United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE
Fairbanks Fish and Wildlife Field Office
101 12th Avenue, Room 110
Fairbanks, Alaska 99701

May 9, 2014

Stan Wullschleger
Environmental Sciences Division
Climate Change Science Institute
Oak Ridge National Laboratory
Building 2040, Room E212
Oak Ridge, TN 37831-6301

Re: Biological Opinion for
2014-2024 NGEE research.

Dear Mr. Wullschleger,

This document transmits the U.S. Fish and Wildlife Service's (Service) final Biological Opinion (BO) on the Next Generation Ecosystem Experiment (NGEE) project, managed by the Oak Ridge National Laboratory (ORNL) and funded by the U.S. Department of Energy's Office of Science.

This BO describes effects of the proposed research on spectacled eiders (*Somateria fischeri*), Alaska-breeding Steller's eider (*Polysticta stelleri*), and polar bears (*Ursus maritimus*) pursuant to section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.).

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

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

Sincerely,

Ted Swem

Ted Swem
Branch Chief
Endangered Species

BIOLOGICAL OPINION

For

NEXT GENERATION ECOSYSTEM EXPERIMENT

BARROW RESEARCH ACTIVITIES 2014-2024

Consultation with
Oak Ridge National Laboratory

for
U. S. Department of Energy
Office of Science
Washington, DC

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

May 12, 2014

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1. INTRODUCTION

This document is the U.S. Fish and Wildlife Service's (USFWS) final Biological Opinion (BO) on the Next Generation Ecosystem Experiment (NGEE) project, managed by the Oak Ridge National Laboratory (ORNL), and funded by the U.S. Department of Energy's Office of Science. The proposed project would include chemical, biological, and energy exchange research near Barrow, Alaska. This BO describes effects of the proposed research on spectacled eiders (*Somateria fischeri*), Alaska-breeding Steller's eider (*Polysticta stelleri*), and polar bears (*Ursus maritimus*) pursuant to section 7 of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 et seq.). Field work associated with the NGEE project is planned for the next 5-10 years (2014-2024).

We used information provided on the project website (http://ngee-arctic.ornl.gov/), information contained in North Slope Borough land use permit (NSB 13-087), project-specific communications with ORNL and NGEE personnel, other Service documents, and published and unpublished literature to develop this BO.

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

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

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

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

2. DESCRIPTION OF THE PROPOSED ACTION

Project Overview

The proposed research would characterize and quantify physical, chemical, and biological systems in permafrost near Barrow, Alaska to monitor variability in response to changing external conditions. Researchers intend to gather meteorological data, conduct plant and soil surveys, and collect gas and water samples. Up to 10 researchers would conduct periodic field work year-round, with the majority of activities during summer. Site access during snow-free months would be limited to established roads and foot travel on existing trail mats or boardwalk where possible. Fuel would be used to operate some field equipment (e.g., soil corers), but no other hazardous materials would be used. Any equipment left in place year-round would be prominently marked to minimize collision risk for winter travelers.

Study Sites

Intensive Site 1

Intensive study sites are located within and adjacent to the Barrow Environmental Observatory (BEO; Figures 2.1 and 2.2).

Southern Transect

An additional transect would be located outside the BEO approximately 0.9 mi (1.5 km) south of Gaswell Road (Figure 2.3). The southern transect would be approximately 1.09 mi (1.75 km) long. Field work conducted at this transect would include two-day water sampling in June and September. Anticipated additional field work at this location may include gas sampling, energy balance measurements, and geophysical surveys.

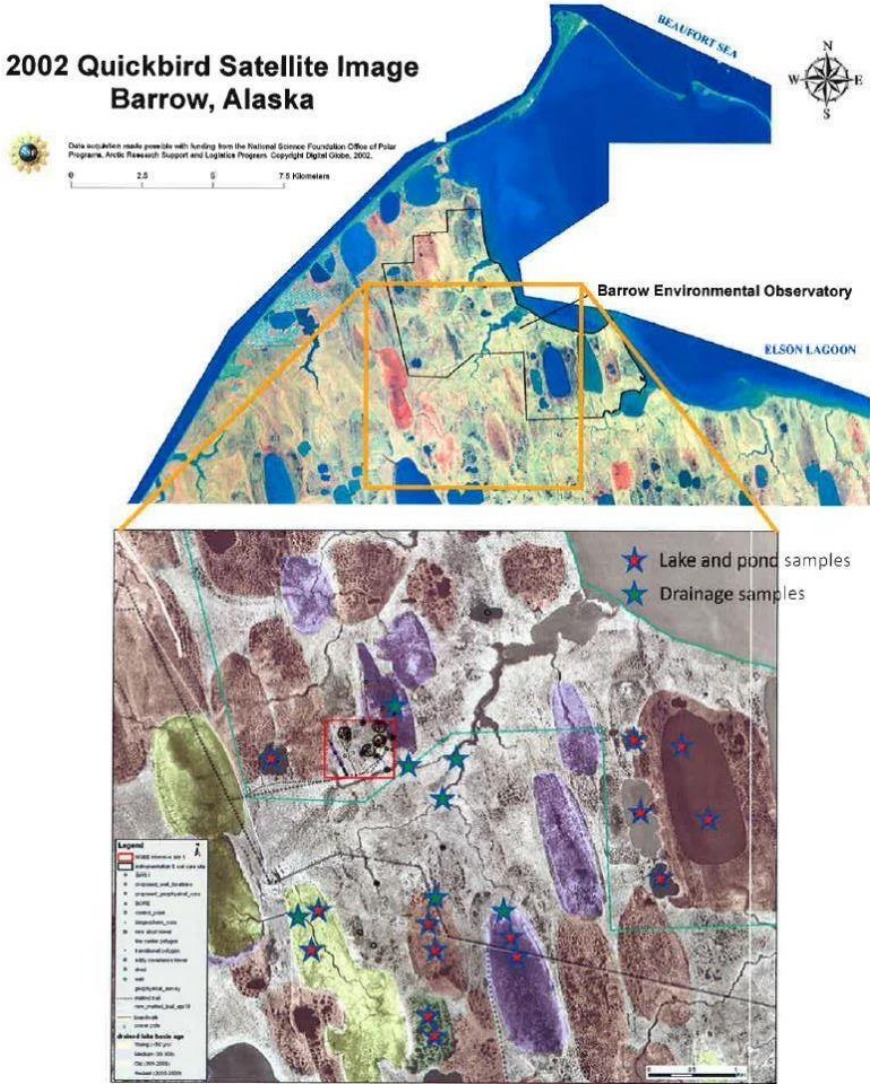

Figure 2.1. Location of NGEE project components within the BEO south of Barrow, Alas

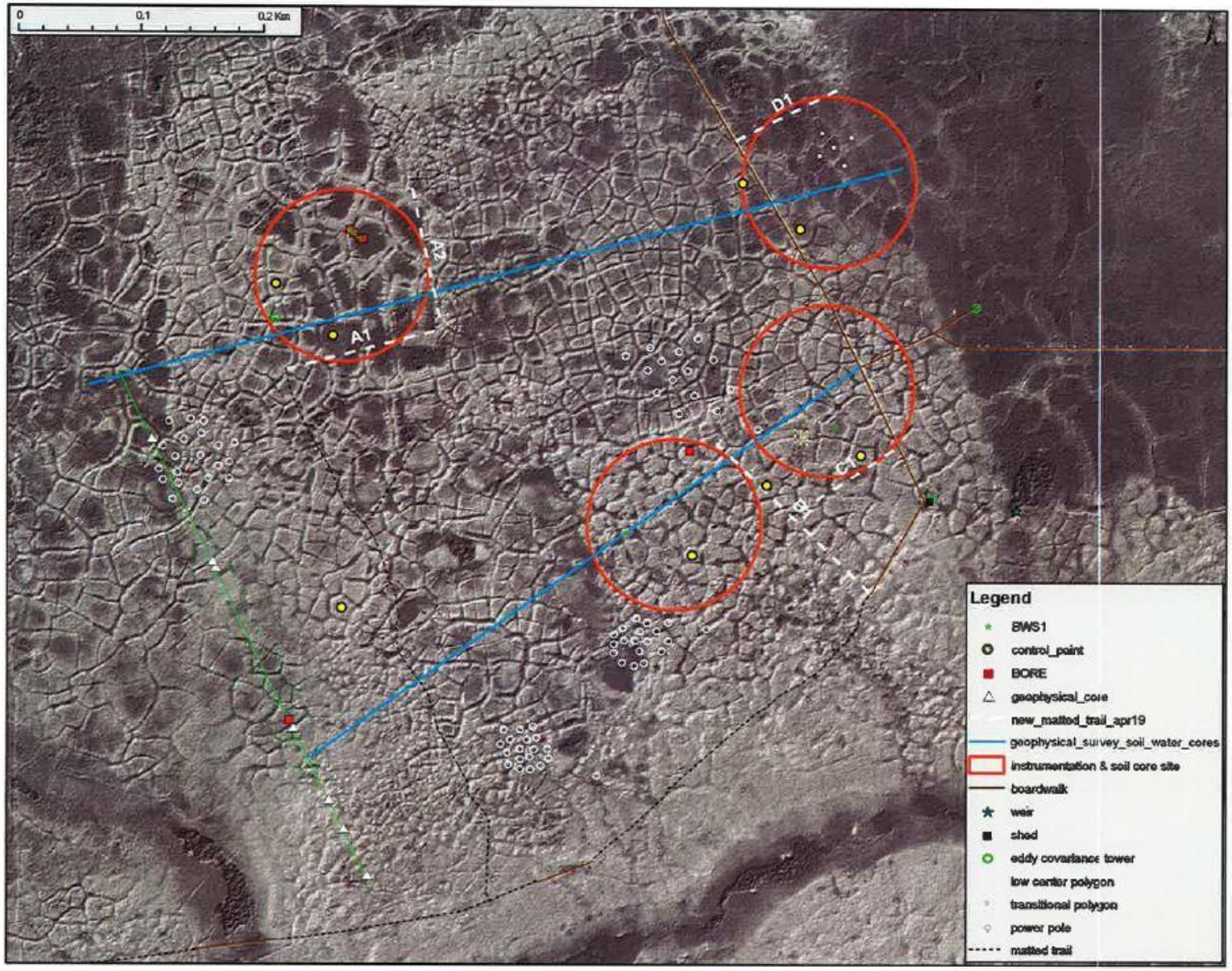

Figure 2.2. Detailed diagram of NGEE project components and sampling transects within the BEO south of Barrow, Alaska.

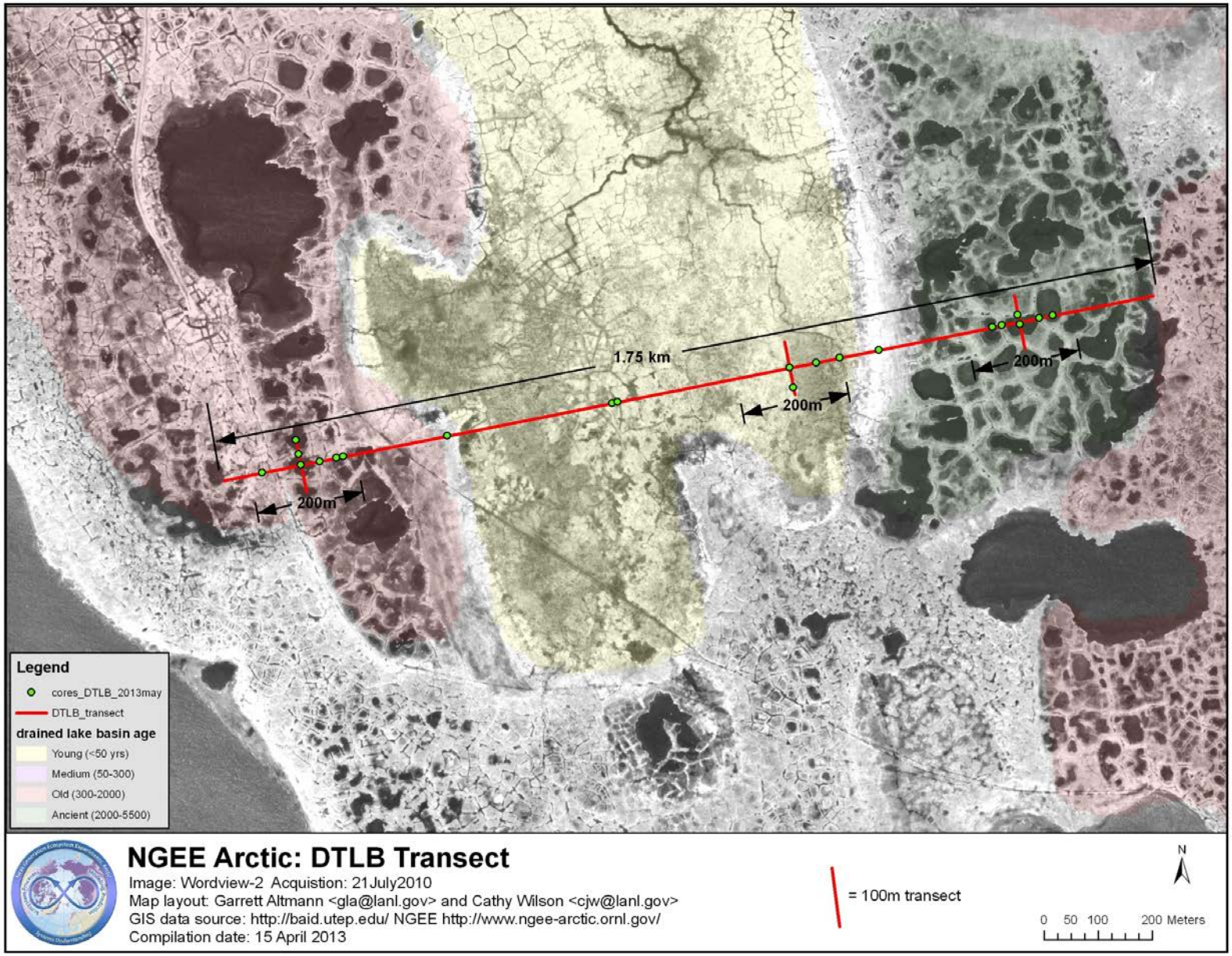

Figure 2.3. Location and dimensions of the southern transect, south of the BEO near Gaswell Road.

Project Components

Geophysical surveys

Subsurface soil structure and permafrost depth would be investigated by towing ground-penetrating radar equipment along 3 linear transects with a snowmobile (Figures 2.2, 2.3, and 2.4). Geophysical survey work would be conducted from October through November, and April through May provided snow conditions are favorable for on-tundra snowmobile travel. During these periods, daily round-trips would be made on snowmobile to the BEO and southern transect.

Figure 2.4. Ground-penetrating radar equipment for investigating subsurface soil structure and permafrost depth within the BEO and southern transect.

Soil and plant sampling

Approximately 24 permafrost cores would be sampled across the study sites in April each year (Figure 2.5). Each core would be approximately 3 in (7.6 cm) in diameter and 36 in (91.4 cm) deep. Some core holes would be converted for subsequent water sampling by installing PVC pipe. During snow-free months, a limited number of smaller diameter cores would be sampled at the intensive study sites.

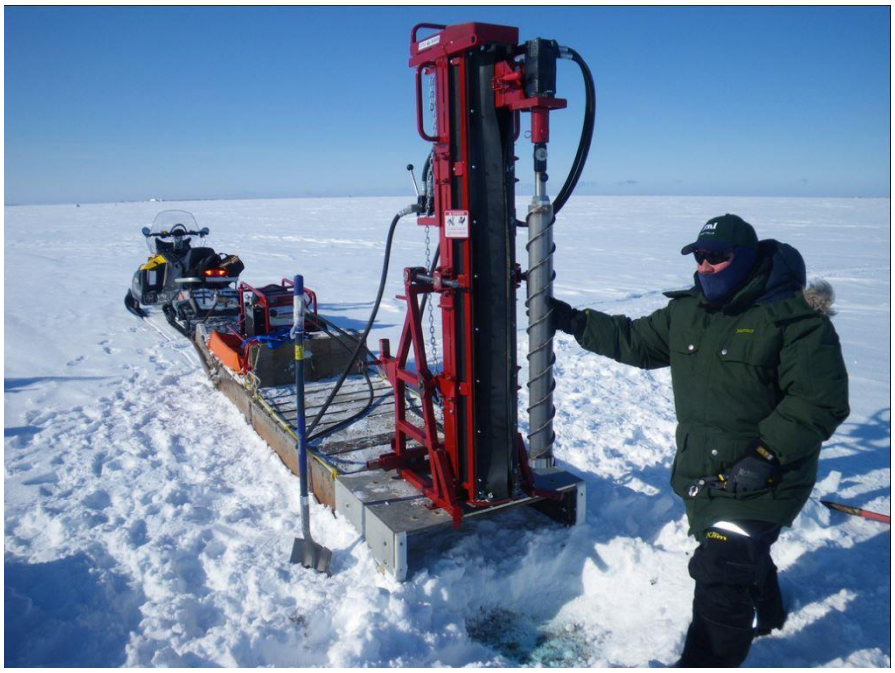

Figure 2.5 Soil coring equipment for permafrost sampling in April.

Vegetation samples would be collected near soil coring sites during August each year. Aboveground biomass would be collected from 1 ft^2 (0.09 m^2) plots, and occasionally roots would be extracted from the active layer (Figure 2.6).

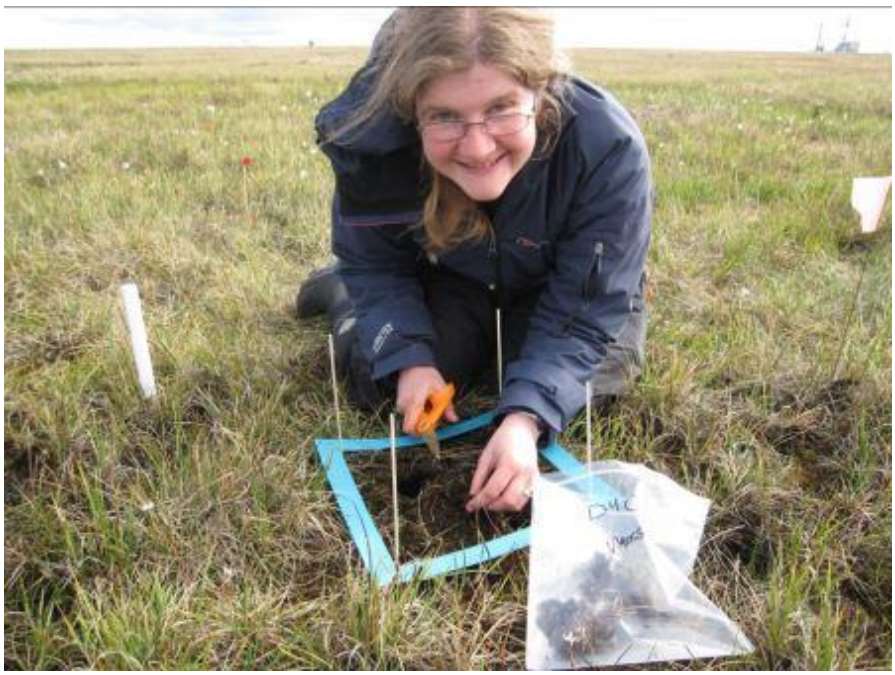

Figure 2.6. 1 x 1 ft plot for vegetation sampling in August.

Water table monitoring and sampling
Ground water would be sampled from select soil coring holes (described above) within the intensive study sites. In addition, stainless steel piezometers would be installed by hand. Piezometers are approximately 1 in (2.4 cm) in diameter and 36 in (91.4 cm) long; no excavation is required for their installation. Water collection sites would be visited in June and September. In total, approximately 20 gallons of water would be collected annually. During the 2014 field season, up to 12 additional water sampling locations may be added.

Figure 2.7. Water sampling at existing piezometer installation.

Gas sampling
Methane and other gasses would be sampled using bundles of approximately 5 sections of 0.25 in (0.64 cm) stainless steel tubing installed in the active layer by hand during snow-free months (Figure 2.8). Gas samples would be collected once every two weeks from Intensive Site 1 and satellite sites within the BEO. Some gas sampling equipment may be in place year-round at Intensive Site 1 although equipment at satellite sites would be periodically installed during summer and removed at the end of the season. No gas samples would be collected from the Southern Transect.

Figure 2.8. Gas sampling tubes installed in active layer for sampling within the BEO.

Meteorological instrumentation

Four meteorological tripod stations would be maintained within Intensive Site 1. Each weather station would consist of an approximately 6.6 ft (2 m) un-guyed central mast and associated atmospheric sensors (Figure 2.9). Power would be supplied by solar panels at the tripod base and a trickle charge battery with secondary containment. A thermistor string would also be installed in the permafrost at each meteorological station. Meteorological stations would be visited as needed to conduct instrument repair and replacement.

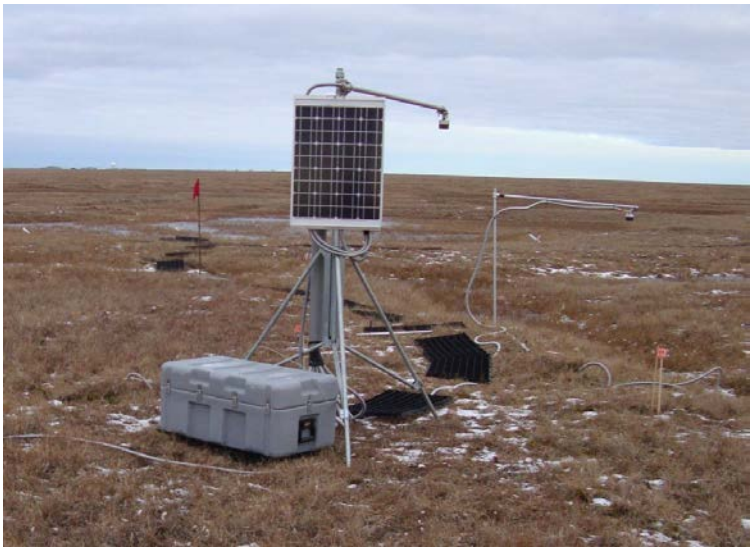

Figure 2.9. Un-guyed meteorological tripod station with solar panels and battery backup.

Eddy covariance instrumentation
A single eddy covariance tower would be monitored within Intensive Site 1. The covariance tower would consist of an adjustable 6.6-13.1 ft (2-4 m) central mast with accompanying instrumentation (Figure 2.10). Power would be supplied by an electrical line run across the tundra from an existing control shed approximately 1,640 ft (500 m) to the northwest. No overhead powerlines are planned. The eddy covariance tower would be installed in May of each year and removed in November. NGEE researchers would visit the tower as needed to repair or recalibrate instrumentation.

Figure 2.10. Un-guyed, tripod-mounted eddy covariance tower and associated instrumentation within the BEO.

Minimization Measures
Minimizing disturbance to nesting Steller's and spectacled eiders

To minimize disturbance to breeding Steller's and spectacled eiders, the following measures will be implemented during field activities from 2014 through 2024:

- If a listed eider nest is found during field activities, researchers will
    - record GPS coordinates;
    - take a photo of the nest;
        - If the above cannot be completed in < 1 minute, researchers will simply mark the approximate location on a map;
    - cover eggs with down; and,
    - leave the area quickly.

- Researchers will report nest observations to the USFWS eider ecology program lead, David Safine, or his designee, as soon as practicable on the day the nest is found;

- Researchers will maintain a distance of ≥ 100 m from known active nests within a study sites and ≥ 200 m from known active nests outside the boundaries of study sites. Nests will be considered active unless the USFWS eider ecology crew confirms failure of the nest;

- Researchers will 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; and,

- Researchers and eider ecology field crews will maintain communications regarding the status of eider nests in the Barrow area.

In addition, all above-ground infrastructure associated with the NGEE project is marked with flagging to minimize the potential for collisions between humans (e.g., snowmobile travel in winter) and animals. Finally, NGEE instrumentation avoids the use of guy wires to further reduce collision risk for migratory birds.

Action Area
The action area includes all transects and sampling locations associated with the NGEE project within the BEO (Figure 2.2), as well as the southern transect and related sampling locations (Figure 2.3), and surrounding areas that may be subject to disturbance from the proposed research activities.

3. EFFECT DETERMINATION FOR POLAR BEARS

Polar bear
The Service listed the polar bear as a threatened species under the ESA on May 15, 2008 (73 FR 28212). Polar bears may occasionally pass through or den in the area, although their density is low and encounters are expected to be infrequent. Transient (non-denning) bears that enter the

action area could be disturbed by the presence of humans or equipment noise. However, we expect disturbances would be minor and temporary because transient bears would be able to respond to human presence or disturbance by departing the area. Furthermore, NGEE researchers are required to view a bear safety video that includes information specific to polar bears before conducting field work in Barrow. In addition, researchers are provided with Umiaq's polar bear interaction plan for personnel to follow in the event that a polar bear enters the project area while researchers are present.

In addition to transient animals, female polar bears may occasionally den in or near the project area. However, because topographic relief in the area is minor and preferred denning habitat is characterized by steep, stable slopes that accumulate snow, we would expect polar bears denning in the project area to be rare.

Because (1) the density of polar bears in the action area is low; (2) encounters with polar bears are expected to be infrequent; (3) behavioral effects to transient bears would be minor and temporary; (4) mitigation measures included Umiaq's interaction plan would minimize potential impacts in the event that transient polar bears are encountered; and (5) the low probability of polar bears denning in the action area, we expect effects of the proposed action on polar bears would be insignificant. Therefore, the proposed research activities are not likely to adversely affect polar bears.

4. STATUS OF THE SPECIES

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

Spectacled eider

Spectacled eiders (Figure 4.1A) were listed as threatened throughout their range on May 10, 1993 (USFWS 1993) based on indications of steep declines in the two Alaska-breeding populations. There are three primary spectacled eider populations, corresponding to breeding grounds on Alaska's North Slope, the Yukon–Kuskokwim Delta (YK-delta), and northern Russia. The YK-delta population declined 96% between the early 1970s and 1992 (Stehn et al. 1993). Data from the Prudhoe Bay oil fields (Warnock and Troy 1992) and information from Native elders at Wainwright, Alaska (R. Suydam, pers. comm. in USFWS 1996) suggested concurrent localized declines on the North Slope, although data for the entire North Slope breeding population were not available. Spectacled eiders molt in several discrete areas (Figure 4.1B) during late summer and fall, with birds from different populations and genders apparently favoring different molting areas (Petersen et al. 1999). All three spectacled eider populations overwinter in openings in pack ice of the central Bering Sea, south of St. Lawrence Island (Petersen et al. 1999; Figure 4.2), where they remain until March–April (Lovvorn et al. 2003).

Life History

Breeding – In Alaska, spectacled eiders breed primarily on the North Slope (ACP) and the YK-delta. On the ACP, spectacled eiders breed north of a line connecting the mouth of the Utukok River to a point on the Shaviovik River about 24 km (15 mi) inland from its mouth, with

breeding density varying across the ACP (Figure 4.2). Although spectacled eiders historically occurred throughout the coastal zone of the YK-delta, they currently breed primarily in the central coast zone within about 15 km (9 mi) of the coast from Kigigak Island north to Kokechik Bay (USFWS 1996). However, sightings on the YK-delta have also occurred both north and south of this area during the breeding season (R. Platte, USFWS, pers. comm. 1997).

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

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

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

Survivorship – Nest success is highly variable and thought to be primarily influenced by predators, including gulls (*Larus* spp.), jaegers (*Stercorarius* spp.), and red (*Vulpes vulpes*) and arctic foxes (*Alopex lagopus*). In arctic Russia, apparent nest success was estimated to be < 2% in 1994 and 27% in 1995; low nest success was attributed to predation (Pearce et al. 1998). Apparent nest success in 1991 and 1993–1995 in the Kuparuk and Prudhoe Bay oil fields on the ACP was also low, varying from 25–40% (Warnock and Troy 1992, Anderson et al. 1998). On Kigigak Island in the YK-delta, nest survival probability ranged from 6–92% from 1992–2007 (Lake 2007); nest success tended to be higher in years with low fox numbers or activity (i.e., no denning) or when foxes were eliminated from the island prior to the nesting season. Bowman et al. (2002) also reported high variation in nest success (20–95%) of spectacled eiders on the YK-delta, depending on year and location.

(A)

(B)

Figure 4.1. (A) Male and female spectacled eiders in breeding plumage. (B) Distribution of spectacled eiders. Molting areas (green) are used July –October. Wintering areas (yellow) are used October –April. The full extent of molting and wintering areas is not yet known and may extend beyond the boundaries shown.

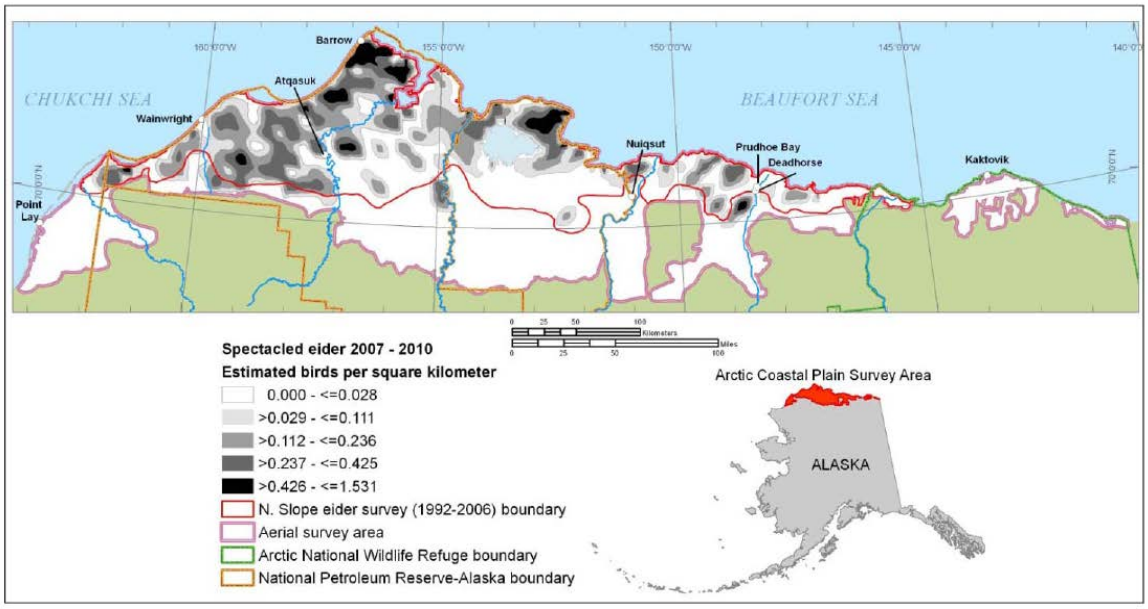

Figure 4.2. Density distribution of spectacled eiders observed on aerial transects sampling 57,336 km^2 of wetland tundra on the North Slope of Alaska during early to mid-June, 2007–2010 (Larned et al. 2011).

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

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

Fall migration and molting – As with many other sea ducks, spectacled eiders spend the 8–10 month non-breeding season at sea. Satellite telemetry and aerial surveys led to the identification of spectacled eider migrating, molting, and wintering areas. These studies are summarized in Petersen et al. (1995 and 1999) and Larned et al. (1995). Results of more recent satellite telemetry research (2008–2011) are consistent with earlier studies (Matt Sexson, USGS, pers.

comm.). Phenology, spring migration and breeding, including arrival, nest initiation, hatch, and fledging, is 3–4 weeks earlier in western Alaska (YK-delta) than northern Alaska (ACP); however, phenology of fall migration is similar between areas. Individuals depart breeding areas July–September, depending on breeding status and success, and molt in September–October (Matt Sexson, USGS, pers. comm.).

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

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

Spectacled eiders use specific molting areas from July to late October/early November. Larned et al. (1995) and Petersen et al. (1999) found spectacled eiders show strong preference for specific molting locations, and concluded that spectacled eiders molt in four discrete areas (Table 4.1). Females generally used molting areas nearest their breeding grounds. All marked females from the YK-delta molted in nearby Norton Sound, while females from the North Slope molted in Ledyard Bay, along the Russian coast, and near St. Lawrence Island. Males did not show strong molting site fidelity; males from all three breeding areas molted in Ledyard Bay, Mechigmenskiy Bay, and the Indigirka/Kolyma River Delta. Males reached molting areas first, beginning in late June, and remained through mid-October. Non-breeding females, and those that nested but failed, arrived at molting areas in late July, while successfully-breeding females and young of the year reached molting areas in late August through late September and remained through October. Fledged juveniles marked on the Colville River Delta usually staged in the Beaufort Sea near the delta for 2–3 weeks before migrating to the Chukchi Sea.

Table 4.1. Important staging and molting areas for female and male spectacled eiders from each breeding population.

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

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

Wintering – Spectacled eiders generally depart molting areas in late October/early November (Matt Sexson, USGS, pers. comm.), migrating offshore in the Chukchi and Bering seas to a single wintering area in pack-ice lead complexes south/southwest of St. Lawrence Island (Figure 4.1B). In this relatively shallow area, > 300,000 spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 230 ft (70 m) to eat bivalves, other mollusks, and crustaceans (Cottam 1939, Petersen et al. 1998, Lovvorn et al. 2003, Petersen and Douglas 2004).

Spring migration – Recent information indicates spectacled eiders likely make extensive use of the eastern Chukchi spring lead system between departure from the wintering area in March and April and arrival on the North Slope in mid-May or early June. Limited spring observations in the eastern Chukchi Sea have documented dozens to several hundred common eiders (*Somateria mollissima)* and spectacled eiders in spring leads and several miles offshore in relatively small openings in rotting sea ice (W. Larned, USFWS; J. Lovvorn, University of Wyoming, pers. comm.). Woodby and Divoky (1982) documented large numbers of king (*Somateria spectabilis*) and common eiders using the eastern Chukchi lead system, advancing in pulses during days of favorable following winds, and concluded that an open lead is probably requisite for spring eider passage in this region. Preliminary results from an ongoing satellite telemetry study conducted by the USGS Alaska Science Center (Figure 4.3; USGS, unpublished data) suggest that spectacled eiders also use the lead system during spring migration.

Adequate foraging opportunities and nutrition during spring migration are critical to spectacled eider productivity. Like most sea ducks, female spectacled eiders do not feed substantially on the breeding grounds, but produce and incubate eggs while living primarily off body reserves (Korschgen 1977, Drent and Daan 1980, Parker and Holm 1990). Clutch size, a measure of

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

Abundance and trends

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

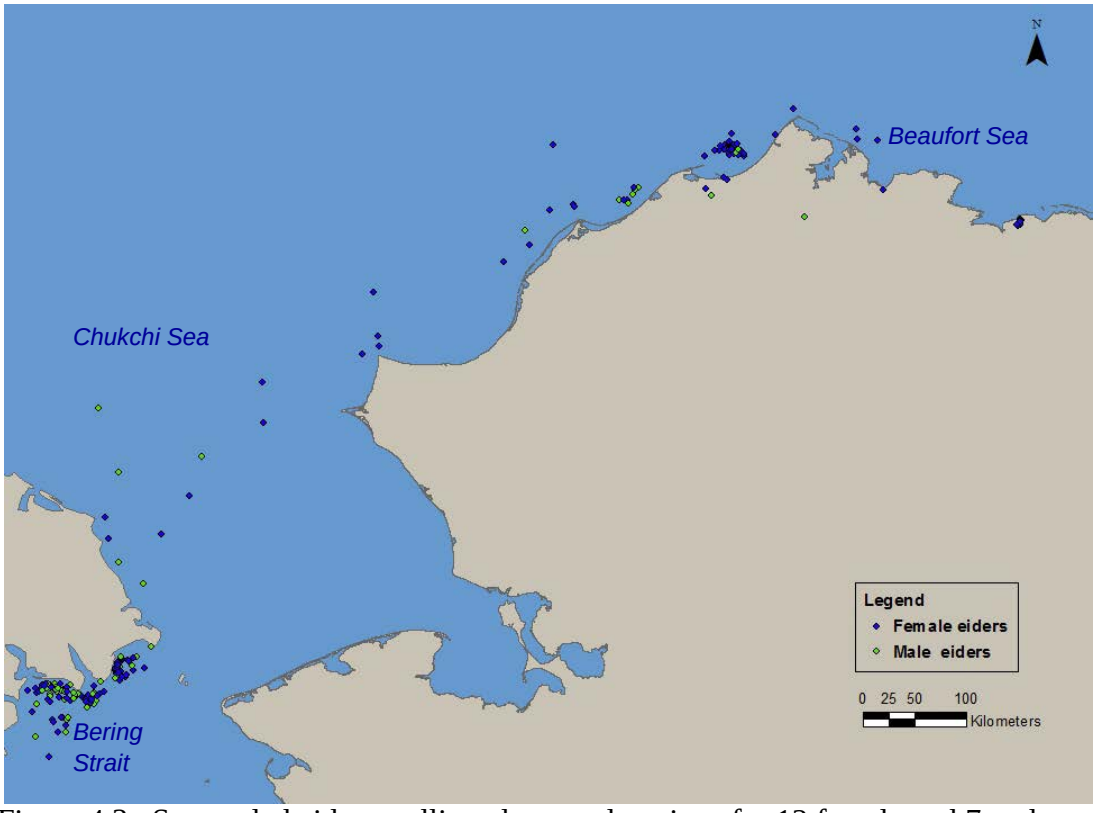

Figure 4.3. Spectacled eider satellite telemetry locations for 12 female and 7 male spectacled eiders in the eastern Chukchi Sea from 1 April – 15 June 2010 and 1 April – 15 June 2011. Additional locations from the northern coast of Russia are not shown. Eiders were tagged on the North Slope during the 2009 and 2010 breeding seasons. Data provided by Matt Sexson, USGS Alaska Science Center (USGS, unpublished).

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

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

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

Spectacled eider recovery criteria

The Spectacled Eider Recovery Plan (USFWS 1996) presents research and management priorities with the objective of recovery and delisting so that protection under the ESA is no longer required. Although the cause or causes of the spectacled eider population decline is/are not known, factors that affect adult survival are likely to be the most influential on population growth rate. These include lead poisoning from ingested spent shotgun pellets, which may have contributed to the rapid decline observed in the YK-delta (Franson et al. 1995, Grand et al. 1998), and other factors such as habitat loss, increased nest predation, over harvest, and disturbance and collisions caused by human infrastructure. Under the Recovery Plan, the species

will be considered recovered when each of the three recognized populations (YK-delta, North Slope of Alaska, and Arctic Russia): 1) is stable or increasing over 10 or more years and the minimum estimated population size is at least 6,000 breeding pairs, or 2) number at least 10,000 breeding pairs over 3 or more years, or 3) number at least 25,000 breeding pairs in one year. Spectacled eiders do not currently meet these recovery criteria.

Steller's eider

The Steller's eider is a small sea duck with circumpolar distribution and the sole member of the genus *Polysticta*. Males are in breeding plumage (Figure 4.4) from early winter through mid-summer (Figure 4.4). Females are dark mottled brown with a white-bordered blue wing speculum. Juveniles are dark mottled brown until fall of their second year, when they acquire breeding plumage.

Figure 4.4. Male and female Steller's eiders in breeding plumage.

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

- Substantial contraction of the species' breeding range on the ACP and Y-K Delta;
    - Steller's eiders on the North Slope historically occurred east to the Canada border (Brooks 1915), but have not been observed on the eastern North Slope in recent decades (USFWS 2002).
    - Only 10 Steller's eider nests have been recorded on the Y-K Delta since 1970 (Hollmen et al. 2007).
- Reduced numbers breeding in Alaska; and
- Resulting vulnerability of the remaining Alaska-breeding population to extirpation (USFWS 1997).

In Alaska, Steller's eiders breed almost exclusively on the ACP and winter, along with the majority of the Russia-breeding population, in south-central Alaska (Figure 4.5). Periodic non-breeding of Steller's eiders coupled with low nesting and fledging success, has resulted in very low productivity (Quakenbush et al. 2004). In 2001, the Service designated 2,830 mi^2 (7,330 km^2) of critical habitat for the Alaska-breeding population of Steller's eiders, including historical breeding areas on the Y-K Delta, a molting and staging area in the Kuskokwim Shoals, and marine molting areas at Seal Islands, Nelson Lagoon, and Izembek Lagoon (USFWS 2001). No critical habitat for Steller's eiders has been designated on the ACP.

Life History

Breeding – Steller's eiders arrive in small flocks of breeding pairs on the ACP in early June. Nesting on the ACP is concentrated in tundra wetlands near Barrow, AK (Figure 4.6) and occurs at lower densities elsewhere on the ACP from Wainwright east to the Sagavanirktok River (Quakenbush et al. 2002). Long-term studies of Steller's eider breeding ecology near Barrow indicate periodic non-breeding by the entire local population. From 1991-2010, Steller's eiders nests were detected in 12 of 20 years (Safine 2011). Periodic non-breeding by Steller's eiders near Barrow seems to correspond to fluctuations in lemming populations and risk of nest predation (Quakenbush et al. 2004). During years of peak abundance, lemmings are a primary food source for predators including jaegers, owls, and foxes (Pitelka et al. 1955*a*, Pitelka et al. 1955*b*, MacLean et al. 1974, Larter 1998, Quakenbush et al. 2004). It is hypothesized that Steller's eiders and other ground-nesting birds increase reproductive effort during lemming peaks because predators preferentially select (prey-switch) for hyper-abundant lemmings and nests are less likely to be depredated. (Roselaar 1979, Summers 1986, Dhondt 1987, and Quakenbush et al. 2004). Furthermore, during high lemming abundance, Steller's eider nest survival (the probability of at least one duckling hatching) has been reported as a function of distance from nests of jaegers and snowy owls (Quakenbush et al. 2004). These avian predators aggressively defend their nests against other predators and this defense likely indirectly imparts protection to Steller's eiders nesting nearby.

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

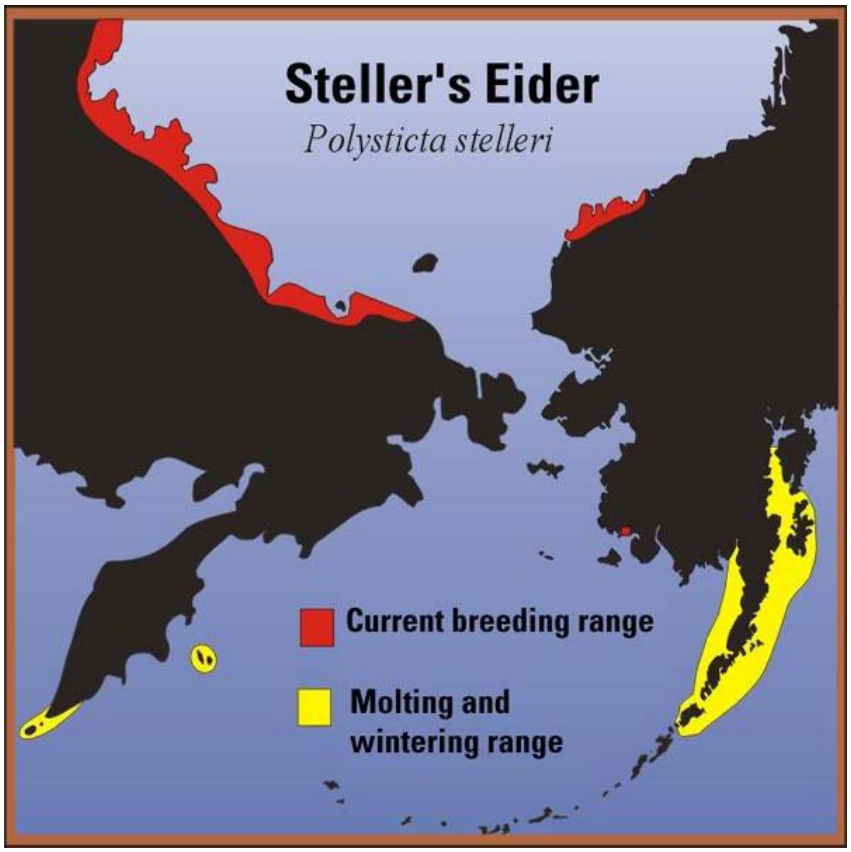

Figure 4.5. Steller's eider distribution in the Bering, Chukchi, and Beaufort seas.

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

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

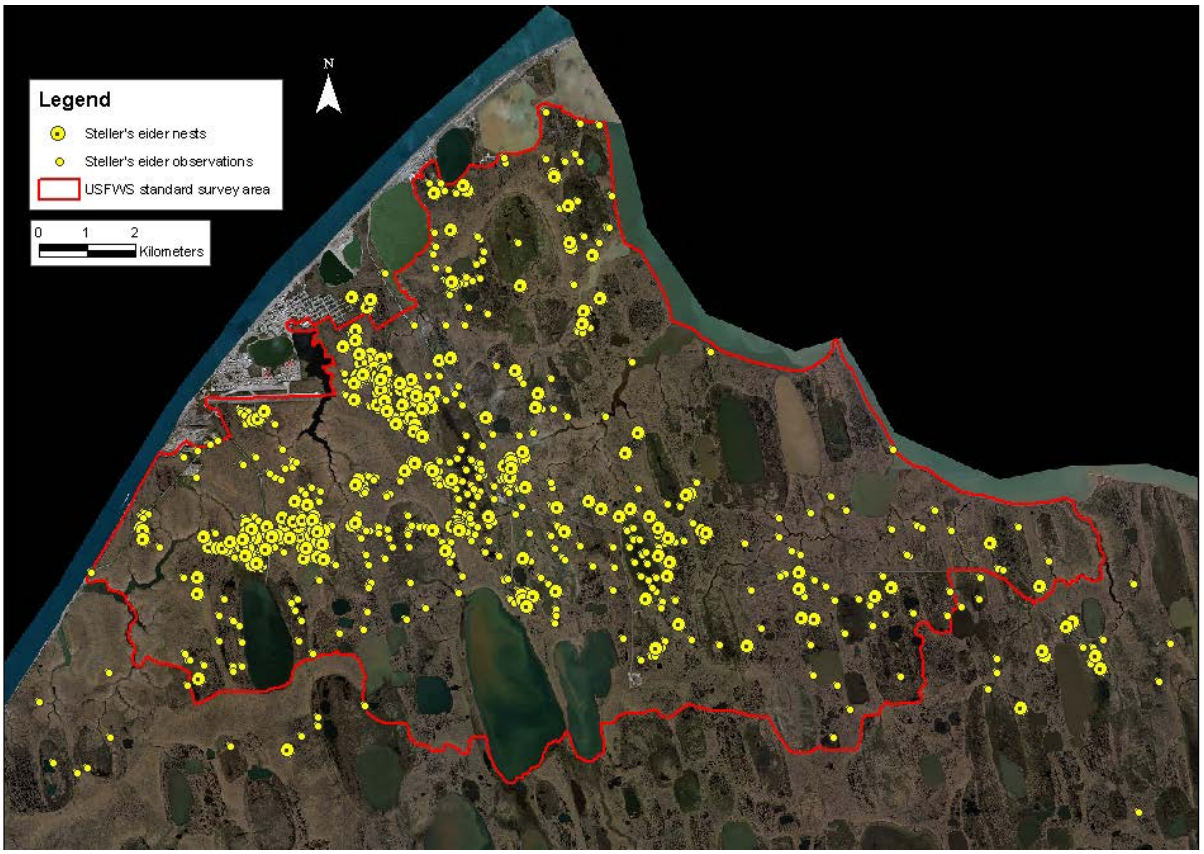

Figure 4.6. Steller's eider nest locations (1991–2010) and breeding pair observations (1999–2010). The red border represents the standard annual survey area. This survey is expanded beyond the standard area in some years.

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

Before fall migration in breeding and non-breeding years, some Steller's eiders rest and forage in in coastal waters near Barrow including Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the vicinity of Pigniq (Duck Camp; Figure 4.7). In breeding years, these flocks are primarily composed of males that remain in the area until the second week of July, while in non-breeding years, flocks are composed of both sexes and depart earlier than in nesting years (J. Bacon, North Slope Borough Department of Wildlife Management [NSBDWM], pers. comm.).

Safine (2012) investigated post-hatch movements of 10 Steller's eider hens with VHF transmitters in 2011. Most (8 of 10) females successfully reared broods to fledging. From late August through early September, females and fledged juveniles were observed in nearshore waters of the Chukchi and Beaufort seas from Point Barrow south along the coast approximately 18 km. During this period, marked Steller's eiders and broods frequented areas traditionally used for subsistence waterfowl hunting (e.g., Duck Camp; Figure 4.7).

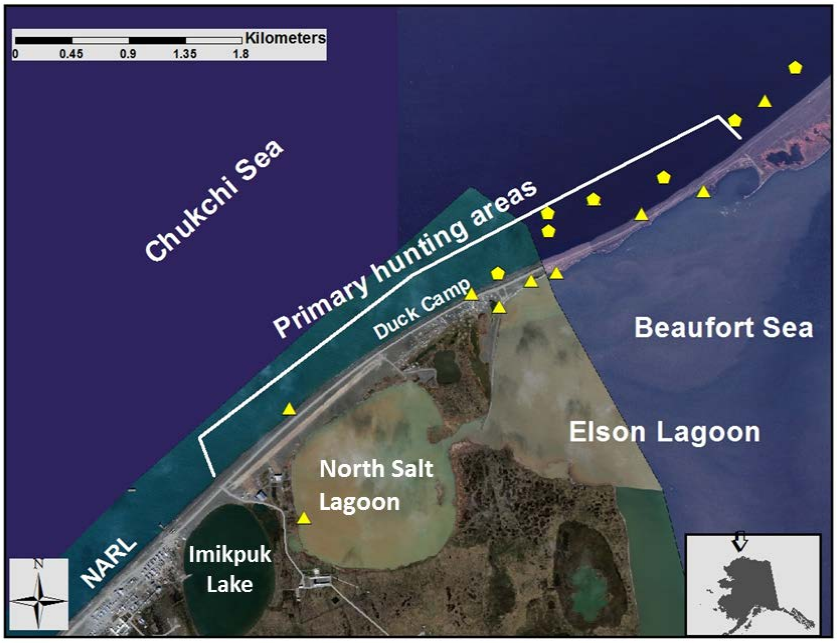

Figure 4.7. Some post-breeding and pre-migration staging areas for Steller's eiders near Barrow, Alaska. Locations of Steller's eider hens with successfully-fledged (triangles) and failed broods (pentagons) from mid-August to early September 2011.

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

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

Winter distribution – After molt, many Pacific-wintering Steller's eiders disperse throughout the Aleutian Islands, Alaskan Peninsula, and western Gulf of Alaska including Kodiak Island and lower Cook Inlet (Figure 4.8; Larned 2000a, Martin et al. *in prep*), although thousands may remain in molting lagoons unless freezing conditions force departure (USFWS 2002). The Service estimates the Alaska-breeding population comprises only ~ 1% of the Pacific-wintering population of Steller's eiders. Wintering Steller's eiders usually occur in shallow waters (< 10 m deep), within 400 m of shore or in shallow waters further offshore (USFWS 2002). However, Martin et al. (*in prep*) reported substantial use of habitats > 10 m deep during mid-winter, although this use may reflect nocturnal rest periods or shifts in availability of food resources (Martin et al. *in prep*).

Spring migration – During spring migration, thousands of Steller's eiders stage in estuaries along the north coast of the Alaska Peninsula and, in particular, at Kuskokwim Shoals in late May (Figure 4.8; Larned 2007, Martin et al. *in prep*). Larned (1998) concluded that Steller's eiders show strong site fidelity to specific areas[1] during migration, where they congregate in large numbers to feed before continuing northward.

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

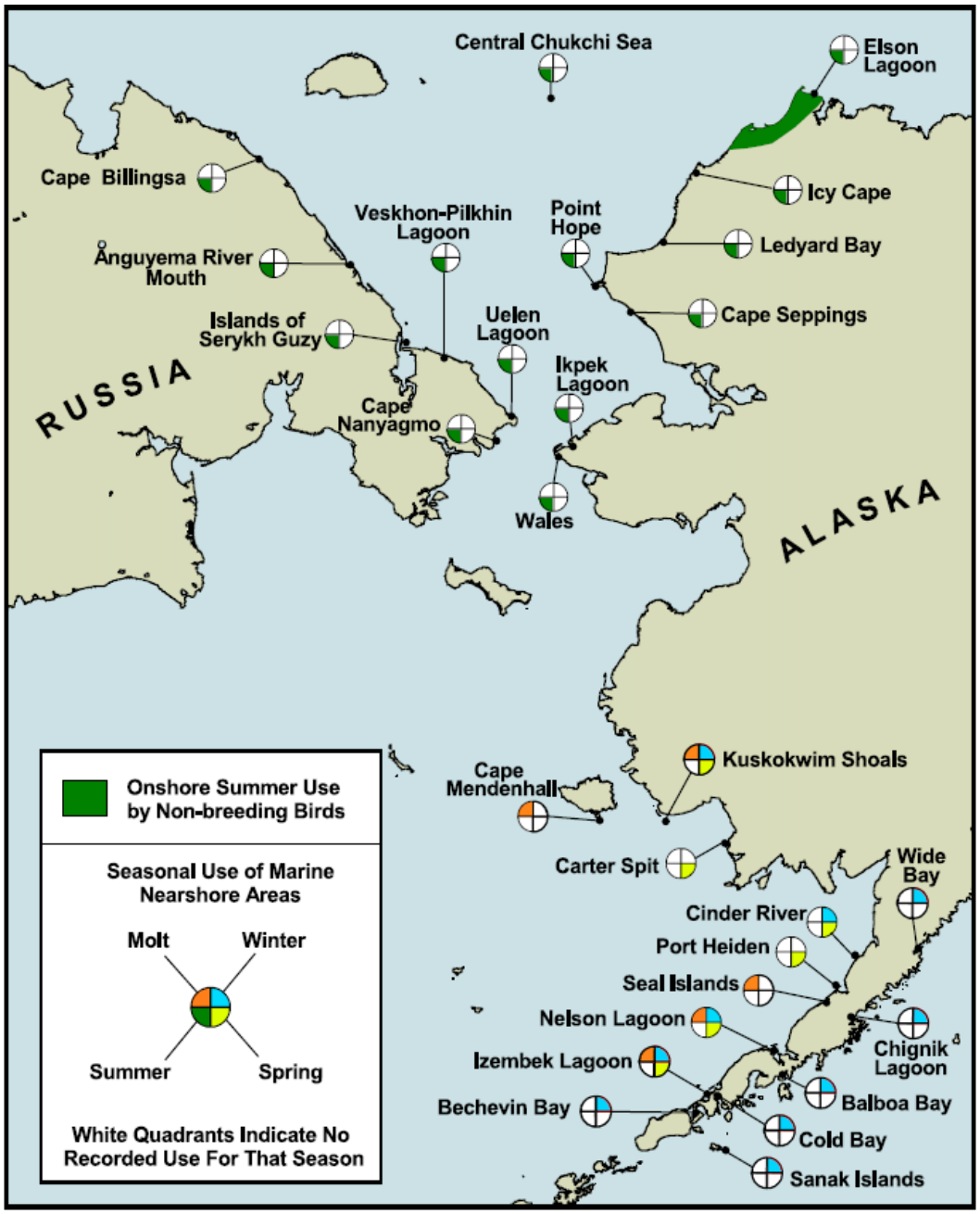

Figure 4.8. Distribution of Alaska-breeding Steller's eiders during the non-breeding season, based on locations of 13 birds implanted with satellite transmitters in Barrow, Alaska, during June 2000 and June 2001. Marked locations include all those at which a bird remained for at least three days. Onshore summer use areas comprise locations of birds that departed Barrow, apparently without attempting to breed in 2001 (USFWS 2002).

Spring migration usually includes movements along the coast, although some Steller's eiders may make straight line crossings of water bodies such as Bristol Bay (W. Larned, USFWS, pers. comm. 2000). Despite numerous aerial surveys, Steller's eiders have not been observed during migratory flights (W. Larned, USFWS, pers. comm. 2000). Steller's eiders likely use spring

leads for feeding and resting as they move northward, although there is little information on distribution or habitat use after departure from spring staging areas.

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

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

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

In 2007, the ACP and NSE surveys were combined under a single ACP survey design. Previously, surveys differed in spatial extent, timing, sampling intensity, and duration, and consequently, produced different estimates of population size and trend for Steller's eiders. These estimates, including results from previous analyses of the ACP and NSE survey data (Mallek et al. 2007, Larned et al. 2009), are summarized in Table 4.2. Most observations of Steller's eider from both surveys occurred within the boundaries of the NSE survey (Figure 4.9).

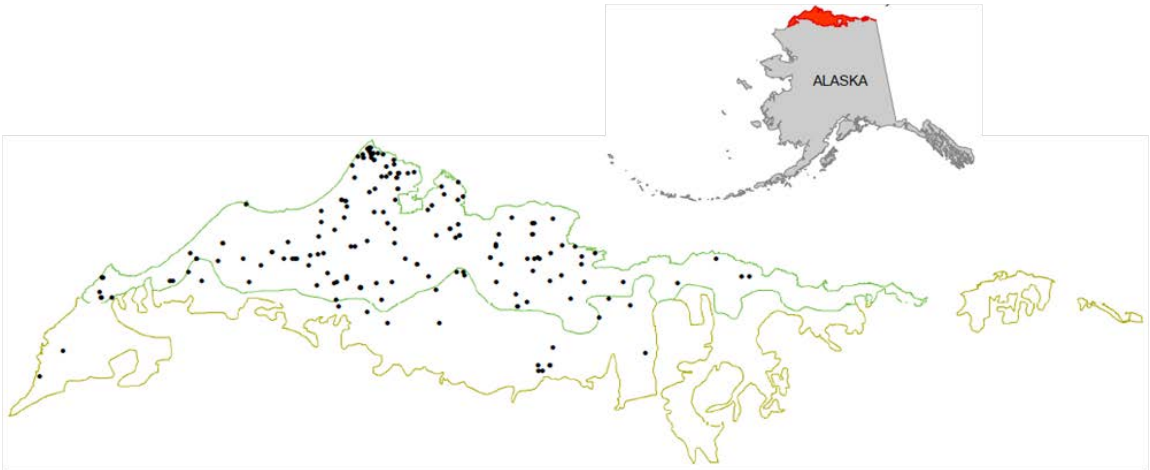

Figure 4.9. All Steller's eider sightings from the Arctic Coastal Plain (ACP) survey (1989–2008) and the North Slope eider (NSE) survey (1992–2006). The ACP survey encompasses the entire area shown (61,645 km^2); the NSE includes only the northern portion outlined in green (30,465 km^2; modified from Stehn and Platte 2009).

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

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

Breeding population near Barrow, Alaska – The tundra surrounding Barrow supports the only significant concentration of Steller's eiders nesting in North America. Barrow is the northernmost community on the ACP and standardized ground surveys for eiders have been conducted near Barrow since 1999 (Figure 4.6; Rojek 2008). Counts of males are the most

[2] Geographically extrapolated total Steller's eiders derived from NSE survey counts.
[3] Detection probability of 30% with a visibility correction factor of 3.33 was selected based on evaluation of estimates for similar species and habitats (Stehn and Platte 2009).

reliable indicator of Steller's eider presence because females are cryptic and often go undetected in counts. The greatest concentrations of Steller's eiders observed during Barrow ground surveys occurred in 1999 and 2008 with 135 and 114 males respectively (Table 4.2; Safine 2011). Total nests found (both viable[4] and post-failure) ranged from 0–78 between 1991 and 2011, while the number of viable nests ranged from 0–27. Steller's eider nests were found in 14 of 22 years (64%) between 1991 and 2012 (Safine 2013).

Table 4.2. Steller's eider males, nests, and pair densities recorded during ground-based and aerial surveys conducted near Barrow, Alaska 1999–2012 (modified from Safine 2013).

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

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

Steller's Eider Recovery Criteria

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

Criteria used to determine when species are recovered are often based on historical abundance and distribution, or on the population size required to ensure that extinction risk, based on population modeling, is tolerably low. For Steller's eiders, information on historical abundance

[4] A nest is considered viable if it contains at least one viable egg.

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

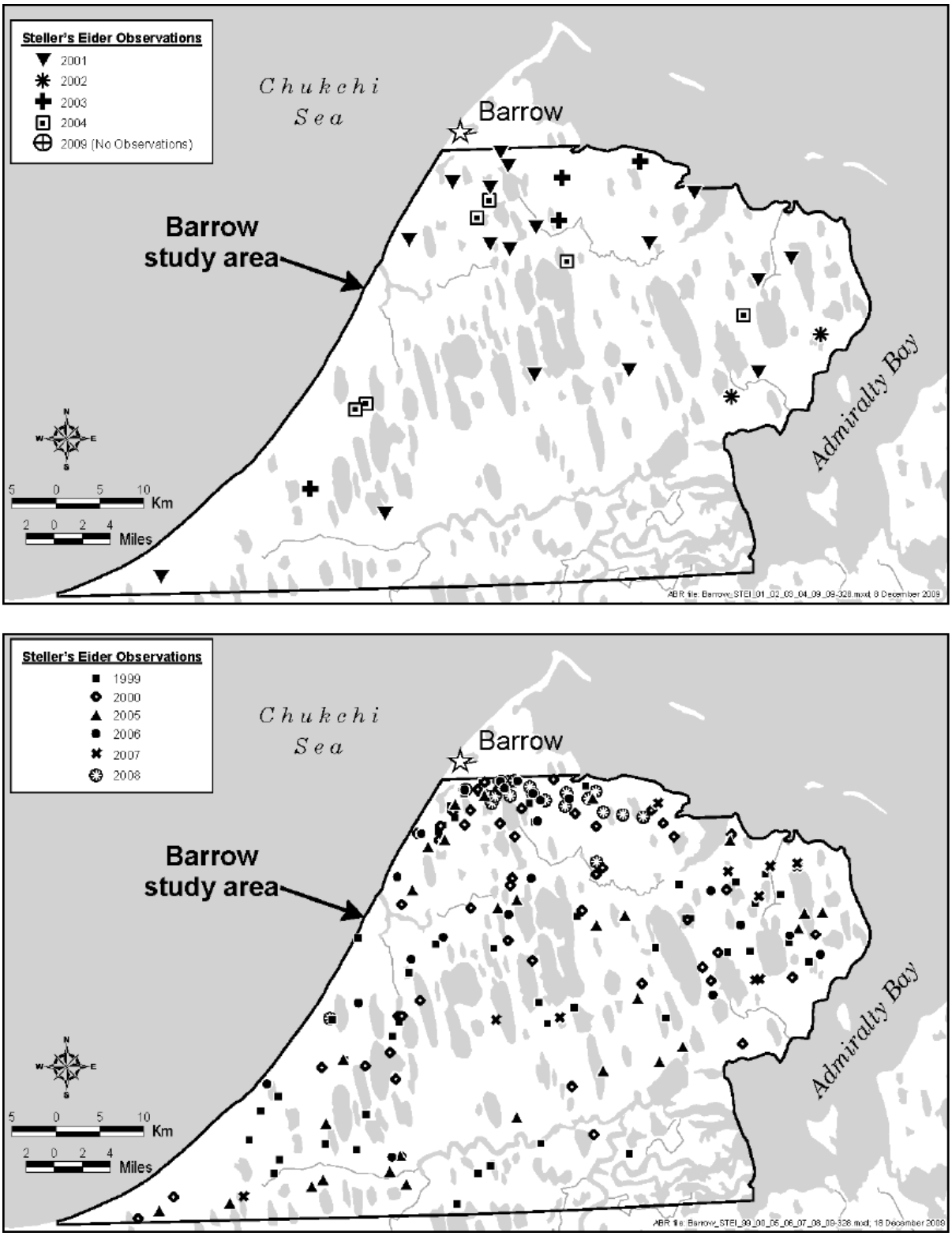

Figure 4.10. Locations of Steller's Eiders observed by ABR, Inc. during aerial surveys in non-breeding (top) and breeding years (bottom) near Barrow, Alaska, June 1999–2009 (Obritschkewitsch and Ritchie 2011).

5. ENVIRONMENTAL BASELINE

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

Status of listed eiders in the action area

Although density of nesting spectacled eiders varies across much of the ACP (Figure 3.2), they regularly breed near Barrow. Breeding Steller's eiders concentrate in tundra wetlands surrounding Barrow (Figure 5.1), and occur at very low densities elsewhere on the ACP (Larned et al. 2010). In the action area, both species arrive between late May and early June and may remain as late as mid-October. The channel at the south end of Middle Salt Lagoon is one of the first open-water areas available when eiders arrive in early June, and frequently functions as a staging area until terrestrial and freshwater habitats are snow-free. Multiple observations of spectacled eider breeding pairs in wetland complexes south of the action area suggest they may nest in the area (Figure 5.1). In addition, numerous observations of Steller's eider breeding pairs and some nests have occurred within the action area (Figure 5.1). Broods of both species may forage in the action area during late summer and early fall. Factors that may have contributed to the current status of spectacled and Steller's eiders in the action area include, but are not limited to, environmental contaminants, increased predator populations, incidental harvest, and habitat loss through development and disturbance. Recovery efforts for both species are underway in portions of the action area.

Environmental contaminants

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

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

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

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

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

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

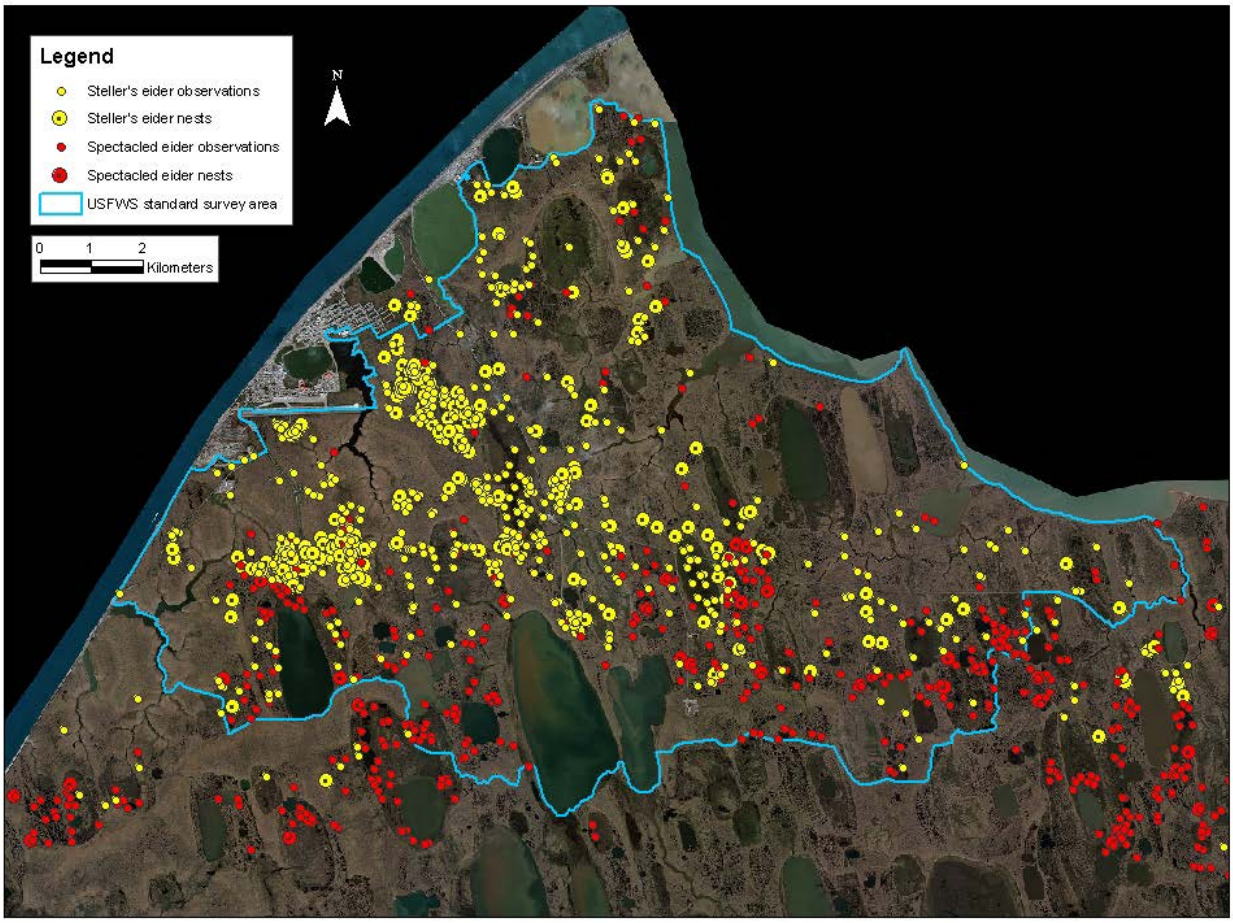

Figure 5.1. Observations of Steller's eiders and spectacled eiders during USFWS breeding pair and nest foot surveys at Barrow, AK (1999–2010; Steller's eider nest locations 1991–2010).

Research

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

Regional activities requiring formal section 7 consultation

Recent activities in the vicinity of Barrow, Alaska that required formal section 7 consultation, and associated estimated incidental take of listed eiders, were considered in the final jeopardy analysis of this biological opinion. The majority of take estimates may be attributed to collisions, disturbance, and habitat loss, although some research projects involve direct take of adults or eggs (most non-lethal) through capture or handling. In considering the number and diversity of actions that have required consultation in the region, we believe these consultations have overestimated, probably substantially, actual take. Take occurs over the life of a project, and in most cases is in the form of potential loss of eggs/ducklings, which we expect to have

substantially lower population-level effects compared to adult mortality (for further discussion see *Effects of the Action on Listed Species*).

Climate change

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

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

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

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

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

6. EFFECTS OF THE ACTION ON LISTED SPECIES

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

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

Effects to listed eiders

Adverse effects to spectacled and Steller's eiders could occur through direct and indirect disturbance.

Researcher disturbance

Investigator disturbance during proposed field activities could adversely impact listed 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 and predators; and 3) 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, data from the YKD indicates that nest disturbance from human activity results in decreased spectacled eider nest survival rate (4%; Bowman and Stehn 2003, and 14%; Grand and Flint 1997); very low rates of desertion, 0.8% attributed to natural causes with an additional 0.7% as a result of human disturbance, were reported from studies of cackling geese and spectacled eiders on the YKD (Mickleson 1975). Additionally, Johnson (1984) documented several nests abandoned by female common eiders after human disturbance on Thetis Island, northern Alaska. However, individual tolerance and behavioral response of listed eiders to disturbance likely varies and the effects of repeated visits by researchers to field sites near listed eider nests are unknown.

Predation is another mechanism through which human disturbance may affect nesting success. In a review of the effects of research on nest success of common eiders, Götmark (1992) found that 76% of studies that reported reduced nest success identified predation as the primary 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 depredate nests as a result of disturbance. Grand and Flint (1997) also suggested avian predators, particularly gulls, were more prevalent than mammalian predators on the YKD. Similar results were reported from other studies in the same area (Mickelson 1975, and Vacca and Handel 1988) where avian predation was attributed to 85.9% and 78% of nest failures respectively. Given that similar fauna, vegetation, and terrain characterize the ACP, it is possible that avian predators would also be significant nest predators during disturbance events in the Barrow area. On one occasion, Safine (2011) confirmed depredation of a camera-monitored nest by glaucous gulls and parasitic jaegers after a spectacled eider delayed returning to incubate following capture by investigators.

In addition to avian predators, mammalian predators like arctic foxes have also been responsible for substantial nest depredations observed during camera-monitoring of waterfowl nests in the Barrow area (Safine 2011). Investigator disturbance may also fragment young broods or separate hens from ducklings, making the ducklings more vulnerable to predators. The proposed activities may result in disturbance of nesting females and broods. Spectacled eiders are more likely to be disturbed than Steller's eiders because spectacled eiders are more abundant on the ACP than Steller's eiders.

Loss of production

In the discussion below, we provide an assessment of potential loss of listed eider production resulting from direct and indirect disturbance associated with the proposed research activities. This assessment uses estimates of spectacled eider density on the ACP from waterfowl breeding population survey data from the region (Larned et al. 2011). These estimates were developed at a coarse regional scale and are not site- or habitat-specific; however, they reflect the best available data on the density of breeding spectacled eiders in the action area. Distribution on a local scale may vary based on the availability of preferred habitats.

Loss of production through disturbance could directly or indirectly. If listed eiders nest within NGEE research sites on the BEO or on the Southern Transect, direct loss of production could occur if nests are disturbed or abandoned as a result of human presence. Indirect loss of production may occur through displacement of eiders from the surrounding area affected by disturbance at NGEE research sites. Assuming this affect may extend over roughly 200 m, the area encompassed by the zone of influence, or the area of total habitat loss, is estimated to be 422 acres (1.71 km^2). This estimate is likely conservative (i.e., biased high) because fewer eiders may nest in the area given the proximity to existing infrastructure and human disturbance.

Spectacled eiders

Spectacled eider density polygons constructed from data collected during the 2007–2010 waterfowl breeding population survey of the ACP (Larned et al. 2011) provide our best estimate of spectacled eider nest density in the action area. Estimated spectacled eider density in the Barrow area ranged from 0.426 to 1.531 birds/km^2 (Larned et al. 2011). To estimate the potential number of spectacled eider pairs displaced by NGEE research activities per year, we multiplied the median estimated density in the action area (0.979 birds/km^2) by the estimated affected footprint (1.71 km^2). We assume the estimated number of pairs displaced is equivalent to the number of nests or broods that may be affected. We also assume that spectacled eiders

will be present and attempt to nest annually in the action area. Finally, we assume that displaced pairs will not move and successfully nest elsewhere, which is an unproven and conservative assumption. The potential loss of production in terms of numbers of eggs or ducklings lost was based on an average clutch size of 3.9 for spectacled eiders in northern Alaska (Petersen et al. 2000, Bart and Earnst 2005, Johnson et al. 2008). Applying these assumptions and this logic, we estimate the proposed action would cause the failure of 13 spectacled eider nests over an estimated 10 year project duration.

$$0.979 \text{ birds/km}^2 \times 0.5 \text{ nests/pair} \times 1.71 \text{ km}^2 = 1.26 \text{ nests annually}$$

$$1.26 \text{ nests annually} \times 10 \text{ years} = 12.63 \text{ spectacled eider nests}$$

Based on an average clutch size of 3.9 eggs for spectacled eiders (Petersen et al. 2000, Bart and Earnst 2005, Johnson et al. 2008), we estimate up to 49 eggs could be lost due to nest abandonment.

$$12.63 \text{ nests} \times 3.9 \text{ eggs or ducklings per nest} = 49.25 \text{ eggs lost}$$

Loss of eggs is of much lower significance for survival and recovery of the species than death of reproductive adults. Furthermore, when hatch success (which includes inviable eggs, as well as those lost to predation), fledging success, over-winter survival, and annual survival are taken in context, we estimate roughly that only 1-7 out of 100 spectacled eiders hatched on the Y-K Delta would enter the breeding population (Grand and Flint 1997, Flint et al. 2000, Grand et al. 1998, and Flint pers. comm). Similarly, we would expect only a small proportion of spectacled eider eggs or ducklings hatched on the North Slope to survive to recruit into the breeding population.

Because the most recent population estimate for North Slope-breeding spectacled eiders is 14,814 (13,501–16,128, 90% CI; Stehn et al. 2013), and recruitment into the breeding population is very low, we would not anticipate population level effects from the loss of 49 eggs from 13 abandoned nests as a result of disturbance associated with the proposed 10-year research project.

Steller's eiders

We estimated the potential number of Steller's eider nests lost by multiplying the average density of breeding pairs within the USFWS standard survey area 1999–2012 (Safine 2013; 0.262 breeding pairs/km^2) by the extent of the affected area (1.71 km^2). Therefore, the mean number of nests affected annually by the proposed project would be:

$$0.262 \text{ pairs/km}^2 \times 0.5 \text{ nest/pair} \times 1.71 \text{ km}^2 = 0.273 \text{ nests annually}$$

Based on the number of potential Steller's eider nests lost annually, we estimate approximately 3 nests may be lost over an assumed 10-year project life (0.273 nests/year × 10 years = 2.73 nests). We estimated the potential number of eggs or ducklings lost over the project life as the product of an average clutch size of 8 for Steller's eiders near Barrow, and the number of affected nests, resulting in an estimated loss of production of 22 Steller's eider eggs or ducklings (2.73 nests × 8 eggs/nest = 21.84 eggs). Given low nest survival and fledging success, only a small proportion of Steller's eider eggs or ducklings would be expected to recruit into the breeding population.

Therefore, we would not anticipate population-level effects from the loss of 22 eggs from 3 abandoned Steller's eider nests over a 10-year project life.

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 research sites are not dependent on the NGEE project for their justification (they are not interrelated actions) and have independent utility apart from the Proposed Action (they are not interdependent actions).

7. CUMULATIVE EFFECTS

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

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.

8. CONCLUSION

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

Listed eiders
In evaluating impacts of the proposed project to listed eiders, the Service identified direct and indirect adverse effects that could result from disturbance. Using methods explained in the *Effects of the Action* section, the Service estimates the loss of up to 49 spectacled eider eggs from 13 nests and 22 Steller's eider eggs from 3 nests over a period of 10 years. However, we expect this loss of production will not have a significant effect at the population level because only a small proportion of listed eider eggs or ducklings on the North Slope would eventually survive to recruit into the breeding populations.

Given that the potential loss in production from the proposed action is a very small proportion of the production of the North Slope-breeding population of spectacled (estimated 13,501–16,128,

90% CI; Stehn et al. 2013) and Steller's eiders (estimated 292–859, 90% CI; Stehn and Platte 2009), we believe the effects of the proposed research will not significantly affect the likelihood of survival and recovery of spectacled or Alaska-breeding Steller's eiders. After reviewing the current status of the species, the environmental baseline, and effects of the proposed action, the Service concludes that the proposed action is *not likely to jeopardize the continued existence* of the spectacled or Steller's eider by reducing appreciably the likelihood of survival and recovery in the wild by reducing reproduction, numbers, or distribution of these species.

Future consultation

This BO's determination of non-jeopardy is based on the assumption that ORNL and their agents will consult with the Service on future activities related to NGEE research that are not evaluated in this document.

In addition to listed eiders, the area affected by NGEE research 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 actions 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.

9. INCIDENTAL TAKE STATEMENT

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

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

Listed eiders
As described in *Effects of the Action*, the activities described and assessed in this BO may adversely affect listed eiders through direct and indirect disturbance associated with research activities. Methods used to estimate loss of listed eider production from disturbance are described in the *Effects of the Action* section. Based on these estimates, the Service anticipates the *loss of production of 13 potential spectacled eider nests with eggs and 3 Steller's eider nests with eggs* as a result of disturbance resulting from the proposed action.

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

10. CONSERVATION RECOMMENDATIONS

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

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

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

11. REINITIATION NOTICE

This concludes formal consultation for proposed NGEE research activities between 2014 and 2024. As provided in 50 CFR 402.16, re-initiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if:

1. The amount or extent of incidental take for listed eiders is exceeded;
    a. More than 49 spectacled eider eggs taken over the life of the project; and
    b. More than 22 Steller's eider eggs taken over the life of the project;

2. New information reveals effects of the action that may affect listed species in a manner or to an extent not considered in this opinion;
3. The project description 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.

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