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
April 18, 2012

MEMORANDUM

To: Harry A. Baij, Jr., Project Manager, U.S. Army Corps of Engineers, Alaska District

From: Sarah C. Conn, Field Supervisor

Subject: Formal Consultation for the Nuna Project (POA-2005-1295-M6)

This memo transmits the U.S. Fish and Wildlife Service's (Service) final Biological Opinion (BO) in accordance with Section 7 of the Endangered Species Act of 1973, as amended, on the effects of a proposal by Pioneer Natural Resources Alaska, Inc. to construct the Nuna Project (POA-2005-1295-M6), which would develop a hydrocarbon reservoir on the Arctic Coastal Plain from two new drill sites near the east bank of the Colville River, approximately 32 km (20 miles) northeast of Nuiqsut, Alaska.

The BO evaluates the effects of the proposed Action on Alaska-breeding Steller's eiders (*Polysticta stelleri*), spectacled eiders (*Somateria fischeri*), polar bears (*Ursus maritimus*), and polar bear critical habitat. Conference reports for yellow-billed loon (*Gavia adamsii*) and Pacific walrus (*Odobenus rosmarus divergens*), which are listed as candidate species under the ESA, are also included in the BO.

The Service has determined the proposed Action may affect but is not likely to adversely affect Steller's eiders and may adversely affect spectacled eiders, polar bears, and polar bear critical habitat. We have also determined that the proposed Action is not likely to jeopardize the continued existence of yellow-billed loons or Pacific walruses.

Following review of the status and environmental baseline of spectacled eiders, polar bears, and polar bear critical habitat, and analysis of the potential effects of the proposed Action to these listed entities, the Service has concluded the proposed Action is not likely to jeopardize the continued existence of spectacled eiders or polar bears, and is not likely to destroy or adversely modify polar bear critical habitat.

If you have comments or concerns regarding this BO, please contact Neesha C. Stellrecht, Acting Endangered Species Branch Chief, Fairbanks Fish and Wildlife Field Office at (907) 456-0297.

BIOLOGICAL OPINION

for

PIONEER NATURAL RESOURCE'S NUNA PROJECT

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

Prepared by:
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April 18, 2012

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1. INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) on a proposal by Pioneer Natural Resources Alaska, Inc. (Pioneer) to construct the Nuna Project, which would develop a hydrocarbon reservoir on the Arctic Coastal Plain from two new drill sites near the east bank of the Colville River, approximately 32 km (20 miles) northeast of Nuiqsut, Alaska. Because the project will impact waters of the United States, Pioneer has requested a section 404 permit from the U.S. Army Corps of Engineers (USACE). The USACE submitted a Biological Assessment for the Nuna Project (BA) prepared by ABR, Inc. – Environmental Research and Services on behalf of Pioneer to the Service on December 6, 2011.

This BO describes the effects of the proposed Action on Alaska-breeding Steller's eiders (*Polysticta stelleri*), spectacled eiders (*Somateria fischeri*), polar bears (*Ursus maritimus*), and polar bear critical habitat pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). Conference reports for yellow-billed loon (*Gavia adamsii*) and Pacific walrus (*Odobenus rosmarus divergens*), which are listed as candidate species under the ESA, are also included in the document. We used information provided in the project BA; project-specific communications with the USFWS Alaska Region Marine Mammal Management (USFWS MMM) office; 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 the proposed Action may affect but is not likely to adversely affect Steller's eiders and may adversely affect spectacled eiders, polar bears, and polar bear critical habitat. We have also determined that the proposed Action is not likely to jeopardize the continued existence of yellow-billed loons or Pacific walruses.

Following review of the status and environmental baseline of spectacled eiders, polar bears, and polar bear critical habitat, and analysis of the potential effects of the proposed Action to these listed entities, the Service has concluded the proposed Action is not likely to jeopardize the continued existence of spectacled eiders or polar bears, and is not likely to destroy or adversely modify polar bear critical habitat.

If you have comments or concerns regarding this BO, please contact Neesha C. Stellrecht, Acting Endangered Species Branch Chief, Fairbanks Fish and Wildlife Field Office at (907) 456-0297.

2. DESCRIPTION OF THE PROPOSED ACTION

Project Overview

The proposed components of the Nuna Project include 2 production drill sites (NDS1 and NDS2) and associated drilling and production structures, 14.8 km (9.2 miles) of interconnecting gravel roads, and 20.5 km (12.8 miles) of flowlines (Figure 1). Flowlines will transport produced oil and gas from both drill sites to Pioneer's existing Oooguruk Tie-in Pad (OTP) (Figure 1). The Nuna Project will be connected by gravel road to the Kuparuk oilfield infrastructure at DS-3S. Ice roads will be constructed in support of flowline and bridge/culvert construction and periodic flowline maintenance for the life of the project. Construction is planned to occur over 4+ years (2013–2016 or later), with gravel placement occurring during winter. The operational life of the Nuna Project is expected to be approximately 20–30 years.

Pioneer has proposed the following schedule for development of the Nuna project:

- NDS1
  - 2013 – mine site activities; ice road construction; gravel construction
  - 2014 – flowline construction; module installation
  - 2014–2018 – development drilling (first production 2014)
- NDS2 – 2015 or later; development schedule similar to NDS1
- End of field life (~30 years) – site decommissioning and closure

Action Area

The Action Area is the area in which direct and indirect effects of the action to listed species and designated critical habitat may occur. The area directly affected by the proposed project includes gravel pads and roads, flowlines, ice roads, the material source site (Mine Site E), and areas potentially affected by terrestrial or marine spills. The area indirectly affected by the proposed project is delineated by a zone of influence[1] surrounding new infrastructure within which listed species may be affected by disturbance resulting from construction activities.

The Nuna Project BA (Johnson et al. 2011) delineates the Action Area as encompassing a rectangular area from 4.0 km (2.5 miles) east of Mine Site E to 4.0 km west of the proposed Nuna Project drill sites, including portions of the East Channel of the Colville River and islands therein (Figure 2), with the northern boundary extending 4.0 km north of Mine Site E and the proposed gravel haul ice road and the southern boundary extending 4.0 km south of the NDS2 gravel pad and road.

[1] This zone of influence is assumed to be 200 m (656 ft) for spectacled eiders and 1.6 km (1 mi) for polar bears.

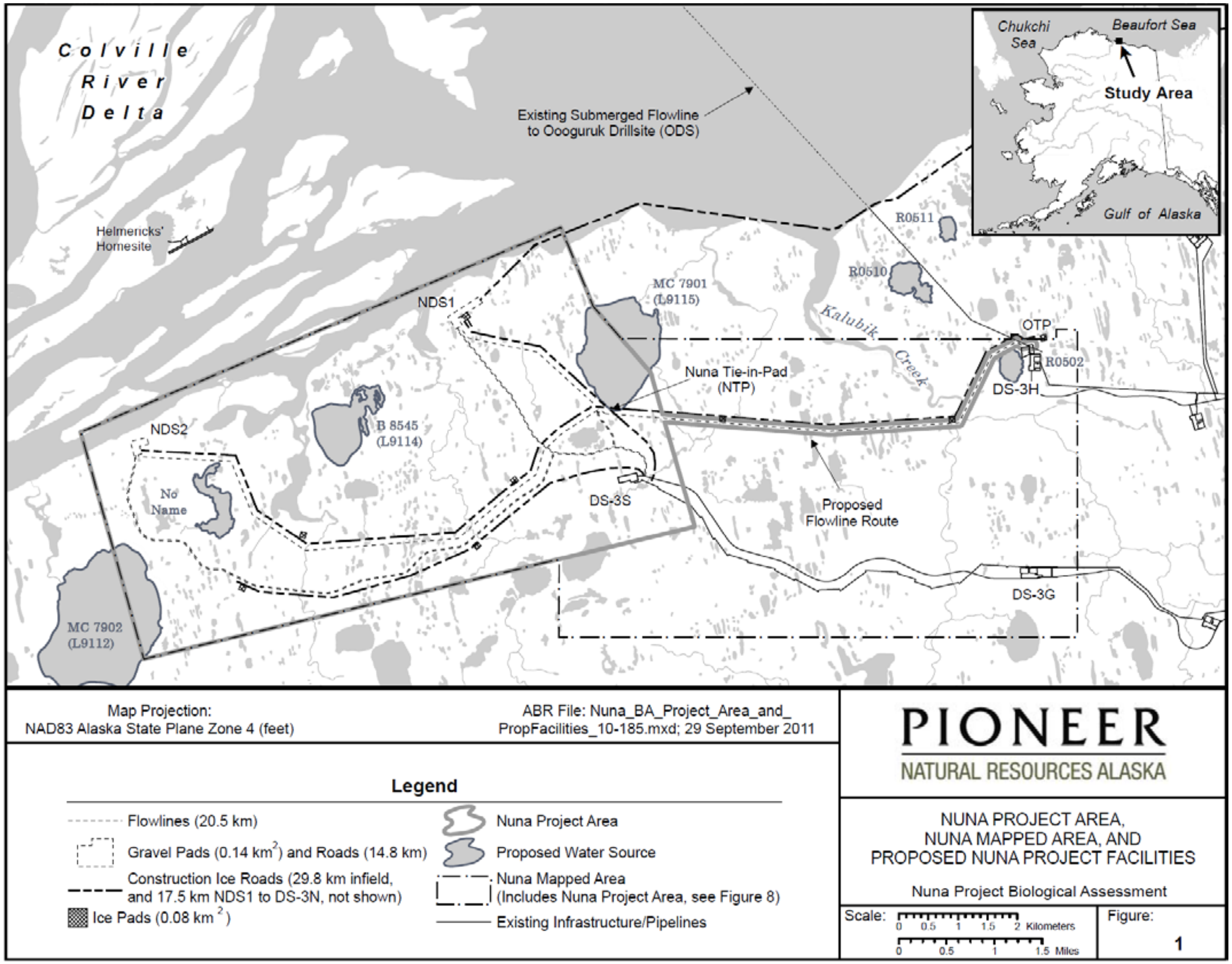

Figure 1. The Nuna project area, proposed facilities, and existing infrastructure. Source: Nuna Project BA (Johnson et al. 2011).

Proposed Action
Project components and associated construction, operations, and maintenance activities are summarized below. Project infrastructure and implementation are described further in the Nuna Project BA (Johnson et al. 2011).

NDS1
The NDS1 drillsite would be constructed over a single winter (2012–2013 or later) with first production anticipated as early as 2014. The gravel footprint of the pad would be 0.09 km^2 (21.9 acres). The L-shaped pad would support drilling and production operations and is designed to accommodate 25–50 wells on 9.1-m (30-foot) spacing. Dimensions of the working surface would be approximately 229 × 110 m (750 × 360 feet) for the support facilities section and 91 × 488 m (300 × 1,600 feet) for the well row. Gravel bag slope erosion protection would be constructed to protect the drillsite from damage during annual flooding of the Colville River or storm surges. The drillsite would be set back 305 m (1,000 feet) from the Colville River to provide a buffer for anticipated future erosion, limit the potential impact of spills, and provide wildlife passage.

Facilities at NDS1 would include production modules and associated equipment, wellhead shelters, production and injection flowlines, pipe racks, disposal well, production tankage, development drilling rig and drilling support equipment, temporary camp facilities to house drilling crews, and a communications tower. NDS1 would also have pigging capabilities.

Development drilling would begin as early as 2014 with construction of a disposal well and then continue with construction of development wells over 4 years. A 53.3-m (175-foot) self-contained mobile arctic drilling rig would be used for well construction. A temporary stationary rig support area with cuttings processing and some fluids storage would be used to support drilling operations.

NDS2
Construction of NDS2 would begin in 2015 or later. The gravel footprint of NDS2 would be a 0.05 km^2 (12.6 acres) and the L-shaped pad would accommodate 10–15 wells. Dimensions of the working surface would be approximately 229 × 110 m (750 × 360 feet) for the support facilities section and 91 × 149 m (300 × 490 feet) for the well row. Gravel bag slope erosion protection would be used to protect the drillsite from flood damage. The drillsite would be set back 229 m (750 feet) from the Colville River. Facilities on NDS2 would be similar to those described for NDS1. NDS2 could be developed simultaneously with NDS1, but would probably be constructed near the end of the drilling campaign at NDS1.

Drilling at NDS2 would begin following completion of drilling operations NDS1. The drilling rig would be moved to NDS2 and complete a similar development drilling campaign over approximately 1.5 years.

Oooguruk Tie-in Pad (existing)
Existing Pioneer facilities at the OTP would be used and potentially expanded in support of the Nuna Project. These facilities include housing (Kalubik Camp), power generation, communications, Oooguruk produced water treatment for Nuna injection, gas compression, and pigging facilities. Pioneer does not anticipate expansion of the OTP gravel pad will be required to accommodate these facilities.

Nuna Tie-in Pad
Flowlines from NDS2 will tie in to the flowlines from NDS1 at the 0.002-km² (0.50-acre) NTP (Figure 1). The NTP will also be used to receive and send flowline pigs for cleaning and inspection through the flowlines to NDS2.

Access roads
Three gravel roads would be constructed to connect the project pads to the Kuparuk infrastructure. Roads would be 9.8 m (32 feet) wide at the crown and have a minimum base width of 15.8 m (52 feet). The NDS1 to DS-3S road would be 4.6 km (2.9 miles) in length and fill 0.18 km² (43.7 acres) of wetlands. The road from NDS2 to the intersection with NDS1–DS-3S road would be 9.6 km in length (6.0 miles) and fill 0.18 km² (43.7 acres). The third road, connecting the NTP to the other roads, would be 0.67 km (0.42 miles) in length and fill 0.012 km² (2.9 acres). The roads from the drillsites to DS-3S would be used year-round for transportation of the drilling rig, other heavy equipment, diesel fuel, chemicals, drilling supplies, personnel, and spill response equipment.

Road construction would occur in winter with the exception of culvert installation, which may also occur during low flow conditions in late summer. Stream crossings would be designed to minimize changes to the existing hydrologic regime and maintain wetland structure and function.

Flowlines
Four flowlines would be placed on VSMs sized to maintain a minimum height of 2.1 m (7 feet) from the tundra surface. Production flowlines (12-inch diameter) would transport produced fluids from the drillsites to the OTP. Additional 8-inch flowlines would transport produced water, seawater, and gas from the OTP to the drillsites.

The flowlines would total 20.5 km (12.8 miles) in length and include 3 segments:

- OTP to NTP, 8.1 km (5.0 miles)
- NDS1 to NTP, 3.0 km (1.8 miles)
- NDS2 to NTP, 9.5 km (5.9 miles)

The flowlines would be supported on VSMs spaced approximately 17 m (55 feet) apart at a minimum height of 2.1 m (7 feet) from the tundra surface and offset at least 152 m (500 feet) from roads except at crossing and pads. Flowlines would be placed a minimum of 2.1 m (7 feet) above the average water level at the Kalubik Creek, which would accommodate the 100-year flood level. Flowline construction would occur during the winter from tundra ice roads.

Integrity monitoring of the flowlines would include inspection of the flowline using in-line inspection tools and periodic visual surveillance of the flowlines and their associated right-of ways. Visual inspections of flowlines would typically be performed on a monthly basis via aerial surveillance or ground-based observations. For aerial surveillance, one pass with the aircraft along the gathering line route would be conducted (J. Lina, Pioneer, pers. comm.). Flowlines would be accessed for required maintenance using Rolligons (or similar tundra travel equipment) when tundra travel is allowed, from ice roads constructed during the winter, or by helicopter.

Gravel mine

The primary gravel source will be Mine Site E, located ~24 km (15 miles) northeast of DS-3S (Figure 2). Gravel would be removed from Cell 4A, which is approximately 0.07 km^2 (18.4 acres) in size.

Ice roads and pads

Ice roads would be constructed during the winter seasons to connect project locations to the existing gravel road system at DS-3S (Figure 2). Onshore ice roads (29.8 km total length; 0.45 km^2) and ice pads (0.08 km^2) would be used to support construction of flowlines and other infrastructure over two winter construction seasons (2014/2015 for NDS1 and after 2015 for NDS2) as well as operations and maintenance activities periodically throughout the project life. Additionally, a 17.5-km gravel haul ice road would be constructed onshore and over nearshore sea ice from DS-3N of the Kuparuk oil field to NDS1 (Figure 2) during the first year of construction.

Prior to ice road construction, Pioneer plans to survey, in cooperation with the USFWS Marine Mammals Management office (USFWS MMM), proposed ice road and flowline routes for potential polar bear dens using forward-looking infrared (FLIR) imaging technology. Known locations of radio- or satellite-collared bears, U.S. Geological Survey (USGS) denning habitat maps, and ground truthing would also be used as necessary to detect dens. Conservation measures to avoid adverse effects to dens would be implemented based on recommendations by USFWS MMM and may include rerouting ice roads to maintain a distance of 1.6 km (1 mile) from known dens.

Water supply

Permitted fresh water sources (Figure 2) are proposed to provide water for the ice road system, potable water for construction camp(s), and water for drilling and long term production operations. Pioneer estimates annual fresh water consumption for ice roads during construction is approximately 41–83 million liters (11–22 million gallons) per year. The development drilling program would use ~144 million liters (38 million gallons) for each drillsite, supplied as a combination of hauled potable water, seawater, and produced water.

Communications
An 18.3-m (60-foot), self-supporting[2] galvanized steel communications tower would provide telephone and data communications links to the each drillsite. Wireless communications would be tied into the existing OTP communications systems.

Electrical power facilities
Electrical power would be provided by gas-fired turbines at the OTP or by temporary diesel fuel-powered electrical generators as necessary for construction and operations. Power and communication lines would be suspended from the flowline VSMs. No overhead power lines would be constructed.

Operations and maintenance
The production life of the drillsites is estimated to be 20–30 years with peak oil production estimated at 14,000 barrels per day. Operations and maintenance responsibilities would include monitoring the wells, pump, and meter units; monitoring the flowlines; periodic well workovers; and routine operations and maintenance.

Workforce estimate
The construction workforce is expected to peak at approximately 400 personnel during construction of ice roads, gravel roads, flowlines, and on-pad structures. The workforce would be housed at the OTP (Kalubik Camp) and other nearby camps, as needed. The project would require a drilling workforce of approximately 100 personnel for the estimated 5.5 years of drilling development and an operations workforce of approximately 50 personnel.

Waste disposal
Wastes would be handled in accordance with the Alaska Waste Disposal and Reuse Guide in full compliance with federal, state, and NSB regulations. A new dual classified disposal well would be drilled at each site. Drilling fluid wastes and cuttings would be processed through a cuttings facility and injected into the disposal well. Cuttings from the first (disposal) well at each drill site would be stored temporarily in on-site reserve pits. These cuttings would be subsequently hauled to an offsite disposal well or be sent through the cuttings process and injected down the disposal well. In addition to disposal wells and temporary storage pits, other on-site waste management facilities would include:

- Dumpsters specified for food waste, burnable waste, construction debris, oily waste, and scrap metal;
- Hazardous waste central accumulation area with satellite accumulation areas;
- Recyclable accumulation areas;
- Waste storage tanks;
- Storage hoppers and bins; and
- Wastewater treatment plant(s).

[2] Communication towers would be free-standing with no guy wires.

Spill prevention and response
Numerous prevention, design, detection, reporting, response, and training measures are described in the Project Plan of Operations Alaska Department of Environmental Conservation approved Oil Discharge Prevention and Contingency Plan (ODPCP), and Environmental Protection Agency required Spill Prevention, Control and Countermeasure (SPCC) Plans for project activities. Pioneer will amend the existing Oooguruk ODPCP spill prevention and response plans to include construction and operation of the Nuna Project.

Closure
Once the economic life of the field has passed, drill-sites and gravel roads would be abandoned. Removal of facilities would be in accordance with state and federal agency approved abandonment plans. At this time, it is not clear how much infrastructure would remain in place or what habitat restoration measures would be implemented.

Conservation Measures
Conservations measures that Pioneer plans to implement (Johnson et al. 2011; J. Lina, Pioneer, pers. comm., April 6, 2012) to reduce potential impacts from the Nuna Project to listed species and other wildlife are listed below.

- Water removal from freshwater lakes (except the domestic water source lakes) used by nesting waterfowl would be limited during the summer in order to reduce the potential for reducing the amount or quality of nesting and brood-rearing habitat through diminished water levels.

- Power lines and fiber-optic cables would be placed on the flowline VSMs to reduce the risk of bird collisions and reduce perching sites for predatory bird species. No overhead power lines will be used.

- Dust-control measures would be applied to roads and pads to protect vegetation, and hence terrestrial and aquatic habitats.

- Structures will be designed to minimize nesting opportunities for birds to prevent population increases of predatory species such as ravens.

- Careful design considerations were given to facility lighting (cut-off lighting to reduce outward-radiating light) to reduce the potential for disorienting migrating birds and to reduce bird strikes.

- A *Wildlife Interaction Plan* will be developed for the Nuna Project, which would include procedures for detecting and discouraging nest building by predatory birds on towers or other structures and detecting and discouraging fox denning activities on or near any of the project facilities.

- The Oooguruk Project *Bear & Pacific Walrus Avoidance & Human Interaction/Encounter Plan* has been amended to include the Nuna Project (Appendix B) and will be updated annually in accordance with regulations for the issuance of Letters of Authorization (LOA) for incidental take under Section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA). The plan provides procedures to protect both polar bears and humans. This plan incorporates the following provisions:
  - A requirement for education and training of project team members (employees and contractors) which includes a "Polar Bear and Wildlife Awareness" module;
  - Training of selected project personnel in polar bear deterrence and hazing using approved protocols, and designating trained personnel as bear monitors;
  - Procedures for early detection of bears, clear roles and responsibilities to quickly report sighted bears, and an effective communication system to warn workers and direct appropriate responses;
  - Site design and layout features to minimize bear encounters;
  - Policies for bear-resistant storage of hazardous material, and waste management, particularly for food, garbage, and sewage, to prevent attracting bears;
  - Procedures for ice road/off-site operations including bear avoidance and interaction methods, den detection and avoidance, and road closures;
  - Procedures for handling and removing marine mammal carcasses if found near the project site;

- Nuna facilities will be designed to reduce polar bear and human interactions by maximizing sight distances and maintaining appropriate visibility, avoiding dead-end corners and alleys, and providing bright lighting at appropriate locations.

- Wastes would be managed to avoid attracting bears, foxes, gulls, and ravens. Bear-resistant dumpsters will be used throughout the Project site.

- Pioneer, working with the USFWS, will survey potential denning habitat using FLIR technology to detect active polar bear dens. Detection efforts will also use locations of radio-collared bears, USGS denning habitat maps, and ground-truthing with handheld FLIR units, as necessary. Polar bear dens will be avoided by 1.6 km (1 mi). Should occupied dens be identified within 1.6 km of activities, work in the immediate area would cease and the USFWS would be contacted for guidance. Potential responses may range from cessation or modification of work to conducting additional monitoring.

- To enhance environmental awareness and compliance, and reduce overall environmental impacts, Pioneer will:
  - Maintain continual on-site environmental compliance presence during all Pioneer construction, drilling, and operations;
  - Continue environmental and cultural awareness training programs;
  - Conduct permit compliance training with all employees; and
  - Conduct periodic safety, security, health, and environmental compliance assessments.

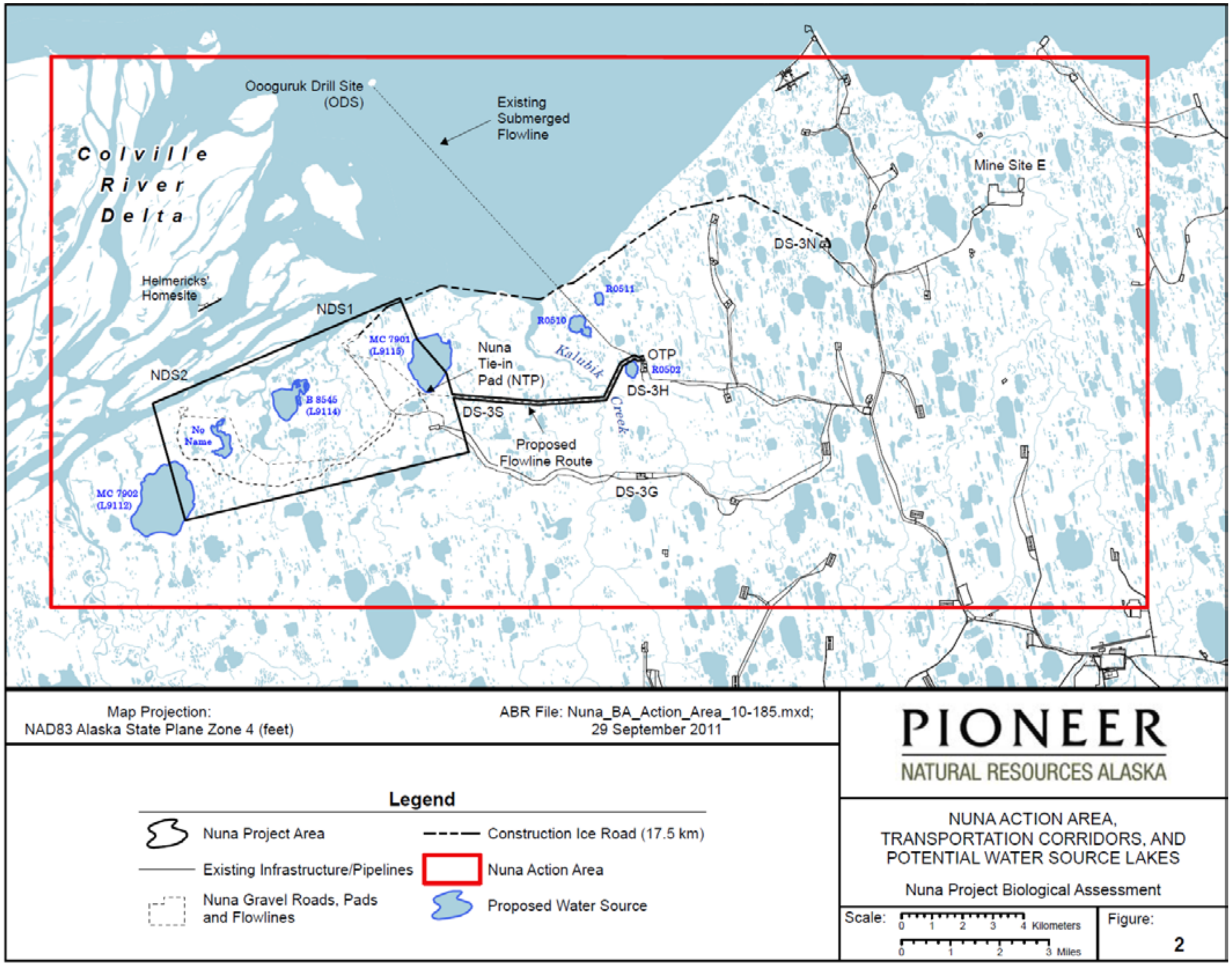

Figure 2. Nuna Action Area, including the project area, proposed facilities, and existing infrastructure. Source: Nuna Project BA (Johnson et al. 2011).

3. EFFECT DETERMINATION FOR STELLER'S EIDER

In Alaska, Steller's eiders breed almost exclusively on the Arctic Coastal Plain (ACP), migrating to the breeding grounds in late spring and remaining in the region as late as mid-October. However, nesting is concentrated in tundra wetlands near Barrow, AK and Steller's eiders occur at very low densities elsewhere on the ACP (Larned et al. 2010). USFWS aerial surveys for breeding eiders conducted annually on the ACP from 1992–2010 reported only 5 observations of Steller's eiders east of the Colville River, with the most recent observation in 1998 (USFWS Alaska Region Migratory Bird Management, unpublished data). The closest observation to the project in the past 10 years occurred ~ 68 km (42 mi) west of the project area in 2006. Because available data indicate Steller's eiders are unlikely to nest near or migrate through the project area, we conclude that adverse effects to the species will be discountable and that the proposed Action is *not likely to adversely affect* Steller's eiders.

4. CONFERENCE REPORT ON YELLOW-BILLED LOON

The yellow-billed loon was listed as a candidate species under the ESA on March 25, 2009 (USFWS 2009) due to its small population size range-wide and concerns about levels of subsistence harvest and other potential impacts to the species. Within Alaska, there are two breeding areas – the North Slope region north of the Brooks Range and the region surrounding Kotzebue Sound in northwest Alaska, primarily the northern Seward Peninsula (Earnst 2004, North 1993). Nest sites are usually located on islands, hummocks, peninsulas, or along low shorelines, within 1 m of water. Young leave the nest soon after hatching and the brood may move from the natal lake to a brood-rearing lake within days of hatch. Both males and females participate in feeding and caring for young (North 1994). Successfully breeding adults feed their young almost entirely from the brood-rearing lake (North 1994). Non-breeding birds remain in marine waters throughout the year, either in wintering areas or offshore from breeding grounds.

Densities of yellow-billed loons are relatively low in the Action Area, with higher concentrations occurring to the east, between the Meade and Colville rivers (Earnst 2004, Larned et al. 2011). Density polygons constructed from data collected during the 2007–2010 waterfowl breeding population surveys of the ACP place yellow-billed loon density in the Action Area in the range of 0–0.203 birds/km^2 (Larned et al. 2011; also see Figure 11 of the Nuna Project BA [Johnson et al. 2011]). Density of yellow-billed loons and nests estimated from 16 years of surveys on the Colville River Delta adjacent to the Nuna Project Area was 0.14 adults/km^2 and 0.06 nests/km^2 (1993–2010), with apparent increases over the past several years (see review in the Johnson 2011). Pioneer conducted nesting and brood-rearing surveys for yellow-billed loons in June and August 2011 on 40 lakes (median size, 15.0 ha) in the Nuna Project area (Wildman and Parrett 2011). Three yellow-billed loons were found on 2 different lakes during the nesting survey, but no nests were found. During the brood-rearing survey, a pair of yellow-billed loons was seen on the same lake where the pair was observed during the nesting survey, indicating the pair was probably a male and female defending the lake as a territory (Wildman and Parrett 2011).

We expect adverse effects to yellow-billed loons would occur primarily through long-term habitat loss resulting from disturbance. Human disturbance could cause yellow-billed loons to abandon reproductive efforts or leave eggs or chicks unattended and exposed to predators or inclement weather (Earnst 2004). Sensitivity to disturbance is probably influenced by the nature of the disturbance, site-specific habitat features, nesting phenology, and variation in the tolerance of individuals to disturbance. Additionally, some yellow-billed loons may habituate to predictable disturbances. While research on the distances at which human activity causes yellow-billed loons to depart from nests or interrupt normal chick-rearing behavior are lacking, incidental observations have shown parents may leave the nest when an approaching human is up to 1.6 km (1 mile) away or as close as a few meters (Earnst 2004). In the Nuna Project BA, Johnson et al. (2011) indicate proposed access roads and the NTP are located within 1.6 km of at least 3 deep lakes that could be breeding habitats for yellow-billed loons and estimate that 3–4 nesting sites could be affected.

Adverse effects to yellow-billed loons could also occur through collisions with structures, increased predator populations, and direct effects from oil spills. Because loon densities are relatively low in the Action Area, we expect the number of birds that could be potentially affected by these threats to be very low. We anticipate collision risk would be reduced by measures implemented by Pioneer to reduce the disorienting effects of lighting on migratory birds. Likewise, potential increases in local predator populations will be managed by measures to reduce nesting by ravens on project infrastructure and minimize the availability of anthropogenic food sources. We expect a very low number of loons could potentially be exposed to oil in the event of a spill because they occur at low densities in the Action Area and risks to yellow-billed loons associated with spills would be reduced by spill prevention and containment measures.

A conference on a candidate species results in a determination of whether the proposed Action is likely to jeopardize the continued existence of the species. Because only a few potential breeding lakes would be impacted by disturbance from Nuna infrastructure and at most very low numbers of individuals may be killed by collisions or oil spills were they to occur, we do not expect the proposed Action to result in significant population-level effects to yellow-billed loons. Therefore, we conclude the proposed Action is *not likely to jeopardize the continued existence* of yellow-billed loons.

5. CONFERENCE REPORT ON PACIFIC WALRUS

The Pacific walrus was listed as a candidate species under the ESA with the publication of the 12-month petition finding on February 10, 2011 (USFWS 2011a). Pacific walruses occur in the Beaufort Sea in extremely low numbers because the continental shelf is relatively narrow along the Beaufort Sea and its deeper, less productive waters provide limited food resources. In years of low ice concentrations in the Chukchi Sea, some animals range east of Point Barrow into the Beaufort Sea (Fay 1982). However, from 1994 to 2004, oil industry monitoring programs recorded only 10 animals in the Beaufort Sea (USFWS 2011a). The USGS also reported that only a few tagged walruses entered the extreme western portion of the Beaufort Sea near Barrow during studies of Pacific walrus movement in 2007–2011 (USGS 2012).

A conference on a candidate species results in a determination of whether the proposed Action is likely to jeopardize the continued existence of the species. Because walruses are rarely observed in the Beaufort Sea, we conclude that effects from the proposed Action will be discountable and the proposed Action is *not likely to jeopardize the continued existence* of Pacific walruses.

6. STATUS OF THE SPECIES AND CRITICAL HABITAT

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.

Spectacled Eider

Spectacled eiders (Figure 3.1A) were listed as threatened throughout their range on May 10, 1993 (USFWS 1993) based on indications of steep declines in the two Alaska-breeding populations. There are three primary spectacled eider populations, 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 3.1B) 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 3.2), 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 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 3.2). 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). 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 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).

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). 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 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. Bowman et al. (2002) also reported high variation in nesting success (20–95%) of spectacled eiders on the YKD, depending on the year and location.

(A)

(B)

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

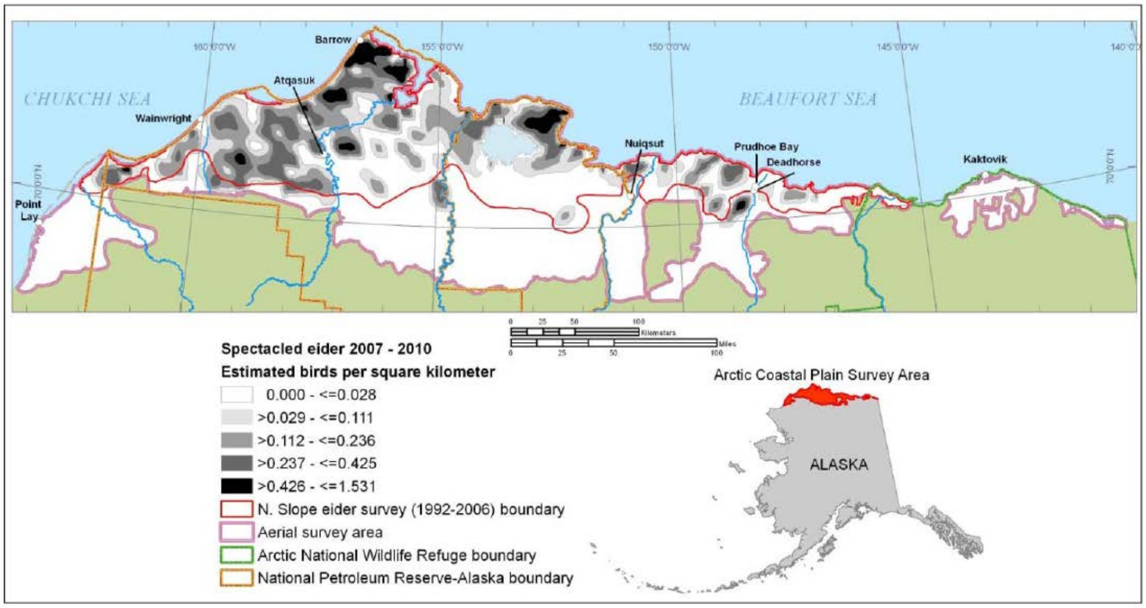

Figure 3.2. Density distribution of spectacled eiders observed on aerial transects sampling 57,336 km^2 of wetland tundra on the North Slope of Alaska during early to mid-June, 2007–2010 (source: Larned et al. 2011).

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 3.1). 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.

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

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

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 3.1). 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 3.3; 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 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 the total number of spectacled eiders was 363,000 (333,526–392,532 95% CI), obtained by aerial surveys of the known wintering area in the Bering Sea in late winter 1996–1997 (Petersen et al. 1999). Winter/spring aerial surveys were repeated in 2009 and 2010. Preliminary results from 2009 indicate an estimate of 301,812 spectacled eiders, but this value will be updated when surveys from both years are analyzed (Larned et al. 2009).

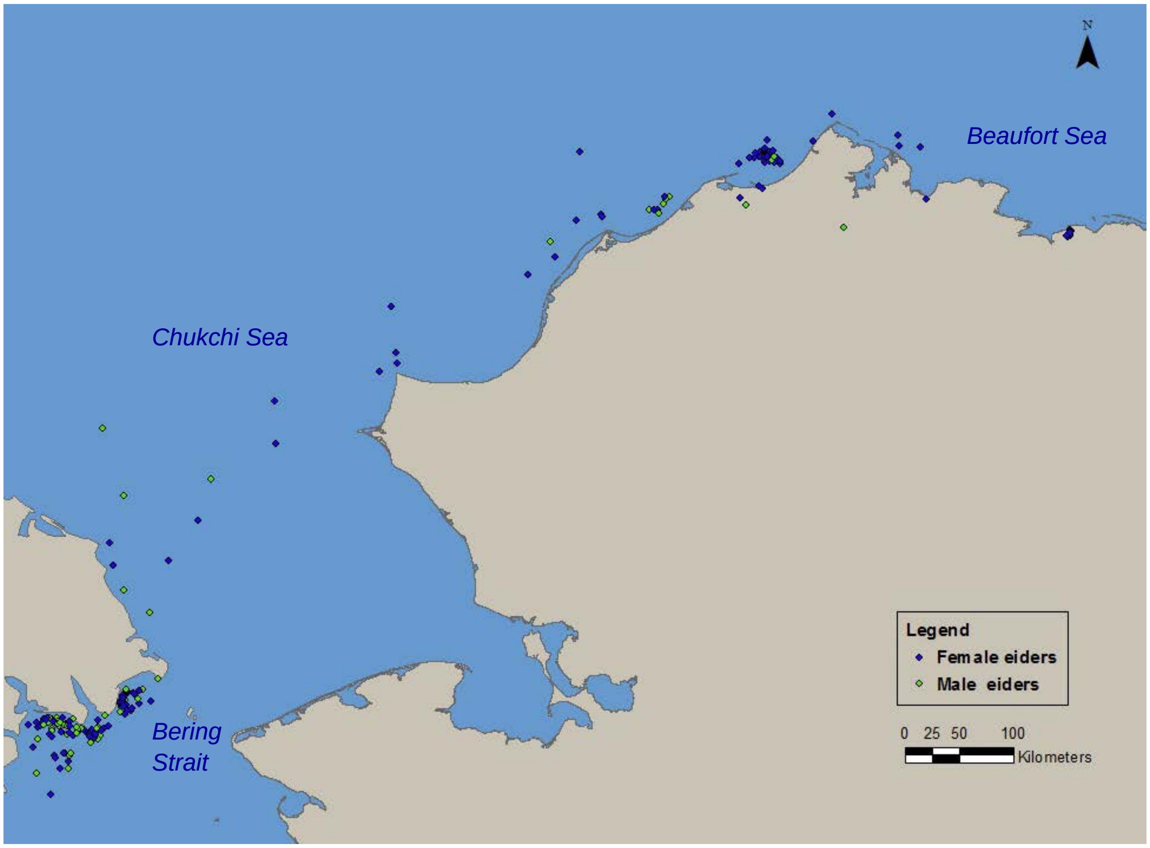

Figure 3.3. Spectacled eider satellite telemetry locations for 12 female and 7 male spectacled eiders in the eastern Chukchi Sea from 1 April – 15 June 2010 and 1 April – 15 June 2011. Additional locations from the northern coast of Russia are not shown. Eiders were tagged on the North Slope during the 2009 and 2010 breeding seasons. Data provided by Matt Sexson, USGS Alaska Science Center (USGS, unpublished).

Population indices for North Slope-breeding spectacled eiders 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 population estimate for North Slope-breeding spectacled eiders is 11,254 (8,338–14,167, 95% CI).

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).

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.

Polar Bear

The Service listed the polar bear (*Ursus maritimus*) as threatened throughout its range on May 15, 2008 (USFWS 2008a). 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 and feeding, for seeking mates and breeding, for denning, for resting, and for 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). Because the principal habitat of polar bears is sea ice, it is considered a marine mammal, and is therefore protected under the Marine Mammal Protection Act of 1972 (MMPA).

Distribution and status

Polar bears are distributed throughout regions of arctic and subarctic waters where the sea is ice covered for large portions of the year. The total number of polar bears worldwide is estimated to be 20,000–25,000 bears (Schliebe et al. 2006). Although movements of individual polar bears overlap extensively, telemetry studies have demonstrated spatial segregation among groups or stocks of polar bear in different regions of their circumpolar range (Schweinsburg and Lee 1982, Amstrup 2000, Garner et al. 1990 and 1994, Messier et al. 1992, Amstrup and Gardner 1994, Ferguson et al. 1999, Carmack and Chapman 2003). Patterns in spatial segregation suggested by telemetry data, along with information from surveys, marking studies, and traditional knowledge, resulted in recognition of 19 partially discrete polar bear groups by the International Union for the Conservation of Nature (IUCN) Polar Bear Specialist Group (PBSG). These 19 groups have been described as management subpopulations (or stocks) in the scientific literature and regulatory actions (IUCN 2006).

Two stocks of polar bears occur in Alaska: the Chukchi/Bering seas (CBS) and Southern Beaufort Sea (SBS) stocks (Figure 3.4). Unlike polar bears in eastern Canada, the Alaskan stocks do not currently spend extended periods of time on land (Garner et al. 1990), with the exception of females that choose to den on land rather than pack ice.

Movement patterns

Telemetry studies indicate polar bear movements are not random, nor do they passively follow ocean currents on the ice as previously thought (Mauritzen et al. 2003) Movement data come almost exclusively from adult female polar bears because male anatomy (their neck is larger than their skull) will not accommodate radio collars. The movements of seven male polar bears surgically implanted with transmitters in 1996 and 1997 were compared to movements of 104 females between 1985 and 1995 (Amstrup et al. 2001). The data indicated males and females had similar activity areas on a monthly basis, but males traveled farther each month (Amstrup et al. 2000). Activity areas have not been determined for many populations, and available information reflects movement data collected prior to recent changes wrought by retreating ice conditions. In the Beaufort Sea, annual activity areas for individually monitored female bears averaged 149,000 km^2 (range 13,000–597,000 km^2, Amstrup et al. 2000). Total annual movements by female bears in the Beaufort Sea averaged 3,415 km and ranged up to 6,200 km, with a movement rate of > 4 km/ hr sometimes sustained for long periods, and movements of > 50 km/day observed (Amstrup et al. 2000). Mean activity area in the Chukchi Sea, which is characterized by highly dynamic ice conditions, was 244,463 km^2 (Garner et al. 1990). Average annual distance moved by CBS female bears was 5,542 km.

Radio-collared females indicate some individuals occupy home ranges (multi-annual activity areas), which they seldom leave (Amstrup 2003). The size of a polar bear's home range is determined, in part, by the annual pattern of freeze-up and break-up of sea ice, and therefore by the distance a bear must travel to access prey (Stirling 1988, Durner et al. 2004). A bear with consistent access to ice, leads, and seals may have a relatively small home range, while bears in areas such as the Barents, Greenland, Chukchi, Bering or Baffin seas may have to move many hundreds of kilometers each year to remain in contact with sea ice from which to hunt (Born et al. 1997, Mauritzen et al. 2001, Ferguson et al. 2001, Amstrup 2003, Wiig et al. 2003).

The CBS population is widely distributed on the pack ice of the northern Bering, Chukchi, and eastern portions of the Eastern Siberian seas (Garner et al. 1990, Garner et al. 1994, Garner et al. 1995). Polar Bears are seasonably abundant in the Chukchi Sea and their distribution is influenced by the movement of seasonal pack ice. Polar bears in the Chukchi and Bering seas move south with advancing ice during fall and winter, and move north in advance of receding ice in late spring and early summer (Garner et al. 1990). Polar bears are dependent upon sea ice for foraging and the most productive areas are near ice edges, leads, or polynyas where ocean depth is minimal (Durner et al. 2004). Polar bears can be present along the Alaskan shoreline as they opportunistically scavenge on marine mammal carcasses.

The SBS population occurs between Icy Cape, Alaska on the western boundary and Pearce Point, NWT (Amstrup et al. 1986, Amstrup and DeMaster 1988, Stirling et al. 1988). It is thought that nearly all bears in the central coastal region of the Beaufort Sea are from the SBS population, and that proportional representation of SBS bears decreases to both the west and east. For example, only 50% of polar bears occurring in Barrow, Alaska and Tuktoyaktuk, NWT are SBS bears, with the remainder being from the CBS and Northern Beaufort Sea populations.

Feeding

Polar bears derive essentially all their sustenance from marine mammal prey and have evolved a strategy that utilizes the high fat content of marine mammals (Best 1985, Amstrup et al. 2007). Over half the caloric content of a seal carcass occurs in the layer of fat between the skin and underlying muscle (Stirling and McEwan 1975) and polar bears quickly remove the fat layer from beneath the skin after they catch a seal. High fat intake from specializing on marine mammal prey allows polar bears to thrive in the harsh Arctic environment (Stirling and Derocher 1990, Amstrup 2003).

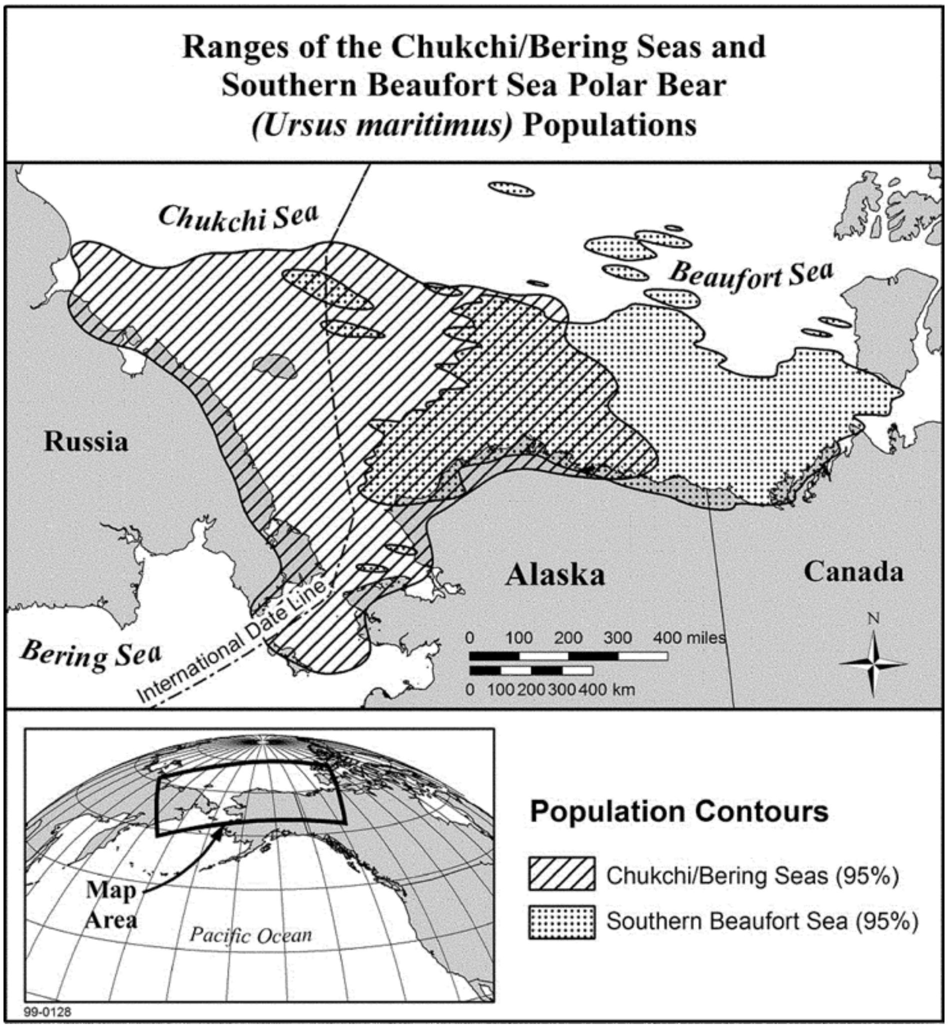

Figure 3.4. Ranges of polar bear stocks in Alaska (USFWS 2010a)

Over much of their range, polar bears are dependent on one species of seal, the ringed seal (*Phoca hispida*) (Smith and Stirling 1975, Smith 1980). The relationship between ringed seals and polar bears is so close that the abundance of ringed seals in some areas appears to regulate the density of polar bears, while polar bear predation in turn regulates density and reproductive success of ringed seals (Hammill and Smith 1991, Stirling and Øritsland 1995). Polar bears occasionally catch belugas (*Delphinapterus leucas*), narwhals (*Monodon monoceros*), walrus (*Odobenus rosmarus divirgens*), and harbor seals (*Phoca vitulina*) (Smith 1985, Calvert and Stirling 1990, Smith and Sjare 1990, Stirling and Øritsland 1995, Derocher et al. 2002). Where common, bearded seals (*Erignathus barbatus*) can be a large part of polar bear diets, and are probably the second most common prey item (Derocher et al. 2002), and walrus can be seasonally important in some parts of the polar bear's range (Ovsyanikov 1996).

Polar bears rarely catch seals on land or in open water (Furnell and Oolooyuk 1980); rather they catch seals and other marine mammals at the air-ice-water interface, where aquatic mammals come to breathe (Amstrup et al. 2007). Although there are local exceptions (e.g. Bentzen et al. 2007, Schliebe et al. 2008), it appears that polar bears gain little overall benefit from alternate foods (Amstrup et al. 2007). Therefore, maintenance of polar bear populations is dependent upon marine prey, largely seals, and polar bears are tied to the surface of the ice for effective access to that prey (Amstrup et al. 2007).

Reproduction

Polar bears have an intrinsically low reproductive rate characterized by late age of sexual maturity, small litter sizes, and extended maternal investment in raising young. Female polar bears enter a prolonged estrus between March and June, when breeding occurs. Ovulation is thought to be induced by mating (Wimsatt 1963, Ramsay and Dunbrack 1986, Derocher and Stirling 1992). Implantation is delayed until autumn, and gestation is 195–265 days (Uspenski 1977), with active development of the fetus suspended for most of that time. The timing of implantation, and hence birth, is likely dependent upon body condition of the female, which in turn is dependent upon a variety of environmental factors (Schliebe et al. 2006).

Throughout their range, most pregnant female polar bears excavate dens in snow located on land during September–November after drifts large enough to excavate a snow cave have formed (Harington 1968, Lentfer and Hensel 1980, Ramsay and Stirling 1990, Amstrup and Gardner 1994). In the southern Beaufort Sea a portion of the population dens in snow caves located on pack and shorefast ice. Successful denning by polar bears requires an accumulation of sufficient snow combined with winds to cause snow accumulation leeward of topographic features that create denning habitat (Harington 1968). The common characteristic of all denning habitat is topographic features that catch snow in the autumn and early winter (Durner et al. 2003). Polar bear denning habitat in Alaska includes areas of low relief topography characterized by tundra with riverine banks within approximately 50 km of the coast (Amstrup 1993, Amstrup and Gardner 1994, Durner et al. 2001, 2003), and offshore pack ice pressure ridge habitat. Although the northern Alaskan coast gets minimal snow fall, because the landscape is flat the snow is blown continuously throughout the winter creating drifts in areas of relief.

Fidelity to denning habitat was investigated by Amstrup and Gardner (1994), who located 27 females at up to four successive maternity dens. Bears that denned once on pack ice were more likely to den on pack ice than on land in subsequent years. Similarly, bears were faithful to general geographic areas – those that denned once in the eastern half of the Alaska coast were more likely to den there than to the west in subsequent years. Annual variations in weather, ice conditions, prey availability, and the long-distance movements of polar bears (Amstrup et al. 1986, Garner et al. 1990) make recurrence of exact denning locations unlikely.

Satellite telemetry studies determined mean dates of den entry in the Beaufort Sea were 11 and 22 November for land (n = 20) and pack ice (n = 16), respectively; however, many pregnant females did not enter dens until late November or early December (Amstrup and Gardner 1994). Female bears foraged until den entry. Mean date of emergence was 26 March for pack-ice dens (n = 10) and 5 April for land dens (n = 18).

Messier et al. (1994) reported mean date of den entry and exit varied among years depending upon sea ice, snow and weather conditions. For bears denning on sea ice or moving from sea ice to land denning habitat, time of sea ice consolidation can alter the onset of denning. Sea-ice dens must be in ice stable enough to stay intact for up to 164 days while possibly moving hundreds of kilometers by currents (Amstrup 2003, Wiig 1998).

Data suggests that an increasing number of SBS females are denning on land. Sixty percent of radio-collared females denned on land from 1996–2006, compared to forty percent in the previous 15 years (Fishbach et al. 2007). The geographic distribution of terrestrial dens also appears to have shifted to the west (USFWS 2006).

Insufficient data exist to accurately quantify polar bear denning locations along the Alaskan Chukchi Sea coast; however, dens in the area are less concentrated than for other areas in the Arctic. The majority of denning of Chukchi Sea polar bears occurs on Wrangel Island, Herald Island, and other locations on the northern Chukotka coast of Russia.

Polar bears give birth in the dens during mid-winter (Harington 1968, Ramsay and Dunbrack 1986). Survival and growth of the cubs depends on the warmth and stable environment within the maternal den (Blix and Lentfer 1979). Family groups emerge from dens in March and April when cubs are about three months old and able to survive outside weather conditions (Blix and Lentfer 1979, Amstrup 1995).

Newborn polar bears are very small, weighing approximately 0.6 kg (Blix and Lentfer 1979), and nurse from their hibernating mothers. Cubs grow quickly and may weigh 10-12 kg by the time they emerge from the den about three months later. Young bears stay with their mothers until weaned, which occurs most commonly in early spring when the cubs are 2.3 years of age. Female polar bears are available to breed again after cubs are weaned. Therefore, in most areas, the minimum successful reproductive interval for polar bears is 3 years (Schliebe et al. 2006).

Age of maturation of mammals is often associated with a threshold body mass (Sadleir 1969), and in polar bear populations it appears to be largely dependent on numbers and productivity of ringed seals. In the Beaufort Sea, ringed seal densities are lower in some areas of the Canadian High Arctic and Hudson Bay. As a possible consequence, female polar bears in the Beaufort Sea usually do not breed for the first time until they are 5 years of age (Lentfer and Hensel 1980), giving birth for the first time at 6 years of age.

Litter size and reproduction rates vary by geographic area and may change in response to hunting pressure, environmental factors, and other population perturbations. Litters of two cubs are common (Schliebe et al. 2006), with litters of three cubs occurring sporadically across the Arctic and most commonly reported in the Hudson Bay region (Stirling et al. 1977, Ramsay and Stirling 1988, Derocher and Stirling 1992). Average litter size across the species' range varied from 1.4 to 1.8 cubs (Schliebe et al. 2006), and several studies have linked reproduction to availability of seal prey, especially in the northern portion of their range. Body weights of mother polar bears and their cubs decreased markedly in the mid-1970s in the Beaufort Sea following a decline in ringed and bearded seal pup production (Stirling et al. 1976, 1977, Kingsley 1979, DeMaster et al. 1980, Stirling et al. 1982, Amstrup et al. 1986). Declines in reproductive parameters varied by region and year with ice conditions and the corresponding reduction in numbers and productivity of seals (Amstrup et al. 1986). In the Beaufort Sea, female polar bears produce a litter of cubs at an annual rate of 0.25 litters per adult female (Amstrup 1995).

Polar bear reproduction lends itself to early termination without extensive energetic investment by the female (Ramsay and Dunbrack 1986, Derocher and Stirling 1992). Female polar bears may defer reproduction in favor of survival when foraging conditions are difficult (Derocher et al. 1992). Repeated deferral of reproduction could cause a decline in populations with an intrinsically low rate of growth (Schliebe et al. 2006).

Life span and survivorship

Polar bears are long-lived animals; the oldest known female polar bear in the wild was 32 years and the oldest known male was 28, although few bears in the wild live beyond 20 years (Stirling 1990). Taylor and colleagues (unpublished data) described survival rates that generally increased by age class up to approximately 20 years of age (cubs-of-the-year, 35–75%; subadults 1–4 years, 63–98%; adults 5–20 years, 95–99%; and adults > 20 years 72–99%).

Survival of cubs is dependent upon their weight when they exit maternity dens (Derocher and Stirling 1992), and most cub mortality occurred early in the period immediately following emergence from the den (Amstrup and Durner 1995, Derocher and Stirling 1996), with early mortality generally associated with starvation (Derocher and Stirling 1996). Survival of cubs to the weaning stage (generally 27–28 months) is estimated to range from 15% to 56% of births (Schliebe et al. 2006). Subadult survival rates are poorly understood because telemetry collars cannot be used on rapidly growing individuals. Population age structure indicates subadults 2–5 years survive at lower rates than adults (Amstrup 1995), probably because their hunting and survival skills are not fully developed (Stirling and Latour 1978).

Eberhardt (1985) hypothesized adult survival rates must be in the upper 90% range to sustain polar bear populations. Studies using telemetry monitoring of individual animals (Amstrup and Durner 1995) estimated adult female survival in prime age groups may exceed 96%, and survival estimates are a reflection of the characteristics and qualities of an ecosystem to maintain the health of individual bears (Schliebe et al. 2006).

Abundance and Trends – Alaska Stocks

A reliable population estimate for the CBS stock currently does not exist (USFWS 2010b); however, the best available information at this time suggests a minimum population estimate of 2,000 (USFWS 2010b), based on extrapolation from multiple years of denning data for Wrangel Island in Russia and an assumed population denning rate (IUCN 2006 in USFWS 2010b). Reliable estimates of population size based upon mark and recapture studies are not available for this region. The combined Alaska–

Chukotka polar bear harvest is currently believed to exceed sustainable levels, and the status of the CBS polar bear population is considered uncertain or declining (Schliebe et al. 2006).

Estimates of the population size of the SBS were 1,778 from 1972 to 1983 (Amstrup et al. 1986), 1,480 in 1992 (Amstrup 1995), and 2,272 in 2001 (Amstrup, USGS unpublished data). Most recently, Regehr et al. (2006) estimated the SBS to be 1,526 (95% CI = 1,211–1,841), the most current and valid estimate of the SBS population (USFWS 2010c). Declining survival, recruitment, and body size (Regehr et al. 2006, 2007), low growth rates during years of reduced summer and fall sea ice (2004 and 2005), and an overall declining growth rate of 3% per year from 2001–2005 (Hunter et al. 2007), indicate the SBS stock population is declining (USFWS 2010c).

Declines in sea ice have occurred in optimal polar bear habitat in the southern Beaufort and Chukchi seas between 1985 to 1995 and 1996 to 2006, and the greatest declines in 21st century optimal polar bear habitat are predicted to occur in these areas (Durner et al. 2009). These stocks are vulnerable to large-scale dramatic seasonal fluctuations in ice movements which result in decreased abundance and access to prey, and increased energetic costs of hunting. The CBS and the SBS stocks are currently experiencing the initial effects of changes in sea ice conditions (Rode et al. 2010, Regehr et al. 2010, and Hunter et al. 2007). Regehr et al. (2010) found that the vital rates of polar bear survival, breeding rates, and cub survival declined with an increasing number of ice-free days/year over the continental shelf, and suggested that declining sea ice affects these vital rates via increased nutritional stress.

Polar bear critical habitat

The Service designated polar bear critical habitat on December 7, 2010 (USFWS 2010a). The Primary Constituent Elements (PCEs) of critical habitat for the polar bear are:

1) Sea ice habitat used for feeding, breeding, denning, and movement, which is further defined as sea ice over waters 300 m (984.2 ft) or less in depth that occurs over the continental shelf with adequate prey resources (primarily ringed and bearded seals) to support polar bears.
2) Terrestrial denning habitat, which includes topographic features, such as coastal bluffs and river banks, with suitable macrohabitat characteristics. Suitable macrohabitat characteristics are:
    a) Steep, stable slopes (range 15.5–50.0°), with heights ranging from 1.3 to 34 m (4.3 to 111.6 ft), and with water or relatively level ground below the slope and relatively flat terrain above the slope;
    b) Unobstructed, undisturbed access between den sites and the coast;
    c) Sea ice in proximity to terrestrial denning habitat prior to the onset of denning during the fall to provide access to terrestrial den sites; and
    d) The absence of disturbance from humans and human activities that might attract other polar bears.

3) Barrier island habitat used for denning, refuge from human disturbance, and movements along the coast to access maternal den and optimal feeding habitat, including all barrier islands along the Alaska coast and their associated spits, within the range of the polar bear in the United States, and the water, ice, and terrestrial habitat within 1.6 km (1 mi) of these islands (no-disturbance zone).

The Service designated three polar bear critical habitat units, which correspond to each of the three PCEs described above. The Sea Ice Unit covers approximately 179,508 mi^2 of primarily marine habitat extending from the mean high tide line of the Alaska coast seaward to the 300 m depth contour, and spans west to the international date line, north to the Exclusive Economic Zone, east to the US–Canada border, and south to the known distribution of the CBS polar bear population. Sea ice is used by polar bears for the majority of their life cycle for activities such as hunting seals, breeding, denning, and traveling (USFWS 2010a).

The Terrestrial Denning Unit covers approximately 5,657 mi^2 of land along the northern coast of Alaska from near Point Barrow east to the Canadian border. It encompasses approximately 95% of the known historical terrestrial den sites from the Southern Beaufort Sea (SBS) population (Durner et al. 2009). The inland extent of denning distinctly varies between two longitudinal zones, with 95% of the dens between the Kavik River and the Canadian border occurring within 20 miles of the mainland coast, and 95% of the dens between the Kavik River and Barrow occurring within 5 miles of the mainland coast.

The Barrier Island Unit covers approximately 4,083 mi^2 of barrier islands and the associated complex of spits, water, ice, and terrestrial habitats within one mile of barrier islands. There is significant overlap between this unit and both the terrestrial denning and sea ice units. The Barrier Island Unit follows a similar coastal extent as the Sea Ice Unit, from near Hooper's Bay in southwestern Alaska to near the Canadian Border.

Critical habitat does not include manmade structures (e.g., houses, gravel roads, generator plants, sewage treatment plants, hotels, docks, seawalls, pipelines) and the land on which they are located existing within the boundaries of designated critical habitat on the effective date of this rule.

Sea ice, including ice designated as critical habitat, is rapidly diminishing. Terrestrial denning locations in Alaska do not appear to be a limiting factor. However, rain-on-snow events may decrease den quality, and later onset of freeze-up in the fall may limit sea ice in proximity and therefore access to terrestrial denning habitat (USFWS 2008a). Erosion of barrier islands and the Arctic shoreline, presumably caused by climate change (Mars and Houseknecht 2007), may be changing terrestrial denning habitat by creating or destroying bluffs.

Human activities such as ground-based vehicular traffic and low-flying aircraft occur in polar bear critical habitat. These activities may temporarily create disturbance between den sites and the coast (e.g., disturbance from ice roads), and may temporarily degrade the ability of barrier island habitat from being a refuge from human disturbance. For example, vessels may need to use barrier islands to weather out a storm, and this may interfere with a polar bear's ability to use barrier islands for the same purpose. However, these activities are usually infrequent and have short-term effects.

7. ENVIRONMENTAL BASELINE

This section provides an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species or critical habitat within the Action Area.

Spectacled eiders

Status of spectacled eiders within the Action Area

Spectacled eiders are present in the Action Area from late May through late October. In summer, spectacled eiders are widely distributed near lakes or coastal margins throughout this area with a trend toward higher abundance towards the coast and within the Colville River Delta (Figure 4.1). On the Colville River Delta, west of the Nuna project area, surveys have indicated pre-nesting spectacled eiders significantly prefer brackish water, salt marsh, salt-killed tundra, deep open water with islands or polygonized margins, shallow open water with islands or polygonized margins, deep polygon complex, and grass (*Arctophyla fulva*) marsh habitats (Johnson et al. 2010 in Johnson et al. 2011). Preferred spectacled eider nesting habitat on the Colville River Delta includes deep polygon complexes and patterned wet meadow (Johnson et al. 2008a in Johnson et al. 2011), while spectacled eiders nested primarily in non-patterned wet meadows within wetland complexes containing emergent grasses and sedges in the Kuparuk oilfield (Anderson and Cooper 1994, Anderson et al. 2009), east of the project area. A single nest observed in the Nuna mapped area in 2001was located in an old basin wetland complex (Johnson et al. 2011). Preferred pre-nesting and nesting habitat for spectacled eiders in the project area is shown in Figure 4.2 (Figure 8 of the BA) and wildlife habitat in the project area are shown in Appendix D of the BA (Johnson et al. 2011). See the Nuna Project BA for additional a detailed description of spectacled eider habitat use in the Action Area.

The factors that have potentially contributed to the current status of spectacled eiders in the Action Area are discussed below and include environmental contaminants, increased predation, collisions with structures, and long-term habitat loss through development and disturbance.

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), and six of the seven tested had blood lead concentrations that indicated poisoning (>0.6

ppm lead); 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 Service reports good compliance in most areas with the lead shot prohibitions. Further, we expect the availability of lead shot in spectacled eider foraging habitat near within the Action Area to be substantially lower than in areas on the Colville River Delta (e.g. Impact Assessment, Inc. 1990), and elsewhere on the North Slope, that are used more frequently for waterfowl hunting.

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.

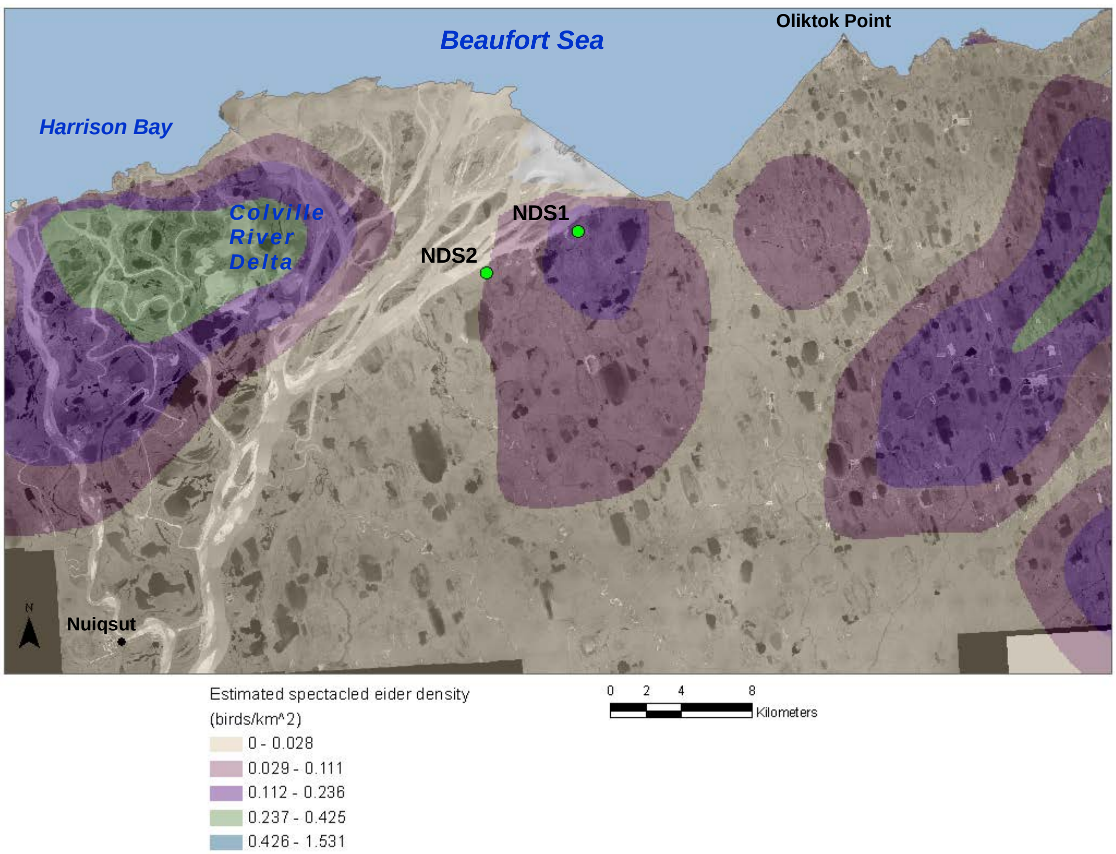

Figure 4.1. Estimated spectacled eider density in the Colville River Delta and project area. Density polygons are based on data collected during the 2007–2010 Arctic Coastal Plain aerial surveys (Larned et al. 2011). NDS1 and NDS2 are the locations of the two proposed Nuna Project drill sites.

Increased predator populations

There is some evidence that predator and scavenger populations have increased on the ACP near 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 (e.g., Day 1998). Although we expect corresponding increases in predation rates have also occurred, studies to substantiate the influence of increased predation on spectacled eiders are lacking. However, studies of Steller's eiders near Barrow have suggested a relationship between predation rates and breeding success (Quakenbush et al. 1995, Obritschkewitsch et al. 2001, Rojek 2008, Safine 2011).

Extensive oil and gas development within the Kuparuk River and Prudhoe Bay Units within and east of the Action Area may have influenced predator populations in the region. Although efforts by industry to manage food waste and discourage nesting on infrastructure have mitigated increases in predator population to an extent, it is possible that spectacled eiders have experienced increased predation rates within the Action Area.

Habitat loss through development and disturbance

Existing oil and gas industry developments in Kuparuk River Unit has resulted in long-term loss of spectacled eider breeding habitat in the Action Area directly through gravel fill and indirectly through disturbance from oilfield activities. Given the extent of development in this area, it is likely that eiders have experienced some loss of production resulting from direct and indirect habitat loss. However, the degree to which spectacled eiders can reproduce in disturbed areas or move to other less disturbed areas to reproduce, and the potential population level consequences of previous development in the Action Area, are unknown.

Climate change

Arctic landscapes are dominated by lakes and ponds (Quinlan et al. 2005), such as those used by spectacled eiders for feeding and brood rearing on Alaska's North Slope. Arctic regions 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). Productivity of some lakes and ponds appears to have increased as a result of nutrient inputs from thawing soil and increased annual 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 regimes have also altered the algal and invertebrate communities that form the basis of the food web in these systems (Smol et al. 2005, Quinlan et al. 2005) and may have resulted in mismatched timing between migration and the availability of food in Arctic ponds (Callaghan et al. 2004).

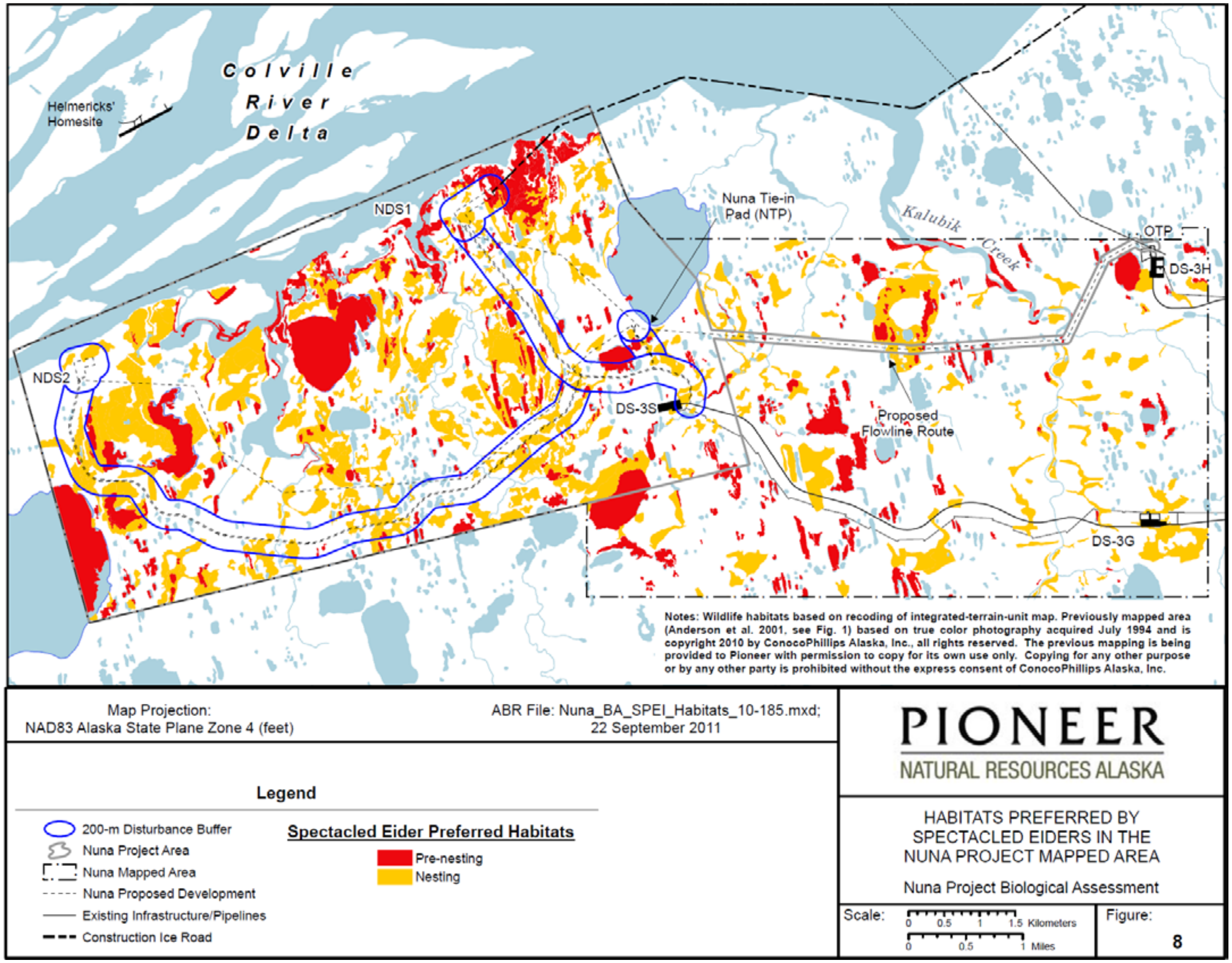

Figure 4.2. Habitats preferred by spectacled eiders in the Nuna Project mapped area. Source: Nuna Project BA (Johnson et al. 2011). Wildlife habitats in the mapped area are shown in Appendix D of the Nuna Project BA (Johnson et al. 2011). Pre-nesting habitats include brackish water, deep open water with islands or polygonized margins, grass marsh, salt marsh, salt-killed tundra, shallow open water with islands or polygonized margins. Nesting habitat is Patterned wet meadow (J. Lina, Pioneer, pers. comm.).

Regional activities requiring formal section 7 consultation

Activities on the eastern ACP that required formal section 7 consultations, and the estimated incidental take of listed eiders, is presented in Table 4.1. The table illustrates the number and diversity of actions that required consultation in the region. We believe these estimates have 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), and is dominated by the potential loss of eggs/ducklings, which we expect to have substantially lower population-level effects compared to adult mortality for this species (see further discussion in the conclusion).

Table 4.1 - Activities on the eastern Arctic Coastal Plain that required formal section 7 consultations and the amount of incidental take provided. Listed activities include those where effects to listed eiders may occur in the Colville River Delta east to the Sagavanirktok River.

Project Name	Impact Type	Estimated Incidental Take
Intra-Service, Issuance of Section 10 permits for spectacled eider (2000)	Disturbance Collection	10 spectacled eiders 10 spectacled eider eggs 25 spectacled eiders
Alpine Development Project (2004)	Habitat loss Collisions	4 spectacled eider eggs/ducklings 3 adult spectacled eiders
ABR Avian Research/USFWS Intra-Service Consultation (2005)	Disturbance	5 spectacled eider eggs/ducklings
Pioneer's Oooguruk Project (2006)	Habitat loss Collisions	3 spectacled eider eggs/ducklings 3 adult spectacled eiders
Intra-Service Consultation on MBM Avian Influenza Sampling in NPR-A (2006)	Disturbance	7 spectacled eider eggs/ducklings
KMG Nikaitchuq Project (2006)	Habitat loss Collisions	2 spectacled eiders/year 7 adult spectacled eiders
BP 69kV powerline between Z-Pad and GC 2 (2006)	Collisions	10 adult spectacled eiders
BP Liberty Project (2007)	Habitat loss Collisions	2 spectacled eider eggs/ducklings 1 adult spectacled eider
Intra-service on Subsistence Hunting Regulations (2007)	No estimate of incidental take provided	
BLM Programmatic on Summer Activities in NPR-A (2007)	Disturbance	21 spectacled eider eggs/ducklings
Intra-Service Consultation on MBM Avian Influenza Sampling in NPR-A (2007)	Disturbance	6 spectacled eider eggs/ducklings
Intra-service on Subsistence Hunting Regulations (2008)	No estimate of incidental take provided	
BLM Programmatic on Summer Activities in NPR-A (2008)	Disturbance	56 spectacled eider eggs/ducklings
BLM Northern Planning Areas of NPR-A (2008)	Disturbance Collision	87 spectacled eider eggs/ducklings/year 12 Steller's eider eggs/ducklings/year < 7 adult spectacled eiders < 1 adult Steller's eider

MBM/USFWS Intra-Service, Shorebird studies and white-fronted goose banding in NPR-A (2008)	Disturbance	21 spectacled eider eggs/ducklings
BP Alaska's Northstar Project (2009)	Collisions	≤ 2 adult spectacled eiders/year ≤ 1 adult Steller's eider/year
Intra-Service, Section 10 permit for USGS telemetry research on spectacled eider use of the Bering, Chukchi, and Beaufort Seas (2009; North Slope field sites)	Loss of Production Capture/surgery	130 spectacled eider eggs/ducklings 4 adult spectacled eiders
Intra-service on Subsistence Hunting Regulations (2009)	No estimate of incidental take provided	
BLM Programmatic on Summer Activities in NPR-A (2009)	Disturbance	49 spectacled eider eggs/ducklings
Minerals Management Service Beaufort and Chukchi Sea Program Area Lease Sales (2009)	Collision	12 adult spectacled eiders <1 adult Steller's eider
Intra-Service, Migratory Bird Subsistence Hunting Regulations (2010)	No estimate of incidental take provided	
Intra-Service, Section 10 permit for USGS telemetry research on spectacled eider use of the Bering, Chukchi, and Beaufort Seas (2010; North Slope field sites)	Loss of Production Capture/handling/ surgery	130 spectacled eider eggs/ducklings 7 adult/juvenile spectacled eiders (lethal take) 108 adult/juvenile spectacled eiders (non-lethal take)
BLM Programmatic on Summer Activities in NPR-A (2010)	Disturbance	32 Spectacled eider eggs
Intra-Service, USFWS Migratory Bird Management goose banding on the North Slope of Alaska (2010)	Disturbance	4 spectacled eider eggs/ducklings
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 Subsistence Hunting Regulations (2011)	Shooting	400 adult spectacled eiders (lethal take) 4 adult Steller's eiders (lethal take)
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, Section 10 permit for USGS telemetry research on spectacled eider use of the Bering, Chukchi, and Beaufort Seas (2011; Colville River Delta field site)	Capture/handling/ surgery	65 juvenile + 13 adult spectacled eiders (non-lethal take) 7 adult/juvenile spectacled eiders (lethal take)
ConocoPhillips Alaska, Inc's CD-5 Project (Alpine reinitiation; 2011)	Habitat loss	59 spectacled eider eggs/ducklings
Intra-Service, Migratory Bird Subsistence Hunting Regulations (2012)	Shooting	400 adult spectacled eiders (lethal take) 4 adult Steller's eiders (lethal take)

Polar bear

Status of polar bears in the Action Area

Polar bears spend the majority of their time on ice in waters over the productive continental shelf. Polar bears are generally widely and sparsely distributed across the Beaufort Sea. The SBS is distributed across the northern coasts of Alaska, and the Yukon, and Northwest territories of Canada. Declining survival, recruitment, and body size (Regehr et al. 2006, Regehr et al. 2010, Rode et al. 2010), and low population growth rates during years of reduced sea ice (2004 and 2005), and an overall declining population growth rate of 3% per year from 2001 to 2005 (Hunter et al. 2007) suggest that the SBS is now declining. The status of this stock is listed as 'reduced' by the IUCN (Obbard et al. 2010) and 'depleted' under the MMPA.

Unlike polar bears in eastern Canada, the Alaskan stocks do not currently spend extended periods of time on land (Garner et al. 1990), except land-denning females. Other members of the population (males, solitary females, and females with older cubs) remain active throughout winter. We expect non-denning bears to occasionally travel through the Action Area. Since 2006, 2 polar bear sightings have been observed at Pioneer's exiting OTP site, one in May 2007 and one in September 2008. Both sightings occurred without incident and without hazing, although one bear crossed the OTP (Johnson et al. 2011).

Maternal dens have been observed in the Action Area (Figure 4.2) and denning female polar bears probably occupy terrestrial denning habitat in the area at low densities.

Oil and gas development, hunting, environmental contaminants and climate change are the primary factors that have contributed to the environmental baseline for polar bears in the Action Area. These factors are discussed further below.

Oil and gas development

Extensive oil and gas development on Alaska's North Slope over the past several decades has likely altered polar bear use of these areas, including existing developments within the Kuparuk River Unit and Pioneer Oooguruk Project infrastructure which occur in the Action Area. Assessing the magnitude of these effects is difficult. It is reasonable to assume that some bears have been excluded from habitat that they may have otherwise used for movements along the coast and denning. However, documented impacts on polar bears by the oil and gas industry in Alaska during the past 30 years have been minimal. Polar bears have been encountered at or near most coastal and offshore production facilities, or along roads and causeways that link these facilities to the mainland. Interactions have been minimized by implementation of Incidental Take Regulations (ITRs) for the Beaufort Sea (USFWS 2006, 2011) and Chukchi Sea (USFWS 2008b) and the associated Letters of Authorization (LOAs) issued under the MMPA. The ITRs only authorize non-lethal incidental take. As part of the LOAs issued pursuant to these regulations, the oil and gas industry is required to report the number of polar bears observed, their response, and if deterrence activities were required (see below). Recent data from the region regulated under the Beaufort Sea ITRs indicate an average of 306 polar bears are observed annually by the oil and gas industry (range 170–420; 2006–

2009). About 81% of these bears showed no change in their behavior, 4% altered their behavior by moving away from (or towards) the industrial activity, while the remaining 15% were intentionally harassed (hazed) to actively deter the bears.

Lethal take associated with the oil and gas industry has occurred on only one occasion during the periods covered by the Chukchi Sea (1991–1996 and 2008–present) and Beaufort Sea (1993–present) ITRs, when a polar bear was accidentally killed in August 2011 due to the misuse of a firecracker round. Prior to issuance of these regulations, lethal takes of adults by industry in Alaska were also rare with two known occurrences since 1968.

Formal section 7 consultations have been conducted for the Chukchi Sea and Beaufort Sea ITRs, which authorize the incidental, unintentional taking of a small number of polar bears in these seas and the adjacent western and northern coasts of Alaska during oil and gas activities in arctic Alaska. These consultations and their conclusions were considered in the jeopardy analysis of this BO.

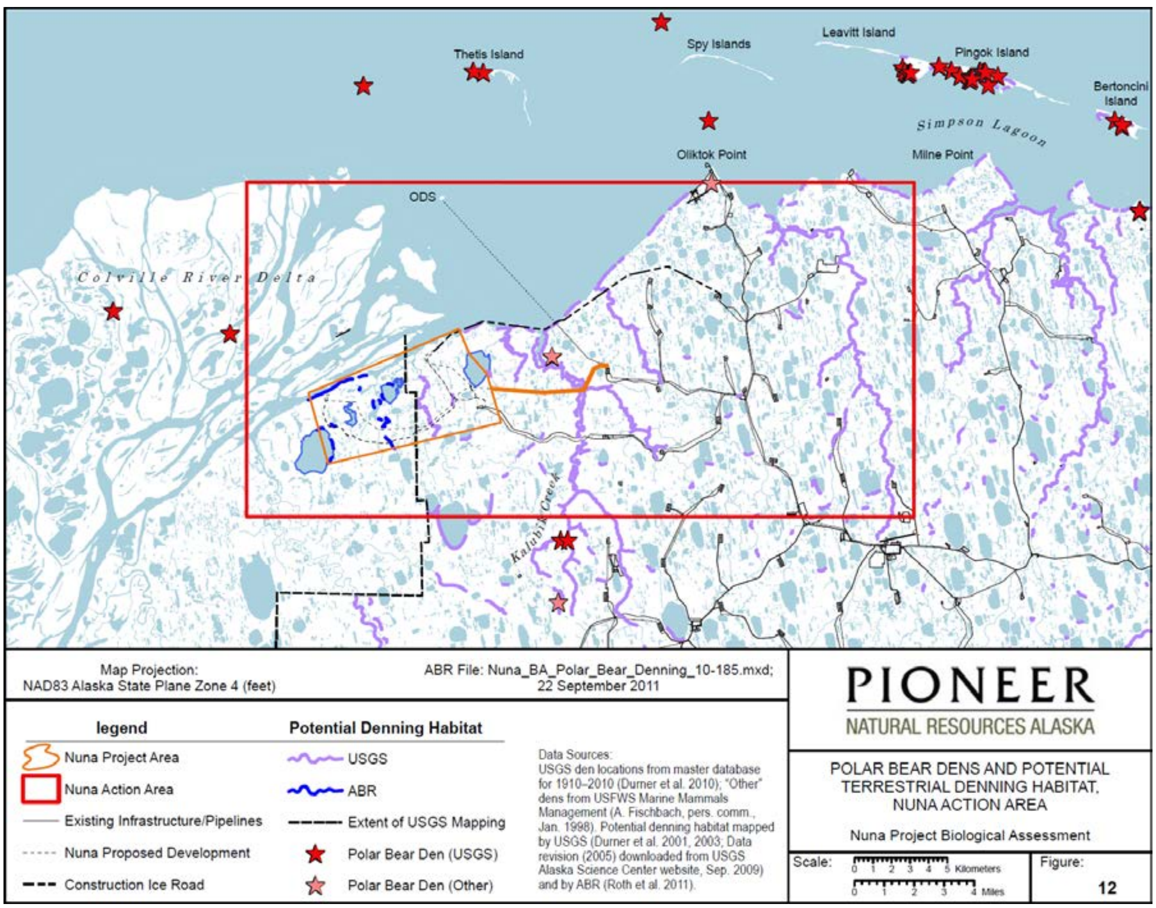

Figure 4.3. Polar bear dens and potential terrestrial denning habitat in the Nuna Action Area. Source: Nuna Project BA (Johnson et al. 2011).

Hunting

Prior to the 1950s, most hunting was by indigenous people for subsistence purposes. Increased sport hunting in the 1950s and 1960s resulted in population declines (Prestrud and Stirling 1994). International concern about the status of polar bears resulted in biologists from the five polar bear range nations forming the Polar Bear Specialist Group (PBSG) within the IUCN SSC (Servheen et al. 1999). The PBSG was largely responsible for the development and ratification of the 1973 International Agreement on the Conservation of Polar Bears (1973 Polar Bear Agreement), which called for international management of polar bear populations based on sound conservation practices. It prohibits polar bear hunting except by local people using traditional methods, calls for protection of females and denning bears, and bans use of aircraft and large motorized vessels to hunt polar bears. The PBSG meets every 3-5 years to review all aspects of polar bears science and management, including harvest management.

Additionally, since passage of the MMPA in 1972 (MMPA), the sport hunting of polar bears in the United States has ceased. However, the MMPA provides a special exemption to Coastal dwelling Alaska Natives who may continue to take polar bears for subsistence or handicraft purposes. Currently, under the MMPA, there are no restrictions on the number, season, or age of polar bears that can be harvested by Alaska Natives. However, there is a more restrictive Native-to-Native agreement between Inupiat from Alaska and Inuvialuit in Canada that was developed in 1988. Regulation of this harvest, which is considered sustainable, is based upon a voluntary harvest agreement between the Inuvialuit of Canada and the Inupiat of Alaska, who share subsistence hunting traditions within the range of the SBS. The Inuvialuit-Inupiat Polar Bear Management Agreement established quotas and recommendations concerning protection of denning females, family groups, and methods of take. Commissioners for the Inuvialuit-Inupiat Agreement set the original quota at 76 bears in 1988, and it was later increased to 80. At the Inuvialuit-Inupiat Polar Bear Management Meeting in July 2010, the quota was again reduced from 80 to 70 bears per year. The Native subsistence harvest from the SBS has averaged 36 bears removed per year (USFWS 2011b). During the period 2005–2009, six polar bears were harvested by residents of Nuiqsut (USFWS 2011b), which is located near the Action Area.

Environmental contaminants

Three main types of contaminants in the Arctic are thought to present the greatest potential threat to polar bears and other marine mammals: petroleum hydrocarbons, persistent organic pollutants (POPs), and heavy metals.

Potential exposure of polar bears to petroleum hydrocarbons comes from direct contact and ingestion of crude oil and refined products from acute and chronic oil spills. Polar bear range overlaps with many active and planned oil and gas operations within 40 km (25 mi) of the coast or offshore (Schliebe et al. 2006). Polar bears occurring in the Action Area may have been exposed to petroleum hydrocarbons associated with oil and gas industry operations in developed areas of the North Slope.

Contamination of the Arctic and sub-Arctic regions through long-range transport of pollutants has been recognized for over 30 years (Bowes and Jonkel 1975, Proshutinsky and Johnson 2001, Lie et al. 2003). The Arctic ecosystem is particularly sensitive to environmental contamination due to the slower rate of breakdown of POPs, including organochlorine compounds (OCs), relatively simple food chains, and the presence of long-lived organisms with low rates of reproduction and high lipid levels. The persistence and lipophilic nature of organochlorines increase the potential for bioaccumulation and biomagnification at higher trophic levels (Fisk et al. 2001). The highest concentrations of OCs have been found in species at the top of the marine food chains such as glaucous gulls, which scavenge on marine mammals, and polar bears, which feed primarily on seals (Braune et al. 2005). Consistent patterns between OC and mercury contamination and trophic status have been documented in Arctic marine food webs (Braune et al. 2005).

Climate change

Warming-induced habitat degradation and loss are negatively affecting some polar bear stocks, and unabated global warming will ultimately reduce the worldwide polar bear population (Obbard et al. 2010). Loss of sea ice habitat due to climate change is identified as the primary threat to polar bears (Schliebe et al. 2006, USFWS 2008a, Obbard et al. 2010). Patterns of increased temperatures, earlier spring thaw, later fall freeze-up, increased rain-on-snow events (which can cause dens to collapse), and potential reductions in snowfall are also occurring. In addition, positive feedback systems (i.e., sea-ice albedo) and naturally occurring events, such as warm water intrusion into the Arctic and changing atmospheric wind patterns, can amplify the effects of these phenomena. As a result, there is fragmentation of sea ice, reduction in the extent and area of sea ice in all seasons, retraction of sea ice away from productive continental shelf areas throughout the polar basin, reduction of the amount of heavier and more stable multi-year ice, and declining thickness and quality of shore-fast ice (Parkinson et al. 1999, Rothrock et al. 1999, Comiso 2003, Fowler et al. 2004, Lindsay and Zhang 2005, Holland et al. 2006, Comiso 2006, Serreze et al. 2007, Stroeve et al. 2008). These climatic phenomena may also affect seal abundances, the polar bear's main food source (Kingsley 1979, DeMaster et al. 1980, Amstrup et al. 1986, Stirling 2002). However, threats to polar bears will likely occur at different rates and times across their range, and uncertainty regarding their prediction makes management difficult (Obbard et al. 2010).

In 2007, a USGS science team released 9 reports[3] to the Service that included (1) new observational data on polar bears, including updated information on the current status of 3 of the world's 19 subpopulations of polar bears, and (2) projections of the future distribution and abundance of polar bears in the rest of the 21st century, given changes expected in future sea ice conditions. The overall conclusion of the USGS research effort was that if projected changes in future sea ice conditions are realized, approximately two-thirds of the world's current polar bear population will be lost by the mid-21st century. Because the observed trajectory of Arctic sea ice decline appears to be underestimated by currently available models, this assessment of future polar bear status may be conservative (Amstrup et al. 2007).

[3] Reports are available at: http://www.usgs.gov/newsroom/special/polar_bears/.

While climate change will have the largest impact on polar bears in the marine environment, it may also lead to changes in use and vulnerability of polar bears in the terrestrial environment. An estimated > 60% of females from the SBS stock den on land, with the remaining bears denning on drifting pack ice (Fischbach et al. 2007). Durner et al. (2006) noted that ice must be stable for ice-denning females to be successful. As climate change continues, the quality of sea ice may decrease, forcing more females to den on land (Durner et al. 2006). However, if large areas of open water persist until late winter due to a decrease in the extent of the pack ice, females may be unable to access land to den (Stirling and Andriashek 1992).

Climate change may affect the availability and quality of denning habitat on land. Durner et al. (2006) found that 65% of terrestrial dens found in Alaska between 1981 and 2005 were on coastal or island bluffs. These areas are suffering rapid erosion and slope failure as permafrost melts and wave action increases in duration and magnitude. In all areas, dens are constructed in autumn snowdrifts (Durner et al. 2003). Changes in autumn and winter precipitation or wind patterns (Hinzman et al. 2005) could significantly alter the availability and quality of denning habitat.

Polar bears' use of coastal habitats in the fall during open-water and freeze-up conditions has increased since 1992 (USFWS 2006). This may increase the number of human – polar bear interactions if bears occur close to human settlements or development. Amstrup (2000) observed that direct interactions between people and bears in Alaska have increased markedly in recent years. The number of bears taken for safety reasons, based on three-year running averages, increased steadily from about 3-per-year in 1993, to about 12 in 1998, and has averaged about 10 in recent years. There are several plausible explanations for this increase. It could be an artifact of increased reporting, or of increased polar bear abundance and corresponding probability of interactions with humans. Alternatively, or in combination, polar bears from the SBS population typically move from the pack ice to the near shore environment in the fall to take advantage of the higher productivity of ice seals over the continental shelf. In the 1980s and early 1990s, the near shore environment would have been frozen by early or mid-October, allowing polar bears to effectively access seals in the area. Since the late 1990s, the timing of ice formation in the fall has occurred later in November or early December, resulting in an increased amount of time that the area was not accessible to polar bears. Consequently, bears spent a greater amount of time on land and not feeding. The later formation of near-shore ice increases the probability of bear-human interactions occurring in coastal villages (Schliebe et al. 2006). Some experts predict the number of polar bear–human interactions will increase as climate change continues (Derocher et al. 2004).

Summary

Primary threats to polar bears in the Action Area relate to increased use of coastal habitats by non-denning bears and increased use of maternal denning habitat on land resulting from climate change, which exposes polar bears to the effects of human activities in these areas with greater frequency. While other stressors exist and are managed, they are not currently thought to be significant threats to polar bear populations; however, each of these factors could become more significant in combination with future effects of climate change and the resultant loss of sea ice.

Polar bear critical habitat

Status of polar bear critical habitat in the Action Area

The Action Area encompasses portions of each of the three polar bear critical habitat PCEs/Units. Activities primarily occur within the Terrestrial Denning Unit (Figure 4.3). Localized effects to critical habitat in the Action Area have been small in scale and include potential disturbance from existing oil and gas infrastructure. At a larger spatial scale, globally distributed pollutants and climate change have diminished the quality of polar bear critical habitat; however, estimating the magnitude of these effects within the Action Area is difficult. These factors are discussed in further detail below.

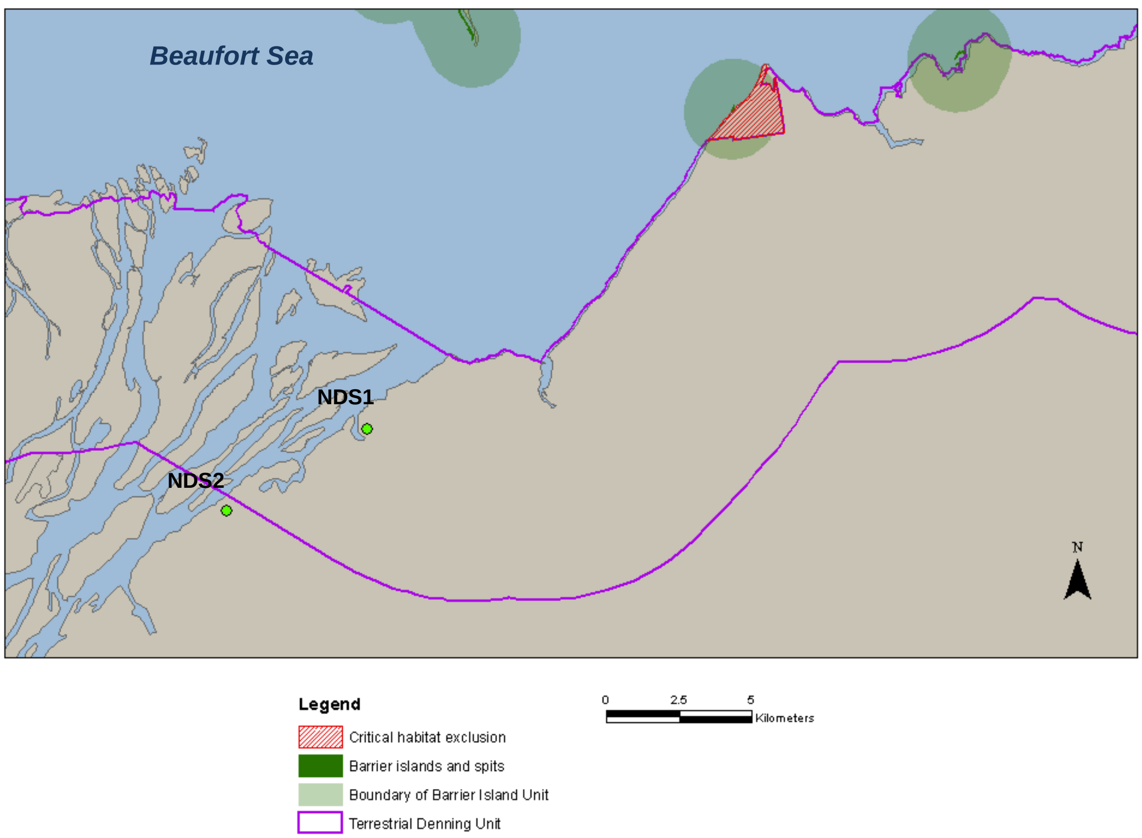

Figure 4.4. Polar bear critical habitat in the Nuna Project area. The Terrestrial Denning Unit, as delineated in the project area, includes terrestrial habitat within 8 km (5 mi) inland from the Beaufort Sea coast. The Barrier Island Unit includes barrier islands, spits, and a 1.6 km zone of adjacent aquatic and terrestrial habitats. The Sea Ice Unit is not shown.

Habitat loss and disturbance from oil and gas development
Most of polar bear critical habitat has not been subject to oil and gas development; however, the Action Area has experienced development in recent decades. Manmade structures existing on the effective date of the final critical habitat rule, January 6, 2011, and the land on which they are located are excluded from critical habitat. However, human activities (e.g., noise produced by equipment and visual stimuli) at these facilities may interfere with the capability of critical habitat adjacent to facilities to provide their intended function. For example, polar bears may alter travel routes to avoid these facilities, and avoid denning, hunting, and resting near them. Interactions and adverse effects to polar bears from these existing oil and gas activities have been minimized by implementation of the Beaufort Sea ITRs (USFWS 2006, 2011) promulgated under the MMPA. We expect that measures implemented to minimize incidental take of polar bears under these MMPA authorizations have also minimized effects to the conservation role of polar bear critical habitat in the Action Area.

Environmental contaminants
Exposure to environmental contaminants may affect polar bear survival or reproduction. Thus, the presence of contaminants within polar bear critical habitat could affect the conservation value of the habitat. Three main types of contaminants in the Arctic are thought to pose the greatest potential threat to polar bears: petroleum hydrocarbons, persistent organic pollutants (POPs), and heavy metals.

Petroleum hydrocarbon contamination from oil and gas development has had a limited effect on the environmental baseline of polar bear critical habitat. A single large spill has been reported for the Chukchi and Beaufort seas. In August 1988, 68,000 gallons (1,619 barrels) of heating fuel were spilled 3–6 miles north of the barrier islands off Brownlow Point by a barge tanker enroute to Kaktovik. No large oil spills from oil and gas activities have occurred in arctic Alaska. Small spills have occurred in terrestrial areas, but have affected a limited area.

Contamination of the Arctic and sub-Arctic regions through long-range transport of pollutants has been recognized for over 30 years (Bowes and Jonkel 1975, Proshutinsky and Johnson 2001, Lie et al. 2003). Arctic ecosystems are particularly sensitive to environmental contamination due to the slower rate of breakdown of POPs, including organochlorine compounds (OCs), relatively simple food chains, and the presence of long-lived organisms with low rates of reproduction and high lipid levels that favor bioaccumulation and biomagnification. Consistent patterns between OC and mercury contamination and trophic status have been documented in Arctic marine food webs (Braune et al. 2005). Presumably, these characteristics have affected the capacity of polar bear critical habitat to support polar bears, although is difficult to estimate the extent of impairment.

Climate change
Climate change is contributing to the rapid decline of sea ice throughout the arctic, and some of the largest declines are predicted to occur in the Chukchi and southern Beaufort Seas (Durner et al. 2009 *in* USFWS 2010a). This directly affects the sea ice PCE, which

provides feeding, breeding, denning, and traveling habitat for polar bears. The decrease in the quality and quantity of sea ice may increase the importance of barrier island and terrestrial habitat for foraging, denning, and resting. For example, Schliebe et al. (2006) demonstrated an increasing trend in the number of observed polar bears using terrestrial habitats in the fall. Additionally, Fischbach et al. (2007) hypothesized that reduced availability of older, more stable sea ice is contributing to the observed decrease in the proportion of female polar bears denning on sea ice in northern Alaska.

Climate change may also affect the availability and quality of denning habitat on land. Durner et al. (2006) found that 65% of terrestrial dens found in Alaska between 1981 and 2005 were on coastal or island bluffs. These areas are suffering rapid erosion and slope failure as permafrost melts and wave action increases in duration and magnitude. In all areas, dens are constructed in autumn snowdrifts (Durner et al. 2003). Changes in autumn and winter precipitation or wind patterns (Hinzman et al. 2005) could significantly alter the availability and quality of snow drifts for denning.

8. 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, 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.

Effects to spectacled eiders

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

Collisions with structures

Migratory birds suffer considerable mortality from collisions with man-made structures (Manville 2004). Birds are particularly at risk of collision when visibility is impaired by darkness or inclement weather (Weir 1976). There is also evidence that lights on structures increase collision risk (Reed et al., 1995, Russell, 2005, numerous authors cited by Manville 2000). Anderson and Murphy (1988) monitored bird behavior and strikes to a 12.5 km power line in the Lisburn area (the southern portion of the Prudhoe Bay oil fields) during 1986 and 1987. They observed 25 different species of birds including spectacled eiders. Results indicated that strike rate was related to flight behavior, in particular the height of flight. Johnson and Richardson (1982) in their study of migratory behavior along the Beaufort Sea coast reported that 88% of eiders flew below an estimated altitude of 10 m (32 ft) and well over half flew below 5 m (16 ft). This tendency to fly low puts eiders at risk of striking objects in their path. A literature review by Day et al. (2005) also suggested that eider species maybe particularly susceptible to collisions with offshore structures as they fly low and at relatively high speed (~45 mph).

Eiders migrating east during spring and west during summer/fall migration periods would be at risk of colliding with Nuna structures. These include buildings; the 53.3-m (175-ft) drill rig, which is estimated to be in operation for 5.5 years between the two sites; temporary aboveground pipe-racks associated with drilling; and the communication tower at each drill site. However, we expect most eiders to remain offshore during spring migration because they are thought to follow open water leads in the pack ice during their spring migration to the breeding grounds (Woodby and Divoky 1982, Johnson and Richardson 1982, Oppel et al. 2009, M. Sexson, USGS, pers. comm.). During post-breeding migration in summer and fall, we anticipate that male eiders would have the greatest collision risk in the Action Area. Satellite telemetry studies from the eastern ACP indicated that male spectacled eiders departed early in the summer and generally remained close to shore, sometimes crossing overland, during westward migration (TERA 2002; see also Petersen et al. 1999). However, we anticipate that the collision risk for spectacled eiders migrating through the Action Area in early summer would be greatly reduced by the improved visibility of structures during the 24 hours of daylight in the project area from mid-May through late July. When females and juveniles migrate during late summer/fall, decreasing daylight and more frequent exposure to foggy weather conditions could increase collision risk. Longer nights increase the time that eiders are vulnerable to collision with unseen structures, and may increase susceptibility to attraction or disorientation from lights. However, we anticipate these birds are also more likely to migrate over open water in the Beaufort Sea (Petersen et al. 1999, TERA 2002), avoiding the inland Nuna structures. Risks are further reduced by design features which reduce outward-radiating light, minimizing the potential disorienting effects to eiders from facility lighting. Thus we anticipate there would be a very low risk of spectacled eider mortality from collisions with project infrastructure.

In summary, we anticipate the likelihood of collisions of spectacled eiders with proposed structures would be very low given 1) improved visibility of structures in late-spring and early summer; 2) the tendency of migrating eiders to fly further offshore in late summer and fall, when eiders would be more vulnerable to collisions; and 3) lighting design would reduce the potential for disorientation of flying eiders. We also note that no collisions of spectacled eiders have been observed to date since monitoring began in 2007 at Pioneer's existing Oooguruk facilities, which include both onshore and offshore structures.

Increased predator populations

There is some evidence that predator and scavenger populations have increased near villages and industrial infrastructure on the ACP (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 numbers of arctic foxes (*Vulpes lagopus*), common ravens (*Corvus corax*), and glaucous gulls (*Larus hyperboreus*) in developed areas of the ACP (e.g., Day 1998). Foxes are important predators of ground-nesting birds in the Prudhoe Bay Oilfield (Liebezeit and Zack 2008, 2010) and appear to occur at higher densities in the Prudhoe Bay region compared to adjacent areas outside of the oil fields (see review in Burgess 2000). Ravens appear to have expanded their breeding range on the North Slope by utilizing buildings and other manmade structures for nest sites (Day 1998). Day (1998) interviewed a number of biologists who work on the North Slope and many felt that ravens may be highly efficient egg predators. Ravens were observed depredating 5 Steller's eider nests near Barrow during 5 nesting years[4] between 1992 and 1999 (Quakenbush et al. 2004). In 2010, Liebezeit and Zack (2010) observed the highest number of ravens since their long-term studies of tundra-nesting birds in the Prudhoe Bay Oilfield began in 2003.

Estimating the effects of predators on spectacled eider production in the Action Area is extremely difficult. We expect structures associated with the Nuna Project would increase the number of potential nesting and perching sites for ravens in the local area and increased availability of anthropogenic food resources for predators may also occur in the project area. However, we anticipate that management of raven nest sites and potential food sources for ravens and foxes through the Wildlife Interaction and Waste Management Plans would be effective in reducing potential increases in predator productivity and depredation of spectacled eider nests. Provided these plans are followed, we anticipate adverse effects to spectacled eiders from increased predator populations would be minimal.

Oil spills

We expect a very low number of spectacled eiders could be potentially exposed to oil in the event of a spill because they occur at low densities in the Action Area (see subsequent discussion on long-term habitat loss) and risks to eiders associated with spills would be reduced by spill prevention and containment measures. Therefore, we anticipate potential adverse effects to spectacled eiders from oil spills would be minimal.

Long-term habitat loss

[4] Steller's eiders have highly variable nesting effort among years and nests are not detected near Barrow in about 50% of years.

Direct habitat loss will result from placement of gravel to construct the NDS1 (21.9 acres), NDS2 (12.6 acres), the NTP pad (0.5 acres), and access roads (67.7 acres). This area of gravel fill would be rendered permanently unavailable as breeding habitat for eiders.

We do not anticipate significant long-term habitat loss to result from ice road construction or operations. There have been several studies on impacts of ice road construction to different tundra types. Overall, these studies found impacts from ice roads are low, with occasional areas of moderate level impacts (Pullman et. al. 2003). In one survey, damage occurred on higher, drier sites with little or no damage observed in wet or moist tundra areas (Payne et al. 2003, cited by Pullman et. al. 2003). Jorgenson (1999) found impacts were limited to isolated patches of scuffed high microsites and crushed tussocks. McKendrick (2003) studied several riparian willow areas and found while branches were damaged the plants remained viable.

We also anticipate that indirect habitat loss will occur within a 200-m (656.17-ft) zone of influence surrounding new development through disturbance from on-pad activities, road operations, and flowline maintenance.

The two principal mechanisms through which disturbance can adversely affect eiders on their breeding grounds are:

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

In the discussion below, we provide an assessment of potential loss of spectacled eider production resulting from the proposed Action. This assessment uses updated estimates of spectacled eider density in the Action Area based on recent 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. Distributions on a local scale may vary based on the availability of preferred habitats.

Direct loss of habitat would occur by placement of gravel onto approximately 103 acres (0.42 km^2) of tundra wetlands during construction of the pads and access road. We expect indirect habitat loss will occur through displacement of eiders within a 200-m zone of influence surrounding gravel pads, gravel roads, and the flowlines. The area encompassed by the zone of influence, or the area of total habitat loss, is estimated to be 3,812 acres (15.43 km^2). This estimate is likely conservative because flowlines represent a substantial portion (53%) of the estimated area of habitat loss and we expect eiders nesting within 200 m of flowlines would be exposed to lower levels of disturbance in most years compared to those nesting near gravel roads and pads.

Spectacled eider density polygons constructed from data collected during the 2007–2010 waterfowl breeding population survey of the ACP (Larned et al. 2011; Figure 4.1) provide our best estimate of spectacled eider nesting effort in the Action Area. These surveys were conducted at a broad spatial scale relative to the Action Area. Eider counts were not corrected for visibility. Predicted spectacled eider density in the Action Area ranged from 0 to 0.236 birds/km^2 (Figure 4.1). We multiplied the median predicted density in the Action Area (0.118 birds/km^2) by the estimated affected area (15.43 km^2) to estimate the potential number of spectacled eider pairs displaced by the proposed Action per year. We assume the estimated number of pairs displaced is equivalent to the number of nests or young broods that may be affected. We also assume that spectacled eiders will be present and attempt to nest annually in the Action Area. 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).

Loss of production of up to 1 nest or 4 eggs/ducklings per year was estimated as follows:

0.118 birds/km^2 × 0.5 nests/pair × 15.43 km^2 = 0.91 nests per year

1 nest × 3.9 eggs or ducklings per nest = 3.9 eggs or ducklings per year

Loss of production of 28 nests or 110 eggs/ducklings over an assumed 31-year project life[5] was estimated as follows:

0.118 birds/km^2 × 0.5 nests/pair × 15.43 km^2 × 31 years = 28.22 nests over 31 years

29 nests × 3.9 eggs or ducklings per nest = 113.1 eggs or ducklings over 31 years

To summarize, we estimate that the proposed Action will result in the loss of 4 spectacled eider eggs or ducklings per year or 114 eggs or ducklings over an assumed 31-year project life through direct loss of breeding habitat and disturbance within a 200-m zone of influence surrounding the project infrastructure within the Action Area. These estimates are based on a series of conservative assumptions and represent the worst case scenario or maximum potential impact to spectacled eiders.

Polar Bears

Adverse effects polar bears could result from the proposed Action primarily through disturbance, increased polar bear–human interactions, and habitat loss.

Denning polar bears

Female polar bears entering dens, or females in dens with cubs, are more sensitive than other age and sex groups to noises (USFWS 2011b). Females appear more likely to abandon their dens in the fall before cubs are born and relocate if disturbed (Lentfer and Hensel 1980, Amstrup 1993), than in the spring when young cubs may not survive if they leave the maternal den early (Amstrup and Gardner 1994)). Industrial noise and activities

[5] One year of construction plus an estimated 30-year field life.

that commence after a female has denned may cause a female to abandon the den site prematurely, before the altricial cubs have developed enough to survive outside the den. Post-emergence, females and cubs spend an average of 8 days in the area before the den site is abandoned (USGS data cited by USFWS 2006). These family groups may be particularly susceptible to disturbance.

Behavioral responses of individual denning females and family groups to disturbance is variable. While observations of den abandonment associated with industry activities have been reported from northern Alaska (see review in USFWS 2011b), available data indicates such events have been infrequent and isolated (USFWS 2011b) and some studies have reported individual denning polar bears to be tolerant of human disturbance (e.g., Amstrup 1993, Smith et al. 2007). Additionally, USFWS (2011b) reported three examples (2006, 2009, and 2010) of pregnant female bears establishing dens prior to the onset of oil industry activity within 400 m (1,312 ft) of the den site and remaining in the den through the normal denning cycle.

Available data indicate polar bears den at low densities in the Action Area. However, use of terrestrial denning habitat by the SBS stock may increase in the future in response to changes in sea ice habitat (Durner et al. 2006). Den abandonment would be most likely to occur during construction activities because ongoing activities during routine operations would allow more sensitive bears to select an alternative den site. However, Pioneer has indicated they would conduct den surveys using FLIR sensors before beginning construction of roads and pads for the Nuna Project in compliance with LOAs issued for the project under the Beaufort Sea ITRs and the project's polar bear interaction plan. If dens are detected within 1.6 km of the proposed locations of ice roads and pads, then the USFWS will be contacted for guidance; if dens are discovered after ice roads and pads are built, then traffic restrictions and emergency closures would be instituted as determined in consultation with the USFWS Marine Mammals Management office.

Disturbance to non-denning bears

Operations at the drill sites and tie-in pads and along flowlines may disturb and displace individual polar bears from the immediate area. There is, however, some evidence that polar bears exposed to routine industrial noises may acclimate to those noises and show less vigilance than bears not exposed to such stimuli (Smith et al. 2007).

The Service expects that potential adverse effects to polar bears will be reduced further by the applicant's compliance with existing and future authorizations issued under the MMPA, such as LOAs issued under the Beaufort Sea ITRs. Disturbance that disrupts behavioral patterns of polar bears is classified as take under the MMPA. The MMPA prohibits incidental take of marine mammals unless specific ITRs have been promulgated under section 101(a)(5) of the MMPA and a subsequent LOA has been issued. Under the MMPA, incidental take is only permitted provided the total of such taking will have no more than a negligible impact[6] on the marine mammal species (or stock in the case of the

[6] Negligible impact - an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.

Beaufort Sea ITRs), and does not have an unmitigable adverse impact[7] on the availability of these species for subsistence uses. Additional information on measures implemented under these regulations to reduce effects to polar bears from oil and gas industry activities can be found in the BO for the 2011 Beaufort Sea ITRs (USFWS 2011c).

Disturbance from helicopters

Occasional helicopter overflights and landings to access flowlines and other structures is not anticipated to adversely affect polar bears in the Action Area. Amstrup (1993) studied the response of denning bears to research aircraft (altitude 150–500 m) and found no detectable motion among collared bears in their dens when flights took place. In two of 40 observations, bears did abandon open dens in response to helicopters prior to capture by researchers (Amstrup 1993). Reactions of non-denning polar bears appear limited to short-term changes in behavior.

Increased polar bear–human interactions

Polar bear–human encounters can be dangerous for both the polar bear and human. For the bear, a human encounter may result in it being hazed from the area or, in the worst case, killed in defense of life and property. While loud noises may deter bears from entering an area of operation, polar bears are curious and commonly approach noise sources, such as industrial sites (Stirling 1988).

Polar bear deterrence activities associated with oil and gas and other activities occur regularly in the Action Area. From August 2006 through July 2010, the oil and gas industry working in the Beaufort Sea or its adjacent coast reported the sightings of 1,414 polar bears, of which 209 (15%) were intentionally harassed, or deterred (C. Perham, pers. comm.). Annually, the percent of total bears sighted that were deterred ranged from ranged from 9% in 2010 to 43% in 2006, with an average of 15%. Since monitoring began at Pioneer's existing OTP in 2006, one polar bear was observed in May 2007 and another in September 2008 (Johnson et al. 2011). Neither bear was hazed, although one crossed the OTP (Johnson et al. 2011).

Authorization to harass (haze) polar bears may be requested under section 112(c), and/or 101(a)(4)(A) of the MMPA, which allows the Service to set up cooperative agreements with industry or other publics, and under sections 109(h) which states that a person may take a marine mammal in a humane manner if such taking is for: (a) protection or welfare of the mammal; (b) protection of public health and welfare; or (c) non-lethal removal of nuisance animals. This type of action is considered Level B Harassment[8]. Although

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[7] Unmitigable adverse impact - is an impact resulting from the specified activity (1) that is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by (i) causing the marine mammals to abandon or avoid hunting areas, (ii) directly displacing subsistence users, or (iii) placing physical barriers between the marine mammals and the subsistence hunters; and (2) that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

[8] Level B Harassment - has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing,

hazing may have some short term adverse effects by displacing a bear, the safe removal of a bear to non-industrial areas may prevent more serious impacts to the bear possibly including lethal take in defense of life and property. Since the implementation of ITRs, LOAs, and authorization of intentional take, only two polar bears are known to have been killed due to encounters with industry on the North Slope of Alaska. In contrast, 33 polar bears were killed in the Canadian Northwest Territories from 1976 to 1986 during encounters with industry (Stenhouse et al. 1988).

The Service also consulted previously on a Final Rule regarding passive and preventative deterrence measures that any person can use (e.g., acoustical and vehicular deterrence) when working in polar bear habitat (USFWS 2010d). The Service concluded that these methods are likely to cause, at most, only short-term changes in behavior, such as bears running away from the disturbance (USFWS 2010d).

Habitat Loss
Habitat loss would occur through the construction of gravel pads and roads and flowlines, impacting approximately 0.42 km^2 (103 acres) of tundra within the Action Area. Polar bears use coastal areas for denning, hunting, and travel corridors, and we expect with changing ice patterns more polar bears would be encountered on land in the future. Oil infrastructure on the North Slope is not thought to significantly interfere with movements of non-denning bears.

Terrestrial dens in Alaska are sparsely distributed along a narrow coastal strip, with observations up to 61 km (37.9 mi) inland (Amstrup and Gardner 1994). Denning habitat includes coastal bluffs, along river banks, and bluffs where snow accumulates early (Durner et al. 2003). It is possible a small amount of potential denning habitat may be destroyed or altered by project activities; however, denning habitat is not limiting population size, and adverse effects from habitat loss are not anticipated (C. Perham, pers. comm. in USFWS 2008c).

Oil Spills
Oil and toxic substance spills may result from the proposed Action, and oil is known to be highly toxic to polar bears (St. Aubin 1990). Bears can be affected by contacting spilled oil or ingesting contaminated prey (Stirling 1990). The size, location, and timing of a spill will determine the number of polar bears affected.

Polar bears are sparsely distributed in the Action Area. Thus, a small spill on the tundra is unlikely to contact polar bears, even if it entered lakes and tundra wetland complexes. A large spill that enters marine waters through streams and rivers in the Action Area has the potential to contact, and kill, polar bears or their prey, but few polar bears would likely be affected due to their sparse distribution. Further, disturbance from spill response activities would likely deter bears from a spill site, reducing the likelihood they would contact oil.

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breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

Because small spills are expected to be infrequent and affect only a small portion of the Action Area and given the extremely low density of polar bears in the area, the Service does not anticipate adverse effects from small spills. However, large spills reaching marine waters could potentially impact polar bears directly and indirectly through effects to their prey.

Polar Bear Critical Habitat

In our effects analysis, we analyzed how the PCEs are likely to be affected and how that is likely to influence the function and conservation role of each PCE at the unit scale. We assumed if the function of any one PCE at the individual critical habitat unit scale was not likely to be appreciably reduced, then it follows that adverse modification for the total polar bear critical habitat is not likely to occur.

Effects on sea ice habitat

Activities will primarily occur on land. The gravel haul sea ice road will traverse several kilometers of nearshore sea ice habitat over one winter; however, changes to sea ice would be temporary, lasting for only one season, and would not affect the intended conservation role of the Sea Ice Unit. Accordingly, we do not expect adverse effects to the Sea Ice Unit.

Effects on terrestrial denning habitat

The proposed Action would alter the physical features of 0.42 km^2 (103 acres) of terrestrial denning habitat through the construction of gravel pads and roads and flowlines (Figure 4.2). Temporary effects to terrestrial denning habitat may also occur from construction of ice roads and pads in support of construction and operations. Additionally, activities that may occur in the Action Area could be a source for disturbances that may affect the conservation role of terrestrial denning habitat.

Topographic features – The terrestrial denning PCE is characterized by steep, stable slopes that accumulate snow. Certain areas such as barrier island, river banks, and coastal bluffs that occur at the interface of mainland and marine habitat receive proportionally greater use for denning (Durner et al. 2004, 2006), with coastal bluffs providing the most preferred topographic relief. For example, of 35 terrestrial dens found on the ACP in 2001, >80% were along coastal bluffs (Durner et al. 2003).

The proposed Action could result in modifications of some slopes and limit their capability to catch snow (see Figure 4.3). We expect that alteration of slopes during construction is likely to be minimal, and, in fact, largely avoided because construction and use of steep terrain is more difficult than flat areas. We expect only a small area containing suitable topographic features for denning would be affected.

Features related to polar bear movement and absence of disturbance – A disturbance may affect critical habitat if it persists and affects the critical habitat's conservation role. Features of the terrestrial denning habitat PCE that relate to disturbance include: 1) unobstructed, undisturbed access between den sites and the coast; and 2) the absence of disturbance from humans and human activities that might attract other polar bears (i.e., non-denning polar bears which may kill females and cubs in dens).

Existing and proposed structures could interfere with the ability of polar bears to use critical habitat for its intended purpose. However, polar bears have frequently been observed crossing existing roads and causeways in the Prudhoe Bay oilfields suggesting that structures associated with oil and gas development do not act as a significant barrier to polar bear movements. Given the limited extent of development anticipated in polar bear critical habitat and the ability of polar bears to negotiate potential obstructions, we do not expect the proposed Action will significantly hinder movement between den sites and the coast through physical obstructions or disturbance.

Human activity could also reduce the quality of terrestrial denning habitat by providing attractants (such as food and scents) that could attract adult male bears, which may kill females and cubs, to nearby dens. Disturbance and attractants resulting from the Action would be most likely to occur where human presence is concentrated or prolonged, such as the drill sites and camp facilities at the existing OTP. However, we expect that these effects will be reduced by following protocols to minimize waste that may attract predators, as described in the Nuna Project BA, and the applicant's compliance with existing and future authorizations issued under the MMPA (see *Polar Bears* section, page 36).

Summary of potential effects to the Terrestrial Denning Unit –Adverse effects of the Action are not expected to substantially impact the conservation role of the Terrestrial Denning Unit because: 1) we expect development in areas where topographic relief produces optimal denning habitat, such as river and coastal bluffs to be very limited; 2) terms and conditions associated with authorizations under the MMPA and measures in Pioneer's wildlife and polar bear interaction plans would minimize the level of persistent disturbance that may result from the Action; and 3) the scale of the potentially affected area would be small relative to the extent of the Terrestrial Denning Unit such that the function of the unit as a whole would not be compromised.

Effects on barrier island habitat

Although, the northeastern portion of the Action Area identified in the Nuna Project BA includes a small amount of barrier island habitat, proposed activities are not planned within these areas. Because proposed activities will not occur in, or within several kilometers of barrier island habitat, we do not anticipate adverse effects to the Barrier Island Unit.

Interdependent and Interrelated Effects

An interrelated action depends on the proposed Action for its justification; an interdependent action has no independent utility apart from the action under consultation. Implementation of the proposed Action may facilitate the additional development related to extraction of hydrocarbon resources on the North Slope, such as future drill sites; however, the Service has not identified specific actions that are interdependent on or interrelated to the proposed Action.

9. CUMULATIVE EFFECTS

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

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

10. 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." This biological opinion does not rely on the regulatory definition of "destruction or adverse modification" of critical habitat at 50 C.F.R. 402.02. Instead, we have relied upon the statutory provisions of the ESA to complete our analysis with respect to critical habitat.

Spectacled eiders

In evaluating the impacts of the proposed project to spectacled eiders, the Service identified direct and indirect adverse effects that could result from habitat loss and disturbance. Using methods and logic explained in the *Effects of the Action* section, the Service estimates up to 29 nests could be lost from long-term habitat loss over an assumed 31-year project life. Loss of production over the life of the project is estimated 114 spectacled eider eggs/ducklings, based on these 29 nests. However, we expect this loss of production will not have a significant effect at the population level because only a small proportion of spectacled eider eggs or ducklings on the North Slope would eventually survive to recruit into the breeding populations. Thus, the loss of eggs or ducklings is of much lower significance for survival and recovery of spectacled eiders than the death of an adult bird. 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 that 0.9–6.6% of eggs/ducklings would be expected to survive and recruit into the breeding population.

If we also apply these rates to the estimated loss of production for the Nuna Project, we would expect the project to preclude 1–8 adults (≤ 4 breeding pairs) from entering the North Slope population over a 31-year project life. The population of North Slope-breeding spectacled eiders was last estimated at 12,916 (10,942–14,890, 95% CI; Stehn et al. 2006) for the period of 2002– 2006. Applying the methods of Stehn et al. (2006) to more recent aerial survey data from the North Slope results in an estimate of 11,254 (8,338–14,167, 95% CI) for the period of 2007–2010. Given the potential loss of recruitment of ≤8 adult eiders is a small percentage of the estimated population size and this loss would be distributed across 31 years, we believe the loss of production that may result from the Nuna Project will not significantly affect the likelihood of survival and recovery of spectacled eiders. Accordingly, it is the Services' biological opinion that the proposed Action is not likely to jeopardize the continued existence of the spectacled eider.

Polar bears

We have assessed potential impacts to polar bears to ensure activities that may result from the Action do not jeopardize the continued existence of the species as required under section 7(a)(2) of the ESA. As described in the *Effects of the Action*, activities that may result from the Action could adversely affect polar bears through disturbance, an increase in polar bear-human interactions, and habitat loss. A small numbers of polar bears may also be adversely affected through disturbance or polar bear-human interactions which may include intentional take. These adverse effects are expected to impact only the Southern Beaufort Sea polar bear stock and population level impacts to the species are not anticipated. Therefore, the Service concludes that the proposed Action is not likely to jeopardize the continued existence of the polar bear.

Polar Bear Critical Habitat

After considering the status of polar bear critical habitat, the environmental baseline, cumulative effects, and effects of the proposed Action on each PCE, we conclude the proposed Action may adversely affect but is not likely to destroy or adversely modify polar bear critical habitat. This conclusion was based on the following factors:

Proposed activities will primarily occur in terrestrial habitats east of the Colville River and west of the Kuparuk oil fields, but will include a section of sea ice road in the lagoon northeast of NDS1 over the first winter of construction that would temporarily alter sea ice habitat. Because the potentially affected area of the Sea Ice Unit is extremely small and effects would not persist beyond one winter, we do not expect adverse effects to the Sea Ice Unit.

Adverse effects of the Action are not expected to substantially impact the conservation role of the Terrestrial Denning Unit because: 1) we expect development in areas where topographic relief produces optimal denning habitat, such as river and coastal bluffs to be limited; 2) terms and conditions associated with authorizations under the MMPA would minimize the level of persistent disturbance that may result from the Action; and 3) the scale of the potentially affected area would be small relative to the extent of the Terrestrial Denning Unit such that the function of the unit as a whole would not be compromised.

We do not anticipate adverse effects to the Barrier Island Unit because proposed activities will not occur in, or within several kilometers of barrier island habitat, including the water, ice, and terrestrial habitat within 1.6 km (1 mi) of barrier islands.

Future Consultation

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

In addition to listed eiders and polar bears, the area affected by the Nuna Project 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.

11. 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).

USACE has a continuing duty to regulate the activity covered by this Incidental Take Statement (ITS). If USACE (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.

Spectacled Eiders

As described in Section 5, *Effects of the Action*, the activities described and assessed in this BO may adversely affect spectacled eiders through direct and indirect long-term habitat loss. Long-term habitat loss would occur directly from placement of gravel fill and indirectly through disturbance associated with facility operations and flowline maintenance. Methods used to estimate loss of spectacled eider production resulting from long-term habitat loss are described in the *Effects of the Action* section. Based on these estimates of loss of spectacled eider production, the Service anticipates that *114 spectacled eider eggs or ducklings* are likely to be taken as a result of the proposed Action through long-term direct and indirect habitat loss (harm).

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.

Polar Bears

The Service is not including an incidental take authorization for polar bears at this time because the incidental take has not been authorized under section 101(a)(5) of the Marine Mammal Protection Act and/or its 1994 Amendments. Following issuance of such regulations or authorizations, the Service may issue an incidental take statement for polar bears, as appropriate.

Similarly, this document cannot issue incidental take for activities that may result in intentional take of polar bears as defined under sections 101(a)(4)(A), 109(h), and 112(c) of the MMPA. Authorization of intentional harassment will be subject to subsequent review under the ESA.

We anticipate authorization for incidental take under the MMPA will be available for the proposed Action in the form of Letters of Authorization (LOAs) issued pursuant to the Beaufort Sea (76 FR 47010) Incidental Take Regulations (ITRs).

12. 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.

Polar Bears

This action may result in the incidental and intentional take of polar bears. As stated previously, the Service is not authorizing incidental take for polar bears at this time; therefore, this ITS does not include RPMs or implementing T&Cs for this species. However, any LOAs issued for this Action will contain terms and conditions to minimize impacts to polar bears.

Spectacled Eiders

As described in *Section 8 – Incidental Take Statement*, activities conducted by the USACE and their agents are anticipated to lead to incidental take of spectacled eiders through long-term habitat loss and disturbance of nesting females during the life of the project. Potential effects of increased predator populations, particularly common ravens, are expected to be managed through development and implementation of wildlife interaction and waste management plans as indicated in the Nuna Project BA (Johnson et al. 2011)

RPM 1 – Breeding spectacled eiders may remain on the tundra in the Action Area through late August, but are considered to be most vulnerable to the effects of disturbance through the early brood-rearing stage. Accordingly, off-pad activities such as flowline maintenance within the Action Area should not be scheduled between June 1 and July 31 to the extent practicable.

13. TERMS AND CONDITIONS

To be exempt from the prohibitions of Section 9 of the ESA, the USACE must comply with the following terms and conditions, which implement the RPMs described above. These terms and conditions are non-discretionary.

T&C 1 – Off-pad activities within the Action Area shall not be scheduled between June 1 and July 31 to the extent practicable. If off-pad activities must be conducted during the June 1 – July 31 window, Pioneer shall consult with USFWS to evaluate potential effects from these activities to spectacled eiders and determine whether additional conservation measures are required.

14. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs federal agencies to utilize 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 no collisions between spectacled eiders and project structures is 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.

2. In order to better understand common raven activity in the vicinity of oil and gas infrastructure, the Service recommends reporting the results of raven nest monitoring to the Endangered Species Branch, Fairbanks Fish and Wildlife Field Office.

15. REINITIATION NOTICE

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

1. The amount or extent of incidental take 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.

13. LITERATURE CITED

Amstrup, S.C. 1993. Human disturbances of denning polar bears in Alaska. Arctic 46:246–50.

Amstrup, S.C. 1995. Movements, distribution, and population dynamics of polar bears in the Beaufort Sea. Ph.D. Dissertation, University of Alaska, Fairbanks, Alaska. 299 pp.

Amstrup, S.C. 2000. Polar bear. pp. 133–157 *in* J.J. Truett and S.R. Johnson, *eds.* The natural history of an Arctic oilfield: development and the biota. Academic Press, Inc. New York.

Amstrup, S.C. 2003. Polar Bear (*Ursus maritimus*). Pages 587–610 *in* Feldhamer, B.C. Thompson, and J.A. Chapman, *eds.* Wild Mammals of North America – Biology, Management, and Conservation. John Hopkins University Press. Baltimore, Maryland.

Amstrup, S.C. and D.P. DeMaster. 1988. Polar bear—*Ursus maritimus*. Pages 39–56 in Lentfer, J.W., ed. Selected marine mammals of Alaska: species accounts with research and management recommendations. Marine Mammal Commission, Washington, DC.

Amstrup, S.C., and G.M. Durner. 1995. Survival rates of radio-collared female polar bears and their dependent young. Canadian Journal of Zoology 73:1312–22.

Amstrup, S.C., G.M. Durner, I. Stirling, N.J. Lunn, and F. Messier. 2000. Movements and distribution of polar bears in the Beaufort Sea. Canadian Journal of Zoology 78:948–66.

Amstrup, S.C., and C. Gardner. 1994. Polar bear maternity denning in the Beaufort Sea. Journal of Wildlife Management 58(1):1–10.

Amstrup, S.C., B.G. Marcot, and D.C. Douglas. 2007. Forecasting the range-wide status of polar bears at selected times in the 21st century. U.S. Geological Survey Administrative Report, Reston, Virginia. 126 pp.

Amstrup, S.C T.L. McDonald, and I. Stirling. 2001. Polar bears in the Beaufort Sea: a 30-year mark–recapture case history. Journal of Agricultural, Biological, and Environmental Statistics 6(2):221–234.

Amstrup, S. C., I. Stirling, and J.W. Lentfer. 1986. Past and present status of polar bears in Alaska. Wildlife Society Bulletin 14: 241–254.

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

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

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

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

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

Bentzen T.W., E.H. Follman, S.C. Amstrup, G.S. York, M.J. Wooler, and T.M. O'Hara. 2007. Variation in winter diet of Southern Beaufort Sea polar bears inferred from stable isotope analysis. Canadian Journal of Zoology 85:596–608.

Best, R.C. 1985. Digestibility of ringed seals by the polar bear. Canadian Journal of Zoology 63:1033–1036.

Blix, A.S. and J.W. Lentfer. 1979. Modes of thermal protection in polar bear cubs: at birth and on emergence from the den. American Journal of Physiology 236:67–74.

Born, E.W., Ø. Wiig, and J. Thomassen. 1997. Seasonal and annual movements of radio collared polar bears (*Ursus maritimus*) in NE Greenland. Journal of Marine Systems 10:67–77.

Bowes, G.W. and C.J. Jonkel. 1975. Presence and distribution of polychlorinated biphenyls (PCB) in arctic and subarctic marine food chains. Journal of the Fisheries Research Board of Canada. 32:2111–2123.

Braune, B.M., P.M. Outridge, A.T. Fisk, D.C.G. Muir, P.A. Helm, K. Hobbs, P.F. Hoekstra, Z.A. Kuzyk, M. Kwan, R.J. Letcher, W.L. Lockhart, R.J. Norstrom, G.A. Stern, and I. Stirling. 2005. Persistent organic pollutants and mercury in marine biota of the Canadian Arctic: an overview of spatial and temporal trends. The Science of the Total Environment 351–352:4–56.

Burgess, R.M. 2000. Arctic Fox. Pages 159–178 *in* J.C. Truett and S.R. Johnson (eds.). The natural history of an Arctic oil field development and biota.

Callaghan, T.V., L.O. Björn, Y. Chernov, T. Chapain, T.R. Christensen, B. Huntley, R.A. Ims, M. Johansson, D. Jolly, S. Jonasson, N. Matveyeva, N. Panikov, W. Oechel, G. Shaver, J. Elster, H. Henttonen, K. Laine, K. Taulavuori, E. Taulavuori, and C.

Zöckler. 2004. Biodiversity, distributions and adaptations of Arctic species in the context of environmental change. Ambio 33:404–417.

Calvert, W. and I. Stirling. 1990. Interactions between polar bears and over-wintering walruses in the central Canadian High Arctic. International Conference on Bear Research and Management 8:351–56.

Carmack, E., and D.C. Chapman. 2003. Wind driven shelf/basin exchange on an Arctic shelf: the joint roles of ice cover extent and shelf-break bathymetry. Geophysical Research Letters 30:1778.

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

Comiso, J.C. 2003. Warming trends in the Arctic from clear sky satellite observations. Journal of Climate 16:3498–3510.

Comiso, J. C. 2006. Abrupt decline in the Arctic winter sea ice cover. Geophysical Research Letters 33:18504.

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

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

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

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

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

DeMaster, D.P., M.C.S. Kingsley, and I. Stirling. 1980. A multiple mark and recapture estimate applied to polar bears. Canadian Journal of Zoology 58:633–638.

Derocher, A.E., N.J. Lunn, and I. Stirling. 2004. Polar bears in a warming climate. Integrative and Comparative Biology 44:163–176.

Derocher, A.E. and I. Stirling. 1992. The population dynamics of polar bears in Western Hudson Bay. Pages 1150–59 *in* McCullough, D.R. and R.H. Barrett, *eds*. Wildlife 2001: Populations. Elsevier Applied Science, London.

Derocher, A. E., and I. Stirling. 1996. Aspects of survival in juvenile polar bears. Canadian Journal of Zoology 74:1246–1252.

Derocher, A.E., I. Stirling, and D. Andriashek. 1992. Pregnancy rates and serum progesterone levels of polar bears in Western Hudson Bay. Canadian Journal of Zoology 70:561–66.

Derocher, A.E., O. Wiig, and M. Andersen. 2002. Diet composition of polar bears in Svalbard and the western Barents Sea. Polar Biology 25:448–452.

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

Durner, G.M., S.C. Amstrup, and K.J. Ambrosius. 2001. Remote identification of polar bear maternal den habitat in northern Alaska. Arctic 54:115–21.

Durner, G.M., S.C. Amstrup, and K.J. Ambrosius. 2006. Polar bear maternal den habitat in the Arctic National Wildlife Refuge, Alaska. Arctic 59(1):31–36.

Durner, G. M., S. C. Amstrup, and A. S. Fischbach. 2003. Habitat characteristics of polar bear terrestrial maternal den sites in Northern Alaska. Arctic 56:55–62.

Durner, G.M., S.C. Amstrup, R. Nielson, T. McDonald. 2004. Using discrete choice modeling to generate resource selection functions for female polar bears in the Beaufort Sea. Pages 107–120 *in* S. Huzurbazar (Editor). Resource Selection Methods and Applications: Proceedings of the 1st International Conference on Resource Selection, 13–15 January 2003, Laramie, Wyoming.

Durner, G.M., D.C. Douglas, R.M. Nielson, S.C. Amstrup, , T.L. McDonald, I. Stirling, Mauritzen, M., E.W. Born, O. Wiig, E. DeWeaver, M.C. Serreze, S. Belikov, M. Holland, J.A. Maslanik, J. Aars, D.A. Bailey, and A.E. Derocher, 2009. Predicting 21st-century polar bear habitat distribution from global climate models. Ecological Monographs 79: 25–58.

Earnst S.L. 2004. Status assessment and conservation plan for the yellow-billed loon (*Gavia adamsii*). Scientific Investigations Report 2004-5258. Prepared by the U.S. Geological Survey in cooperation with the U.S. Fish and Wildlife Service. 42 pp.

Eberhardt, L.E. 1985. Assessing the dynamics of wild populations. Journal of Wildlife Management 49:997–1012.

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

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

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

Fay, F. H. 1982. Ecology and biology of the Pacific walrus, *Odobenus rosmarus divergens* Illiger. North American Fauna 72, U.S. Fish and Wildlife Service, Washington, D. C. 279 pp.

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

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

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

Ferguson, S.H., M.K. Taylor, E.W. Born, A. Rosing-Asvid, and F. Messier. 1999. Determinants of home range size for polar bears (*Ursus maritimus*). Ecology Letters 2:311–18.

Ferguson, S.H., M.K. Taylor, E.W. Born, A. Rosing-Asvid, and F. Messier. 2001. Activity and movement patterns of polar bears inhabiting consolidated versus active pack ice. Arctic 54:49–54.

Fischbach, A.S., S.C. Amstrup, D.C. Douglas. 2007. Landward and eastward shift of Alaskan polar bear denning associated with recent sea ice changes. Polar Biology 30:1395–1405.

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

Fisk, A.T., K.A. Hobson, and R.J. Norstrom. 2001. Influence of chemical and biological factors on trophic transfer of persistent pollutants in the Northwater Polynya marine food web. Environmental Science and Technology 35:732–738.

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

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

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

Fowler, C., W.J. Emery, and J. Maslanik. 2004. Satellite-derived evolution of Arctic sea ice age: October 1978 to March 2003. Geoscience and Remote Sensing Letters:, 1:71–74.

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

Furnell, D.J. and D. Oolooyuk. 1980. Polar bear predation on ringed seals in ice-free water. Canadian Field-Naturalist 94: 88–89.

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

Garner, G.W., S.C. Amstrup, I. Stirling, and S.E. Belikov. 1994. Habitat considerations for polar bears in the North Pacific Rim. Transactions of the North American Wildlife and Natural Resources Conference 59:111–20.

Garner, G.W., S.E. Belikov, M.S. Stishov, and S.M. Arthur. 1995. Research on polar bears in western Alaska and eastern Russia 1988–92. Pages 155–164 *in* Wiig, O., E.W. Born, and G.W. Garner, *eds*. Polar bears: proceedings of the eleventh working meeting of the IUCN/SSC Polar Bear Specialist Group. IUCN, Gland, Switzerland and Cambridge, UK.

Garner, G.W., S.T. Knick, and D.C. Douglas. 1990. Seasonal movements of adult female polar bears in the Bering and Chukchi Seas. International Conference on Bear Research and Management 8:219–26.

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

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

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

Hammill, M.O. and T.G. Smith. 1991. The role of predation in the ecology of the ringed seal in the Barrow Strait, Northwest Territories, Canada. Marine Mammal Science 7:123–135.

Harington, C.R. 1968. Denning habits of the polar bear (*Ursus maritimus* Phipps). Report Series 5, Canadian Wildlife Service, Ottawa, Canada.

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

Hinzman, L.D., N.D. Bettez, W.R. Bolton, F.S. Chpin, M.B. Dyurgerov, C.L. Fastie, B. Griffith, R.D. Hollister, A. Hope, H.P. Huntington, A.M. Jensen, G.J. Jia, T. Jorgenson, D.L. Kane, D.R. Klien, G. Kofinas, A.H. Lynch, A.H. Lloyd, A.D. McGuire, F.E. Nelson, W.C. Oechel, T.E. Osterkamp, C.H. Racine, V.E. Romanovsky, R.S. Stone, D.A. Stow, M. Strum, C.E. Tweedie, G.L. Vourlitis, M.D. Walker, D.A. Walker, P.J. Webber, J.M. Welker, K.S. Winklet, K. Yoshikawa. 2005. Evidence and implications of recent climate change in northern Alaska and other arctic regions. Climatic Change 72: 251–298.

Holland, M., C.M. Bitz, and B. Tremblay. 2006. Future abrupt reductions in summer Arctic sea ice. Geophysical Research Letters 33:L23503. 5 pp.

Hunter, C.M., H. Caswell, M.C. Runge, E.V. Regehr, S.C. Amstrup, and I. Stirling. 2007. Polar bears in the southern Beaufort Sea II: demographic and population growth in relation to sea ice conditions. U.S. Dept. of the Interior, U.S. Geological Survey Administrative Report. 46 pp.

Impact Assessment Inc. 1990. Subsistence resource harvest patterns: Nuiqsut. Special Report No. 8. Anchorage, AK: Minerals Management Service.

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

IUCN. 2006. Status of the polar bear. Pages 33–56 in J. Aars, N.J. Lunn, and A.E. Derocher (Eds.), Proceedings of the 14th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Seattle, United States. IUCN, Gland, Switzerland and Cambridge, UK.

Johnson, C.B., A.M. Wildman, B.E. Lawhead, R.M. Burgess. 2011. Nuna Project: biological assessment for polar bear, spectacled eider, Steller's eider, and yellow-billed loon. Prepared for Pioneer Natural Resource Alaska, Inc. by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. September 2011 103 pp. + appendices.

Johnson, C. B., A. M. Wildman, J. P. Parrett, J. R. Rose, and T. Obritschkewtitsch. 2010. Avian Studies for the Alpine Satellite Development Project, 2009. Seventh annual report for ConocoPhillips Alaska, Inc., Anchorage, AK, and Anadarko Petroleum Corporation, Anchorage, by ABR, Inc. 71 pp.

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

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

Jorgenson, M.T. 1999. Assessment of tundra damage along the ice road to the Meltwater South exploratory well site. Unpublished report prepared for ARCO Alaska, Inc., Anchorage, AK, by ABR, Inc., Fairbanks, AK. 11pp.

Kingsley, M.C.S. 1979. Fitting the von Bertalanffy growth equation to polar bear age–weight data. Canadian Journal of Zoology 57:1020–25.

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

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

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

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

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

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

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

Lentfer, J.W. and R.J. Hensel. 1980. Alaskan polar bear denning. International Conference on Bear Research and Management 4:101–8.

Lie, E., A. Bernhoft, F. Riget, S.E. Belikov, A.N. Boltunov, G.W. Garner, Ø Wiig, and J.U. Skaare. 2003. Geographical distribution of organochlorine pesticides (OCPs) in polar bears (*Ursus maritimus*) in the Norwegian and Russian Arctic. The Science of the Total Environment 306:159–170.

Liebezeit, J.R.. and S. Zack. 2008. Point counts underestimate the importance of arctic foxes as avian nest predators: evidence from remote video cameras in Arctic Alaskan oil fields. Arctic 61:153–161.

Liebezeit, J.R., and S. Zack. 2010. Avian habitat and nesting use of tundra-nesting birds in the Prudhoe Bay oilfield – long-term monitoring: 2010 annual report. Interim report prepared by the Wildlife Conservation Society in fulfillment of U.S. Bureau of Land Management grant L10AS0005737. 37 pp. Accessed 19 January 2012 through http://www.wcsnorthamerica.org/AboutUs/Publications/tabid/3437/Default.aspx.

Lindsay, R.W., and J. Zhang. 2005. The thinning of the Arctic sea ice, 1988-2003: have we passed a tipping point? Journal of Climate 18: 4879–4894.

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

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

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

Mars, J.C. and D.W. Houseknecht. 2007. Quantitative remote sensing study indicates doubling of coastal erosion rate in the past 50 yr along a segment of the Arctic coast of Alaska. Geology 35:583–586.

Mauritzen, M., A.E. Derocher, O. Pavlova., and Ø. Wiig. 2003. Female polar bears, *Ursus maritimus*, on the Barents Sea drift ice: walking the treadmill. Animal Behavior 66: 107–113.

Mauritzen, M., A.E. Derocher, and Ø Wiig. 2001. Space-use strategies of female polar bears in a dynamic sea ice habitat. Canadian Journal of Zoology 79:1704–1713.

McKendrick, J.D. 2003. Report on condition of willows at four streams crossed by the 2002 Grizzly ice road. Report prepared for ConocoPhillips, Alaska, Inc., Anchorage, AK by Lazy Mountain Research Company, Inc., Palmer, AK. 13pp.

Messier, F., M.K. Taylor, and M.A. Ramsay. 1992. Seasonal activity patterns of female polar bears (*Ursus maritimus*) in the Canadian Arctic as revealed by satellite telemetry. Journal of Zoology (London) 226:219–29.

Messier, F., M.K. Taylor, and M.A. Ramsay. 1994. Denning ecology of polar bears in the Canadian Arctic Archipelago. Journal of Mammalogy 75:420–30.

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

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

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

North, M.R. 1993. Distribution and migration of yellow-billed loons in North America. Bird Populations 1:36–49.

North, M.R. 1994. Yellow-billed Loon (*Gavia adamsii*). In The Birds of North America, No. 121 (A. Poole and F. Gill, Eds.). Philadelphia: The Academy of Natural Sciences; Washington, D.C.: The American Ornithologists' Union.

Obbard, M.E., G.W. Thiemann, E. Peacock, and T.D. DeBruyn, eds. 2010. Polar Bears: Proceedings of the 15th Working Meeting of the IUCN/SSC Polar Bear Specialist Group, Copenhagen, Denmark, 29 June–3 July 2009. Gland, Switzerland and Cambridge, UK: IUCN. vii + 235 pp.

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

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

Ovsyanikov, N. 1996. Polar Bears. Living with the White Bear. Voyager Press, Stilwater, Minnesota. 144 pp.

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

Parkinson, C.L., D.J. Cavalieri, P. Gloersen, H.J. Zwally, and J.C. Comiso. 1999. Arctic sea ice extents, areas, and trends, 1978–1996. Journal of Geophysical Research 104(C9):20837–20856.

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

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

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

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

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

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

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

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

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

Proshutinsky, A.Y. and M. Johnson. 2001. Two regimes of Arctic's circulation from ocean models with ice and contaminants. Marine Pollution Bulletin 43:61–70.

Pullman, E.R., M.T. Jorgenson, T.C. Cater, W.A. Davis, and J.E. Roth. 2003. Assessment of ecological effects of the 2002–2003 ice road demonstration project. Final report prepared for ConocoPhillips Alaska, Inc., by ABR, Inc., Fairbanks, Alaska. 39pp.

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

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

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

Ramsay, M.A. and R.L. Dunbrack. 1986. Physiological constraints on life history phenomena: the example of small bear cubs at birth. American Naturalist 127:735–43.

Ramsay, M.A. and I. Stirling. 1988. Reproductive biology and ecology of female polar bears (*Ursus maritimus*). Journal of Zoology (London) 214:601–34.

Ramsay, M.A. and I. Stirling. 1990. Fidelity of female polar bears to winter den sites. Journal of Mammalogy 71:233–36.

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

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

Regehr, E.V., S.C. Amstrup and I. Stirling. 2006. Polar bear population status in the Southern Beaufort Sea. Report Series 2006-1337, U.S. Department of the Interior, U.S. Geological Survey, Anchorage, Alaska. 20 pp.

Regehr, E.V., C.M. Hunter, H. Caswell, S.C. Amstrup, and I. Stirling. 2007. Polar bears in the southern Beaufort Sea I: survival and breeding in relation to sea ice conditions, 2001–2006. U.S. Dept. of the Interior, U.S. Geological Survey Administrative Report, Reston, Virginia. 45 pp.

Regehr, E.V., C.M. Hunter, H. Caswell, S.C. Amstrup, and I. Stirling. 2010. Survival and breeding of polar bears in the southern Beaufort Sea in relation to sea ice. Journal of Animal Ecology 79:117–127.

Rode, K.D., S.C. Amstrup, and E.V. Reghr. 2010. Reduced body size and cub recruitment in polar bears associated with sea ice decline. Ecological Applications. 20: 798–782.

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

Rothrock, D.A., Y. Yu, and G.A. Maykut. 1999. Thinning of the Arctic sea-ice cover, Geophysical Research Letters 26: 3469–3472.

Sadleir, R.M.F.S. 1969. The ecology of reproduction in wild and domestic mammals. Methuen, London.

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

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

Schliebe, S., T.J. Evans, K. Johnson, M. Roy, S. Miller, C. Hamilton, R. Meehan, and S. Jahrsdoerfer. 2006. Status assessment in response to a petition to list polar bears as a threatened species under the U.S. Endangered Species Act. U.S. Fish and Wildlife Service, Marine Mammals Management, Anchorage, Alaska. 262 pp.

Schliebe S., K.D. Rode, J.S. Gleason, J. Wilder, K. Proffitt, T.J. Evans, and S. Miller. 2008. Effects of sea ice extent and food availability on spatial and temporal distribution of polar bears during the fall open-water period in the Southern Beaufort Sea. Polar Biology 31: 999–1010.

Schweinsburg, R.E. and L.J. Lee. 1982. Movement of four satellite-monitored polar bears in Lancaster Sound, Northwest Territories. Arctic 35:504–11.

Serreze, M. C., M. M. Holland, and J. Stroeve. 2007. Perspective on the Arctic's shrinking sea-ice cover. Science. 315:1533–1536.

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

Smith, T.G. 1980. Polar bear predation of ringed and bearded seals in the landfast sea ice habitat. Canadian Journal of Zoology 58:2201–9.

Smith, T.G. 1985. Polar bears, *Ursus maritimus*, as predators of belugas, *Delphinapterus leucas*. Canadian Field-Naturalist 99:71–75.

Smith, T.G. and B. Sjare. 1990. Predation of belugas and narwhals by polar bears in nearshore areas of the Canadian High Arctic. Arctic 43: 99–102.

Smith, T.G. and I. Stirling. 1975. The breeding habitat of the ringed seal (*Phoca hispida*): the birth lair and associated structures. Canadian Journal of Zoology 53:1297–1305.

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

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

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

Stenhouse, G.B., L.J. Lee, and K.G. Poole. 1988. Some characteristics of polar bears killed during conflicts with humans in the Northwest Territories, 1976–1986. Arctic 41:275–278.

Stirling, I. 1988. Polar bears. University of Michigan Press, Ann Arbor, Michigan, USA. 220 pp.

Stirling, I. 1990. Polar bears and oil: ecological perspectives. Pages 223–34 *in* Geraci, J.R. and D.J. St. Aubin, *eds*. Sea Mammals and Oil: Confronting the Risks. Academic Press, Inc. New York, New York.

Stirling, I. 2002. Polar bears and seals in the eastern Beaufort Sea and Amundsen Gulf: a synthesis of population trends and ecological relationships over three decades. Arctic 55:59–76.

Stirling, I., and D. Andriashek. 1992. Terrestrial maternity denning of polar bears in the Eastern Beaufort Sea area. Arctic 45(4):363–366.

Stirling, I., D. Andriashek, C. Spencer, C. Derocher, and A.E. Derocher. 1988. Assessment of the polar bear population in the eastern Beaufort Sea. Final report to the Northern Oil and Gas Assessment Program. Canadian Wildlife Service, Edmonton, Alberta, Canada. 81 pp.

Stirling, I., and A.E. Derocher. 1990. Factors affecting the evolution and behavioral ecology of the modern bears. International Conference on Bear Research and Management 8:189–204.

Stirling, I., C. Jonkel, P. Smith, R. Robertson, and D. Cross. 1977. The ecology of the polar bear (*Ursus maritimus*) along the western coast of Hudson Bay. Occasional Paper No. 33. Canadian Wildlife Service, Ottawa, Canada. 64 pp.

Stirling, I., M. Kingsley, and W. Calvert. 1982. The distribution and abundance of seals in the eastern Beaufort Sea, 1974–79. Canadian Wildlife Service Occasional Paper No. 47, Ottawa, Canada.

Stirling, I. and P.B. Latour. 1978. Comparative hunting abilities of polar bear cubs of different ages. Canadian Journal of Zoology 56:1768–72.

Stirling, I. and M. McEwan. 1975. The caloric value of whole ringed seals (Phoca hispida) in relation to polar bear (*Ursus maritimus*) ecology and hunting behavior. Canadian Journal of Zoology 53:1021–1027.

Stirling, I. and N.A. Øritsland. 1995. Relationships between estimates of ringed seal (Phoca hispida) and polar bear (*Ursus maritimus*) populations in the Canadian Arctic. Canadian Journal of Fisheries and Aquatic Sciences 52:2594–2612.

Stirling, I., A.M. Pearson, and F.L. Bunnell. 1976. Population ecology studies of polar and grizzly bears in northern Canada. Transactions of the North American Wildlife and Natural Resources Conference 41:421–30.

Stroeve, J., M. Serreze, S. Drobot, S. Gearheard, M. Holland, J. Maslanik, W. Meier, and T. Scambos. 2008. Arctic Sea Ice Extent Plummets in 2007. EOS, Transactions, American Geophysical Union 89(2):13–14.

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

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

Trust, K., K.T. Rummel, A.M. Scheuhammer, I.L. Brisbin, Jr., MG Hooper. 2000. Contaminant exposure and biomarker responses in spectacled eiders (Somateria fischeri) from St. Lawrence Island, Alaska. Arch. Environ. Contam. Toxicol. 38:107-113.

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

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

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

USFWS. 2006. Marine mammals; incidental take during specified activities. Final rule [to authorize the nonlethal, incidental, unintentional take of small numbers of polar bears and Pacific walruses during year-round oil and gas industry exploration, development, and production and operations in the Beaufort Sea and adjacent northern coast of Alaska]. U.S. Fish and Wildlife Service, Anchorage, Alaska. Federal Register 71:43926–43953.

USFWS. 2008a. Determination of threatened status for the polar bear (*Ursus maritimus*) throughout its range; final rule. U.S. Fish and Wildlife Service. Federal Register 73:28212–28303.

USFWS. 2008b. Marine mammals; incidental take during specified activities. Final rule [to authorize the nonlethal, incidental, unintentional take of small numbers of polar bears and Pacific walruses during year-round oil and gas industry exploration, development, and production and operations in the Chukchi Sea and adjacent western coast of Alaska]. U.S. Fish and Wildlife Service, Anchorage, Alaska. Federal Register 73:33212–33255.

USFWS. 2008c. Biological Opinion for Bureau of Land Management for the Northern Planning Areas of the National Petroleum Reserve – Alaska. U.S. Fish and Wildlife Service, Fairbanks, Alaska.

USFWS. 2009. Twelve-month finding on a petition to list the yellow-billed loon as threatened or endangered. Published 25 March 2009 by the U.S. Fish and Wildlife Service. Federal Register 74 (56): 12931–12968.

USFWS. 2010a. Designation of critical habitat for the polar bear (*Ursus maritimus*) in the United States; final rule. U.S. Fish and Wildlife Service. Federal Register 75:76086–76137.

USFWS. 2010b. Polar Bear (*Ursus maritimus*): Chukchi/Bering Seas Stock. Stock Assessment Report. Marine Mammals Management Office, Anchorage, AK. 9 pp.

USFWS. 2010c. Polar Bear (*Ursus maritimus*): Southern Beaufort Sea Stock. Stock Assessment Report. Marine Mammals Management Office, Anchorage, AK. 9 pp.

USFWS. 2010d. Marine Mammal Protection Act; Deterrence guidelines; final rule. U.S. Fish and Wildlife Service. Federal Register 75:61631–61638.

USFWS. 2011a. Endangered and threatened wildlife and plants; 12-month finding on a petition to list the Pacific walrus as endangered or threatened; proposed rule. Published 10 February 2011 by the U.S. Fish and Wildlife Service. Federal Register 76:7634–7679.

USFWS. 2011b. Marine mammals; incidental take during specified activities. Final rule [to authorize the nonlethal, incidental, unintentional take of small numbers of polar bears and Pacific walruses during year-round oil and gas industry exploration, development, and production and operations in the Beaufort Sea and adjacent northern coast of Alaska]. U.S. Fish and Wildlife Service, Anchorage, Alaska. Federal Register 76:47010–47054.

USFWS. 2011c. Programmatic biological opinion for polar bears (*Ursus maritimus*), polar bear critical habitat, and conference opinion for the Pacific walrus (*Odobenus rosmarus divergens*) on the Beaufort Sea incidental take regulations. U.S. Fish and Wildlife Service, Fairbanks, Alaska. 92 pp.

USGS. 2012. Walrus research: walrus tracking. Alaska Science Center, U.S. Geological Survey, Anchorage, AK. http://alaska.usgs.gov/science/biology/walrus/tracking.html. Accessed March 27, 2012.

Uspenski, S M., ed. 1977. The polar bear and its conservation in the Soviet Arctic. A collection of scientific papers. Central Laboratory of Nature Conservation, Moscow, Russia.

Warnock, N. and D. Troy. 1992. Distribution and abundance of spectacled eiders at Prudhoe Bay, Alaska: 1991. Unpublished report prepared for BP Exploration

(Alaska) Inc., Environmental and Regulatory Affairs Department, Anchorage, Alaska, by Troy Ecological Research Associates (TERA), Anchorage, Alaska. 20 pp.

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

Wiig Ø. 1998. Survival and reproductive rates for polar bears at Svalbard. *Ursus*. 10:25–32.

Wiig Ø., E.W. Born, and L.T. Pedersen. 2003. Movements of female polar bears (*Ursus maritimus*)in the East Greenland pack ice. Polar Biology 26:509–516.

Wildman, A.M. and J.P. Parrett. 2011. Yellow-billed loon surveys for the Nuna Project—2011. Final report prepared for Pioneer Natural Resources, Anchorage, AK by ABR, Inc.—Environmental Research & Services, Fairbanks, AK. 8 November 2011

Wimsatt, W.A. 1963. Delayed implantation in the Ursidae, with particular reference to the black bear (*Ursus americanus pallas*). Pages 49–76 in A.C. Enders, ed. Delayed implantation. University of Chicago Press, Chicago.

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