatch at least one egg) 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 0.49 (±0.10 SE) from 2005–2011 during years with fox control (USFWS, unpublished data). Steller's eider nest and egg loss has been attributed to depredation by pomarine jaegers, parasitic jaegers (*Stercorarius parasiticus*), common raven (*Corvus corax*), arctic fox (*Alopex lagopus*), and glaucous gulls (*Larus hyperboreus*) (Quakenbush et al. 1995, Rojek 2008, Safine 2011). Nest depredation by a family group of polar bears was also documented in 2011 (Safine in prep).

[1] Steller's eiders nest in extremely low numbers on the YKD and will not be treated further here. See the *Status and Distribution* section for further discussion of the YKD breeding population.

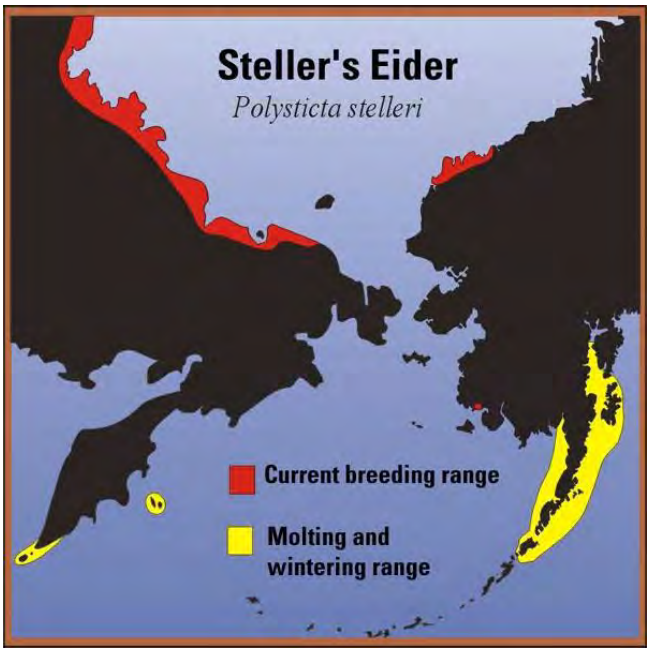

Figure 3.2. Steller's eider distribution in the Bering, Beaufort, and Chukchi seas.

Hatching occurs from mid-July through early August (Rojek 2006, 2007, 2008). Hens move their broods to adjacent ponds with emergent vegetation dominated by *Carex* spp. and *Arctophila fulva* (Quakenbush et al. 2000, Rojek 2006, 2007). There they feed on aquatic insect larvae and freshwater crustaceans. Broods tracked in 1995–1996 (n = 13) remained within 0.7 km of their nests (Quakenbush et al. 2004); however, 9 broods tracked in 2005–2006 moved up to 0.3–3.5 km from their nests (Rojek 2006, 2007). Rojek (2006) speculated that drying of ponds in the vicinity of nests in 2005 may have caused broods to move greater distances. Observations of known-age ducklings indicate that fledging occurs 32–37 days post hatch (Obritschkewitsch et al. 2001, Quakenbush et al. 2004, Rojek 2006, Rojek 2007).

Information on breeding site fidelity of Steller's eiders is limited. However, some information is available from the breeding ecology study at Barrow. Since the mid-1990s, six birds that were originally captured as confirmed nesters near Barrow were recaptured in subsequent years nesting near Barrow. The time between capture events ranged from 1 to 12 years and the distance between nests ranged from 0.1 to 6.3 km (USFWS, unpublished data).

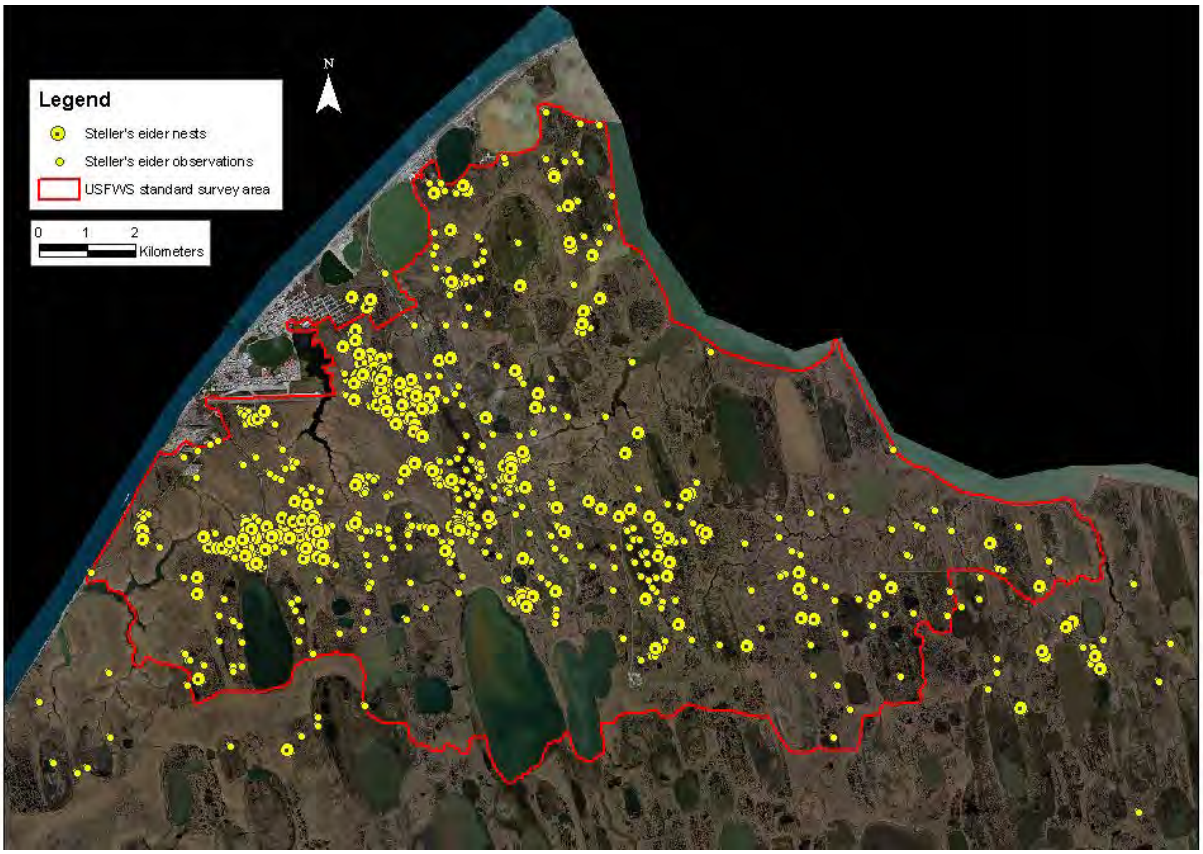

Figure 3.3. Steller's eider nest locations (1991–2010) and breeding pair observations (1999–2010). The standard survey area is surveyed annually. The survey area is expanded beyond the standard area in some years.

Localized post-breeding movements – 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, 2007). Females with fledged broods depart the breeding grounds in late August to mid-September and rest and forage in water bodies near the Barrow spit prior to their southward migration along the Chukchi coast.

Prior to spring migration in both nesting and non-breeding years, some Steller's eiders rest and forage in Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the Chukchi Sea in the vicinity of Pigniq (Duck Camp; Figure 3.4). Groups of Steller's eiders have been observed in nearshore areas of the Chukchi Sea from the gravel pits located south of Barrow north to Nuvuk, the northern most point of the Barrow spit. In nesting years, these flocks were primarily composed of males and persist until about the second week of July; in non-breeding years, the flocks have more even sex ratios and departed earlier compared to nesting years (J. Bacon, North Slope Borough Department of Wildlife Management [NSBDWM], pers. comm.). From mid-July through September single hens, hens with broods, and small groups of two to three birds have been observed in North

Saltwater Lagoon, Elson Lagoon and near shore on the Chukchi Sea. The majority of observations have been of individuals swimming in North Salt Lagoon, but occasionally individuals and small groups flying between North Salt Lagoon, Elson Lagoon and the Chukchi Sea have been observed. Females with broods have been observed mostly 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 daily between late August and mid-September staging in Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the Chukchi Sea (USFWS, Unpublished data).

To further study Steller's eider post-fledging and post-failure movements, Safine (*in prep*) marked 10 female Steller's eiders with VHF radio transmitters just prior to nest hatching in 2011. Movements of females and ducklings were monitored until early September or until females could no longer be located in the Barrow area. Most radio-marked females hatched their nests and their ducklings survived until they achieved flight (8 of 10 females produced broods that fledged). For the females whose broods fledged, females and broods were first located post-fledging near their brood rearing areas, and later, most were found in nearby marine areas. Over half (5/8) of the successful adult females were located subsequently in marine areas near Barrow, and the remaining females could not be located after leaving brood rearing areas. Starting in late August and continuing until monitoring ceased in early September, females and fledged juveniles were observed on both the Chukchi and Beaufort Sea sides of the narrow spit of land that extends to Point Barrow. During this time adult females and juveniles were also observed further South along the Chukchi coast, near the City of Barrow. Marine locations of Steller's eiders from mid-August to early September in 2011 overlapped with the most commonly used subsistence waterfowl hunting locations near Barrow, Alaska (Figure 3.5). There is both a spatial and temporal overlap between Steller's eiders and subsistence hunters during the post-fledging period.

Wing molt – Following departure from the breeding grounds, Steller's eiders migrate to molting areas in the nearshore waters of southwest Alaska where they undergo a complete flightless molt for about 3 weeks. Steller's eiders seem to have high molting site fidelity (Flint et al. 2000). Preferred molting areas are characterized by extensive shallow areas with eelgrass (*Zostera marina*) beds and intertidal sand flats and mudflats where Steller's eiders forage primarily on bivalve mollusks and amphipods (Petersen 1980, 1981; Metzner 1993).

Both the Russia- and Alaska-breeding populations molt in numerous locations in southwest Alaska. Primary molting locations include four areas along the north side of the Alaska Peninsula: Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands (Gill et al. 1981, Petersen 1981, Metzner 1993). However, Kuskoskwim Shoals, in northern Kuskokwim Bay, may also be an important molting location for Alaska-breeding Steller's eiders (Martin et al. *in prep*), especially considering the high molting site fidelity reported by Flint et al. (2000). Larned (2005) also reported >2,000 eiders molting in lower Cook Inlet near the Douglas River Delta, and smaller numbers of molting Steller's eiders have been reported from 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).

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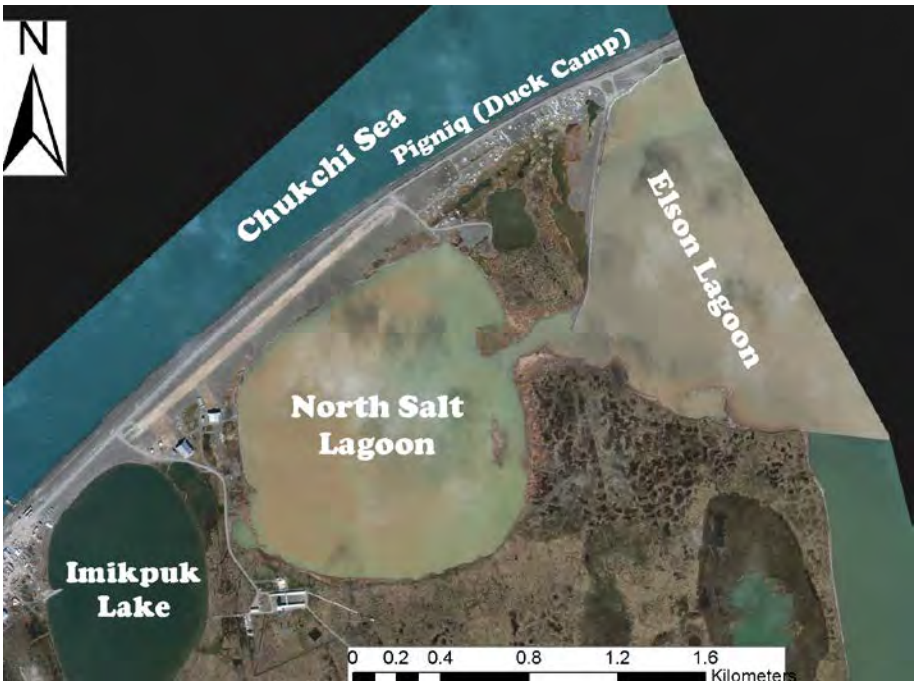

B

Figure 3.4. (A) Location of Steller's eider post-breeding staging areas in relation to Pigniq (Duck Camp) hunting area north of Barrow, Alaska. (B) VHF marked Steller's eider hen with brood of fledglings resting in Elson Lagoon in close proximity to Duck Camp. Photo by N. Docken, USFWS.

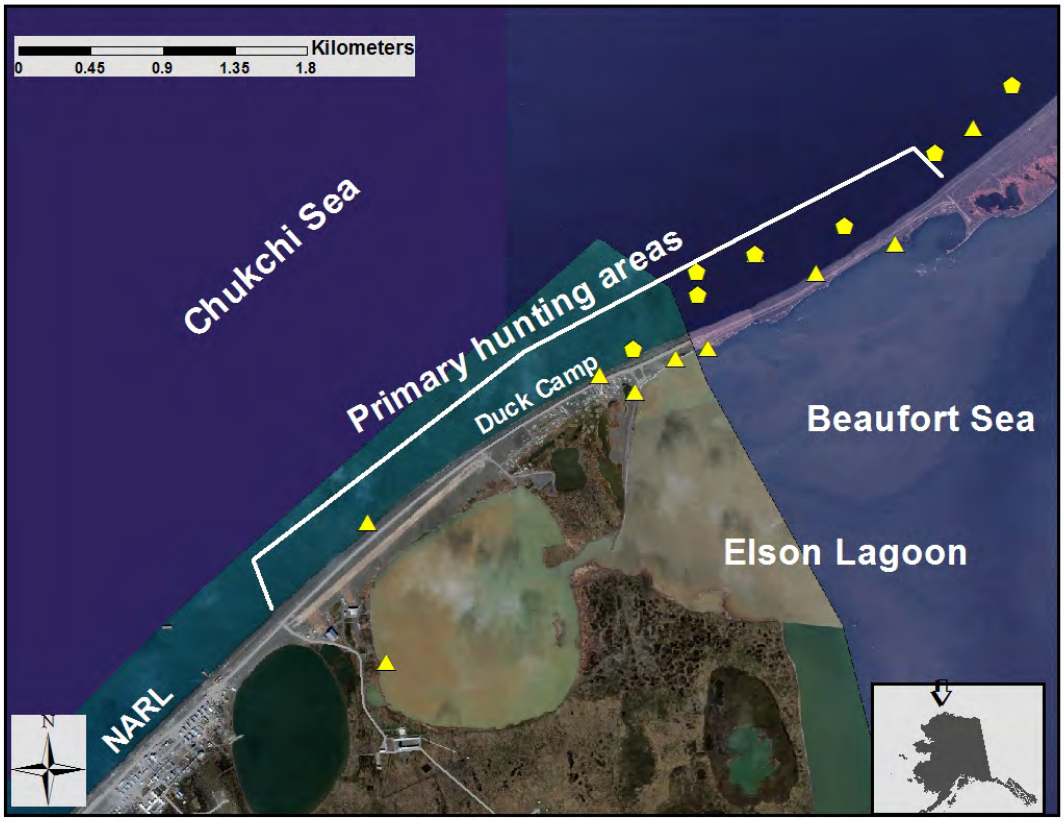

Figure 3.5. Marine locations of successful (triangles) and failed (pentagons) adult Steller's eiders (and juveniles) in the immediate vicinity of areas commonly used for subsistence hunting near Barrow, Alaska from mid-August to early September 2011.

Wintering distribution – After molt, many of the Pacific-wintering Steller's eiders disperse throughout the Aleutian Islands, the Alaskan Peninsula, and the western Gulf of Alaska including Kodiak Island and lower Cook Inlet (Figure 3.6; Larned 2000a, Martin et al. *in prep*), although thousands may remain in lagoons used for molting unless freezing conditions force them to move (USFWS 2002). The USFWS estimates the Alaska-breeding population comprises only ~ 1%[2] of the Pacific-wintering population of Steller's eiders. Wintering Steller's eiders usually occur in shallow waters (< 10 m deep), which are generally within 400 m of shore or at offshore shallows (USFWS 2002). However, Martin et al. (*in prep*) reported substantial use of habitats > 10 m deep during mid-winter. Use of these habitats by wintering Steller's eiders may be associated with night-time resting periods or with shifts in the availability of local food resources (Martin et al. *in prep*).

Spring migration – Early in spring migration, thousands of Steller's eiders stage in estuaries along the north side of the Alaska Peninsula, including some molting lagoons, and at Kuskokwim Shoals near the mouth of the Kuskokwim River in late May (Figure

[2] See further discussion under Population Dynamics subsection.

3.6; Larned 2007, Martin et al. *in prep*). Larned (1998) concluded that Steller's eiders show strong site fidelity to preferred habitats[3] during migration, where they congregate in large numbers to feed before continuing northward migration.

Figure 3.6. Distribution of Alaska-breeding Steller's eiders during the non-breeding season, based on the location of 13 birds implanted with satellite transmitters in Barrow, Alaska, June 2000 and June 2001. Marked locations include all those at which a bird remained for at least three days. Onshore summer use area comprises the locations of birds that departed Barrow, apparently without attempting to breed in 2001. (Fig 9 in USFWS 2002; study described further in Martin et al. *in prep*).

[3] 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).

Spring migration usually includes movements along the coast, although some Steller's eiders may take shortcuts across water bodies such as Bristol Bay (W. Larned, USFWS, pers. comm. 2000). Interestingly, despite many daytime aerial surveys, Steller's eiders have never been observed during migratory flights (W. Larned, USFWS, pers. comm. 2000). Like other eiders, Steller's eider probably use spring leads for feeding and resting as they move northward, but there is little information on habitat use after departing spring staging areas.

Migration patterns relative to breeding origin – There is limited information available on the migratory movements of Steller's eiders, particularly in relation to their breeding origin, and it remains unclear where the Russia and Alaska breeding populations merge and diverge during molt and spring migrations, respectively. The best available information is from the Martin et al. (in prep; Figure 3.6) satellite telemetry study discussed previously and a second telemetry study by Rosenberg et al. (2011). Martin et al. (*in prep*) marked 14 birds near Barrow, Alaska (within the range of the listed Alaska-breeding population) in 2000 and 2001. Although samples sizes were small, results suggested 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. The second study marked Steller's eiders wintering on 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 of the birds marked on Kodiak 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).

Population Dynamics

Pacific population: spring population estimates and trends – The majority of the world population of Steller's eiders migrates along the Bristol Bay coast of the Alaska Peninsula in the spring, where they linger en route to feed at the mouths of lagoons and other productive habitats. Annual spring aerial surveys have been conducted most years since 1992 to monitor the population status and habitat use of Steller's eiders staging in southwest Alaska prior to spring migration. Annual abundance estimates have ranged from 54,888 (2010) to 137,904 (1992) to with a mean of 81,925 birds. The long-term trend (1992–2011) indicates an annual decline of 2.3 percent per year (R^2=0.34; Larned 2012). Larned (2012) suggests that a slight negative trend bias may have resulted from a higher frequency of optimally-timed counts in early years due to free selection from among survey replicates, compared to single annual counts in later surveys.

The best available estimate of North Slope breeding Steller's eiders (576 birds; Stehn and Platte 2009; also see discussion below) is approximately 1% of the estimate of Pacific-wintering Steller's eiders from 2011 (74,369; Larned 2012). Thus, the listed Alaska-breeding population is thought to represent only a small proportion of the Pacific-wintering population of Steller's eiders.

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

- USFWS Arctic Coastal Plain (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 new ACP survey design. Surveys differed in spatial extent, seasonal timing, sampling intensity, and duration. Consequently, they produced different estimates of Steller's eider population sizes and trends. 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 3.1. Most observations of Steller's eider from both surveys occurred within the boundaries of the NSE survey (Figure 3.7).

Figure 3.7. All 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 the two USFWS surveys, Stehn and Platte (2009) identified a subset of the NSE survey data (1993–2008) that they determined was "least confounded by changes in survey timing and observers." Based

on this subset of the NSE survey, the average population index[4] for Steller's eiders was 173 (90% CI 88–258) with an estimated population growth rate of 1.011 (90% CI 0.857–1.193). The average population size of Steller's eiders breeding in the ACP was estimated at 576 (292–859, 90% CI; Stehn and Platte 2009) assuming a detection probability of 30%[5]. Currently, this analysis provides the best available estimate of the Alaska-breeding Steller's eider population size and growth rate from the ACP. Note that these estimates are based on relatively few observations of Steller's eiders each year with none seen in many survey years.

The Barrow Triangle (ABR) survey, conducted annually by ABR, Inc., provides more intensive coverage (50%, 1999–2004; 25–50%, 2005–2010) of the northernmost portion of the ACP. Based on ABR survey data, Stehn and Platte (2009) estimated the average population index for Steller's eiders residing within the Barrow Triangle was 99.6 (90% CI 55.5–143.7) with an estimated population growth rate of 0.934(90% CI 0.686–1.272). If we also assume the same 30% detection probability applied to the NSE estimate described in the previous section, the average population size of Steller's eiders breeding in the Barrow Triangle survey area would be 332 (185–479, 90% CI).

Alaska-breeding population near Barrow, Alaska – The tundra surrounding Barrow, Alaska supports the only significant concentration of nesting Alaska-breeding Steller's eiders in North America. Barrow is the northernmost community on the ACP. Standardized ground surveys for eiders near Barrow have been conducted since 1999 (Rojek 2008; standard survey area shown in Figure 3.3). Counts of males are the most reliable indicator of Steller's eider presence because females are cryptic and often underrepresented in counts. The highest numbers of Steller's eiders observed during ground surveys at Barrow occurred in 1999 with 135 males and in 2008 with 114 males (Table 3.1; Safine 2011). Total numbers of nests found (those found viable[6] and post-failure) ranged from 0–78 during 1991–2011, while the number of viable nests ranged from 0–27. Steller's eider nests were found in 12 or 60% of years between 1991 and 2010 (Safine 2011).

The Barrow Triangle (ABR) aerial survey, discussed above, has been conducted annually by ABR, Inc., over a 2,757 km^2 area south of Barrow since 1999 to compliment ground surveys closer to Barrow (Figure 3.8). Estimated densities for the survey area range from <0.01–0.03 birds/km^2 in non-nesting years and 0.03–0.08 birds/km^2 in nesting years, except in 2010 when only 2 nests were found during ground surveys and density was 0.01 birds/km^2.

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

Table 3.1. Steller's eider males, nests, and pair densities recorded during ground-based and aerial surveys conducted near Barrow, Alaska 1999–2010 (modified from Safine 2011, 2011 data from Safine *in prep*).

	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).

Status and Distribution

On June 11, 1997, the Alaska-breeding population of Steller's eiders was listed as threatened based on a substantial decrease in this population's breeding range and the increased vulnerability of the remaining Alaska-breeding population to extirpation (USFWS 1997). Although population size estimates for the Alaska-breeding population were imprecise, it was clear Steller's eiders had essentially disappeared as a breeding species from the YKD, where they had historically occurred in significant numbers, and that their Arctic Coastal Plain (North Slope) breeding range was much reduced. On the North Slope they historically occurred east to the Canada border (Brooks 1915), but have not been observed on the eastern North Slope in recent decades (USFWS 2002). The Alaska-breeding population of Steller's eiders now nests primarily on the Arctic Coastal Plain (ACP; Figure 3.2), particularly near Barrow and at very low densities from Wainwright to at least as far east as Prudhoe Bay. A few pairs may still nest on the YKD; only 10 Steller's eider nests have been recorded on the YKD since 1970 (Hollmen et al. 2007).

Recovery

The Steller's Eider Recovery Plan (USFWS 2002) presents research and management priorities that are re-evaluated and adjusted every year, 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, but 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, 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 reclassification to endangered if the population has ≥ 20% probability of extinction in the next 100 years for 3 consecutive years, or the population has ≥ 20% probability of extinction in the next 100 years and is decreasing in abundance. 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.

Steller's Eider Critical Habitat

In 2001, the Service designated 7,330 km^2 (2,830 mi^2) of critical habitat for the Alaska-breeding population of Steller's eiders at breeding areas on the YKD, a molting and staging area in the Kuskokwim Shoals, and molting areas in marine waters at Seal Islands, Nelson Lagoon, and Izembek Lagoon (USFWS 2001). No critical habitat for Steller's eiders has been designated on the ACP.

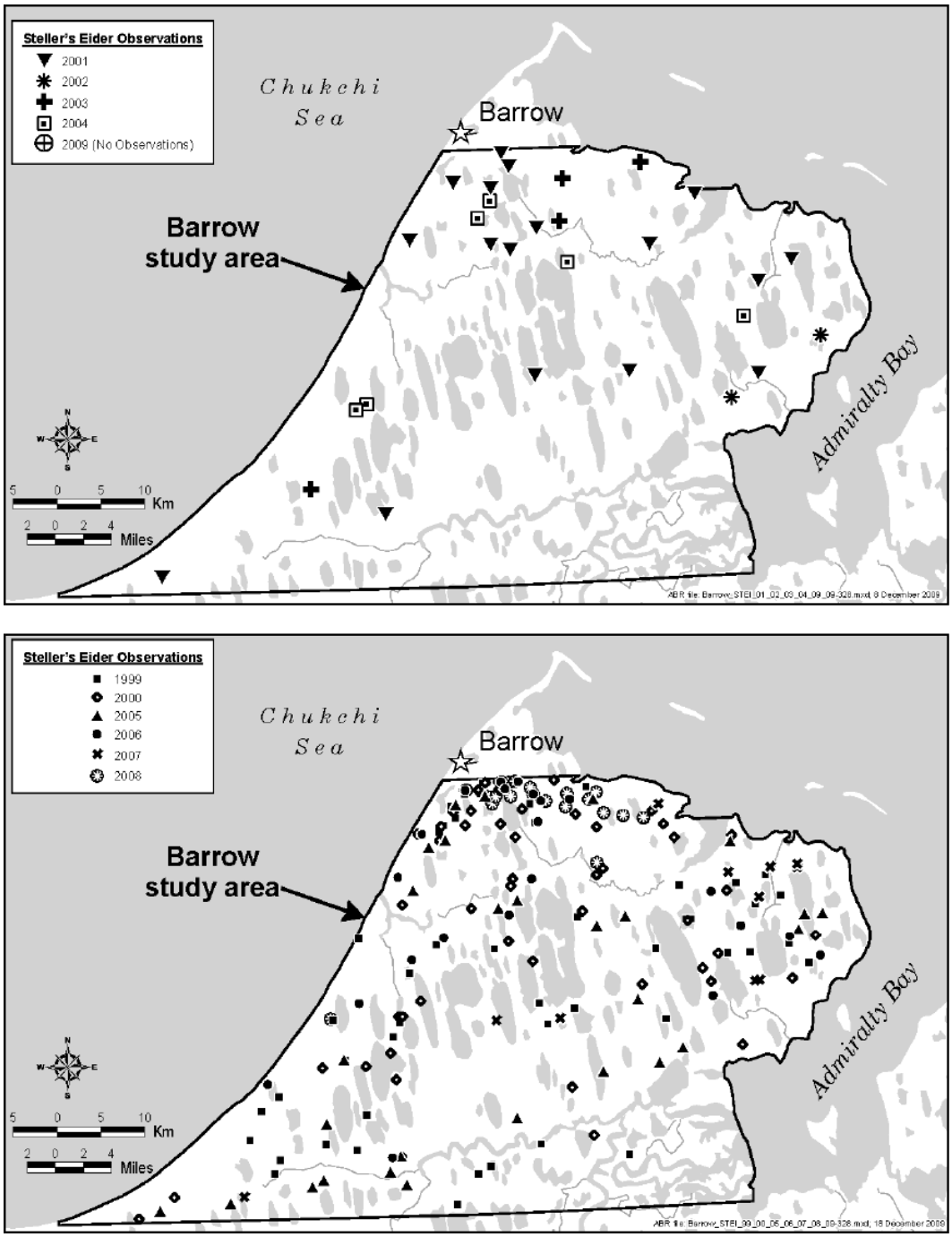

Figure 3.8. Locations of Steller's Eiders Located by ABR, Inc. during the Barrow Triangle aerial surveys in non-nesting years (top) and nesting years (bottom) near Barrow, Alaska, June 1999–2009 (Obritschkewitsch and Ritchie 2011). Obritschkewitsch and Ritchie (2011) reported 5 Steller's eiders from 3 locations in the study area during 2010 (not shown)

Spectacled Eiders

Spectacled eiders are large sea ducks. Males in breeding plumage have a white back, black breast, and pale green head with large white "spectacles" around the eyes (Figure 3.9A) Spectacled eiders 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, each corresponding to breeding grounds on Alaska's North Slope, the Yukon–Kuskokwim Delta (YKD), and northern Russia. The YKD 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, AK (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 3.9B) during late summer and fall, with birds from the 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 and southwest of St. Lawrence Island (Petersen et al. 1999; Figure 3.9B), 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 YKD. 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 miles) inland from its mouth. Breeding density varies across the ACP (Figure 3.10). Although spectacled eiders historically occurred throughout the coastal zone of the YKD, they currently breed primarily in the central coast zone within about 15 km (~9 miles) of the coast from Kigigak Island north to Kokechik Bay (USFWS 1996). However, a number of sightings on the YKD 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). Mean spectacled eider clutch size near Barrow was 4.1 ± 0.3 SE in 2009–2010 and 4.7 ± 0.3 in 2011 (Safine 2011, Safine *in prep*). Hatching occurs in mid-July (Bart and Earnst 2005, Safine 2011, Safine *in prep*).

Nest initiation on Kigigak Island on the YKD 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 YKD compared to the ACP. Mean annual clutch size ranged from 3.8–5.4 in coastal areas of the YKD (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).

(A)

(B)

Figure 3.9. (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.

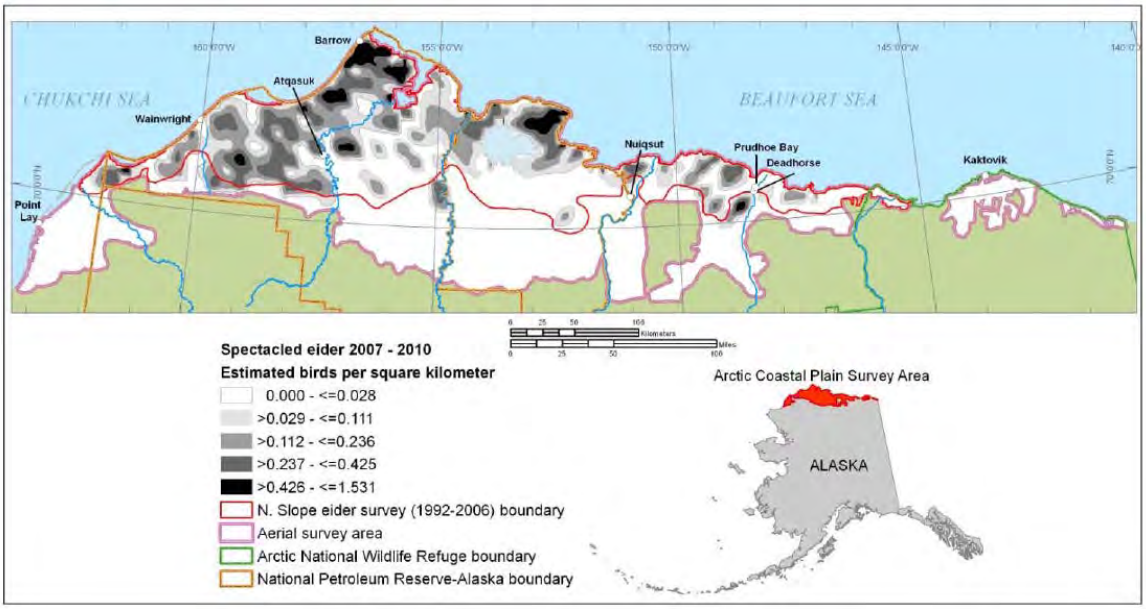

Figure 3.10. Density distribution of spectacled eiders observed on aerial transects sampling 57,336 km^2 of wetland tundra on the North Slope of Alaska during early to mid-June, 2007–2010 (Larned et al. 2011).

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, and then females with broods move directly from freshwater to marine habitat to stage prior to fall migration.

Survivorship – Nest success is highly variable and thought to be influenced by predators, including gulls (*Larus* spp.), jaegers (*Stercorarius* spp.), and red (*Vulpes vulpes*) and arctic (*Alopex lagopus*) foxes. In arctic Russia, apparent nest success was calculated as <2% in 1994 and 27% in 1995; low nest success was attributed to predation (Pearce et al. 1998). On the ACP, apparent nest success was 40% for 15 spectacled eiders nests monitored in the Prudhoe Bay oil fields from 1981 to 1991 (Warnock and Troy 1992) and 35% (range 27–42%) for nests in the Kuparuk oilfields in 1993–1998 (Anderson et al. 1998). On Kigigak Island in the YKD, 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. Estimates of spectacled eider nest success within the YKD coastal zone in 1985–2011 varied from 45% to 93% (Fischer at al. 2011).

Available data indicates egg hatchability is high for spectacled eiders nesting on the ACP, in arctic Russia, and at inland sites on the YKD, but considerably lower in the coastal region of the YKD. 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 YKD 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 YKD 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 natural attenuation of existing lead pellets (Flint and Schamber 2010) in coastal YKD 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 YKD, 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, but until recently much about the species' life in the marine environment was unknown. Satellite telemetry and aerial surveys led to the discovery of spectacled eider migrating, molting, and wintering areas. These studies are summarized in Petersen et al. (1995), Larned et al. (1995), and Petersen at al. (1999). Results of 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 (YKD) compared to northern Alaska (ACP); however, phenology of fall migration is similar between areas. Individuals depart breeding areas July–September, depending on their breeding status and molt in September–October (Matt Sexson, USGS, pers. comm.).

Males generally depart breeding areas on the North Slope (ACP) when the 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 moved rapidly (average travel of 1.75 days), over near shore 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). Preferred areas for males appeared to be 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 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 are likely follow coast lines but also migrate straight across the northern Bering and Chukchi seas in route to northern Russia (Matt Sexson, USGS, pers. comm.).

Females generally depart the breeding grounds later, when much more of the Beaufort Sea is ice-free, allowing for 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 the 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 indicates 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) discussed spectacled eiders' apparently strong preference for specific molting locations, and concluded that all spectacled eiders molt in four discrete areas (Table 3.2). Females generally used molting areas nearest their breeding grounds. All marked females from the YKD 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.

Avian molt is energetically demanding, especially for species such as spectacled eiders that complete molt in a few weeks. Molting birds must have ample food resources, and the rich benthic community of Ledyard Bay (Feder et al. 1989, 1994a, 1994b) likely provides these for spectacled eiders. Large concentrations of spectacled eiders molt in Ledyard Bay to use 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).

Table 3.2. Important molting areas for female and male spectacled eiders by breeding population.

Population and Sex	Molting Area
Arctic Russia males	Indigirka-Kolyma Delta Area
	Mechigmenskiy Bay
	Ledyard Bay
Arctic Russia females	unknown
North Slope males	Ledyard Bay
	Indigirka-Kolyma Delta Area
	Mechigmenskiy Bay
North Slope females	Ledyard Bay
	Mechigmenskiy Bay
Yukon–Kuskokwim Delta males	Mechigmenskiy Bay Eastern Norton Sound Indigirka-Kolyma Delta Area
Yukon–Kuskokwim Delta females	Eastern Norton Sound

Wintering – Spectacled eiders generally depart all molting sites in late October/early November (Matt Sexson, USGS, pers. comm.), migrating offshore in the Chukchi and Bering Seas to a single wintering area in openings in pack ice of the central Bering Sea south/southwest of St. Lawrence Island (Figure 3.9B). In this relatively shallow area, > 300,000 spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 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 about spectacled and other eiders indicates they probably 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 aerial observations in the eastern Chukchi 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 eiders (*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 the spring eider passage in this region. Preliminary results from an ongoing satellite telemetry study conducted by the USGS Alaska Science Center (Figure 3.11; 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 their 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 their spring 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), indicating that spectacled eiders must maintain or enhance their physiological condition during spring staging.

Abundance and trends

The most recent rangewide estimate of spectacled eider population size was 369,122 ± 4,932 90% CI, obtained by aerial surveys of the known wintering area in the northern Bering Sea south of St. Lawrence Island, Alaska in late winter 2010 (Larned et al. 2012). Fewer birds were documented in the wintering area in 2009 (305,261 ± 2,977 90% CI); however, satellite telemetry and other survey data indicated the survey may have been timed late relative to the beginning of spring migration (Larned et al. 2012). Comparison of the appropriately timed 2010 estimate (369,122) to the results of similar aerial surveys in 1997 (363,030 eiders) and 1998 (374,792 eiders) suggests a stable global wintering population (Larned et al. 2012).

Population indices for North Slope-breeding spectacled eiders are unavailable prior to 1992. 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 YKD. If the same methods are applied to the 2007–2010 ACP aerial index reported in Larned et al. (2011), the resulting North Slope-breeding population estimate is 11,254 (8,338–14,167, 95% CI).

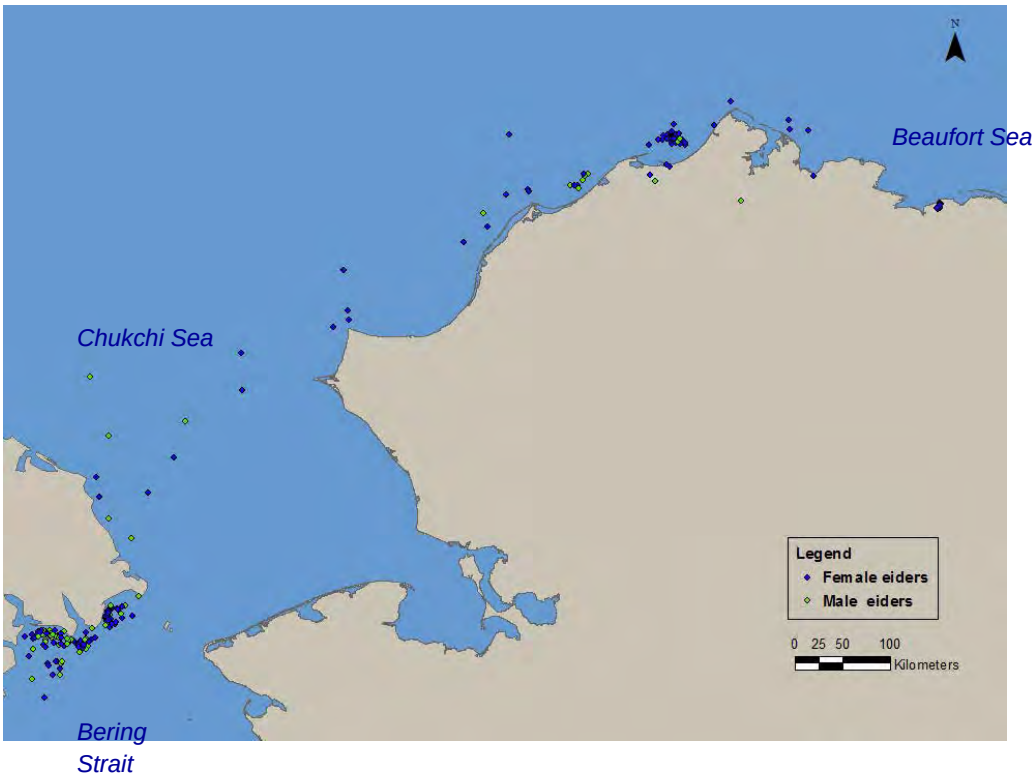

Figure 3.11. Spectacled eider satellite telemetry locations for 12 female and 7 male spectacled eiders in the eastern Chukchi Sea from 1 April – 15 June 2010 and 1 April – 15 June 2011. Additional locations from the northern coast of Russia are not shown. Eiders were tagged on the North Slope during the 2009 and 2010 breeding seasons. Data provided by Matt Sexson, USGS Alaska Science Center (USGS, unpublished).

The YKD spectacled eider population was thought to be about 4% of historic levels in 1992 (Stehn et al. 1993). Evidence of the dramatic decline in spectacled eider nesting on the YKD was corroborated by Ely et al. (1994). They documented a 79% decline in eider nesting between 1969 and 1992 for areas near the Kashunuk River. Aerial and ground survey data indicated that spectacled eiders were undergoing a decline of 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 YKD 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 YKD 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 YKD in 2011 and evaluate long-term trends in the YKD breeding population from 1985 to 2011. The estimated total number of nests measures the minimum number of breeding pairs in the population in a given year and does not include potential breeders that did not establish nests that year or nests that were destroyed or abandoned at an early stage (Fischer et al. 2011). The total number of nests in 2011 was estimated at 3,608 (SE 448) spectacled eiders nests on the YKD, 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 YKD 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). The 2010 population index based on these aerial surveys was 5362 birds (SE 527). Platte and Stehn (2011) estimated the YKD spectacled eider breeding population to be 12,601 (95% CI[7] = 10,173–15,028) in 2010.

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 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 YKD (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 (YKD, 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.

6. ENVIRONMENTAL BASELINE

The environmental baseline, as described in section 7 regulations (50 CFR §402.02) includes the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area, the anticipated impacts of all proposed Federal projects in the Action Area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The environmental baseline provides the context within which the effects of the Action will be analyzed and evaluated.

Status of Listed Eiders in the Action Area

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). Although spectacled eiders breed at variable densities across much of the ACP (Figure 3.2), they also regularly breed near Barrow. Both species arrive in the action area in late May to early June and may remain as late as mid-October.

In 2011, 4 Steller's eiders and one spectacled eider nested in or within 200 m of shorebird study Plots 1, 2, 3, and 5. Five additional Steller's eider nests were also found within

[7] Confidence intervals calculated based on information provided in Platte and Stehn (2011).

~800 m of Plots 3 and 5. In 2012, one Steller's eider nest was found within 70 m of Plot 2. Historically, numerous nests of both eider species have been found within 1 km of the shorebird plots, including two Steller's eider nests in Plot 5 (2005, 2008) and two spectacled eider nests in Plot 8 (2000, 2008).

Factors that may have contributed to the current status of Steller's and spectacled eiders are discussed below and include, but are not limited to, toxic contamination of habitat, increase in predation, over harvest, and habitat loss through development and disturbance. Recovery efforts for both species are underway in portions of the Action Area.

Environmental contaminants

The deposition of lead shot in tundra or nearshore habitats used for foraging is considered a threat to spectacled eiders. Lead poisoning of spectacled eiders has been documented on the YKD (Franson et al. 1995, Grand et al. 1998) and Steller's eiders on the ACP (Trust et al. 1997; Service unpublished data). Female Steller's eiders nesting at Barrow in 1999 had blood lead concentrations that reflected exposure to lead (>0.2 ppm lead; A. Matz, USFWS, unpublished data), and six of the seven tested had blood lead concentrations that indicated poisoning (>0.5 ppm lead; Franson and Pain 2011). Additional lead isotope tests confirmed the lead in the Steller's eider blood was of lead shot origin, rather than natural sources such as sediments (A. Matz, USFWS, unpublished data). Use of lead shot for hunting waterfowl is prohibited statewide, and for hunting all birds on the North Slope, and the USFWS reports good compliance in most areas with the lead shot prohibitions.

Other contaminants, including petroleum hydrocarbons from local sources and globally distributed heavy metals, may also affect spectacled eiders. For example, Trust et al. (2000) reported high concentrations of metals and subtle biochemical changes in spectacled eiders wintering near St. Lawrence Island. Spectacled eiders breeding and staging on the Colville River Delta area may have experienced varying levels of exposure to petroleum hydrocarbons, heavy metals, and other contaminants; however, it is difficult to assess the impacts of this exposure to eiders.

Increases in Predator Populations

There is some evidence that predator and scavenger populations may be increasing on the North Slope near sites of human habitation, such as villages and industrial infrastructure (Eberhardt et al. 1983, Day 1998, Powell and Bakensto 2009). Researchers have proposed that reduced fox trapping, anthropogenic food sources in villages and oil fields, and nesting/denning sites on human-built structures have resulted in increased fox, gull, and raven numbers (R. Suydam and D. Troy pers. comm., Day 1998). These anthropogenic influences on predator populations and predation rates may have affected eider populations, but this has not been substantiated. However, increasing predator populations are a concern, and Steller's eider studies at Barrow attributed poor breeding success to high predation rates (Obritschkewitsch et al. 2001), and in years where arctic fox removal was conducted at Barrow prior to and during Steller's eider nesting, nest success appears to have increased significantly (Rojek 2008, Safine 2011).

Subsistence Harvest
Prior to the listing of Steller's and spectacled eiders under the ESA, some level of subsistence harvest of these species occurred across the North Slope (Braund et al. 1993). Hunting for 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. Recent harvest data indicate that listed eiders continue to be taken during subsistence hunting on the North Slope. Although estimates of the number taken are imprecise, the Service is concerned about the scale of impacts, particularly for Steller's eiders. Continued efforts to eliminate harvest are being implemented in North Slope villages, and particularly at Barrow, where the greatest known concentrations of listed Steller's eiders occur. Intra-service consultations for the Migratory Bird Subsistence Hunting Regulations are conducted annually and harvest of all species, included listed eiders, is being monitored.

Habitat Loss from Development and Disturbance
With the exception of contamination by lead shot, destruction or modification of North Slope nesting habitat of listed eiders has been limited to date, and is not thought to have played a major role in population declines of spectacled or Steller's eiders. Until recently eider breeding habitat on the ACP was largely unaltered by humans, but limited portions of each species' breeding habitat have been impacted by fill of wetlands, the presence of infrastructure that presents collision risk, and other types of human activity that may disturb birds or increase populations of nest predators.

The population of communities such as Barrow has been increasing, and BLM (2007) expects growth to continue at approximately 2% per annum until at least the middle of this century. Assuming community infrastructure and footprint grow at roughly the same pace as population, BLM (2007) estimates that community footprint could cover 3,600 acres (14.6 km^2) by the 2040s. Oil and gas development has steadily moved westward across the ACP towards NPR-A since the initial discovery and development of oil on the North Slope. Given industries interest in NPR-A, as expressed in lease sales, seismic surveys, and drilling of exploratory wells, the westward expansion of industrial development is likely to continue.

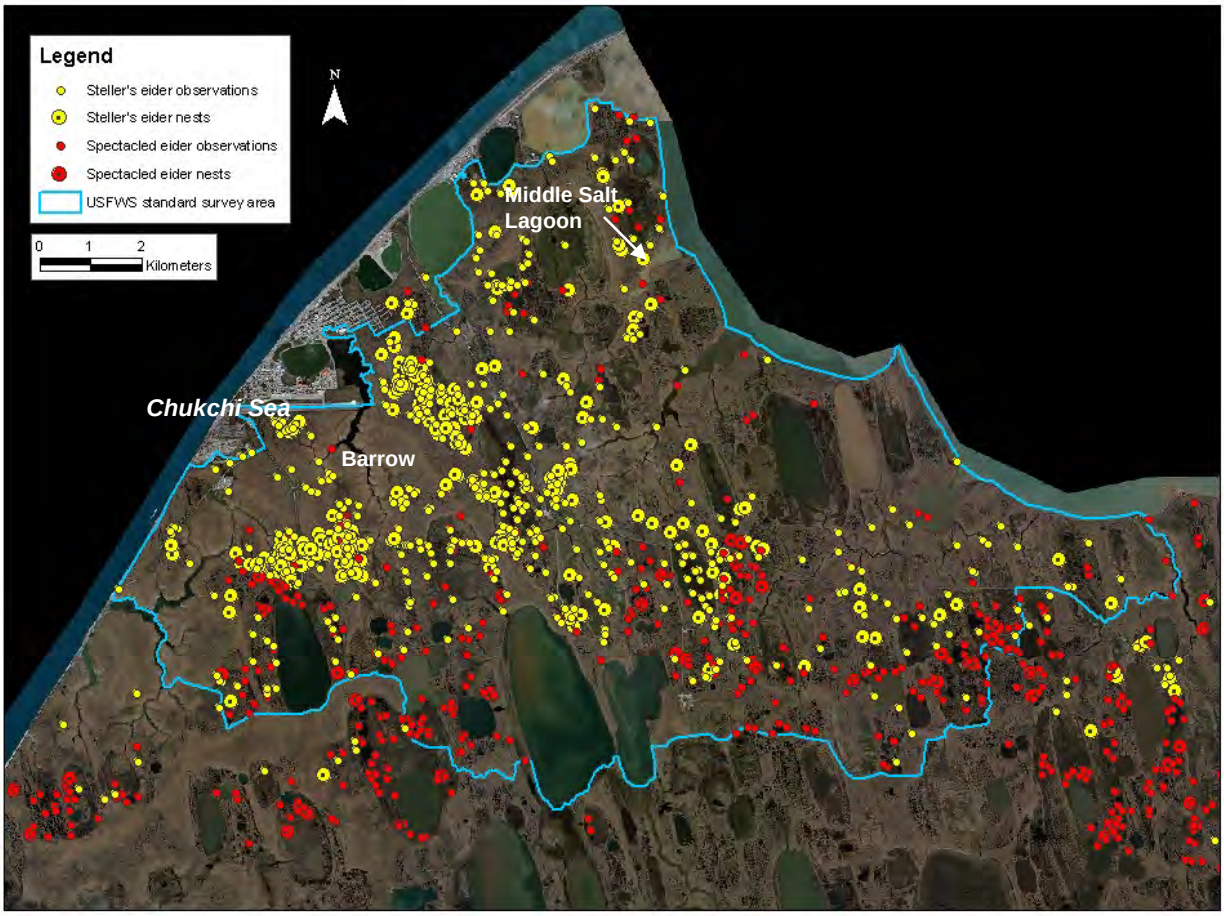

Figure 4.1. Observations of Steller's eiders and spectacled eiders during USFWS breeding pair and nest foot surveys at Barrow, AK (1999–2010; Steller's eider nest locations 1991–2010).

Research

Scientific, field-based research has also increased on the ACP in response to interest in climate change and its effects on Arctic ecosystems. While many of these activities have no impacts on listed eiders as they occur in seasons when eiders are absent from the area, or use remote sensing tools, on-the-ground activities and tundra aircraft landings likely disturb a small number of listed eiders each year. Many of these activities are considered in intra-Service consultations, or under a programmatic consultation with BLM for summer activities in NPR-A.

Federal Actions

Activities in the vicinity of Barrow, AK that have required formal section 7 consultation under the ESA are summarized in Table 4.1. We believe these estimates have likely overestimated, possibly significantly, actual take. Actual take is likely reduced by the implementation of terms and conditions in each biological opinion, is spread over the life-span of a project (often 50 years). Also, it remains unknown to what degree spectacled and Steller's eiders can reproduce in disturbed areas or move to other less

disturbed areas to reproduce. If either or both occur, these factors also serve to reduce levels of actual take

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 the effects of climate change (Quinlan et al. 2005, Schindler and Smol 2006, and Smol et al. 2005). While climate change will likely affect individual organisms and communities it is difficult to predict with any specificity how these effects will manifest. Biological, climatological, and hydrologic components of the ecosystem are interlinked and operate on multiple spatial, temporal, and organizational scales with feedback between the components (Hinzman et al. 2005).

There are a wide variety of changes occurring in the arctic worldwide, including Alaska's North Slope. Arctic landscapes are dominated by lakes and ponds (Quinlan et al. 2005), such as those used by listed eiders for feeding and brood rearing. In many areas these water bodies are drying out during the summer as a result of thawing permafrost (Smith et al. 2005 and Oechel et al. 1995), and increased evaporation and evapotranspiration as they are ice-free for longer periods (Schindler and Smol 2006, and Smol and Douglas 2007). Productivity of lakes and ponds appears to be increasing as a result of nutrient inputs from thawing soil and an increase in degree days (Quinlan et al. 2005, Smol et al. 2005, Hinzman et al. 2005, and Chapin et al. 1995). Changes in water chemistry and temperature are resulting in changes in the algal and invertebrate communities, which form the basis of the food web in these areas (Smol et al. 2005, Quinlan et al. 2005).

With the reduction in summer sea ice, the frequency and magnitude of coastal storm surges has increased. These often result in breaching of lakes and low lying coastal wetland areas killing salt intolerant plants and altering soil and water chemistry, and hence, the fauna and flora of the area (USGS 2006). Historically sea ice has served to protect shorelines from erosion; however, this protection has decreased as sea ice has declined. Coupled with softer, partially thawed permafrost, the lack of sea ice has significantly increased coastal erosion rates (USGS 2006), potentially reducing available coastal tundra habitat.

Changes in precipitation patterns, air and soil temperature, and water chemistry are also affecting tundra vegetation communities (Hinzman et al. 2005, Prowse et al. 2006, Chapin et al. 1995), and boreal species are expanding their range into tundra areas (Callaghan et al. 2004). Changes in the distribution of predators, parasites, and disease causing agents resulting from climate change may have significant effects on listed species and other arctic fauna and flora. Climate change may also result in mismatched timing of migration and the development of food in Arctic ponds (Callaghan et al. 2004), and changes in the population cycles of small mammals such as lemmings to which many other species, including nesting Steller's eiders (Quakenbush and Suydam 1999), are linked (Callaghan et al. 2004).

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.

Investigator Disturbance

Investigator disturbance during proposed field activities could adversely impact Steller's or spectacled eiders by: 1) displacing adults and/or broods from preferred habitats during pre-nesting, nesting, and brood rearing; 2) displacing females from nests, exposing eggs or small young to inclement weather or predators; and 3) interrupting normal behavior, possibly reducing foraging efficiency and feeding time. The results of published studies on the impacts of human disturbance to nesting waterfowl are variable but suggest low to moderate effects on nest survival and rates of nest abandonment. For example, two studies on the YKD found nest disturbance from human activity decreased spectacled eider nest survival rates by 4% (Bowman and Stehn 2003) and 14% (Grand and Flint 1997). Mickleson (1975) found very low rates of nest desertion (0.8%) by cackling geese and spectacled eiders on the YKD, which were only very slightly increased by 0.7% as a result of human disturbance. Johnson (1984) documented several nests abandoned by female common eiders after human disturbance on Thetis Island, northern Alaska. Presumably numerous factors affect how different individuals and species respond to disturbance, including the number, timing, duration, and intensity of disturbance, as well as independent factors such as weather, the density and proximity of predators, etc. In summary, we lack the empirical basis to reliably predict the effect of disturbance upon survival rates of nests or ducklings.

Predation is an important mechanism through which human disturbance may affect nesting success. In a review of the effects of field observers on nesting success of common eiders, Götmark (1992) found that 76% of studies that reported reduced nest success identified predation as the primary proximate cause. While both avian and mammalian predators have been documented depredating nests after a hen has been flushed by humans, Götmark (1992) concluded that avian predators were most likely to have an effect as a result of disturbance. Grand and Flint (1997) suggested avian predators, particularly gulls, were more prevalent than mammalian predators on the YKD. Similar results were reported from studies in the area by Mickelson (1975) who attributed 85.9% of nest predation to avian predators, while Vacca and Handel (1988) attributed 78% of predation to avian predators. Given the similar fauna, vegetation, and terrain it is possible that avian predators would also be more significant than mammalian predators following nest disturbance on the ACP. Safine (2011) reported depredation of a camera- monitored nest by glaucus gulls and parasitic jaegers after a spectacled eider delayed returning to incubate the nest following capture by investigators. However, arctic foxes were also responsible for a substantial portion of nest depredation observed in camera-monitoring studies of waterfowl nests in the Barrow area (Safine 2011) and shorebird and passerine nests in the Prudhoe Bay region of the ACP (Liebezeit and Zack

2008). Investigator disturbance may also fragment young broods or separate hens from ducklings, making the ducklings more vulnerable to predators.

Breeding Steller's and spectacled eiders within or near the action area are likely to experience investigators walking near their nest up to several times during nest initiation and incubation periods. We expect the Proposed Action would affect listed eiders nesting within study plots and near off-plot field activities to the extent that reproductive success may be compromised. Assuming that eiders are affected by human presence and activities within 200 m of nests (a predicted zone of influence), we estimate the area affected by on-plot activities would be 2.3 km^2. Hiking paths were not included in this estimate of affected area because researchers will remain ≥ 200 m from known nests along these paths and we do not expect that flushing a hen only once during initial discovery of a nest would likely cause the nest to fail.

Activities within Shorebird Study Plots

Steller's eiders

Given observed extreme interannual variation in the abundance and distribution of Steller's eider nests near Barrow, it is difficult to predict the number of Steller's eiders that may nest within the shorebird plots in a given year. To provide a rough estimate of the number of potentially affected eider nests and broods, however, we multiplied the mean historical density of breeding pairs[8] in the Barrow eider ecology study area by the combined area of the plots and associated zone of influence in which eiders may be disturbed:

$0.32 \text{ pairs/km}^2 \times 5.79 \text{ km}^2 = 1.85$ nests affected per year

It should be noted that using density calculated as an average over many years could substantially underestimate the actual number of Steller's eider nests in the action area in some locations in some years due to their patchy, variable distribution and considerable interannual variation in nesting effort.

Spectacled eiders

Spectacled eider density polygons constructed from the 2007–2010 waterfowl breeding population survey of the Arctic Coastal Plain, Alaska (ACP survey; USFWS Migratory Bird Management, unpublished data) provide our best estimates of spectacled eider nesting in the project area. We used the median of the spectacled eider density range for each long-term plot and transect (0.174, 0.331 or 0.9785 birds/km^2). We divided densities of individuals by two to estimate the density of breeding pairs. We estimated the potential number of spectacled eider nests lost by multiplying the estimated number of breeding pairs by the extent of the affected area.

Activities in the 6 nest plots would affect eiders nesting in 0.97 km^2 per plot. The number of nests in and within 200 m of the long-term plots was calculated separately for each of the 4 different spectacled eider densities occurring in the study area:

[8] Estimated as the number of males observed in foot surveys of breeding pair in the eider ecology standard study area.

1 plot × 0.97 km^2/plot × 0.174 birds/km^2 × 0.5 nests/bird = 0.08 nests

3 plots × 0.97 km^2/plot × 0.331 birds/km^2 × 0.5 nests/bird = 0.48 nests

2 plots × 0.97 km2/plot × 0.9785 birds/km2 × 0.5 nests/bird = 0.95 nests

Thus, the total number of spectacled eider nests potentially affected per season is 1.51.

Loss of production
The frequency of investigator activity in the Action Area during nest searching, return visits to shorebird nests, and other field activities can be expected to increase the risk of adverse effects to listed eiders in terms of loss of production, which may occur through abandonment of the nest; full or partial depredation of an unattended nest; or depredation of ducklings associated with fragmented broods. However, conservation measures described in the *Proposed Action* section, including a requirement for field crews to remain ≥100 m from active listed eider nests within and near shorebird study plots, would greatly reduce the risk of adverse effects. Thus, we anticipate no more than 1 Steller's eider nest and 1 spectacled eider nest would be lost through investigator disturbance during field activities. Based on average clutch sizes for the two species, we estimate loss of production of up to 5 Steller's eider and 4 spectacled eider eggs or ducklings may result from the Proposed Action.

Off-plot Activities
Although some shorebird research activities also occur outside the plots, the shorebird investigators have more flexibility in the locations where these activities will occur. Because field crews will remain at least 200 m from known active nests, we do not anticipate incidental take of listed eiders during off-plot research activities.

Indirect Effects
Indirect effects of the action are defined as "those effects that are caused by or will result from the proposed action and are later in time, but are still reasonably certain to occur" (50 CFR §402.02). While the activities that may be authorized could lead to additional research in the future, they cannot be said to be reasonably expected to occur. Therefore, no indirect effects to listed eiders are anticipated to result from the proposed activities.

Interrelated and Interdependent Actions
Interdependent actions are defined as "actions having no independent utility apart for the proposed action," while interrelated actions are defined as "actions that are part of a larger action and depend upon the larger action for their justification" (50 CFR §402.02). The Service has not identified any actions that are interrelated or interdependent to the Proposed Action. Similar studies at other ASDN sites are not dependent on the ASDN for their justification (they are not interrelated actions) and have independent utility apart from the Proposed Action (they are not interdependent actions).

8. 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 biological opinion. 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 Act. 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.

Under the ESA, cumulative effects are 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 because they require separate consultation under the ESA.

Additional scientific research is likely to occur in the Action Area. We anticipate that most research would involve a Federal action agency through funding or permitting of those activities. While there is the possibility future scientific research may occur in the action area that does not require consultation under the ESA, we have determined that such research is not reasonably certain to occur.

9. 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."

In evaluating the impacts of the proposed project to listed eiders, the Service identified direct and indirect adverse effects that could result from habitat loss and disturbance. Using methods and logic explained in the *Effects of the Action* section, the Service estimates 1 Steller's eider and 1 spectacled eider nest may be lost through investigator disturbance each year for the 2013 and 2014 field seasons. We estimate that loss of production of up to 5 Steller's eider and 4 spectacled eider eggs or ducklings may result from the Proposed Action each year, based on average clutch sizes for the two species. We expect this loss of production will not have a significant effect at the population level because only a small proportion of eider eggs or ducklings would typically survive to recruit into the breeding populations. For example, spectacled eider nest success recorded on the YKD ranged from 18-73% (Grand and Flint 1997). From the nests that survived to hatch, spectacled eider duckling survival to 30-days ranged from 25–47% on the YKD (Flint et al. 2000). Over-winter survival of one-year old spectacled eiders was estimated at 25% (P. Flint pers. comm.), with annual adult survival of 2-year old birds (that may enter the breeding population) of 80% (Grand et al. 1998). Using these data (in a very simplistic scenario) we estimate only 0.9–6.6% of eggs/ducklings would be

expected to survive and recruit into the breeding population. Thus, the loss of eggs or ducklings is of lower significance for survival and recovery of listed eiders than the death of an adult bird.

Applying this range in estimated recruitment rates for both listed eider species, we roughly estimate the project may preclude 0.05–0.4 adult Steller's eiders and 0.04–0.3 adult spectacled eiders from entering the breeding populations per year. Because this potential loss of recruitment is very small, we believe the Proposed Action will not have significant population–level effects and will not affect the likelihood of survival and recovery of Alaska-breeding Steller's eiders or spectacled eiders. Accordingly, it is the Services' biological opinion that the Proposed Action is not likely to jeopardize the continued existence of Alaska-breeding Steller's eiders or spectacled eiders.

This BO's determination of non-jeopardy is based on the assumption that USFWS MBM and their agents will consult with the USFWS Endangered Species Program on any future activities related to the Proposed Action that are not evaluated in this document. *Thus, should the project description change in 2013-2014, MBM should contact the Fairbanks Field Office to ensure that potential impacts have been evaluated and authorized.*

In addition to listed eiders and polar bears, the area affected by the Proposed Action 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.

10. 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, respectively, 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).

Adverse effects to listed eiders have been substantially reduced through implementation of conservation measures (see section 2) by MBM. However, the Service still anticipates some adverse effects to listed eiders. As described in Section 5, *Effects of the Action*, the activities described and assessed in this BO may adversely affect Steller's eiders and spectacled eiders through investigator disturbance. Methods used to estimate loss of eider production resulting from investigator disturbance are described in the *Effects of the Action* section. Based on these estimates of loss of production, the Service anticipates that *5 Steller's eider eggs or ducklings and 4 spectacled eider eggs or ducklings* are likely to be taken each year as a result of the Proposed Action through the effects of disturbance (harm).

While the incidental take statement provided in this consultation satisfies the requirements of the Act, 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.

The measures described below are non-discretionary, and must be undertaken/required by USFWS MBM so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. MBM has a continuing duty to regulate the activity covered by this ITS. If MBM should (1) fail to assume and implement the terms and conditions or (2) fail to require any applicant to adhere to the terms and conditions of the Incidental Take Statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse.

11. REASONABLE AND PRUDENT MEASURES

These reasonable and prudent measures (RPMs) and their implementing terms and conditions (T&Cs) aim to minimize the incidental take anticipated from activities described in this BO. USFWS has not identified RPMs for listed eiders; however, we anticipate conservation measures identified in the *Proposed Action* section above will be fully implemented by MBM and will serve to effectively minimize potential individual-level effects of the proposed action to Steller's or spectacled eiders. Conservation measures include, but are not limited to, following appropriate procedures to reduce the risk of depredation or abandonment of the listed eider nests discovered during field activities and adhering to predetermined buffers (100 m or 200 m depending on location) to reduce disturbance to known active nests. Field procedures related to listed eiders will

be developed cooperatively by the shorebird and eider ecology program leads before 2012 fieldwork commences.

If injured or dead Steller's or spectacled eiders are encountered during field activities, please contact David Safine (Fairbanks, 907-456-0354; Barrow, 907-367-3761), Neesha Stellrecht (907-456-0297), or Angela Matz at (907-456-0442) with the Fairbanks Fish and Wildlife Field Office, Endangered Species Branch, Fairbanks, Alaska at for instructions on the handling and disposal of the injured or dead bird.

13. REINITIATION NOTICE

This concludes formal consultation for the WCS 2012 and 2013 avian field studies near Prudhoe Bay, AK. 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 is exceeded;
2. New information reveals effects of the action agency that may affect listed species or critical habitat 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.

8. REINITIATION NOTICE

This concludes formal consultation on proposal by MBM to conduct shorebird research in the vicinity of Barrow, AK during summer 2011. As provided in 50 CFR 402.16, reinitiation 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 is exceeded;
2) New information reveals effects of the action agency that may affect listed species or critical habitat 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 or critical habitat not considered in this opinion; or
4) A new species is listed or critical habitat designated that may be affected by the action.

While this BO satisfies the requirements of the Act 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.

Thank you for your concern for endangered species and for your cooperation in the development of this biological opinion. If you have any comments or require additional information, please contact Ted Swem with the Fairbanks Fish and Wildlife Field Office, Endangered Species Branch, Fairbanks, Alaska at (907) 456-0297.

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APPENDIX A: POLAR BEAR INTERACTION GUIDELINES

These Polar Bear Interaction Guidelines (Guidelines) were developed to ensure that activities are conducted in a manner that avoids conflicts between humans and polar bears. Polar bears are protected under the Marine Mammal Protection Act (MMPA), and were listed as a threatened species under the Endangered Species Act (ESA) in 2008. The MMPA and ESA both prohibit the "take" of polar bears without authorization. Take includes disturbance/harassment, as well as physical injury and killing of individuals.

In addition to sea ice, polar bears use marine waters and lands in northern Alaska for resting, feeding, denning, and seasonal movements. They are most likely to be encountered within 25 miles of the coastline, especially along barrier islands during July-October. Polar bears may also be encountered farther inland, especially females during the denning period (October-April). Polar bears may react differently to noise and human presence. The general methods for minimizing human-bear conflicts are to: 1) avoid detection and close encounters; 2) minimize attractants; and 3) recognize and respond appropriately to polar bear behaviors. These Guidelines provide information for avoiding conflicts with polar bears during air, land, or water-based activities.

Unusual sightings or questions/concerns can be referred to: Susanne Miller or Craig Perham, Marine Mammals Management Office (MMM Office), 1-800-362-5148; or to Sarah Conn (907) 456-0499 of the Fairbanks Fish & Wildlife Field Office (FFWFO).

When operating aircraft:

- If a polar bear(s) is encountered, divert flight path to a minimum of 2,000 feet above ground level or ½ mile horizontal distance away from observed bear(s) whenever possible.

When traveling on land or water:

- Avoid surprising a bear. Be vigilant—especially on barrier islands, in river drainages, along bluff habitat, near whale or other marine mammal carcasses, or in the vicinity of fresh tracks.

- Between October and April special care is needed to avoid disturbance of denning bears. If activities are to take place in that time period the MMM Office should be contacted to determine if any additional mitigation is required. In general, activities are not permitted within one mile of known den sites.

- Avoid carrying bear attractants (such as strongly scented snacks, fish, meat, or dog food) while away from camp; if you must carry attractants away from camp, store foods in air-tight containers or bags to minimize odor transmission until you return them to "bear-resistant" containers.*

- If a polar bear(s) is encountered, remain calm and avoid making sudden movements. Stay downwind if possible to avoid allowing the bear to smell you.

Do not approach polar bears. Allow bears to continue what they were doing before you encountered them. Slowly leave the vicinity if you see signs that you've been detected. Be aware that safe viewing distances will vary with each bear and individual situation. Remember that the closer you are to the animal, the more likely you are to disturb it.

- If a bear detects you, observe its behavior and react appropriately. Polar bears that stop what they are doing to turn their head or sniff the air in your direction have likely become aware of your presence. These animals may exhibit various behaviors:

  - *Curious* polar bears typically move slowly, stopping frequently to sniff the air, moving their heads around to catch a scent, or holding their heads high with ears forward. They may also stand up.

  - *A threatened or agitated* polar bear may huff, snap its jaws together, stare at you (or the object of threat) and lower its head to below shoulder level, pressing its ears back and swaying from side to side. These are signals for you to begin immediate withdrawal by backing away from the bear. If this behavior is ignored, the polar bear may charge. Threatened animals may also retreat.

  - In rare instances you may encounter a *predatory* bear. It may sneak or crawl up on an object it considers prey. It may also approach in a straight line at constant speed without exhibiting curious or threatened behavior. This behavior suggests the bear is about to attack. Standing your ground, grouping together, shouting, and waving your hands may halt the bear's approach.

- If a polar bear approaches and you are in the bear's path—or between a mother and her cubs—get out of the way (without running). If the animal continues to approach, stand your ground. Gather people together in a group and/or hold a jacket over your head to look bigger. Shout or make noise to discourage the approach.

- If a single polar bear attacks, defend yourself by using any deterrents available. If the attack is by a surprised female defending her cubs, remove yourself as a threat to the cubs.

When camping:

- Avoid camping or lingering in bear high-use areas such as river drainages, coastal bluffs and barrier islands.

- Store food and other attractants in "bear-resistant" containers*. Consider the use of an electric fence as additional protection. Do not allow the bear to receive food as a reward in your camp. A food-rewarded bear is likely to become a problem bear for you or someone else in the future.

- Maintain a clean camp. Plan carefully to: minimize excess food; fly unnecessary attractants out on a regular basis (i.e. garbage, animal carcasses, excess anti-freeze or petroleum products); locate latrines at least ¼ mile from camp; and wash kitchen equipment after every use.

- If a polar bear approaches you in camp, defend your space by gathering people into a large group, making noise and waving jackets or tarps. Continue to discourage the bear until it moves off. Have people watch the surrounding area in case it returns later, keeping in mind that polar bears are known to be more active at night. Additional measures to protect your camp, such as electric fences or motion sensors can be used.

Harassment of polar bears is not permissible, unless such taking (as defined under the MMPA) is imminently necessary in defense of life, and such taking is reported to FWS within 48 hours.

*Containers must be approved and certified by the Interagency Grizzly Bear Committee as "bear-resistant." Information about certified containers can be found at http://www.igbconline.org/html/container.html.

FOR DEPARTMENT OF INTERIOR EMPLOYEES ONLY

Use of Deterrents

In addition to following the Guidelines above, all U.S. Fish and Wildlife Service (Service) employees must have completed the Department of the Interior's (DOI) Bear and Firearm Safety Training course and be current in certification before engaging in field activities. Service staff must practice with and know how to use deterrents prior to conducting field work. If working in bear habitat, Service staff must anticipate and plan for possible scenarios of encountering polar bears, and identify appropriate responses, prior to initiating field work. Use of non-lethal polar bear deterrents by Service staff is only permissible if it is done in a humane manner and is for the purposes of protection or welfare of the bear or the public. Service staff has the right to use lethal methods to protect the public from polar bears in defense of life situations, and may do so when all reasonable steps to avoid killing the bear(s) have been taken.

Notification of Use of Deterrents

The Department of the Interior Bear Incident Report Form will be used to record and report polar bear-human interactions *that require use of deterrents*. These incidents will be reported to the MMM Office. This information will be used to track interactions over time and improve polar bear conservation and management.