



BIOLOGICAL OPINION

For

CHUKCHI SEA PLANNING AREA

OIL AND GAS LEASE SALE 193

AND

ASSOCIATED SEISMIC SURVEYS

AND EXPLORATORY DRILLING

Consultation with the

Minerals Management Service – Alaska OCS Region
Anchorage, Alaska

March 2007

TABLE OF CONTENTS

1. Introduction	1
2. Description of the Proposed Action	5
Leasing and Exploration	6
Future Activities	8
3. Status of Species and Critical Habitat	10
Spectacled Eider	10
Ledyard Bay Critical Habitat Unit (LBCHU)	15
Steller's Eider	18
Kittlitz's Murrelet	24
4. Environmental Baseline	26
Spectacled and Steller's Eiders	26
Kittlitz's Murrelet	29
Ledyard Bay Critical Habitat Unit	29
Regional-Scale Environmental Shift	30
5. Effects of the Action on Listed Species and Critical Habitat	31
I. Incremental Step (Leasing and Exploration) Effects	31
A. Loss of Habitat - Incremental Step	31
B. Disturbance and Displacement - Incremental Step	32
C. Collisions - Incremental Step	36
D. Increased Predation - Incremental Step	37
E. Increased Subsistence Hunting - Incremental Step	37
F. Toxic Contamination - Incremental Step	37
G. Crude and Refined Oil Spills - Incremental Step	38
H. Summary of Effects - Incremental Step	40
II. Effects of the Entire Action (Development and Production)	40
A. Loss of Habitat - Entire Action	40
B. Disturbance and Displacement - Entire Action	42
C. Collisions - Entire Action	43
D. Increased Predation - Entire Action	44
E. Increased Subsistence Hunting - Entire Action	44
F. Toxic Contamination - Entire Action	44
G. Crude and Refined Oil Spills - Entire Action	45
H. Summary of Effects - Entire Action	52
III. Indirect Effects	52
IV. Interdependent and Interrelated Effects	52

6. Cumulative Effects	52
7. Conclusions	53
Conclusion for Incremental Step (Leasing and Exploration)	54
Conclusion for Entire Action	56
8. Incidental Take Statement	64
9. Information Needs	66
10. Reasonable and Prudent Measures	68
11. Terms and Conditions	69
12. Conservation Recommendations	71
13. Reinitiation Notice	71
14. Literature Cited	73
Appendix 1. Summary of Consultation Activities	86
Appendix 2. Spectacled Eider Expert Meeting	87
Agenda and materials from expert meeting on spectacled eiders	
Notes from expert meeting on spectacled eiders	
Workflow from spectacled eider model	
List of Tables	
Table 1. Recent projects in Lease Sale 193 action area that required section 7 consultation and estimated incidental take of listed eiders.	28
List of Figures	
Figure 1.1. Area of Lease Sale 193 and surrounding features.	1
Figure 1.2. Boundaries and corner points of the Ledyard Bay Critical Habitat Unit.	3
Figure 3.1. Male and female spectacled eiders in breeding plumage.	10
Figure 3.2. Distribution of spectacled eiders.	11
Figure 3.3. Spectacled eider observations in 2005 and density on the Alaska arctic coastal plain from 1999-2002.	12

Figure 3.4.	Spring migration locations of satellite-transmitted North Slope king eiders, 2002-2006.	14
Figure 3.5.	Representative Chukchi Sea food web with spectacled eider in apex predator functional role.	17
Figure 3.6.	Male and female Steller's eider in breeding plumage.	19
Figure 3.7.	Steller's eider distribution in the Bering and Chukchi Seas.	20
Figure 3.8.	Distribution of Steller's eiders from aerial surveys on the Arctic Coastal Plain, Alaska.	22
Figure 3.9.	Steller's eider bird and nest observations in the vicinity of Barrow, Alaska, 1991-2005.	22
Figure 3.10.	Breeding distribution of the Kittlitz's murrelet in North America.	25
Figure 5.1.	Location of eiders observed during aerial surveys in Ledyard Bay in relation to the critical habitat unit boundaries and Lease Sale 193 boundaries.	32
Figure 5.2.	Chukchi Sea spring lead ERAs 20-23 in relation to Lease Sale 193 boundaries.	34
Figure 5.3.	Chukchi Sea spring lead ERA 19 in relation to Lease Sale 193 Boundaries.	34
Figure 5.4.	MMS illustration of spill launch areas with hypothetical routes and platform locations.	46
Figure 9.1.	Spring Lead System for Information Needs and Terms and Conditions	68

1. INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) in accordance with section 7 of the Endangered Species Act of 1973, as amended (Act), on effects to the species discussed below of the Mineral Management Service's (MMS) proposed Chukchi Sea Lease Sale 193. The proposed action (Fig. 1) involves the sale of oil and gas leases on 34 million acres of the Chukchi Sea Outer Continental Shelf (OCS). MMS, the action agency, has statutory authority (under Chapter 345 of the OCS Lands Act of August 7, 1953, 43 USC 1331 et. seq.) to complete its OCS energy development actions in a tiered approach for review under the National Environmental Policy Act (NEPA), including an incremental step consultation process under the Act. Under this authority MMS asked the Service to perform an incremental step consultation for the project, including the first step referred to in this document as leasing and exploration (including seismic surveys and exploratory drilling).



Figure 1.1. Area of Lease Sale 193 and surrounding features.

Regulations at 50 C.F.R. 402.14(k) outline the procedures to be used in conducting incremental step consultations. The regulation states that “the Service shall, if requested by the Federal agency, issue a biological opinion on the incremental step being considered, including its views on the entire action.” The regulation further states that upon issuance of the biological opinion, the Federal agency may proceed with or authorize the incremental steps of the action if the following five requirements are met:

1. The BO does not conclude that the incremental step would violate section 7(a)(2) of the Act (i.e., it is not likely to jeopardize listed species or result in the destruction or adverse modification of critical habitat);
2. The action agency continues consultation with respect to the entire action, and obtains BOs, as required, for each incremental step;
3. The action agency fulfills its continuing obligation to obtain sufficient data upon which to base the final BO on the entire action;
4. The incremental step does not violate section 7(d) of the Act concerning the irreversible or irretrievable commitment of resources; and
5. There is a reasonable likelihood that the entire action will not violate section 7(a)(2) of the Act.

In accordance with the applicable regulations, this BO includes analysis and conclusions as to whether (1) the incremental steps on leasing and exploration (hereafter referred to as the first incremental step) would violate section 7(a)(2) of the Act (i.e., whether these steps would likely jeopardize listed species or destroy or adversely modify critical habitat), and (2) there is a reasonable likelihood that the entire action of leasing, exploration, development, production, and field abandonment that may result from Lease Sale 193 would violate section 7(a)(2) of the Act. The leasing of tracts pursuant to Lease Sale 193 and subsequent exploration, development, production, and abandonment would entail consultation between the Service and MMS at each incremental step in the process, providing opportunities for each agency to refine conservation measures for listed species as project plans develop and listed species status or information changes. Hereafter in this BO, the term “exploration” is used to include seismic surveys and exploratory drilling, and “production” is used to include production and post-production abandonment of facilities.

The proposed lease sale may affect the threatened spectacled eider (*Somateria fischeri*), the threatened Steller’s eider (*Polysticta stelleri*), and the Ledyard Bay Critical Habitat Unit (LBCHU) designated for spectacled eiders (Fig. 2). At MMS’s request, the Service also evaluated potential effects on the candidate Kittlitz’s murrelet (*Brachyramphus brevirostris*) to aid planning in the event it becomes listed during this project’s life, but the current document does not represent a formal BO for Kittlitz’s murrelets.

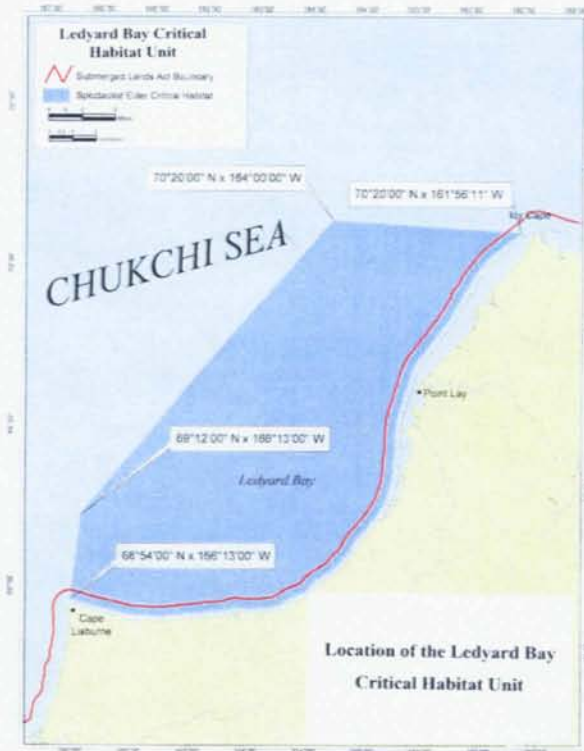


Figure 1.2. Boundaries and corner points of the Ledyard Bay Critical Habitat Unit.

This BO was prepared using the “Biological Evaluation of Spectacled Eider, Steller’s Eider, and Kittlitz’s Murrelet for Chukchi Lease Sale 193” (BE) (MMS 2006a), received from MMS on September 25, 2006; the Chukchi Sea Planning Area Draft EIS Volume I (MMS 2006b); the Chukchi Sea Planning Area Draft EIS Volume II (MMS 2006c); published literature, agency and consultant biological surveys and reports; other information in our files; and personal communication with species experts in the Service and the U.S. Geological Survey (USGS). Formal consultation began on October 23, 2006. Supplemental information was requested on January 23, 2007 and received on February 6, 2007. The complete administrative record of this consultation is on file at the Service’s Fairbanks Fish and Wildlife Field Office.

For each species, the BO addresses whether the incremental step of leasing and exploration would be likely to jeopardize the continued existence of listed species or destroy or adversely modify critical habitat. The BO also addresses whether there is a reasonable likelihood that the entire action, which may also include development and production, would jeopardize listed species or result in the destruction or adverse modification of critical habitat.

The Service concurs with MMS’s determination that the proposed action for the incremental step of leasing and exploration may adversely affect spectacled and Steller’s eiders, and determines that incidental take would be minimized with the specified

Reasonable and Prudent Measures (RPMs), which would be implemented under the prescribed terms and conditions. However, based on the limited number of Steller's and spectacled eiders likely to be affected, and MMS measures that regulate seismic and exploratory drilling activities, the Service has determined the incremental step of leasing and exploration is not likely to jeopardize listed spectacled or Steller's eiders, and is not likely to destroy or adversely modify designated critical habitat.

To assist the Service in evaluating possible impacts of the entire action, including potential development and production, MMS provided a hypothetical, 1 billion barrel (bbl) oil development scenario that included one major production platform in the eastern Chukchi Sea; a new seafloor pipeline from the platform to a new shore base; and a new land-based pipeline (with access road and pump stations) which crosses the North Slope to connect to the existing Trans-Alaska Pipeline System (TAPS). Based on the best scientific and commercial data available to date, the Service concludes that there is a reasonable likelihood that the entire action would not jeopardize listed species or result in the destruction or adverse modification of critical habitat. This non-jeopardy/non-adverse modification conclusion is based on information provided by MMS that indicates that while possible, population-level impacts are not reasonably likely to occur. Specifically, population-level impacts could occur if infrastructure is placed in areas where large concentrations of eiders occur. However, given the implications of doing so, and the availability of viable alternatives, we believe this is unlikely. Our greatest concern for potential population-level impacts is from large marine oil spills that could reach concentrations of eiders, but we believe this also is not reasonably likely to occur. Based on information provided by MMS and analyzed in this BO, we do not believe that it is likely that development will occur, *and* a large spill will result, *and* that spill will occur at such a time and place that it reaches large numbers of eiders. Thus, we conclude that there is a reasonable likelihood that the entire action would not jeopardize listed species or result in the destruction or adverse modification of critical habitat.

This non-jeopardy/non-adverse modification conclusion is based on the low probability of population-level effects occurring. However, as additional information about the nature, location, and timing of proposed oil and gas activities becomes available during this phased leasing, exploration, development, and production process, the Service could later determine that proposed activities are likely to jeopardize listed species or result in destruction or adverse modification of critical habitat. Threats most likely to lead to jeopardy or destruction/adverse modification conclusions include, for spectacled eiders, oil spills that could result in high mortality during molt in Ledyard Bay or staging in spring leads during spring migration, or that could impact the quantity and quality of the Ledyard Bay invertebrate community, a principle constituent element of designated critical habitat. For Steller's eiders, primary threats include an oil delivery pipeline landfall sited at Barrow that could result in substantial loss of Steller's eider nesting habitat, and oil spills that could result in high mortality of migrating Steller's eiders in spring leads or adjacent nearshore waters.

2. DESCRIPTION OF THE PROPOSED ACTION

This BO was prepared as part of an incremental step consultation on Lease Sale 193 in the Chukchi Sea. Activities that could ensue from the leasing of tracts pursuant to Lease Sale 193 include potential exploration, development, and production of offshore oil and gas reserves. The first incremental step includes leasing and exploration (which includes seismic surveys and exploratory drilling). This BO also provides an evaluation of whether it is reasonably likely that the entire project, including development and production (including field abandonment), that may result from Lease Sale 193, would violate section 7 (a)(2) of the Act. This section includes descriptions of the action area; activities proposed under the first incremental step (leasing and exploration); and development, production, and abandonment activities that may result from Lease Sale 193.

The Chukchi Sea OCS is viewed as one of the most petroleum-rich provinces in the country, with MMS assessments indicating the mean recoverable oil resource is 12 billion barrels (Bbbl) with a 5% chance of 29 Bbbl (MMS 2006a). MMS concludes it is reasonable to assume exploration of the area could lead to significant oil discoveries. To date there have been 5 exploration wells drilled in the Chukchi, and no active leases since 1998. The likelihood of oil development depends upon many factors in the remote, high-cost location. MMS's current analysis (MMS 2006b), based upon oil prices \geq \$30.00 per barrel (bbl) oil, indicates the realistic probability for commercial success in the Chukchi Sea is less than 10%. However, MMS predicts when the first project overcomes the cost, logistical, and regulatory hurdles, more projects are likely to follow. Typical of many frontier areas, development usually starts with a relatively large project that supports the cost of initial infrastructure; progressively small fields are developed after using this infrastructure, and the industrial footprint expands away from the core area (MMS 2006a). MMS also indicates Chukchi Sea OCS development would have a synergistic effect on the level of offshore activities in the adjacent Beaufort Sea and field development in the NPR-A (MMS 2006a).

The action area is that area in which direct and indirect effects of the proposed action may occur. Lease Sale 193, part of the current 5-year OCS leasing program, encompasses approximately 137,600 km² (34 million acres) of the Chukchi Sea (Fig. 1). The boundaries of the lease sale area do not limit or define the action area of the entire project, however, as some structures would be constructed in marine waters outside the lease sale boundaries (e.g., platform-to-shore pipelines) and in the terrestrial environment (e.g., shore facilities, pump stations, and a pipeline connecting to the TAPS) if oil leasing occurred. Because the specific location of future development is unknown, we have defined the action area for the purposes of this analysis to include the lease sale area, all marine waters between the eastern boundary of the lease sale area and the Alaskan coastline, and the North Slope of Alaska from Point Hope north to the Beaufort Sea, and east to the Alpine satellite development (currently, the closest TAPS tie-in point). Additionally, areas identified by MMS's spill trajectory model as being potentially affected by large oil spills from Lease Sale 193 are considered to be within the action area.

Leasing & Exploration Activities

Following the lease sale, exploration for oil and gas reserves may occur. Exploration begins with seismic surveys and may proceed to exploratory drilling.

Seismic Surveys

Seismic surveys, including two- and three-dimensional (2-D and 3-D), may be conducted at various resolution (distance between transects) in the lease sale area to locate geological structures with petroleum accumulation potential. MMS estimates that approximately 100,000 line-miles of low-resolution 2-D surveys have been conducted in the Chukchi Sea, suggesting that most future surveys would be 3-D, and focused on potential development sites. Before development occurs, high-resolution site-clearance surveys would be conducted on 300 x 900 m grid transects (or 50 x 900 m grid transects for archeological resources) to locate shallow hazards, obtain engineering data, and detect archeological resources.

Seismic surveys use source and receiving arrays to generate and record sound energy, towed often (but not always) from the same boat. Towed source arrays are air guns fired at short, regular intervals; 2-D surveys generally use fewer guns than 3-D. While most of the sound energy is focused down into the water column, it can also propagate horizontally for several kilometers. Sound energy reflected from the water column and off the bottom is recorded by a series of passive hydrophones in the receiving arrays, from 600 m to 3-8 km behind the source array. Receiving arrays are attached by streamer cables, which are often filled with liquid, solid, or gel paraffin to provide buoyancy, and may have tail buoys. Total array width may be 1,500 m.

Marine seismic survey vessels are designed to operate for several months without refueling or re-supply, although guard or chase boats and limited helicopter support may be used for crew changes or vessel support. Surveys can commence as soon as ice conditions allow, and continue throughout the ice-free period, approximately early June through mid-October.

To avoid disturbing spectacled eiders molting in the LBCHU, MMS would not permit seismic surveys in this area after July 1 of each year (MMS 2006a, email dated 11/21/06 from Mark Schroeder, MMS).

Exploratory Drilling

Five test wells have been drilled in the lease sale area and MMS estimates that 7-14 additional test wells would be required to discover and delineate the first commercial field. Drilling operations are expected to range from 30-90 days at each well site, so up to four wells could be drilled by each drill rig in each open water season. Currently, there are only two drill rigs capable of operating in the Chukchi and Beaufort Seas, and no

other exploratory drilling proposals have been announced (Kristen Nelson, *Petroleum News*, pers. comm.).

MMS anticipates exploratory drilling would be conducted by paired drill ships, and support vessels. Drill ships would be able to move off the drill site if sea or ice conditions require, unlike platforms. Drill ships are attended by at least two icebreakers and up to seven other support vessels for re-supply, anchor handling, and oil spill response.

Air activity associated with exploratory drilling is anticipated to include helicopter support for crew changes and other activities (including search and rescue), conducted via 1-3 daily helicopter flights from Barrow or other land base. Daily (weather permitting) marine mammal surveys would be conducted by up to three fixed-wing aircraft in the area. Survey methods, set by the National Marine Fisheries Service (NMFS), would include monitoring the presence of bowhead whales during their migration (August 1-October 1) in relation to noise isopleths out from drill ships. The altitude of these flights has not been specified except over the LBCHU after July 1 when aircraft must maintain an altitude of 1,500 feet above sea level (ASL) unless safety or poor weather demand a lower flight level, as explained below.

Specifically, because exploratory drilling may potentially be allowed in the LBCHU, MMS developed the following stipulations to reduce disturbance effects from any associated activities. These stipulations would be in effect between July 1 and November 15 when eiders may be present.

- (a) Except in cases to protect human safety or respond to an oil spill, vessels associated with drilling operations will avoid operating within the LBCHU to the maximum extent practicable. Support vessels must enter the LBCHU from the northwest and proceed directly to the drill rig, remain in close proximity to the drill rig while providing support, and exit the drill rig vicinity to the northwest until out of the LBCHU.
- (b) Except in cases to protect human safety, when landing, or to participate in an oil spill response, aircraft supporting drilling operations will not operate below 1,500 feet ASL when operating over the LBCHU. If weather prevents attaining this altitude, aircraft will use pre-designated flight routes at the outer margin of the LBCHU. Pre-designated flight routes will be established by the lessee and MMS, in collaboration with the Service, during review of the Exploration Plan.
- (c) An Oil Spill Response Vessel must be on-site when a drill rig is within the LBCHU. The lessee will also pre-stage wildlife hazing equipment (including at least 3 *Breco* buoys or similar devices) either on the Oil Spill Response Vessel or in Point Lay or Wainwright. The lessee will ensure on-site oil-spill response personnel are trained in the use of wildlife hazing equipment.

Future Activities

To determine if it is reasonably likely that activities that may result from Lease Sale 193 would not violate section 7(a)(2) of the Act, we evaluated the development scenario provided by MMS in their BE (MMS 2006a), where additional details can be found. The scenario includes likely activities, based on current understanding of resources and environmental conditions, associated with development of one large (1 billion bbl) oilfield in the lease area, with an estimated lifespan (exploration through abandonment) of 30-40 years. MMS describes the development scenario in three phases: construction, estimated at 3-5 years once a commercial field has been delineated; production; and abandonment. Each phase includes activities in both marine and terrestrial environments, but at unknown locations. Marine facilities would include a central production facility; satellite wells linked to the central production facility by flowlines; and a pipeline from the central production facility to a shore base. Terrestrial facilities would include the shore base and a pipeline connecting to TAPS, with associated pump stations and an access road.

Construction

Marine facilities would include a large bottom-founded platform as the likely type of central production facility, due to the deep waters and ice movement in the Chukchi Sea. Because no platform has operated yet in environmental conditions equivalent to those on the Chukchi Shelf, platform design is conceptual at this time, but includes a circular concrete structure with a wide base, constructed in several component sections transported separately and mated at the site. The platform would be pinned to the seafloor and stabilized by its wide base, anchoring system, and ballast. The platform would support one or two drill rigs, production and service (injection) wells, processing equipment, fuel and production storage capacity, and personnel quarters. Transportation of materials and personnel during the offshore construction phase would be by helicopter, barge, or other vessel from Barrow, the shore base, or West Dock (vessels only).

MMS estimates that half the production wells would be drilled from the central production facility; this drilling could occur year-round. Oil would flow from the central production facility to the mainland through a main pipeline, which would probably be trenched into the seafloor to avoid ice damage. Other wells would be drilled by drill rigs in the open-water season. These “subsea” wells (no structures above the surface of the ocean) would be developed in templates of four. Oil from these wells would be transported to the central production facility by trenched pipelines (called “flowlines” when coming from subsea wells to the central production facility) up to 15 miles long. Pipeline installation (main and flowlines) would occur during open-water season while the platform is being constructed.

Terrestrial facilities would include a new shore base and an oil pipeline with pump stations connecting to TAPS. The new shore base, estimated by MMS at 50 acres with an

additional 50-acre staging area, would support offshore operations and be the first pump station. An additional four pump stations are estimated at 40 acres each. The pipeline and its adjacent access road may be up to 300 miles long. Much of the terrestrial infrastructure would be within the National Petroleum Reserve – Alaska (NPR-A) and would therefore require authorization from the Bureau of Land Management (BLM).

For the shore base, heavy equipment and materials would be transported using barges, marine vessels, aircraft (C-130 Hercules, smaller planes, and helicopters), and possibly via a winter ice road. Gravel material for the pads and access road would likely be mined from an unspecified number of unknown upland material sources along the route and possibly from coastal areas such as barrier islands.

Production

The estimated time from leasing to full production capability is expected to be 10-15 years. Once in operation production rates are estimated at 200,000 to 250,000 bbl/day. The entire field, including subsea wells, could be approximately 30 miles (48 km) in diameter (based on 15 mile flowline length from subsea wells to the central production facility).

At the central platform facility production, slurry (oil, gas, and water) would be separated before gas and produced water are re-injected. Some gas recovered during oil production may be used as fuel for the facility. Non-recycled drill cuttings and mud wastes from the on-platform wells would be placed in shallow disposal wells, while those from the subsea wells would be barged to an onshore treatment and disposal facility.

Other operations would largely involve re-supply of materials and personnel, inspection of systems, and maintenance and repair. Processing equipment may be upgraded to remove bottlenecks in production systems. Well workovers would be made every 5-10 years to restore flow rates in production wells. Pipelines would be inspected and cleaned regularly, and weekly crew changes are likely. MMS estimates that during production up to three helicopter flights per day from the shore base to the offshore platform would be made, and vessel traffic would be one to two trips per week.

Abandonment

Once the oil reserve has been depleted, production costs exceed production income, or the central production facility is no longer useful as a hub for satellite developments or natural gas production facility (which may extend the life of the project), the operation would be shut down. Wells would be permanently plugged with cement and equipment removed. Subsea pipelines would be decommissioned (cleaned, plugged at both ends, and left in place). The central production platform would be dismantled and removed, and seafloor restoration would occur at the site. Post-abandonment surveys would confirm that no debris remained following abandonment.

3. 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 Eider Life History and Distribution

Spectacled eiders are large sea ducks that inhabit the North Pacific. Males in breeding plumage have a white back, black breast, and pale green head with large white "spectacles" around the eyes. In late summer and autumn, males molt into a mottled brown plumage that lasts until late fall, when they re-acquire breeding plumage. Females are mottled brown year round, with pale tan spectacles. Juveniles attain breeding plumage in their second (female) or third (male) year; until then they are mottled brown (Petersen et al. 2000). Both males and females have long sloped bills, giving them a characteristic profile (Fig. 3.1).



Figure 3.1. Male and female spectacled eiders in breeding plumage.

All spectacled eider breeding populations were listed as threatened on May 10, 1993 (Federal Register 58(88):27474-27480) because of documented population declines. The Yukon-Kuskokwim Delta (Y-K Delta) population declined 96% between the 1970s and early 1990s (Stehn et al. 1993, Ely et al. 1994). Anecdotal information indicated that populations in the other two primary breeding areas, the Russian and Alaskan Arctic Coastal Plains (ACP), also declined, along with the much smaller breeding population on St. Lawrence Island in the Bering Sea (USFWS 1996) (Fig. 3.2).

Research and spring aerial surveys have provided data on spectacled eider populations on Alaska's ACP (the "North Slope" breeding population) since 1992. Breeding density varies across the North Slope (Fig. 3.3; Larned et al. 2006). Breeding pair numbers peak in mid-June and the number of males declines 4-5 days later (Smith et al. 1994, Anderson and Cooper 1994, Anderson et al. 1995, Bart and Earnst 2005). Male spectacled eiders generally depart breeding areas when females begin incubation, usually in late June, and they apparently make little use of the Beaufort Sea en route to their molting locations (Petersen et al. 1999, Troy 2003).



Figure 3.2. Distribution of spectacled eiders (USFWS 2002a).

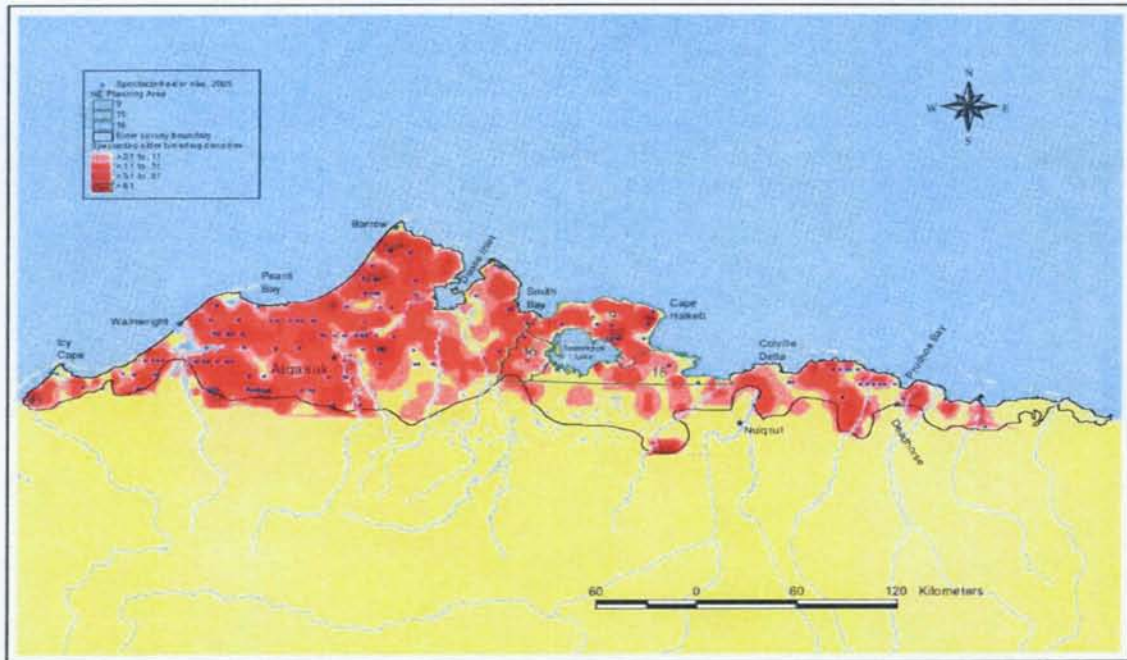


Figure 3.3. Spectacled eider observations in 2005 and density on the Alaska ACP from 1999-2002 (Larned et al. 2006).

North Slope spectacled eider clutch size averages 3.2-3.8, with clutches of up to eight eggs reported (Quakenbush et al. 1995). 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). On the nesting grounds, spectacled eiders feed on mollusks, insect larvae (craneflies and caddisflies), midges, small freshwater crustaceans, and plants and seeds (Kondratev and Zadorina 1992) in shallow freshwater or brackish ponds, or on flooded tundra. Young fledge approximately 50 days after hatch, and then females with broods move directly from freshwater to marine habitats.

Nest success is variable and greatly 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; predation was believed to be the cause of high failure rates, with foxes, gulls and jaegers the suspected predators (Pearce et al. 1998). On Kigigak Island in the Y-K Delta, nest success ranged from 20-95% in 1991-1995 (Harwood and Moran 1993, Moran 1996). Nest success was higher in 1992 than in other years of observation, presumably because foxes were eliminated from the island prior to the nesting season. Apparent nest success in 1991 and 1993-1995 in the Kuparuk and Prudhoe Bay oil fields on the North Slope varied from 25-40% (Warnock and Troy 1992, Anderson et al. 1998).

As with other sea ducks, spectacled eiders spend the 8-10 month-long 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 at sea. These studies are summarized in Petersen et al. (1995), Larned et al. (1995), and Petersen et al. (1999).

Spectacled eiders use specific molting areas from July to late October. Larned et al. (1995) and Peterson et al. (1999) discussed spectacled eiders' apparent strong preference for specific molting locations, and concluded that all spectacled eiders molt in four discrete areas (Fig. 3.2). Females generally used molting areas nearest their breeding grounds. All transmittered females from the Y-K Delta molted in nearby Norton Sound (n=18), while females from the North Slope (n=15) molted in Ledyard Bay (10), along the Russian coast (4), and near St. Lawrence Island (1). 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 or September and remained through October.

Avian molt is energetically demanding, especially for species such as spectacled eiders that complete molt in a few weeks. Molting birds must have ample nutritious food sources, 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 utilize 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). The environmental characteristics of Ledyard Bay are described in the *Ledyard Bay Critical Habitat Unit* section below.

After molting, spectacled eiders migrate 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 (Fig. 3.2). In this relatively shallow area, hundreds of thousands of spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 70 m to eat bivalves, mollusks, and crustaceans (Cottam 1939, Petersen et al. 1998, Petersen and Douglas 2004). Twelve spectacled eiders collected in the Bering Sea wintering area in March 2001 contained primarily the bivalve *Nuculana radiata* (Lovvorn et al. 2003).

Although migratory movements between the wintering area and the North Slope are poorly understood, it is likely that spectacled eiders follow open water in order to rest and feed en route. Recent information about spectacled and other eiders indicates that 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 (*Somateria mollissima*) and spectacled eiders in spring leads and several miles offshore in relatively small openings in rotting sea ice (William Larned, USFWS; James Lovvorn, University of Wyoming, pers. comm.). Woodby and Divoky (1982) documented large numbers of king (*Somateria spectabilis*) and common eiders using the eastern Chukchi lead system, advancing in pulses during days of favorable following winds, and concluded that an open lead is

probably requisite for the spring eider passage in this region. Information obtained in 2002-2006 about 57 satellite-transmitted king eiders found that 100% of the birds migrating from the Bering Sea to breeding grounds in North America occupied the spring lead system in the eastern Chukchi (Fig. 3.4) for approximately 3-4 weeks (Steffen Oppel, University of Alaska-Fairbanks, unpubl. data).

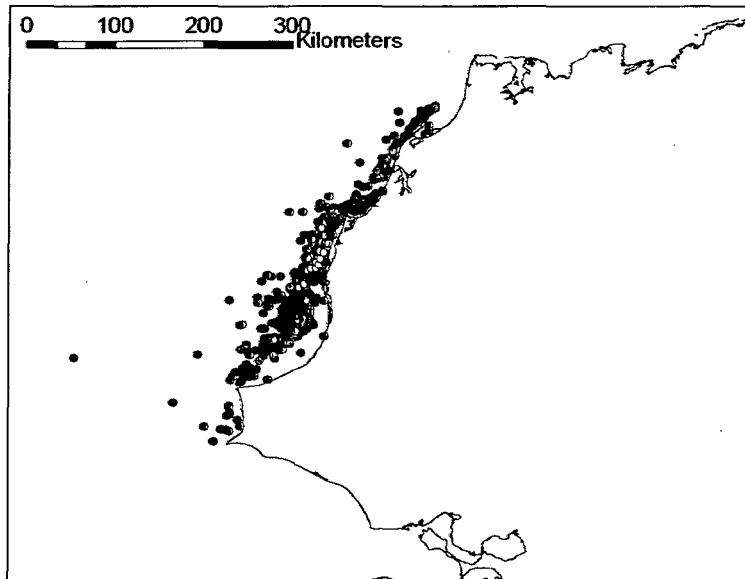


Figure 3.4. Spring migration locations of satellite-transmitted North Slope king eiders, 2002-2006 (Steffen Oppel, University of Alaska-Fairbanks, unpubl. data).

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, so produce and incubate their eggs while living 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 1971, Korschgen 1977, Parker and Holm 1990). For spectacled eiders, average female body weight in late March in the Bering Sea was $1,550 \pm 35$ g ($n=12$), and slightly (but not significantly) more upon arrival at breeding sites ($1,623 \pm 46$ g, $n=11$) (Lovvorn et al. 2003), indicating that spectacled eiders must maintain or enhance their physiological condition during spring staging.

Spectacled Eider 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). For the North Slope breeding population, the most recent (2002-2006) population index¹ of 6458 (5471-7445 95% CI) was adjusted by a factor that accounts for the number of nests missed during aerial surveys² (developed on the Y-K Delta) and used to calculate a North Slope breeding spectacled eider population estimate of 12,916 (10,942-14,890 95% CI), 2002-2006 (Stehn et al. 2006, included in Appendix 2). The spectacled eider population size from 1993-2006 was stable, with an average (n=14) annual growth rate of 0.997 (0.978-1.016 90% CI), a number not significantly different from 1.0 (Stehn et al. 2006).

Spectacled Eider Recovery Goals and Status

The Spectacled Eider Recovery Plan (USFWS 1996) presents research and management priorities with the objective of recovery and delisting so that protection under the Act is no longer required. Although cause of the spectacled eider population decline is not known, factors that affect adult survival may 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 Y-K Delta (Franson et al 2005, Grand et al. 1998), and other factors such as habitat loss, increased nest predation, over harvest, and disturbance and collisions caused by human infrastructure (factors discussed in Section 4 – *Environmental Baseline*). Under the Recovery Plan, the species will be considered recovered when each of the three recognized populations (Y-K Delta, North Slope of Alaska, and Arctic Russia): 1) is stable or increasing over 10 or more years and the minimum estimated population size is at least 6,000 breeding pairs, or 2) number at least 10,000 breeding pairs over 3 or more years, or 3) number at least 25,000 breeding pairs in one year. Spectacled eiders do not currently meet these recovery criteria.

Ledyard Bay Critical Habitat Unit (LBCHU)

Critical habitat for molting spectacled eiders was designated in Norton Sound and Ledyard Bay on February 6, 2001 (Federal Register 66(25): 9146-9185), and nesting and wintering habitat in other locations (none on the North Slope). In accordance with section 3(5)(A)(i) of the Act and regulations in 50 C.F.R. 424.12, critical habitat for a species contains those physical or biological features that are essential for the conservation of the species and which may require special management considerations and protection. Under the Act these features are considered “primary constituent elements” of critical habitat, and include, but are not limited to: space for individual and population growth, and for normal behavior; food, water air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and habitats that are

¹ A standard index used to monitor waterfowl populations based on the number of birds seen during aerial surveys but adjusted for cryptic females that are presumably missed when single males are detected (USFWS and Canadian Wildlife Service 1987).

² The detection correction factor compares the number of eiders observed during aerial surveys with the number of nests located on ground surveys in order to presume actual population size from the number detected in aerial surveys.

protected from disturbance or are representative of the historical geographic and ecological distribution of a species.

The LBCHU was designated because of its importance to migrating and molting spectacled eiders, and includes waters of Ledyard Bay within about 1.85-74 km (1-40 nautical miles [nm]) from shore. Individuals from all three breeding populations molt in Ledyard Bay, including most (77%) females that nest on the North Slope (Petersen et al. 1999). Primary constituent elements identified for LBCHU are marine waters > 5 m and \leq 25 m deep, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community. Conserving the ecosystem processes and physical and biological features of Ledyard Bay may be essential for the conservation of spectacled eiders, so additional detail is provided below to better analyze the potential effects of the project on this critical habitat unit.

Grebmeier and Duncan (2000) summarized the current understanding of processes in the northern Bering and Chukchi seas that contribute to the relatively abundant benthic community found in Arctic sea shelves like Ledyard Bay. The seasonally ice-covered Bering and Chukchi sea shelves are some of the largest in the world, and they support an extremely productive and dynamic benthic system containing some of the highest faunal biomass in the Arctic Ocean. An inflow of nutrient-rich Pacific waters across the shallow shelves supports high primary production, with high edge-ice productivity in regions of limited open water. In general, the high primary production is not directly consumed by pelagic secondary consumers so it settles quickly to the underlying benthos, generating a particularly rich macrobenthic community (Grebmeier 1993, Highsmith and Coyle 1992, Grebmeier and Cooper 1995). As a result, large populations of benthic-feeding marine mammals and birds are apex predators in relatively short food chains and simple food webs in Arctic sea-shelf ecosystems (Grebmeier and Harrison 1992, Highsmith and Coyle 1992, Hunt 1991, Oliver and Slattery 1985, Oliver et al. 1983). Grebmeier and Dunton (2000) described a representative Chukchi Sea food web in which the spectacled eider is a direct predator on a deposit-feeding benthic mollusk (Fig. 3.5); this likely characterizes the ecosystem of Ledyard Bay.

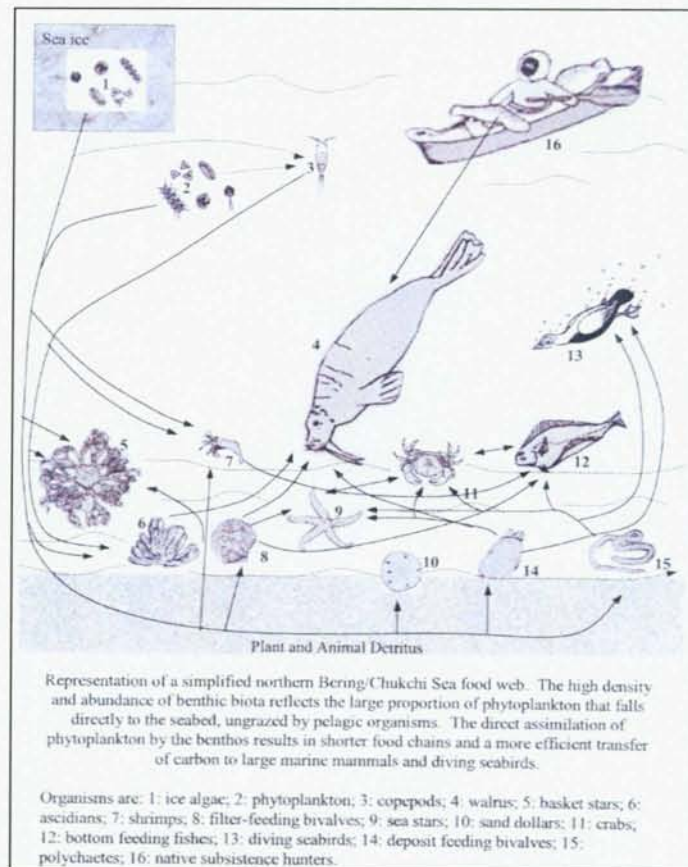


Figure 3.5. Representative Chukchi Sea food web with spectacled eider in apex predator functional role (from Grebmeier and Dunton 2000).

Some specific information exists about the benthic community within Ledyard Bay, as Feder et al. (1989, 1994a and 1994b) sampled sediment and benthic invertebrates at 37 sites in the eastern Chukchi Sea, including six sites within the LBCHU. In the LBCHU, seafloor depth varied from 18-32 m. Five LBCHU sample sites were from two statistically distinct groups: a sand/gravel-bottom assemblage with an infauna (organisms that dwell in the sediment) dominated by a nucloida clam (*Yoldia scissurata*), and epibenthos (organisms that are on or attached to the bottom substrate) dominated by scallops (*Chlamys behringiana*), gastropods (*Neptunea* spp.), and acorn barnacles (*Balanus crenatus*); and a sand-bottom assemblage with an infauna dominated by mussels (*Musculus* spp.) and epibenthos dominated by sand dollars (*Echinarachnius parma*). The sixth site, near the western edge of the LBCHU boundary, was an offshore muddy-gravel assemblage. Feder et al. (1994a and 1994b) noted the relatively high standing stocks of benthos in this area was possible because local carbon was augmented by particulate organic carbon advected by ocean currents from highly productive areas in the Pacific. Feder et al. (1994b) further determined the distribution of infaunal and epifaunal mollusks was related to the environmental variables of bottom substrate and water masses in the northeastern Chukchi Sea. They concluded that abundance and biomass of infaunal mollusks increased from the Bering Shelf towards the coast. Indeed,

some of the Ledyard Bay sites had the highest invertebrate abundance and biomass in the study.

This rich Ledyard Bay benthic community likely provides an important and predictable food resource for spectacled eiders during two energetically demanding portions of their life history: 1) during northward migration immediately prior to egg-laying when females must maintain or increase their body weight; and 2) the post-breeding molt. Although food habits studies have not been conducted for listed eiders in Ledyard Bay, the LBCHU benthic community is likely similar to (or exceeds) the food value of the Bering Sea wintering area benthos.

In summary, a particular set of environmental conditions coincide in the vicinity of Ledyard Bay to create a predictable and abundant food supply for bottom-feeding diving predators like eiders: a shallow ocean shelf with near-shore sandy or gravelly substrates overlain by rich ocean currents; enhanced ice-edge productivity during the brief open water season; short but productive food chains and food webs; high benthic invertebrate biomass and abundance; near-shore spring leads that provide early season access to the food resources for migrating eiders; and open water conditions over those resources during the summer/autumn molt. The Service believes these are the features of the primary constituent elements of Ledyard Bay that provide the conservation value of the critical habitat designated for spectacled eiders.

Steller's Eider

Steller's Eider Life History and Distribution

The Steller's eider is a circumpolar sea duck, and it is the smallest of the four eider species. From early winter until mid-summer males are in breeding plumage - black back, white shoulders and sides, chestnut breast, white head with black eye patches and a greenish tuft (Fig. 3.6). During late summer and fall, males molt to dark brown with a white-bordered blue wing speculum; this plumage is replaced during the autumn molt when males reacquire breeding plumage, which lasts through the next summer. Females are dark mottled brown with a blue wing speculum. Juveniles are dark mottled brown until the fall of their second year, when they acquire breeding plumage (Fredrickson 2001).



Figure 3.6. Male and female Steller's eider in breeding plumage.

Steller's eiders are divided into Atlantic and Pacific populations; the Pacific population is further divided into the Russia-breeding population along the Russian eastern arctic coastal plain, and the Alaska-breeding population. On June 11, 1997, the Alaska-breeding population of Steller's eiders was listed as threatened based on a substantial decrease in the species' breeding range in Alaska and the resulting increased vulnerability of the remaining Alaska-breeding population to extirpation (Federal Register 62(112):31748-31757). The Service concluded the available information did not support listing the species range-wide because counts in 1992 indicated at least 138,000 Steller's eiders wintered in southwest Alaska, and the counts were too imprecise to determine trends with confidence. Although population size estimates for the Alaska-breeding population were also imprecise, it was clear Steller's eiders had essentially disappeared as a breeding species from the Y-K Delta, where they had historically occurred in significant numbers, and that their ACP breeding range was much reduced. On the ACP, they historically occurred east to the Canada border (Brooks 1915), but have not been observed in the eastern ACP in recent decades (USFWS 2002b). The Alaska-breeding population of Steller's eiders now nests primarily only on the ACP, particularly around Barrow and at very low densities from Wainwright to at least as far east as Prudhoe Bay (Fig. 3.7). A few pairs also apparently remain on the Y-K Delta (approximately 9 nests found in the last 14 years).

Steller's eiders arrive in pairs on the ACP in early June, but may be episodic breeders; since 1991, Steller's eiders near Barrow apparently nested in 9 years but did not nest in 7 years (Rojek 2006). Non-breeding years are common in long-lived eider species and is typically related to inadequate body condition (Coulson 1984), but reasons for Steller's eiders non-breeding may be more complex. In the Barrow area Steller's eider nesting has been observed related to lemming numbers and other environmental cues; nest success could be enhanced in years of lemming abundance because nest predators are less likely to prey-switch to eider eggs and young, or because avian predator such as pomarine jaegers (*Stercorarius pomarinus*) and snowy owls (*Nyctea scandiaca*) that nest nearby (and consume abundant lemmings) may protect eider nests from mammalian predators such as arctic fox (Quakenbush and Suydam 1999, and summarized by Rojek 2006).

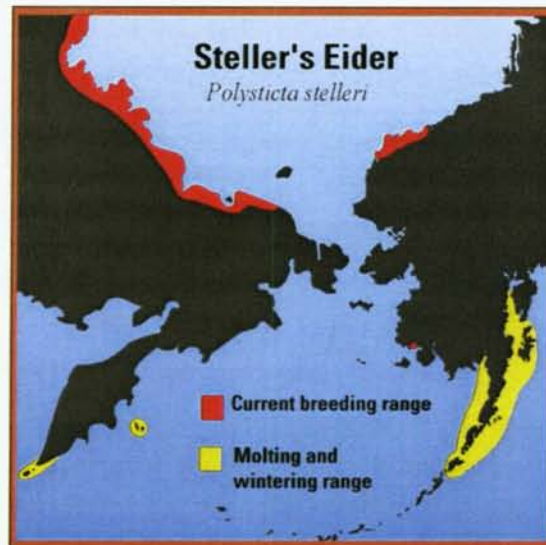


Figure 3.7. Steller's eider distribution in the Bering and Chukchi Seas (USFWS 2002b).

When they do breed, Alaska-breeding Steller's eiders nest on coastal tundra adjacent to small ponds or within drained lake basins, occasionally as far as 90 km inland. Nests are initiated in the first half of June (Quakenbush et al. 1995), and hatching occurs from July 7 to August 3 (Quakenbush et al. 1998). Nests located in the vicinity of Barrow were in wet tundra, in drained lake basins or low-center or low indistinct flat-centered polygon areas (Quakenbush et al. 1998). Average clutch sizes at Barrow varied from 5.3-6.3, with clutches of up to 8 reported (Quakenbush et al. 1998, Rojek 2005). Nest success (proportion of nests with at least one egg hatched) at Barrow averaged 17% from 1991-2002 (Service, unpublished data). As with spectacled eiders, nest and egg loss was attributed to predation by jaegers, common raven (*Corvus corax*), arctic fox, and possibly glaucous gulls (*Larus hyperboreus*) (Quakenbush et al. 1995, Obritschkewitsch et al. 2001).

Immediately after hatch, hens move their broods to adjacent ponds with emergent vegetation, particularly *Carex* spp. (Rojek 2005) and *Arctophila fulva* (Quakenbush et al. 1998). Here they feed on insect larvae and other wetland invertebrates. Broods may move up to several kilometers from the nest prior to fledging (Quakenbush et al. 1998, Rojek 2005). Fledging occurs from 32-37 days post hatch (Obritschkewitsch et al. 2001, Quakenbush et al. 2004, Rojek 2005).

Departure from the breeding grounds differs between sexes and between breeding and non-breeding years. Male Steller's eiders typically leave the breeding grounds after females begin incubating, around the end of June or early July (Quakenbush et al. 1995, and Obritschkewitsch et al. 2001). Females whose nests fail may remain near Barrow later in summer; a single failed-breeding female equipped with a transmitter in 2000 remained near the breeding site until the end of July and stayed in the Beaufort Sea off Barrow until late August (Martin et al. in prep). Successfully-breeding females and fledged young depart the breeding grounds in early to mid-September. In a non-breeding year, satellite-transmitted males and females dispersed across the area between

Wainwright and Admiralty Inlet in late June and early July, with most birds entering marine waters by the first week of July. They were tracked at coastal locations from Barrow to Cape Lisburne, and made extensive use of lagoons and bays on the north coast of Chukotka (Martin et al. in prep.).

After the breeding season, Steller's eiders move to marine waters where they undergo a complete flightless molt for about 3 weeks. The combined (Russia- and Alaska-breeding) Pacific population molts in numerous locations in southwest Alaska, with exceptional concentrations in four areas along the north side of the Alaska Peninsula: Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands (Gill et al. 1981, Petersen 1981, Metzner 1993). Molting areas are characterized by extensive shallow eelgrass (*Zostera marina*) beds and intertidal sand flats and mudflats, where Steller's eiders forage on marine invertebrates such as mollusks and crustaceans (Petersen 1980, 1981; Metzner 1993).

After molt, many of the Pacific-wintering population of Steller's eiders disperse to winter in the eastern Aleutian Islands, the south side of the Alaskan Peninsula, and as far east as Cook Inlet, although thousands may remain in lagoons used for molt unless or until freezing conditions force them to move (USFWS 2002). Wintering Steller's eiders usually (although not always; Martin et al. in prep.) occur in waters less than 10 m deep, which are normally within 400 m of shore or at offshore shallows.

Prior to spring migration, thousands of Steller's eiders stage in estuaries along the north side of the Alaska Peninsula, including some molting lagoons, and at the Kuskokwim Shoals near the mouth of the Kuskokwim River in late May (Larned 2005, Martin et al. in prep.). Like other eiders, Steller's eider may use spring leads for feeding and resting, but there are few conclusive data about habitat use during spring migration. During winter, Steller's eiders generally use and feed in shallower water than the other eider species, although they may also use deeper (i.e., 20-30 m) habitats if feeding on water-column invertebrates (Philip Martin, USFWS, pers. comm.). They are likely associated with shallow spring leads, therefore, although they possibly also use leads in deeper water if an abundant and nutritious invertebrate community is present in the water column. Alaska-breeding Steller's eiders typically return to breeding areas near Barrow in early June (Rojek 2006).

In 2001, the Service designated 2,830 mi² (7,330 km²) of critical habitat for the Alaska-breeding population of Steller's eiders at breeding areas on the Y-K Delta, a molting and spring-staging area in the Kuskokwim Shoals, and molting areas in marine waters at the Seal Islands, Nelson Lagoon, and Izembek Lagoon. No critical habitat for Steller's eiders has been designated on the ACP.

Steller's Eider Abundance and Trends

Aerial surveys optimized to detect eiders have been conducted on the North Slope since 1992 (Larned et al. 2006), and indicate Steller's eiders occur at very low densities across the ACP, with a higher density in the vicinity of Barrow (Fig. 3.8). Standardized ground

surveys for eiders near Barrow have been conducted since 1999, and have found an average density near Barrow of 0.66 birds/ km² (Rojek 2006) (Fig. 3.9). The Barrow vicinity supports the largest known concentration of nesting Steller's eiders in North America.

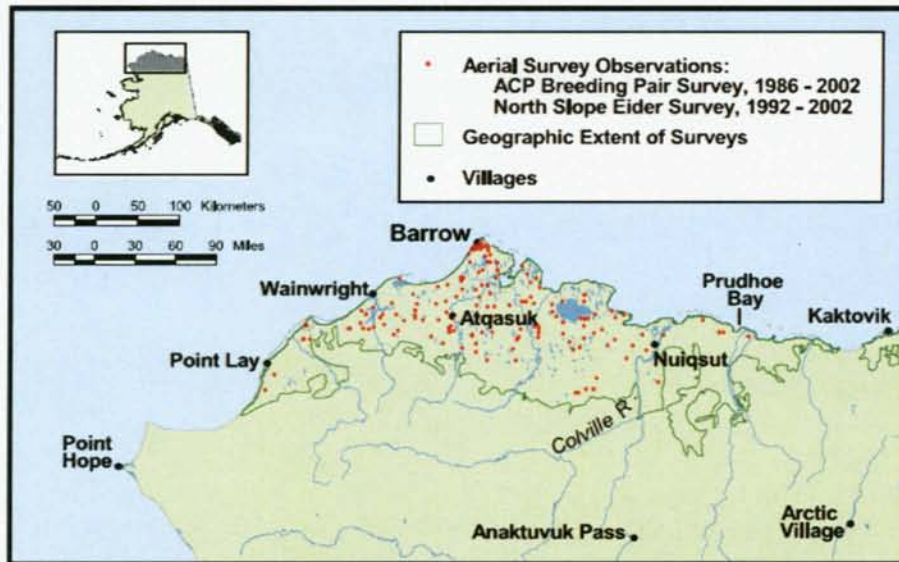


Figure 3.8. Distribution of Steller's eiders from aerial surveys on the Arctic Coastal Plain, Alaska (USFWS 2002b).

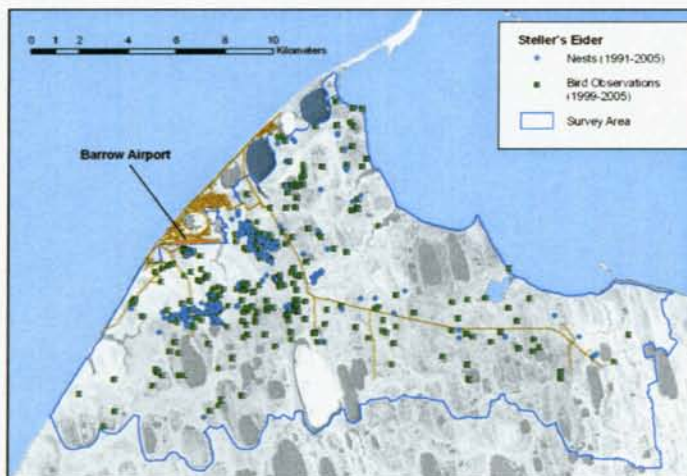


Figure 3.9. Steller's eider bird and nest observations in the vicinity of Barrow, Alaska, 1991-2005 (Rojek 2005).

Because Alaska-breeding Steller's eiders occur at very low densities, there is not sufficient information to estimate population size or detect population trends. The mean

1992-2006 aerial-survey generated population index³ was 116 (n=15, standard deviation [sd] = 204), but the range of indices in these years ranged from 20 (calculated in a year when no birds were seen) to 785 (Larned et al. 2006). The most recent index (2002-2006) was 112 (n=5, sd=98). However, aerial surveys likely undercount Steller's eiders for several reasons. An unknown number are simply missed when observers count from aircraft; this proportion varies by species and is unknown for Steller's eiders. Additionally, because observations at Barrow indicate that many Steller's eiders vacate nesting habitat early in non-nesting years, it is possible that aerial surveys fail to detect some individuals that were present early in the season, at least in some years. Further, the concentration area at Barrow, which contains a significant proportion of Steller's eiders detected on the entire ACP in most years, may be under-sampled because: 1) the scale of the concentration is too small to be adequately represented in the sampling regime; and 2) a portion of the concentration area is excluded because the area near the Barrow airport cannot be flown due to aviation safety concerns. Due to these biases, we cannot precisely estimate Steller's eider abundance on the North Slope, but the best available information leads the Service to estimate that roughly several hundred Steller's eiders occupy the North Slope in most years. For purposes of this consultation, such as estimating incidental take, we assume that there are 500 North Slope-breeding Steller's eiders.

Steller's Eider Recovery Goals

The Steller's Eider Recovery Plan (1992) presents research and management priorities with the objective of recovery and delisting so that protection under the Act is no longer required. When the Alaska-breeding population was listed as threatened, factors causing the decline were unknown, but potential causes identified were predation, over hunting, ingestion of spent shot in wetlands, and changes in the marine environment (factors discussed in Section 4 - *Environmental Baseline*). Since listing, other potential threats have been identified, including exposure to oil or other contaminants near fish processing facilities in southwest Alaska, but causes of decline and obstacles to recovery remain poorly understood.

Criteria to be used in determining when species are recovered are often based on historical abundance and distribution, or on the number needed to ensure the risk of extinction is tolerably low (with extinction risk estimated by population modeling). For Steller's eiders, information on historical abundance is lacking, and life history parameters needed for accurate population modeling are inadequately understood. Therefore, the Recovery Plan for Steller's eiders establishes interim recovery criteria based on extinction risk, with the assumption that numeric population goals will be developed as life history parameters become better understood. Under the Recovery Plan, the Alaska-breeding population will be considered for reclassification to endangered when the population has $\geq 20\%$ probability of extinction in the next 100 years for 3 consecutive years, or the population has $\geq 20\%$ probability of extinction in the next 100 years and is decreasing in abundance. The Alaska-breeding population will

³ We present only an index (no population abundance estimate, as with spectacled eiders) because no aerial survey-ground survey correction factor has been created for Steller's eiders on the North Slope.

be considered for delisting from threatened status when it has $\leq 1\%$ probability of extinction in the next 100 years, and each of the northern and western subpopulations are stable or increasing and have $\leq 10\%$ probability of extinction in 100 years.

Kittlitz's Murrelets

Kittlitz's Murrelet Life History and Distribution

Kittlitz's murrelets are small diving seabirds in the family Alcidae (including puffins, guillemots, and murre) which inhabit Alaskan coastal waters. Breeding plumage is mottled golden-brown and winter non-breeding plumage is more distinct, with a white underbelly and face and dark back and chest band.

On May 4, 2004, the Kittlitz's murrelet was designated a candidate for protection under the Act because its numbers have declined sharply and it may warrant listing as threatened or endangered (Federal Register 69(86):24875-24904). The Service places a species on the candidate list when there is sufficient information on biological vulnerability and threats to warrant proposing to list the species as endangered or threatened. Candidate status signals conservation concern for a species, and the Service encourages agencies, organizations and individuals to participate in research and conservation activities that may preclude the need to list under the Act. The Service will prepare a proposal to list the Kittlitz's murrelet when funding becomes available.

The causes of decline in Kittlitz's murrelets is not known, but may be related to the retreat of tidewater glaciers since the turn of the century. Exactly how glacier retreat might affect the murrelets is unknown, but studies in other regions have recorded low biological productivity in fjords with receding glaciers as a result of increased sedimentation and lowered salinity (Day et al. 1999). Lowered productivity could result in fewer forage fish, or sedimentation that affects feeding efficiency. In addition to changes in fjord habitats, Kittlitz's murrelets may also be affected by changes in their available prey species relative to changes in the greater marine environment (Kuletz 2004). The Kittlitz's murrelet could also be affected by increased marine traffic and tourist helicopter flights in Kenai Fjords, Prince William Sound, and Yakatak and Glacier bays (Kuletz 2004).

Kittlitz's murrelets are often found in association with marine tidewater glaciers and glacial-influenced water and in protected fjords (Kuletz and Piatt 1992, Day and Nigro 1998) as far north as the Chukchi Sea. The entire North American population occurs in Alaskan waters, migrating between winter offshore and summer inshore regions, which are presumably near breeding areas (Fig. 3.11). Lower numbers are scattered along the coast of eastern Russia (Day et al. 1999). Kittlitz's murrelets possibly nest as far north as Cape Sabine and Cape Beaufort, (inland of Ledyard Bay), although suitable habitat may not be available in that location (D.G. Roseneau, pers. comm., reported by Day et al. 1999). Suitable nesting habitat disappears north of Cape Beaufort, so the species rarely

occurs and probably does not breed north of there (from Wainright to Barrow; Huey 1931, Bailey et al 1933, Bailey 1948, Pitelka 1974).



Figure 3.10. Breeding distribution of Kittlitz's murrelet in North America (Day et al. 1999).

Kittlitz's murrelets arrive on their nesting grounds in pairs and nest non-colonially on steep, barren hillsides and talus slopes above timberline, generally near glaciers and cirques. Their nest site is on the ground with little vegetation, as much as 300-1000 m (980-3300 ft) above sea level, and up to several miles inland. The nest is often at the base of a large rock and possibly near a flowing stream (Day et al. 1999). Kittlitz's murrelets lay one large egg in a stone nest bowl, and the same site may be used for nesting year after year (Piatt et al. 1999). Eggs are laid from May 15-June 14 in southern Alaska, and June 16-28 in northern Alaska (Day et al. 1999). Incubation lasts approximately 30 days and young fledge August 9-21 in the northern part of their range, including the Chukchi Sea coast (Day et al. 1999). Both males and females incubate eggs and brood the young. There is no information on annual or lifetime reproductive success but some evidence suggests this species may forego breeding in some years (Day et al. 1999).

Kittlitz's murrelets occur at sea in substantial numbers along the ice edge in late summer and fall, particularly in the central Chukchi Sea, although there is much interannual variation in abundance (fall population in Chukchi Sea estimated as 1,000-5,000 birds by G.J. Divoky, University of Alaska-Fairbanks, unpubl. data). The species is not recorded in the Beaufort Sea (Divoky 1984, Johnson and Herter 1989). Both the timing and migration routes to and from the breeding grounds are unknown. It is likely that Kittlitz's murrelets follow the retreating ice edge, feeding on the biomass associate with ice plankton blooms. There is no information on migration routes.

Principal summer foods are thought to be small fishes and macro-zooplankton; winter foods are unknown, although the stomach of one museum specimen contained macro-zooplankton (Day et al. 1999). This species has been documented to forage extensively in turbid waters near tidewater glaciers and near glacier-fed streams as well as within clear water areas. Kittlitz's murrelets forage singly or in small groups during the day and night (Day et al. 1999).

The Kittlitz's murrelet's winter range is poorly known. Only 31 have been seen on Alaska Christmas Bird Counts from 1967 to 1997, suggesting most leave protected bays and go to sea during winter.

Kittlitz's Murrelet Abundance and Trends

The Kittlitz's murrelet is thought to be one of the rarest seabirds in North America, with a total population estimate of 9,000-25,000 birds. Surveys indicate significant population declines have occurred in three core areas: 84% in Prince William Sound since 1989; 38-75% near Malaspina Glacier; and a rate of decline that could result in extinction in 40 years in Glacier Bay. Recent summer population estimates for Kittlitz's murrelets are $5,408 \pm 7,039$ (95% CI) birds for Southeastern Alaska, $3,368 \pm 4,073$ birds for Prince William Sound, and $3,353 \pm 1,718$ birds for Cook Inlet, for a total of $12,129 \pm 8,312$ (Kendall and Agler 1998). There are no long-term data with which to calculate a range-wide population trend.

4. ENVIRONMENTAL BASELINE

The environmental baseline is the current status of listed species and their habitats, and the current status of critical habitat, as a result of past and ongoing human and natural factors in the area of the proposed action. Also included in the environmental baseline are the anticipated impacts of other proposed Federal projects in the action area.

Spectacled and Steller's Eiders

The North Slope-breeding population of spectacled eiders (approximately 12,916 breeding birds) and Steller's eiders (approximately 500 breeding birds) occupy terrestrial and marine parts of the action area for significant portions of their life history. Spectacled eiders breed, molt, and migrate in the action area, and Steller's eiders breed and migrate in the action area. Spectacled eiders nest throughout much of the ACP, whereas Steller's eiders have limited distribution across the ACP and highest breeding density near Barrow. Neither species is present in the action area from November 15 to April 15. Both species have undergone significant, unexplained declines in their Alaska-breeding populations. Factors that have possibly contributed to the current status of spectacled and Steller's eiders are discussed below and include, but are not limited to, toxic contamination of habitat, increase in predation, over harvest, and habitat loss

through development and disturbance. Factors that affect adult survival may be most influential on population growth rates. Recovery efforts for both species are underway in portions of the action area.

Toxic Contamination of Habitat

The deposit of lead shot in tundra or nearshore habitats used for foraging is a threat for Spectacled and Steller's eiders. Lead poisoning of spectacled eiders has been documented on the Y-K Delta (Franson et al. 1995, Grand et al. 1998) and Steller's eiders on the ACP (Trust et al 1997; Service unpublished data). Use of lead shot for hunting waterfowl is prohibited statewide, and for hunting all birds on the North Slope. Hunter outreach programs are being undertaken to reduce any lingering illicit use of lead shot that may be occurring on the North Slope.

Water birds in arctic regions are also exposed to global contamination, including radiation, and industrial and agricultural chemicals that can be transported by atmospheric and marine transport. Twenty male spectacled eiders wintering near St. Lawrence Island examined for the presence and effects of contaminants apparently were in good condition, but had high concentrations of metals and subtle biochemical changes that may have long term effects (Trust et al. 2000a).

Increase in Predator Populations

It has been speculated that anthropogenic influences on predator populations or predation rates may have affected eider populations, but this has not been substantiated. Steller's eider studies at Barrow suggest that high predation rates explain poor breeding success (Quakenbush et al. 1995, Obritschkewitsch et al. 2001). Researchers have proposed that reduced fox trapping, anthropogenic food sources in villages, oil fields, and nesting sites on human-built structures have increased fox, gull, and raven numbers (R. Suydam and D. Troy pers. comm., Day 1998), but the connection between these factors and increased predation rates has not been proven.

Over Harvest

Hunting for spectacled and Steller's eiders was closed in 1991 by Alaska State regulations and Service policy. Outreach efforts have been conducted by the North Slope Borough, BLM, and Service to encourage compliance. Accurate information on current subsistence harvest rates is not available, but hunter surveys and other observations indicate that shooting of listed eiders continues in northwest Alaska (Paige et al. 1996, Georgette 2000, Service unpublished data).

Habitat Loss through Development and Disturbance

With the exception of contamination by lead shot, destruction or modification of nesting habitat is not thought to have played a major role in the decline of spectacled or Steller's eiders. Until recently eider breeding habitat on the ACP was largely unaltered by

humans, but now limited portions of each species' breeding habitat has been altered by fill of wetlands, the presence of infrastructure that presents collision risk, and other types of human activity that may disturb birds or increase populations of nest predators. There is also increase in scientific field research occurring on the ACP, much of which occurs in the summer nesting season. Table 1 summarizes recent activities within the Lease Sale 193 action area that required a section 7 consultation, and the estimated incidental take of listed eiders. Note that the estimated take is presumably ameliorated to an unknown degree by Reasonable and Prudent Measures in the BOs.

Table 1. Recent projects in Lease Sale 193 action area that required section 7 consultation and estimated incidental take of listed eiders.

Project Name	Impacts	Estimated Incidental Take¹
Barrow Airport Expansion	137.8 acres (includes material site)	14 spectacted eider eggs/chicks 29 Steller's eider eggs/chicks
Barrow Hospital	20 acres	10 spectacted eider 17 Steller's eider
Barrow Landfill	55 acres	1 spectacted eider yearly 1 Steller's eider yearly
Barrow Artificial Egg Incubation	No loss of habitat	Maximum of 24 eggs
Barrow Tundra Manipulation Experiment	111 acres	2 spectacted eiders 2 spectacted eider eggs/chicks 2 Steller's eiders 1 Steller's eider eggs/chicks
Barrow Global Climate Change Research Facility Phase I & II	4.75 acres loss of habitat 25 acres preferred-use habitat disturbed	1 spectacted eider 6 spectacted eider eggs/chicks 1 Steller's eider 25 Steller's eider eggs/chicks
Barrow Wastewater Treatment Facility	4.18 acres loss of habitat 35.24 acres of habitat disturbed	3 Steller's eider eggs/chicks 3 spectacted eider eggs/chicks
BLM Northeast NPRA Planning Area	Habitat loss/disturbance Collisions	104 spectacted eiders 9 Steller's eiders
BLM Northwest NPRA Planning Area	Collisions	14 spectacted eiders 1 Steller's eider
Beaufort Sea Planning Area Lease Sale 186, 195, & 202	Collisions	5 spectacted eiders 1 Steller's eider

ABR Avian Research/USFWS Intra-Service Consultation	Disturbance	5 spectacled eider eggs/chicks
Avian Influenza Survey/USFWS Intra-Service Consultation	Disturbance	6 spectacled eider eggs/chicks

¹ “eggs/chicks” indicates that the estimated level of take will affect either eggs *or* chicks.

Kittlitz’s Murrelet

The principle distribution and breeding range of Kittlitz’s murrelets occurs in southeast Alaska, outside of the action area. The Service believes the species has undergone a sharp population decline and it is a candidate for listing should funds become available. Kittlitz’s murrelets are closely associated with marine tidewater glaciers and their decline may be related to the retreat of glaciers and decreased foraging habitat. Boat tours of tidewater glaciers have increased substantially in southeast Alaska, and this may be increasing disturbance of Kittlitz’s murrelets in foraging areas. Most factors thought to contribute to the Kittlitz’s murrelet decline are occurring outside of the action area, with the exception of changes in the marine environment (discussed below).

Ledyard Bay Critical Habitat

The LBCHU was designated as critical habitat because it is used by large numbers of spectacled eiders during molt, which is an energetically demanding portion of their life cycle (described in Section 3 – *Status of the Species and Critical Habitat*). Its relatively rich and abundant benthic community is food for spectacled eiders when they occupy Ledyard Bay. Therefore, environmental conditions that support the rich and abundant benthic community are ultimately important to Ledyard Bay’s capacity to support spectacled eiders. Due to the lack of industrial development and minimal human presence and vessel traffic in the region, the Chukchi Sea is currently largely in natural condition. A waterbody in its natural condition is free from the harmful effects of pollution, habitat loss, and other negative stressors (MMS 2006b). Several key environmental factors, such as good water quality and lack of contamination, contribute to what can be considered the current good environmental conditions of the LBCHU.

The MMS (2006b) reviewed water quality and sediment assessments of the Chukchi Sea and concluded that the general water quality of the Alaska Arctic region OCS is relatively pristine due to the remoteness, harsh but active ecological system, and limited presence

of human (anthropogenic) inputs. Current industrial impacts are minimal and pollution and/or sediments occur at very low levels in Arctic waters and do not pose an ecological risk to marine organisms in this region. The majority of water flowing into the marine environment is not subject to human activity or stressors and is considered unimpaired (Alaska's Final 2002/2003 Integrated Water Quality Monitoring and Assessment Report). There are no Section 303(d) impaired waterbodies identified within the Arctic Subregion by the State of Alaska. Background hydrocarbon concentrations in Chukchi waters appear to be biogenic (naturally occurring) and on the order of 1 part per billion or less; concentrations in the Hope Basin and Chukchi Sea are entirely biogenic in origin and are typical of levels found in unpolluted marine water and sediments. A study of heavy metals in sediments collected from portions of the eastern Chukchi in the 1990's (Naidu 2005) found concentrations were low and the environment was considered "pristine."

We believe, therefore, that the LBCHU is currently largely in natural condition, free of physical modification or significant pollutants in either its water and sediments; and its physical and biological processes are functioning and promote production of a rich and abundant benthic community upon which spectacled eiders feed when they occupy the LBCHU.

Regional-Scale Environmental Shifts

There are indications regional-scale environmental shifts may be underway in both the Chukchi and the Bering seas, which have important hydrologic and biologic connections. An observed increase in Atlantic water in the western Arctic Ocean (Zangh and Hunke 2001) can warm surface water, which in turn thins arctic sea ice (Manabe and Stouffer 1995). An average 1-m reduction in sea ice thickness has been estimated in the Chukchi and Beaufort seas (Rothrock et al 1999). Late summer arctic sea ice has declined 2-7.7% per decade (Parkinson et al. 1999, Stroeve et al. 2005), and the area of perennial sea ice has declined 9.8% per decade of since 1978 (Comiso 2006). Sea ice and the associated ice-edge productivity is a key factor in the heightened carrying capacity of arctic sea shelves (Grebmeier and Dunton 2000), including the LBCHU. Grebmeier et al. (2006) suggest that an ecological shift from arctic to subarctic conditions is occurring in the northern Bering Sea; this shift resulting in decreased sea ice may have profound impacts on arctic marine mammals and diving seabird populations through ecosystem linkages that change food supplies. A similar trend may be underway in the Chukchi Sea as recent retrospective studies of benthic communities indicate a changing marine system in both the Bering and Chukchi Seas (Iken and Konar 2003, Sirenko and Koltun 1992, Grebmeier and Dunton 2000). There are indications bivalve populations in the northern Bering Sea (where spectacled eiders winter) are in decline (Richman and Lovvorn 2003, Grebmeier and Cooper 2004).

Current understanding of regional-scale shifts in the arctic marine environment is primarily limited to measurements in the physical environment, such as sea ice thickness and water temperatures. Because similar types of changes are recently being linked to ecological shifts in the Bering Sea (Grebmeier et al. 2006), it may be reasonable to conclude unmeasured ecological shifts may be occurring in the Chukchi Sea, or will

occur, if trends continue. Specific effects of environmental shifts in the arctic environment are speculative at this point, so possible effects on listed species or the LBCHU were not considered in this biological opinion. However, it should be noted that the marine environment of spectacled eiders, Steller's eiders, and Kittlitz's murrelets may be changing, and is likely to be a dynamic factor affecting all three species in the future. If future consultations regarding Lease Sale 193 are undertaken, the environmental baseline may have changed considerably due to regional-scale environmental shifts that could cause changes in the status of species or condition of the LBCHU.

5. EFFECTS OF THE ACTION ON LISTED SPECIES AND CRITICAL HABITAT

This section of the BO analyzes direct and indirect effects of the action on listed species, important habitats, and critical habitat (the LBCHU), considering the potential threats identified by MMS (2006a):

- A. Habitat Loss
- B. Disturbance and Displacement
- C. Collisions
- D. Increased Predation
- E. Increased Subsistence Hunting
- F. Toxics Contamination
- G. Crude and Refined Oil Spills

The effects analysis is divided into the current incremental step (leasing and exploration), presented first, and then the entire Lease Sale 193 action (also including development and production). Direct effects are addressed first; indirect effects and effects from interdependent and interrelated actions are discussed at the end of this section.

I. Effects of the First Incremental Step (Leasing and Exploration)

Activities proposed under the first incremental step are seismic surveys and exploratory drilling, and associated vessel and aircraft traffic. They are temporary, largely confined to the marine environment, and have relatively small impact areas.

A. Loss of Habitat – Incremental Step

Structures constructed in high-quality habitats can affect birds by rendering those habitats permanently unsuitable, thus relegating birds to lower quality habitats. The only permanent structures expected to result from seismic surveys and exploratory drilling are abandoned exploratory wells, which are capped below the sea floor and thus would not cause permanent impacts to the sea floor (email dated 3/16/07 from Mark Schroeder, MMS). Thus, the Service concludes that permanent habitat loss from leasing and drilling up to 14 exploratory wells would not occur and would not pose adverse effects to listed eiders or Kittlitz's murrelets.

A small portion of the western LBCHU is in the lease sale area, and this portion has fewer recorded molting eider observations than the central and eastern LBCHU (Larned et al. 1995, Petersen et al. 1999) (Fig. 5.1). Further, Feder et al. (1989, 1994a, 1994b) found a different substrate (muddy-gravel) and invertebrate community in the western LBCHU than sites sampled further east. This information suggests the western portion of LBCHU is less favorable for molting spectacled eiders than the central and eastern LBCHU. Combined with the small impact area of permanent structures from exploratory drilling, the Service anticipates no adverse effects to critical habitat from direct habitat loss due to exploratory drilling in the LBCHU.



Figure 5.1. Location of eiders observed during aerial surveys in Ledyard Bay in relation to the critical habitat unit boundaries and Lease Sale 193 boundaries (Larned et al. 1995).

B. Disturbance and Displacement – Incremental Step

Severity of disturbance and displacement effects depends upon the duration, frequency, and timing of the disturbing activity. Disturbance that results in agitated behavior, flushing, or other movements in response to a stimulus can increase energy costs, especially for birds that are already energetically stressed from cold, lack of food, or physiologically demanding life cycle phases such as molt. Resulting displacement from preferred habitats could increase stress by reducing available resources. Disturbance and displacement to listed eiders and Kittlitz’s murrelets during seismic surveys and exploration activities could occur from aircraft, vessel traffic, and seismic survey acoustic sources, especially in important habitats (spring leads and the LBCHU).

Aircraft – Aircraft may disturb molting and flighted eiders. Studies of king eiders in western Greenland found birds dove when survey aircraft approached (Mosbech and Boertmann 1999). Bird response varied with time of day, and increased with decreasing

plane altitude. After a preliminary dive by nearly all birds, over 50% remained submerged until the plane passed. Also, molting king eiders appeared to be sensitive to boat and aircraft engine noise, and flushed, dove, or swam from that disturbance, sometimes leaving the area for several hours (Frimer 1994).

No fixed-wing flights, and limited helicopter support (<1 flight/day), are anticipated during seismic survey work. During exploratory activities, two helicopter flights per day between the drill site and a coastal community, such as Barrow, to allow crew changes and vessel re-supply, would occur. A third helicopter with search and rescue capabilities may also be located in the area. However, the following MMS stipulation (MMS 2007), limits aircraft overflights within the LBCHU from July 1–November 15 when eiders may be present:

Except in cases to protect human safety, when landing, or to participate in an oil spill response, aircraft supporting drilling operations will not operate below 1,500 feet ASL when operating over the Ledyard Bay Critical Habitat Area. If weather prevents attaining this altitude, aircraft will use pre-designated flight routes at the outer margin of the Ledyard Bay Critical Habitat Area. Pre-designated flight routes will be established by the lessee and MMS, in collaboration with the USDO, FWS, during review of the Exploration Plan.

With the low number of anticipated flights and additional protection in the LBCHU, adverse effects to listed eiders or Kittlitz's murrelets from aircraft disturbance are not anticipated.

Vessel transits – Seismic, exploratory, and support vessels may transit through the entire spring lead system, including those areas outside of the lease sale area (Fig. 5.2, Fig. 5.3). Vessels may disturb birds in the spring lead system, but these flight-capable birds can move to alternative locations, and harmful effects are likely minimized by the low frequency and duration of disturbances. Seismic surveys are conducted by one or two self-contained vessels that may be accompanied by a guard boat; during exploratory drilling each pair of drill ships would be supported by two ice breakers and up to seven other vessels. The Service assumes that seismic and exploratory flotillas in the spring leads would consist of a small number of boats and cause few and temporary disturbance episodes.

Exploratory and support vessels may also transit the entire LBCHU, which in summer and autumn is occupied by large numbers of flightless, molting spectacled eiders (seismic surveys are not allowed in the LBCHU after July 1). Molting birds are energetically stressed and less mobile, so the impact of displacing them from preferred habitats are presumably greater than for a flight-capable bird. If so, displacement of a molting bird could reduce survival.

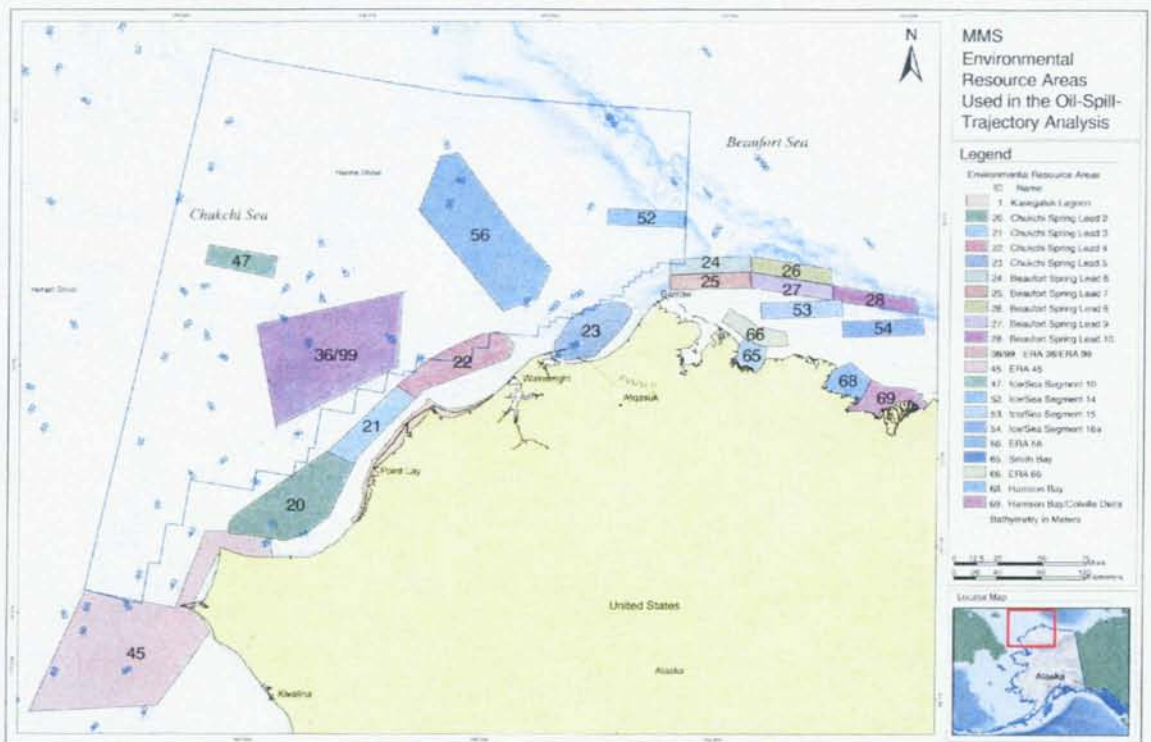


Figure 5.2. Chukchi Sea spring lead ERAs 20-23 in relation to Lease Sale 193 boundaries (adapted from MMS 2006c).

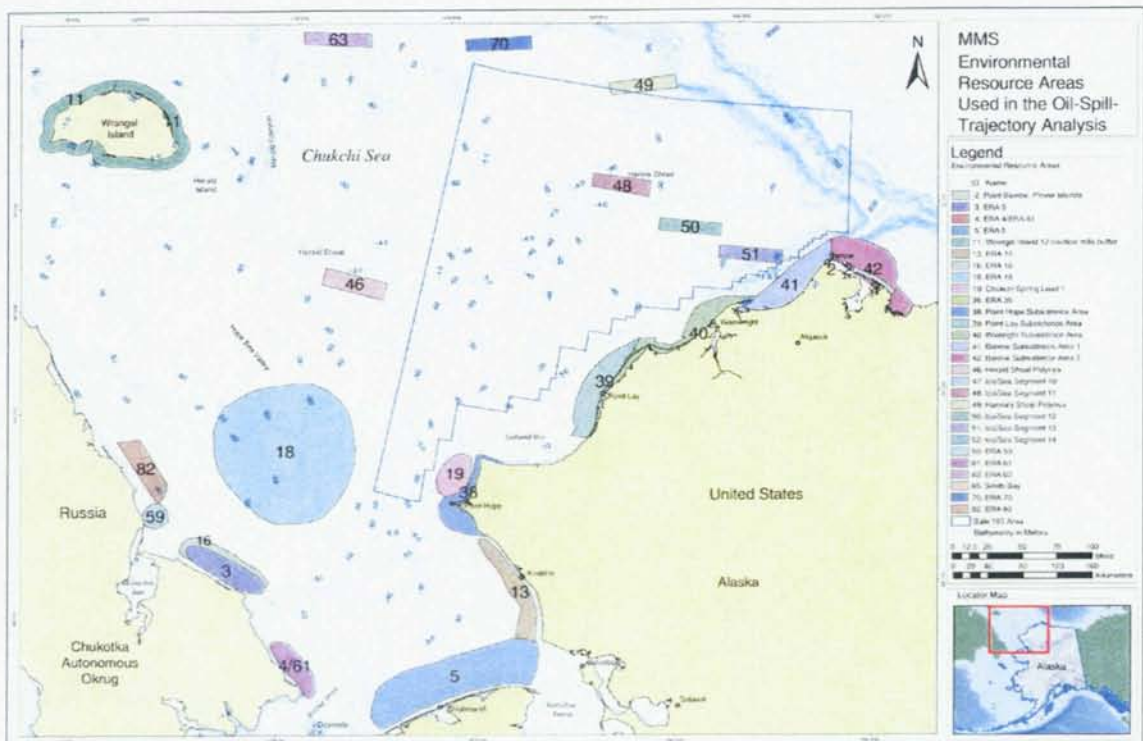


Figure 5.3. Chukchi Sea spring lead ERA 19 in relation to Lease Sale 193 boundaries (adapted from MMS 2006c).

Since available data indicate that molting spectacled eiders concentrate in the central portion of the LBCHU (Larned et al. 1995, Petersen et al. 1999), MMS (2007) developed a stipulation to reduce disturbance from vessel transit in Ledyard Bay. This stipulation is in effect from July 1–November 15 when molting eiders may be present:

Except in cases to protect human safety or respond to an oil spill, vessels associated with drilling operations will avoid operating within the Ledyard Bay Critical Habitat Area to the maximum extent practicable. Support vessels must enter the Ledyard Bay Critical Habitat Area from the northwest and proceed directly to the drill rig, remain in close proximity to the drill rig while providing support, and exit the drill rig vicinity to the northwest until out of the Critical Habitat Area.

Disturbance and displacement from vessel transits would be minimized by several factors. First, we expect the amount of vessel traffic in the region to be limited. Few vessels are used during seismic surveys, and although more are involved in exploratory drilling efforts, the number of efforts underway at any time is severely limited by the number of drill ships available for use (currently only two). Also, the portion of the LBCHU thought to receive the greatest use by eiders is outside Lease Sale 193 boundaries, which would also serve to reduce impact. Finally, an MMS stipulation restricting vessel traffic in the LBCHU from July 1–November 15 will further minimize disturbance of molting eiders and transiting vessels. Based on these factors, adverse effects are not anticipated for listed eiders or Kittlitz's murrelets from vessel transits.

Seismic surveys – The effects of seismic surveys would be similar to those of transiting vessels, although surveys will be longer in duration than vessels simply moving through an area. However, seismic surveys can only occur within the lease sale area, which overlaps only small portions of important spring lead habitat (Fig. 5.2) (or the LBCHU, discussed below), and seismic surveys would not overlap temporally with bird use there. King eider satellite telemetry data indicate males have left the Chukchi Sea and arrived in the Beaufort Sea between April 20 and May 20, while females arrive from May 17 to June 8 (Phillips 2005). Similar timing of spring migration of king eiders was noted by Suydam et al. (2000) in their May 1–June 2 1996 observations at Point Barrow. Based on North Slope tundra arrival dates for Steller's and spectacled eiders (Service, unpubl. data), it is likely that Steller's and spectacled eiders show a similar timing of departure from the Chukchi Sea spring lead system. Seismic surveys cannot commence until the area is ice free (early June), so there may only be a few days in which listed eider use overlaps with seismic survey activity in spring leads.

Temporal separation of seismic activity and energetically stressed molting eiders in the LBCHU is provided by MMS's stipulation that seismic surveys not occur in the LBCHU after July 1. Further, the small portion of the LBCHU within the lease sale area (Fig. 5.1) may be of lower quality than the LBCHU outside the lease sale area boundary (discussed under Habitat Loss, above). Because of natural and stipulated temporal separation of seismic activities and listed eiders or Kittlitz's murrelets, and because seismic activities may only occur in small portions of important habitats (spring leads and the LBCHU),

the Service does not anticipate adverse effects to listed eiders and Kittlitz's murrelets from vessel activities associated with seismic surveys.

Seismic acoustic sources – Seismic survey vessels move slowly through an area, gradually ramping up acoustic sources during the course of a survey. The sounds generated during seismic work may cause disturbance to listed eiders, as these sounds can travel horizontally through the water column. Little is known about avian response to seismic acoustics; however, in a study of long-tailed ducks (*Clangula hyemalis*) in the Beaufort Sea, Lacroix et al. (2003) found no significant difference in numbers of ducks in an area before and after seismic survey work. In some survey areas, long-tailed ducks were observed to dive more frequently than in undisturbed areas, but the cause (vessel or seismic acoustic source) was unclear. In the absence of information on the specific effects of seismic noise on listed eiders or Kittlitz's murrelets, we assume that the reasons used for concluding no adverse effects for other seismic survey activities (temporal separation; small amount of important habitats in the lease sale area) apply here, and anticipate no adverse effects to listed eiders and Kittlitz's murrelets from seismic acoustic sources.

Exploratory drilling – Except in the spring lead system and the LBCHU, disturbance and displacement from exploratory drilling activities (aside from transit activities addressed above), should not cause disturbance of listed eiders or Kittlitz's murrelets, because drilling would occur in a relatively small and stationary impact area. Displacement of listed eiders may occur in the small portions of the spring lead system and the LBCHU that overlap with the lease sale area; however, impact areas would be small, stationary, and occur only once. The Service therefore anticipates no adverse effects to listed eiders and Kittlitz's murrelets from exploratory drilling.

C. Collisions – Incremental Step

Migratory birds suffer substantial mortality from collisions with man-made structures (Manville 2004). Birds are particularly at risk of collision with objects in their path when visibility is impaired during darkness or inclement weather, such as rain, drizzle, or fog (Weir 1976). In a study of avian interactions with offshore oil platforms in the Gulf of Mexico, Russell (2005) found collision events were more common, and more severe (by number of birds) during poor weather. Certain types of lights (such as steady-state red) on structures increase collision risk (Reed et al. 1985, Russell 2005, numerous authors cited by Manville 2000). This is particularly apparent in poor weather when migrating birds appeared to get into circulation patterns around structures after being attracted to lights and becoming unable to escape the “cone of light” (Russell 2005, Gauthreaux & Belser 2002, Federal Communications Commission 2004).

Flight behavior over water of the listed eiders and Kittlitz's murrelets places them at risk of colliding with human-built structures. Day et al. (2005) suggested that eider species may be particularly susceptible to collisions with offshore structures as they fly low and at relatively high speed (~ 45 mph) over water. Johnson and Richardson (1982), in their study of migratory behavior along the Beaufort Sea coast, reported that 88% of eiders flew below an altitude of 10 m and >50 % flew below 5 m. Kittlitz's murrelets also fly

low and fast (>2 m above the water surface, average 94 km/hr) (Day et al. 1999). Their flight was described as having a long and sweeping pattern, which renders them unable to change direction quickly (Kishchinski 1968 cited by Day et al. 1999), further increasing their risk of collision.

MMS (2006a) considered the potential for collisions with aircraft. However, based on the low flight height of eiders over water (Day et al. 1999; Day et al. 2005) and the diving behavioral response to aircraft over flights documented by Mosbech and Boertmann (1999), the Service considers this to be an extremely unlikely event.

Depending upon location and timing of operations, vessels and exploration structures pose a collision risk for Steller's and spectacled eiders migrating to and from Alaska's North Slope, and males of both species as they move between Alaska and Russia. Kittlitz's murrelets may also be at risk for collisions. The Service concludes that there may be adverse effects to listed eiders, and Kittlitz's murrelets, from collisions. Our estimate of the magnitude of this threat is presented in Section 8.0 - *Incidental Take Statement*.

D. Increased Predation – Incremental Step

No activities proposed during leasing and exploration would result in an increase in predators of either listed eider species or Kittlitz's murrelet. The Service anticipates no adverse effects to listed eiders or Kittlitz's murrelets from increased predation.

E. Increased Subsistence Hunting – Incremental Step

Prior to the listing of Steller's and spectacled eiders under the Act, some level of subsistence harvest of these species occurred across the North Slope (Braund et al. 1993). This has continued since listing, even though it is illegal. The Service has been working with several agencies such as the North Slope Borough and BLM to educate local residents about the protected status of the species to reduce subsistence harvest, and will continue to do so. No records were found that suggest either the adults or eggs of Kittlitz's murrelets are used by Alaska Natives for subsistence activities. No activities proposed during leasing and exploration would result in an increase in subsistence hunting. The Service anticipates no adverse effects to listed eiders or Kittlitz's murrelets from increased subsistence hunting.

F. Toxics Contamination - Incremental Step

Toxics contamination from oil extraction activities can result from exploratory well blowouts or other oil spills (addressed below) and from disposal of drilling muds and cuttings. Disposal of drilling muds (used to lubricate drill bits), and cuttings (material removed from drill holes) can result in heavy metal and petroleum hydrocarbon contamination in the disposal area. At exploratory wells, an estimated 80% of drilling muds would be recycled; 20% (approximately 95 tons) would be discharged, as would all rock cuttings (approximately 600 tons) (MMS 2006a). Discharged muds and cuttings are toxic to benthic communities, can alter substrates, and cause physical and bacterial anoxia; these impacts would be expected at the discharge site. However, given the size of the lease sale area (34 million acres) and the low number of exploratory wells expected

(up to 14), the Service does not anticipate adverse effects to listed eiders or Kittlitz's murrelets from drilling mud and cuttings discharges. However, this will be evaluated further under a consultation with the EPA for NPDES permits required to discharge drilling wastes to the ocean.

A small portion of the western LBCHU is within the lease sale area; however, this portion has fewer recorded molting eider observations than the central and eastern LBCHU (Larned et al. 1995, Petersen et al. 1999) (Fig. 5.1). Further, Feder et al. (1989, 1994a, 1994b) found a different substrate (muddy-gravel) and invertebrate community in the western LBCHU than sites sampled further east. This information suggests the western portion of LBCHU is less favorable for molting spectacled eiders than the central and eastern LBCHU. Combined with the small impact areas of exploratory drill sites, the Service anticipates no adverse effects to critical habitat from exploratory drilling mud and cuttings discharges in the LBCHU. However, this will be evaluated further under a consultation with the EPA for NPDES permits required to discharge drilling wastes to the ocean.

G. Crude and Refined Oil Spills – Incremental Step

We evaluated the effects of oil spills on listed eiders and Kittlitz's murrelets using information on important habitats (spring leads and molting areas), bird location and condition throughout the annual cycle (e.g., nesting, molt), and the toxic effects of oil on birds (individuals and populations) and their prey. We assumed the biological effects of oil exposure did not differ between oil sources (crude or refined oil). For the incremental step, we also evaluated spill probability and size estimates developed by MMS for activities associated with vessel movements and exploratory drilling.

The Service has concerns that a spill anywhere in the eastern Chukchi Sea has the potential to contact listed species or impact their habitat. However, certain areas are of particular concern because of their importance to listed species or because large numbers of listed birds congregate there. In the eastern Chukchi Sea these key areas are the LBCHU (Fig. 5.1) and spring leads in sea ice along the Alaska coast (Fig. 5.2, Fig. 5.3). There is little specific information about spring migration routes for either listed species, but it is believed the listed eiders advance northward similarly to other species of eiders as spring leads develop in the eastern Chukchi Sea ice. Both spectacled eiders and Steller's eiders occupy Ledyard Bay seasonally during their north and south migrations, although the duration of each species' use is not documented in detail. In spring they presumably move through Ledyard Bay as spring leads open, and in summer and autumn they return utilizing the open waters of Ledyard Bay, with spectacled eiders remaining in the area to molt. Large numbers of molting spectacled eiders are present in Ledyard Bay from approximately late June until late October (Larned et al. 1995, Petersen et al. 1999). Steller's eiders that breed on the North Slope also use Ledyard Bay and nearshore Chukchi Sea water during their southward migration (Martin et al. in prep.)

Exposure to oil can cause mortality and sublethal effects (Albers 2003). However, because the Arctic marine environment is cold and harsh, sublethal health effects on eiders or murrelets are likely to affect their survival in the marine environment. Therefore, for this analysis, the Service assumed that all birds coming into contact with

oil would either be killed outright (direct mortality) or eventually (indirect effects leading to reduced survival).

Death can be caused in a number of ways after exposure to oil. External oiling disrupts feather structure, causes matting of feathers, and permits wetting of the bird. Death typically results from hypothermia and drowning (Vermeer and Vermeer 1975, Tseng 1993, Jenssen 1994). Ingesting petroleum through feather preening or consumption of contaminated food or water, and inhalation of fumes from evaporating oil, may not be immediately lethal, but debilitating effects include gastrointestinal irritation, pneumonia, dehydration, red blood cell damage, impaired osmoregulation, immune system suppression, hormonal imbalance, inhibited reproduction, retarded growth, and abnormal parental behavior (Jenssen 1994, Hartung and Hunt 1966, Miller et al. 1978, Szaro et al. 1981, Albers 1983, Leighton 1991, Burger and Fry 1993, Fry 1986, Eppley 1992, Fowler et al 1995, Walton 1997, and Briggs et al. 1997). These effects can cause death from starvation, disease, or predation, especially in the harsh arctic environment.

Mortality following exposure to oil is common in waterfowl and alcids, which spend much time in the water and are therefore vulnerable to surface oil (Albers 2003). Clark (1984) found seabird species most vulnerable to population-level effects of oil pollution were those whose life history characteristics include high adult survival, adaptation to stable and predictable marine environments, and high site fidelity, such as the listed eiders and Kittlitz's murrelets.

Because oil, fuel, or other toxic substances would cause mortality to listed eiders and Kittlitz's murrelets, particularly in important habitats (spring leads and the LBCHU) with high densities of birds, we evaluated the probability and likely extent and persistence of either large or small oil spills during leasing and exploration using information provided by MMS (2006c). No exploratory drilling blowouts have occurred in 98 wells in the Arctic offshore region or Alaska OSC. Of the 13,463 exploratory wells that have been drilled in the coastal U.S., there were 66 blowouts during drilling, only four of which resulted in oil spills (range 1 to 200 barrels; average ~78 barrels). Of 35 exploratory wells drilled in the Beaufort or Chukchi OCS, there have been 35 small spills totaling 1,120 gallons, of which 90% was recovered. If a ≤ 50 bbl spill were to occur, MMS estimates it would persist for a two-day period

To reduce potential mortality of molting spectacled eiders in the LBCHU if an exploratory well oil spill occurred, MMS will implement the following stipulation:

An Oil Spill Response Vessel must be on-site when a drill rig is within the Ledyard Bay Critical Habitat Area. The lessee will also pre-stage wildlife hazing equipment (including at least 3 *Breco* buoys or similar devices) either on the Oil Spill Response Vessel or in Point Lay or Wainwright. The lessee will ensure on-site oil-spill response personnel are trained in the use of wildlife hazing equipment.

Due to the high recovery rates of low-volume spills, and the low probability of occurrence of large oil spills during leasing and exploration, the Service anticipates no adverse effects to listed eiders or Kittlitz's murrelets, and no adverse impacts to critical habitat, from oil spills during leasing and exploration.

H. Summary of Effects – Incremental Step

In the incremental step of Lease Sale 193 (leasing and exploration), no adverse effects to listed eiders or Kittlitz's murrelets are anticipated from habitat loss, disturbance and displacement, increased predation, increased subsistence hunting, toxics contamination, or oil spills. No adverse impacts to critical habitat is anticipated from habitat loss, toxics contamination, or oil spills. Adverse effects to listed species are anticipated from collisions; these are further evaluated in Section 8 - *Incidental Take Statement*.

II. Effects of the Entire Action (Development and Production)

In addition to considering the effects of activities permitted under the first incremental step (leasing and exploration), we also analyzed the effects of the entire Lease Sale 193 action, including development and production. While the nature and location of future development activities are unknown, we used MMS's hypothetical development scenario (detailed in Section 2.0 – *Description of the Proposed Action*) to identify the types of impacts that could occur, and examine their effects on the species of concern. Activities associated with development and production would occur in marine and terrestrial environments, and would include construction of permanent facilities (central production facility, satellite facilities, subsea and terrestrial pipelines, pump stations) and associated aircraft and vessel traffic; operation of those facilities over the life of the field; and removal and/or abandonment of facilities.

A. Loss of Habitat – Entire Action

If development occurs and a central platform, satellite wells, and subsea pipelines are constructed, a marine area up to 30 mi in diameter may be permanently impacted, with some structures above the water surface. Given the size of the lease sale area (34 million acres) and that only one central production facility is anticipated, the impact of permanent habitat loss in the marine environment would likely be negligible, unless development facilities were located within the LBCHU, spring leads, or areas important to Kittlitz's murrelets. While the Service concluded that the impact area from subsea capped exploratory wells in the LBCHU was not likely to cause adverse impact to critical habitat, a larger (up to 30 mi in diameter), permanent facility with above-surface structures might. Even though the lease sale area covers only a small portion of spring leads and LBCHU, development may require infrastructure such as pipelines, within both of these important habitats. Indeed, development in much of the lease sale area would require crossing of spring leads or the LBCHU to reach a shore base. Therefore, development and production may result in permanent marine habitat alterations that could adversely affect listed eiders, Kittlitz's murrelets, or critical habitat.

In the terrestrial environment, direct loss of habitat would occur by placement of gravel fill onto the tundra or by excavation of materials at mine sites. In MMS's hypothetical development scenario, a 50-acre shore base with an additional 50-acre storage pad would be constructed in the vicinity of the pipeline landfall. From the shore base an access road and pipeline would connect to the TAPS. The length of the road and pipeline would depend upon where they connect to existing infrastructure, but could be up to 300 miles long. MMS estimates the footprint of the road and pipeline corridor would be 100 feet wide, hence an area of 3,636 acres of habitat would be lost. MMS anticipates that four pump stations would be developed along the pipeline, each 40 acres in size. Gravel material for access road, pipeline, and pad construction could be mined from coastal areas, existing but unspecified material sites, and new borrow pits along the road or pipeline right-of-way (ROW), resulting in 395 additional acres of habitat loss. The total anticipated lost habitat is 4,291 acres (17.4 km²).

Estimating effects of breeding habitat loss on spectacled eiders is dependent upon development location, because spectacled eider density varies across the North Slope (Fig. 3.3). Assuming that the gradient in observed density reflects a gradient in habitat quality, and displacing birds from preferred habitat reduces their reproductive potential, placing fill in areas used by nesting eiders may compromise their reproductive potential. To estimate the number of pairs affected, the footprint size (17.4 km²) was multiplied by the density of birds. If the infrastructure and associated fill were placed in areas of average spectacled eider density (0.223 birds/km²; calculated for 2002-2006; Larned et al. 2003, 2005a, 2005b, 2006), a few pairs would be affected each year. However, given the variation in density (0.01 to >3 birds/km²), the total number of pairs potentially affected ranges from less than one to over 50 pairs, depending on location.

Impacts of terrestrial habitat loss on Steller's eiders are also dependent on location. Aerial surveys optimized to detect eiders since 1992 (Larned et al. 2006) indicate Steller's eiders occur at very low densities across the ACP, with highest density in the vicinity of Barrow (Fig. 3.8). The average density of Steller's eiders observed during ACP surveys in 2002-2006 was 0.0045 birds/km² (Larned et al. 2003, 2005a, 2005b, 2006), but near Barrow was 0.66 birds/km² (Rojek 2006). Thus, the number of pairs potentially affected varies significantly depending on how much habitat loss occurs near Barrow. Terrestrial habitat loss near Barrow could affect a significant portion of the listed population of Steller's eiders; terrestrial habitat loss elsewhere may affect many fewer.

The terrestrial portion of the action area is on the northern edge of the breeding range for Kittlitz's murrelets. This species nests near the coast in steep, rocky habitat, which is presumably unsuitable for a pipeline landfall and associated infrastructure. It also seems likely that a road and pipeline ROW connecting to the TAPS would run predominantly east-west, nearly perpendicular to the coast, which would reduce the amount of possible infrastructure within Kittlitz's murrelet habitat. Given these factors, we conclude that little Kittlitz's murrelet breeding habitat loss would occur with development and production.

B. Disturbance and Displacement – Entire Action

As noted in our analysis of the effects of the first incremental step, the severity of disturbance and displacement effects depends upon the duration, frequency, and timing of the disturbing activity, which are all likely to increase with development and production.

Ships would be operating in the lease sale area during all phases of the project. MMS estimated that several barge lifts of materials would be brought to the shore base site and to the offshore platform during construction. Support vessels would travel to the offshore facilities approximately three times a week during development, decreasing to one trip every 1-2 weeks during production. MMS estimates three daily round-trip helicopter flights between shore and offshore facilities during development and production. During construction of the shore base, up to five daily fixed-wing flights may bring materials; this number would drop to two daily fixed-wing and three daily helicopter flights during production. The amount of activity during abandonment is expected to be much less than during construction because some structures may be left in place and activities can be scheduled for periods when disturbance or other impacts are minimized (email dated 3/21/07 from Mark Schroeder, MMS).

The effects of vessel and aircraft disturbance on listed eiders are not fully understood but escape response behavior occurs at some energetic cost to individual birds. Depending upon the frequency of operations and routes traversed by vessels and aircraft impacts could range from negligible (few listed birds are encountered at irregular intervals) to substantial (vessels or aircraft repeatedly encounter large molting flocks of spectacled eiders in the LBCHU).

It is difficult to assess the effects of this traffic on listed eiders and Kittlitz's murrelets in the marine environment. First, it is unclear what management stipulations will be in place to reduce impacts. An MMS stipulation (MMS 2007) limits aircraft overflights within the LBCHU from July 1 – November 15 when eiders may be present but this stipulation currently applies only to seismic surveys and exploration. It is also currently unclear if management stipulations would be applied in spring leads or other areas outside of the LBCHU. Further, until aircraft routes, which would be determined by the location of the shore base and offshore facilities, are known, it is unclear how many birds would be disturbed, or if disturbance would take place during sensitive times of the life cycle, such as molt or spring staging when adults are acquiring reserves prior to nesting.

In the terrestrial environment, human activities such as the movement of personnel and equipment at the shore base, storage pads, along the access road and pipeline ROW by ground-based activities and aircraft could result in the repeated disturbance of Steller's and spectacled eiders. If disturbance were to occur during the nesting period (approximately June 1 - August 15) it could adversely affect individuals by: 1) flushing females from nests or shelter in brood-rearing habitats, exposing eggs or ducklings to inclement weather and predators; and 2) displacing adults and or broods from preferred habitats during pre-nesting, nesting, and brood rearing, leading to reduced foraging efficiency and higher energetic costs.

The individual tolerance and behavioral response (i.e., habituation) of Steller's and spectacled eiders to disturbance may vary. There doesn't appear to be a clear relationship between the movements of spectacled eiders and oil infrastructure (Troy 1995), but it is possible that females could choose to avoid nesting in habitats near repeated human activities (Troy 1992) (essentially, habitat loss). If this occurred in areas supporting high densities of listed eiders, such as near Barrow, the resulting disturbance during the nesting season could lead to significant impacts to the species. It is difficult to estimate how much habitat would be rendered less suitable for nesting as a result of disturbance, but the Service typically assumes that nesting behavior may be disrupted by human activities within 200 m of nests. If so, the potential for the habitat to support nesting would be compromised. Based upon calculations by MMS, total habitat loss due to disturbance near infrastructure would total 52,379 acres, or 213.58 km² [shore base and storage area (350 acres), road and pipeline ROW (51,397 acres) and pump stations, (632 acres)].

C. Collisions – Entire Action

As described under effects of leasing and exploration, migratory birds suffer substantial mortality from collisions with man-made structures in marine and terrestrial environments. If development were to occur as a result of Lease Sale 193 several structures including an offshore production platform, shore base buildings and equipment, and pump stations could be constructed which may pose a collision risk for listed eiders and Kittlitz's murrelets. Collision risks include Steller's and spectacled eiders migrating north through the Chukchi Sea during the spring migration; south, east, and west during molt migrations, and south during fall migrations; small numbers of listed Steller's and spectacled eiders near the shore base and terrestrial infrastructure during the breeding season (local flights); and Kittlitz's murrelets, particularly in the marine environment.

Without knowing the number, location, and design of structures that may result from Lease Sale 193, it is difficult to estimate with precision the number of listed eiders and Kittlitz's murrelets that may be killed through collisions. Collision data for common eiders at Northstar Island (an artificial offshore oil production island in the Beaufort Sea) averaged 4.2 collisions per year since 2000. This collision rate was used as a surrogate to assess potential impacts to Steller's and spectacled eiders, by converting it to a percentage and applying that to the estimated population sizes of Alaska-breeding Steller's eiders and the North Slope population of spectacled eiders. For each structure, an estimated 0.31 spectacled eiders and 0.024 Steller's eiders could be killed each year. Multiplied by the number of facilities (offshore production platform, shore base, and four pump stations), we roughly estimate 56 spectacled eiders and four Steller's eiders could be killed through collisions over the 30-year lifespan of these structures. Actual collision risk would vary with the proximity of structures to habitats and migratory routes used, however. Although Kittlitz's murrelets may also be vulnerable to collisions, we are not aware of data upon which to base a comparable estimate of potential collisions.

D. Increased Predator Populations – Entire Action

No actions described in MMS's development scenario are likely to result in an increase of marine-based predators of either listed eider species or Kittlitz's murrelets.

In the terrestrial environment, however, predator and scavenger populations may be increasing near sites of human habitation, such as villages and industrial infrastructure. Day (1998) conducted a comprehensive literature review examining four key predators of tundra-nesting birds, and concluded that individual glaucous gulls, grizzly bears (*Ursus arctos*), arctic foxes, and common ravens had increased survival and reproductive success when additional anthropogenic food sources such as garbage dumps were available. A population increase in these species could affect listed eiders and other ground nesting avifauna, including Kittlitz's murrelets, through egg, young, and even adult predation. If development were to occur as a result of Lease Sale 193, solid waste and garbage would be generated. Although practices in the existing North Slope oil fields have not prevented predators and scavengers from accessing human wastes, more recent regulations applied by BLM in NPR-A have required complete control of waste to eliminate this problem. The Service anticipates that similar policies and practices would be applied to any new developments in NPR-A, but the effectiveness of the newer required practices is unproven.

New infrastructure may also lead to an increase in the number of ravens in the area by providing suitable nesting substrate. Ravens appear to have expanded their breeding range on the North Slope by utilizing buildings and other manmade structures for nest sites (Day 1998). While there is little data describing ravens regularly depredating tundra-nesting birds, Day (1998) interviewed a number of biologists who work on the North Slope and many felt that ravens may be highly efficient egg predators. Similarly, new gravel pads could provide additional denning sites for foxes allowing them to increase in density near pads and depredate nearby nests of ground nesting birds. The Service anticipates that standard operating procedures currently being developed on the North Slope would be applied to new development resulting from Lease Sale 193, but the effectiveness of the newer required practices is unproven.

E. Increased Subsistence Hunting – Entire Action

Prior to the listing of Steller's and spectacled eiders under the Act, some level of subsistence harvest of these species occurred across the North Slope (Braund et al. 1993). Harvest continues despite prohibitions against taking spectacled and Steller's eiders, although harvest levels are poorly documented. MMS's development scenario includes a new road into previously undeveloped areas, which could provide access to previously inaccessible areas for hunters. The Service will continue to work with local communities to ensure that hunters are aware of prohibitions on hunting listed eiders to minimize additional impacts from hunting. No records were found that suggest either the adults or eggs of Kittlitz's murrelets are used by Alaska Natives for subsistence purposes.

F. Toxics Contamination - Entire Action

Production wells are estimated to generate approximately 125 tons of spent muds and 825 tons of rock cuttings as drilling wastes (MMS 2006a). Up to 14 production wells, a

central platform and satellite wells could impact a marine area up to 30 mi in diameter. Given the size of the lease sale area (34 million acres), that only one central production facility is anticipated, and that all drilling wastes will be treated and disposed of in shallow wells (production platforms) or barged to shore treatment facilities (subsea wells), impacts to the marine environment would likely be negligible, unless shallow wells or shore treatment facilities were located with the LBCHU, spring leads, or areas important to Kittlitz's murrelets. However, should development be proposed, these potential impacts would be evaluated further under a consultation with the EPA for NPDES permits required to discharge drilling wastes to the ocean.

G. Crude and Refined Oil Spills – Entire Action

The effects of oil on birds were discussed under the incremental step (leasing and exploration) analysis; based on these effects and the harsh arctic environment, we assumed that a listed eider or Kittlitz's murrelet that comes in contact with oil will die. To analyze the effects of spills due to the entire action, we used spill probability, size, and trajectory data (from historical data and MMS's oil spill modeling), and potential location and timing (which affects cleanup potential), to determine impacts from either small or large oil spills associated with development and production.

Effects on bird survival not discussed under the incremental step analysis include persistent environmental contamination by oil and its toxic breakdown products, and reduced food resources, which may occur after a large oil spill. Esler et al. (2000) evaluated the long-term effects of an oil spill on harlequin ducks (*Histrionicus histrionicus*), another northern sea duck. After the Exxon Valdez oil spill in Prince William Sound (PWS), approximately 1,000 harlequin ducks were killed directly (Piatt et al. 1990, and personal communication with J. Piatt reported in Esler et al. 2000). Esler et al. (2000) subsequently found winter survival of adult female harlequin ducks was 5.7 % lower in oiled areas than unoiled areas, primarily due to lower survival in oiled areas during the mid-winter period. Concurrent studies found harlequin ducks were exposed to hydrocarbons from residual oil in intertidal areas of PWS up to nine years after the spill (Trust et al. 2000b).

Large crude or refined oil spills - MMS assumes if a 1-Bbbl development occurs in the lease sale area at least one large crude oil spill (large spill defined as 1,500 bbl from a platform or 4,600 bbl from a pipeline) would occur over the lifetime of the project (MMS 2006a, 2006c). This assumption is based upon their estimate of a 60% chance of zero spills, a 31% chance of one spill, an 8% chance of two spills, and a 1.3% chance of three spills. MMS modeled spill behavior and calculated the probability a large spill from 13 possible launch areas or five possible pipeline routes (Fig. 5.4), would reach different environmental resource areas (ERAs) in the eastern Chukchi Sea. MMS oil spill trajectory modeling indicates the annual conditional probability of a large oil spill entering spring leads ranged from ≤ 0.5 to 26% depending upon spill source (platform or pipeline), time of year, and launch site (MMS 2006c, Table A.2-27). Because the MMS lease sale proposal did not preclude development or pipelines near spring leads, we assumed a platform or pipelines may occur near or in spring leads, and that a spill could occur in those areas. In fact, because all proposed pipeline routes cross spring leads, it is

logical to assume that a nearshore pipeline spill would be almost certain to be in the vicinity of a spring lead. The annual conditional probability of a large summer oil spill reaching the LBCHU (ERA 10) within 30 days ranges from <0.5 to 72%, depending upon oil spill source (platform or pipeline), time of year, and launch site (MMS 2006c, Table A.2-27). Not surprisingly, oil released from launch areas and pipeline routes closest to ERA 10 has the highest probability of reaching Ledyard Bay.

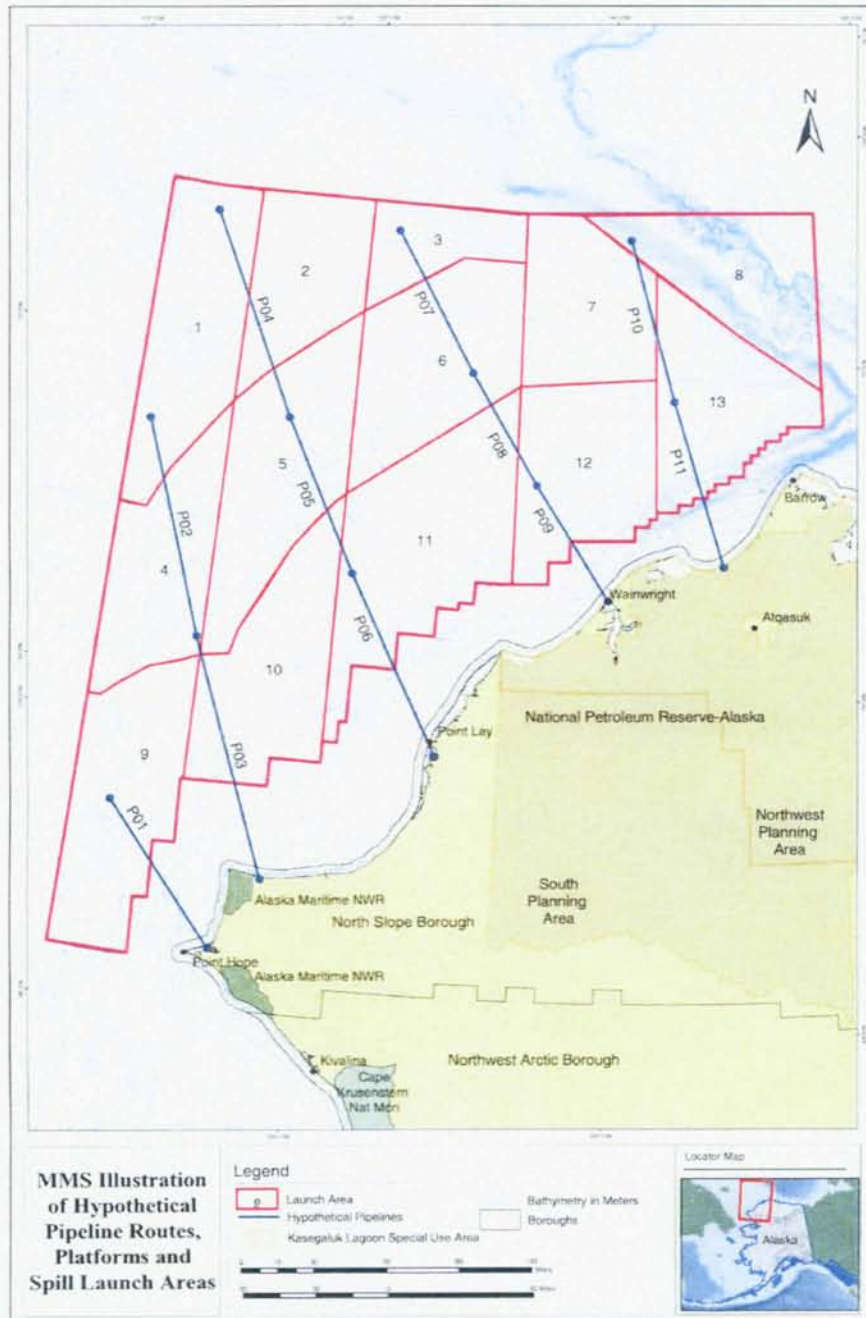


Figure 5.4. MMS illustration of spill launch areas with hypothetical routes and platform locations (adapted from MMS 2006c).

Effect of a large oil spill on spectacled eiders - A population model developed by Dr. Barry Grand, USGS, under contract with MMS, to evaluate the consequences of oil spills on spectacled eiders was run under several scenarios to estimate population-level effects of an oil spill on spectacled eiders in Ledyard Bay. The framework under which these scenarios were run (essentially, the probability of an oil spill contacting the LBCHU) was provided by MMS's oil spill trajectory model. MMS predicted the area of sea surface oiled after a 1,500 bbl or 4,600 bbl summertime crude oil spill would be 577 or 1,008 discontinuous km² area, respectively, after 30 days (MMS 2006c, Table A.1-9). An estimate of the area known to be used by spectacled eiders in Ledyard Bay was 348-709 km² (95 and 100% of counted birds, respectively, from an aerial survey dated September 1, 1995; William Larned pers. comm.). A large oil spill could therefore enter critical habitat and be large enough to impact an area of the size used by all spectacled eiders in Ledyard Bay.

Model assumptions and parameters included endpoints in the Act's definition of "jeopardy," which are "appreciable reduction in likelihood of survival or recovery." For modeling purposes, survival was defined as the opposite of extinction, with extinction approximated as a "quasi-extinction" threshold of fewer than 50 females. The recovery threshold was the lowest population size (6,000 breeding pairs) that would meet recovery goals in the Spectacled Eider Recovery Plan⁴ (USFWS 1996). This equated to 6,000 breeding females, as the model, in common with other avian population models, considered female parameters for population growth projections. The model timeframe of 50 years approximated the anticipated project life as well as 10 spectacled eider generations. (Additional model assumptions and parameters are detailed in Appendix 2.)

To provide baseline population trajectories against which to compare the effects of a catastrophic oil spill, the model was first run assuming no spill and using population demographics (population size and growth rate) summarized by Stehn et al. (2006), and agreed upon by a working group of USFWS and USGS scientists with eider expertise (hereafter referred to as Flint et al. 2006 pers. comm., with deliberations of the group detailed in Appendix 2). Results of this scenario were that the North Slope spectacled eider population had zero probability of extinction, and that the probability of meeting the recovery goal of 6,000 breeding pairs was approximately 0.50. Thus, with no catastrophic oil spill, the stochastic model showed that in 50 years the North Slope spectacled eider population was highly likely to persist but may or may not have reached recovery goals.

Next, the model was run assuming an oil spill contacted molting eiders in Ledyard Bay. The Service estimated that the number of affected eiders could be up to 33,192 (maximum count from four aerial survey conducted on four different dates in four different years; Larned et al. 1995). However, the population ramifications of the death of those birds (all birds contacted by oil are assumed to be killed) depended upon the

⁴ Recovery goals are that all three spectacled eider breeding populations (Arctic Russia, Yukon-Kuskokwim Delta, and North Slope) must: 1) Be stable or increasing over 10 or more years, with a minimum estimated size of at least 6,000 breeding pairs; or 2) Number at least 10,000 breeding pairs over three or more years; or 3) Number at least 25,000 breeding pairs in one year.

origin, and sex and age structure, of the molting birds. At least 2/3 of North Slope nesting females with satellite transmitters molted in Ledyard Bay, and females from the Y-K Delta did not molt there (Petersen et al. 1999). Also, Flint et al. (pers. comm., 2006) concluded that Ledyard Bay was too distant from Russian Arctic breeding areas for females from there to molt, so the model assumption was that all breeding females molting in Ledyard Bay were from the North Slope breeding population.

However, only 4,880 of the 33,192 individual spectacled eiders identified by photographs in Ledyard Bay were brown birds (Larned et al. 1995) and therefore could have been breeding females. Further, the actual proportion was not estimated, as brown birds could be females of breeding age, females younger than breeding age (most two-year olds and all one-year olds), and one-year old males. Flint et al. (pers. comm. 2006) suggested three model scenarios to account for this, each with a different proportion of breeding-age females comprising the brown birds. These were that brown birds: 1) were all females, distributed by age in proportion to the population structure; 2) were females and one-year old males, distributed by age in proportion to the population structure; and 3) were only breeding females (all females aged three and older, and 25% of two-year olds).

Scenarios accommodating long-term effects of oil on spectacled eiders in Ledyard Bay were also needed, because in addition to substantial spill-year mortality (Piatt et al. 1990), female harlequin ducks in PWS had a 5.7% lower overwinter survival in oiled compared to unoiled areas nine years after the Exxon Valdez oil spill (Esler et al. 2000). In the absence of species and region specific data, we used the 5.7% decrease in PWS harlequin female survival as a surrogate for decreases in spectacled eider female survival occurring in years after the oil spill. Three scenarios were used to define the unknown relationship between survival over time (i.e., the shape and length of the survival curve after impact). The first was that there was no long-term impact on survival, and reduction in survival in years after the spill was zero. The second reduced survival by 0.057 for 10 years after the oil spill, then not at all. The third used a sigmoidal decay curve, with initial survival reduced by 0.114 ($0.057 * 2$), dropping to 0.057 at year 10, then to zero by year 20.

Model results from the various scenarios including variations on the proportion of breeding females and reductions in survival rates years after the spill showed similar effects on the probabilities of reaching extinction and meeting recovery goals regardless of the scenarios or combinations run. The chance of reaching extinction increased from zero in the baseline scenario to up to 6.5% in the oil spill scenarios. The chance of reaching the conservative recovery goal of 6,000 breeding pairs (i.e., 6,000 breeding females) went from approximately 50% (baseline) to less than 20% (oil spill scenarios). Thus, a potential oil spill associated with possible oil development in or near the LBCHU may appreciably affect both survival and recovery of the North Slope population of threatened spectacled eiders.

Effect of a Large Oil Spill on the LBCHU - The Service evaluated the potential for a large oil spill to reduce the conservation value of LBCHU for spectacled eiders by affecting the critical habitat constituent elements. These include near-shore sandy or gravelly

substrate, 5-25 m deep, overlain by rich ocean currents; enhanced ice-edge productivity; short, productive food chains and food webs; high benthic invertebrate biomass and abundance; near-shore spring leads over those resources during spring staging and migration, and open water over those resources during the summer and autumn molt (Federal Register 66(25): 9146-9185).

Oil spill effects on marine invertebrates include temporary debilitation, death, population change, contamination of zooplankton and benthic organisms, and invertebrate community change in the water column, deepwater benthic, and tidal areas (Albers 2003, Peterson et al. 2000, Suchanek 1993, Teal and Howarth 1984). The typical response of invertebrate communities to acute catastrophic oil pollution or severe chronic oil pollution (Suchanek 1993) is initial massive mortality and lowered community diversity followed by extreme fluctuations in populations of opportunistic mobile and sessile fauna. Oscillations in population numbers slowly dampens over time and diversity slowly increases to original levels, but recovery time is dependent upon type of oil, extent of contamination, habitat type, weather conditions, latitude, and the species assemblages.

Specific biological effects of an oil spill in the Chukchi Sea have not been predicted, but several studies report on the response of Arctic and Antarctic marine benthos to oil exposure. Percy (1977) demonstrated several benthic crustaceans avoided sediments lightly contaminated with crude oil, but their ability to discriminate diminished when exposed to highly contaminated sediments. *In situ* studies of Prudhoe crude oil simulated oil spills in different arctic ecosystems (Atlas et al. 1978) and demonstrated that although numbers of oil-degrading organisms increased after oil contamination, indigenous invertebrates were killed, petroleum hydrocarbons degraded slowly, and oil contamination was persistent in arctic ecosystems. Experimental releases of oil in arctic nearshore environments of Baffin Island did not necessarily result in invertebrate mortality, although some species bioaccumulated hydrocarbons and had physiological responses to the contamination (Cross and Thomson 1987). At McMurdo Station, Antarctica, species composition and infaunal density decreased dramatically along a steep gradient related to hydrocarbon, metal and PCB contamination (Lenihan and Oliver 1995). The benthic community in highly contaminated areas resembled that of bottom areas gouged by icebergs, and recovery from the chemical contamination was predicted to take many more decades than recovery from a natural disturbance because chemical degradation in polar environments is slow.

The LBCHU would be contacted by a large oil spill under many of the spill trajectory scenarios evaluated by MMS, thereby exposing constituent elements of the critical habitat to effects of an oil spill. Whereas some of the features that contribute to the rich benthic community would not be affected by an oil spill (presence of the ocean shelf, particular water depth, the presence of spring leads and ice edges, and inflow of nutrient-rich Pacific water), other processes and components of the critical habitat would be impacted. The high ice-edge primary productivity that drives the food web of Ledyard Bay could be altered by the physical and toxic effects of oil on the water or ice surface, entrainment in the water column, and direct and indirect effects on primary producers in the water column. The rich benthic invertebrate community that serves as the predictable food

resource for spectacled eiders would probably be impacted both directly and indirectly by a large oil spill. Direct toxicity would reduce the abundance or biomass of benthic invertebrates, and the community composition could be altered by indirect effects. The Ledyard Bay benthic community could be impacted by an oil spill regardless of whether oil reaches the sea floor, due to changes in primary production near the surface that would have ramifications through the relatively simple and direct food chains and food webs occurring in the eastern Chukchi Sea.

The Service concurs with MMS (2006a) that food resources used by eiders in the LBCHU could be displaced or reduced following an oil spill for an unknown length of time, and that the remaining invertebrate prey species could bioaccumulate oil and subsequently contaminate eiders. Therefore, a large oil spill associated with Lease Sale 193 development and production would negatively impact critical habitat. The magnitude of impacts, and the degree to which the LBCHU's ability to support spectacled eiders will be compromised, will be determined, at least in part, by the amount of oil spilled, the amount which actually enters the LBCHU, the degree to which the biotic and abiotic characteristics of the LBCHU are affected, and the duration of the effects.

Effects of a large oil spill on Steller's eiders - Because all North Slope-breeding Steller's eiders may migrate northward in spring leads or broken ice near shore, the Service believes it is possible for an oil spill in the spring lead system to contact and kill a majority of Alaska-breeding Steller's eiders. This would be a catastrophic population-level mortality event for this listed species.

Effect of a large oil spill on Kittlitz's murrelets - The Lease Sale 193 area is on the northern edge of the Kittlitz's murrelet's range in Alaska. Even in years when Bering Sea water and its associated fauna moves north into the Chukchi providing additional prey, the density of Kittlitz's murrelets in the northeast Chukchi is thought to be low (Divoky 1987). When in the marine environment, these birds are generally solitary or found in very small flocks (Day et al. 1999). However, in late summer and fall, substantial numbers have been estimated along the ice edge in the central Chukchi Sea (1,000 to 5,000 birds; G. Divoky unpubl. data, cited by Day et al. 1999). It is not known if Kittlitz's murrelets concentrate in other areas of the eastern Chukchi Sea at other times of year. Due to the general lack of information about Kittlitz's murrelets distribution in the Chukchi Sea, evaluation of specific spill trajectories was not useful. However, the Service believes that Kittlitz's murrelets could be exposed to and killed by spills that occurred in the eastern Chukchi.

To summarize the potential for listed species to be exposed to an oil spill from Lease Sale 193, significant numbers of North Slope-breeding spectacled eiders and Steller's eiders could be exposed to an oil spill that entered important habitats within the Chukchi Sea. In particular, adult spectacled eiders molt in late summer in the LBCHU; during that time the birds are especially vulnerable to a spill because they are flightless and could not be hazed away from oil. The majority of listed Steller's eiders could be killed by an oil spill in spring leads or open water nearshore. In addition, possibly thousands of Kittlitz's

murrelets could be exposed to an oil spill that enters the central or southern portion of the eastern Chukchi Sea. Additionally, the Service concurs with the MMS (2006) assumption that oil spill response in the Chukchi Sea would be ineffective due to the unpredictable response time, proximity of launch sites to bird habitats, known ineffectiveness of response during adverse environmental conditions (such as broken-ice), and the large number of birds that could be impacted in a brief time.

Small crude or refined oil spills - Based upon the North Slope spill record, MMS estimates that 179 small (<1000 bbl) onshore or offshore spills of crude oil or diesel and 440 spills of refined fuels (0.7 bbl each) would occur over the life time of the proposed project, with an average of 25 small-volume spills occurring each year of production. The causes of North Slope crude oil spills were leaks; faulty valves, gauges, or connections; vent discharges; ruptured lines; seal failures; human error; and explosions; and approximately 30% of spills were of unknown causes (MMS 2006c, Appendix A.1).

Although the average small spill size is estimated to be about 3 bbl, MMS estimates that two 500 bbl crude or diesel spills and one 1000 bbl spill would occur over the 30-year life of the project. Spill trajectory analysis was not conducted for small spills, so the Service evaluated the hazard based solely on information provided by MMS on the possible aerial extent of a 1,500 bbl spill. MMS spill models indicated that a summertime 1,500 bbl spill could cover a discontinuous 577 km² area after 30 days, and, if it occurred in landfast ice and moved with meltout, 188 km² after 30 days. Using simple interpolation of those figures, we calculate that a 1,000 bbl spill could cover 384 km² and 125 km² of ocean surface if it occurred in the summer or meltout, respectively, and a 500 bbl spill could cover 192 km² and 63 km² during summer and meltout, respectively.

Dense molting flocks of spectacled eiders could be vulnerable to population-level effects from a 1,000 bbl oil spill because the possible aerial extent of the spill (384 km²) is slightly greater than the 348 km² covered by 95% of the 33,192 spectacled-eider count estimate observed in Ledyard Bay (Larned et al. 1995). Therefore, a 1,000 bbl oil spill may pose nearly as great a potential risk to spectacled eiders in Ledyard Bay as a large oil spill. The risks associated with the two 500 bbl spills predicted to occur during the project also pose substantial mortality risk to spectacled eiders, although we do not know if population-level impacts could occur at that volume. Because molting eiders cannot fly way from a hazard, they would sustain a continuing risk of exposure to even a small-volume oil spill.

If small spills reached spring leads, they could also cause substantial mortality of both spectacled eiders and Steller's eiders using leads during spring migration, especially as oil in broken ice cannot be effectively recovered (MMS 2006a, 2006c). Therefore, even a small-volume spill in the spring lead system could kill a significant portion of Alaska-breeding Steller's eiders and North Slope-breeding spectacled eiders.