Biological Evaluation of

Spectacled Eider (*Somateria fischeri*),

Steller's Eider (*Polysticta stelleri*), and

Kittlitz's Murrelet (*Brachyramphus brevirostris*)

for

Chukchi Sea Lease Sale 193

Minerals Management Service

September 2006

(includes 6 February 2007 Addendum)

Table of Contents

note *Please see these materials in the original Lease Sale 193 FEIS

Biological Evaluation of Steller's Eider (*Polysticta stelleri*), Spectacled Eider (*Somateria fischeri*), and Kittlitz's Murrelet (*Brachyramphus brevirostris*) for Chukchi Sea Lease Sale 193

Purpose and Need

The United States has a high dependency on imported oil to supply current and projected demands. Consequently, Congress passed the Outer Continental Shelf Lands Act, which mandated that it is in the national interest to investigate and develop potential domestic supplies to reduce this dependency.

Action Area

Under the current 5-year OCS leasing program (2002-2007), the Chukchi Sea Program Area encompasses approximately 137,600 km^2 (34 million acres) (Figure 1). Lease sale 193 is part of the current 5-year OCS-leasing program. Lease sales 211 in 2010 and 221 in 2012 are proposed in the next 5-year program.

Description of Lease Sale 193

Existing Framework for the Exploration and Development Scenario.
The MMS traditionally bases its hypothetical development scenarios on geologic potential, industry trends, and available technology. While no development has occurred in the Chukchi Sea lease sale area after two lease sales and limited exploration activity has occurred, we assume that the next lease sale will result in an oil field that is leased, discovered, developed, and produced in the sale area under consideration. This section details the scientific, economic, geologic, and other assumptions on which the exploration, development, and transportation scenarios in this biological assessment are based.

The location of any commercial oil accumulation is purely hypothetical until oil is proven by drilling. While the following scenario is reasonable and provides a basis for analyzing the effects, considerable uncertainty exists about where and when activities may take place, if they take place at all. In addition to uncertainty about the size and location of geologic resources, many other factors would influence where leasing, exploration, and development might take place such as the price of oil, the availability of competing oil-production areas, and company perspectives about Alaska. Offshore development in the Chukchi outer continental shelf (OCS) would have synergistic effect on the level of offshore activities in the adjacent Beaufort Sea as well as field development in the NPR-A.

This section describes the overall framework or setting for petroleum activities in the Chukchi Sea leasing area. Scenarios are conceptual views of the future and represent possible, though not necessarily probable, sets of activities. To develop the scenarios we consider the petroleum-resource potential of the area, the technology to explore and produce oil and gas from the offshore area, and industry trends in northern Alaska. The scenario is generated using professional judgment, not rigorous statistical data, because the size and location of oil and gas pools are unknown at the present time and MMS has no direct knowledge of future industry strategies. The timing of exploration and development activities and volume of petroleum ultimately produced as a result of the next lease sale in the Chukchi OCS is impossible to predict with any certainty. However, the assumed scenario provides a common basis for the analysis of potential environmental impacts, should future activities occur similar to those postulated here.

Although all scenarios are hypothetical and, therefore, uncertain, they can be categorized as either *reasonably foreseeable* or *speculative*. Reasonably foreseeable scenarios are viewed as extensions of current trends that are more likely to occur within a decade or two. For this biological evaluation, MMS considered oil production from the Chukchi shelf as reasonably foreseeable, because the area has high oil-resource potential and there is existing transportation infrastructure to move oil from northern Alaska to distant markets.

Future oil production from the Chukchi Sea will depend on many factors, including the access to prime areas for exploration and sustained high oil prices, which will attract industry investments to this remote, high-cost location. Offshore petroleum development in the Chukchi OCS will face a number of logistical and regulatory hurdles. These hurdles could negatively impact industry activities to convert undiscovered resources to producing reserves. Although theoretically present and potentially viable, all of the estimated economic resources will not be developed in a foreseeable timeframe, because exploration effort is likely to target only the largest prospects. Marginal discoveries probably would not be developed, because the risk of economic failure is too high. This means that future production from this frontier area is unlikely to ever reach the full economic potential as estimated by petroleum-resource assessments. Consequently, there is a rather low probability for commercial success in any frontier area, particularly a challenging area such as the Chukchi Sea. A realistic probability for commercial success is likely to be less than 10%.

For purposes of impact analysis, recoverable oil resources from this field are assumed to be 1 Bbbl, as lower oil volumes are not likely to be economic. If oil prices drop below $30.00 per barrel (they were above $50.00 when this scenario was written), exploration in the Chukchi OCS is expected to be minimal and oil discoveries may not be developed.

No permanent petroleum infrastructure exists in this remote area; therefore, a realistic scenario includes only the discovery, development, and production of the first offshore project. When the first project overcomes the cost, logistical, and regulatory hurdles, more projects are more likely to follow. If the challenges are not overcome, the area will remain undeveloped. As typical of many frontier areas, development usually starts with a relatively large project that supports the cost of initial infrastructure. Progressively smaller fields are developed after using this infrastructure, and the industrial footprint expands away from the core area.

A scenario that assumes any offshore oil development in the Chukchi OCS represents an abrupt increase in the level of activity compared to the past. There have been no lease sales and virtually no petroleum exploration in the Chukchi Sea since 1991. Four lease sales were held on different parts of the Chukchi shelf between 1988 and 1991, but only a small fraction of the tracts were leased by industry (483 leases, or approximately 5% of those offered). Five exploration wells drilled in 1989-1991 tested five large prospects, none of which resulted in commercial-size discoveries. There have been no active leases in the Chukchi Sea since 1998.

Future leasing and exploration interest in the Chukchi will be supported by high oil prices and advancements in exploration and production technology. High prices and new technology are both vital in overcoming the challenges of this difficult setting. The Chukchi OCS is viewed as one of the most petroleum-rich offshore provinces in the country, with geologic plays extending offshore from some of the largest oil and gas fields in North America on Alaska's North Slope. Our current petroleum assessment indicates that the mean recoverable oil resource is 12 billion barrels (Bbbl) with a 5% chance of 29 Bbbl. Most government and industry analysts agree that this province could hold large oil fields comparable to any frontier area in the world. It is reasonable to assume that exploration of this area could lead to significant oil discoveries. The uncertainty is whether offshore development will follow successful exploration. In a frontier area, this is not a solid assumption. However, for purposes of analysis we assume that one large oil field will be developed as a result of the next Chukchi lease sale.

MMS considers offshore gas production to be speculative for the current Chukchi leasing program, because although the area has a high potential for natural gas occurrence, there is no existing transportation infrastructure to move produced gas to markets. Natural gas has been produced in low quantities (0.7 billion cubic feet per year [Bcf/yr]) for local use in the village of Barrow since the mid-1940's and in high quantities (8 Bcf/day) from Prudhoe Bay area fields since 1969. Associated gas produced from North Slope oil fields has been reinjected to increase oil recovery and also used for fuel in facilities. It is estimated that approximately 35 trillion cubic feet (Tcf) of natural gas is contained in known accumulations and another 200 Tcf could occur in undiscovered pools throughout northern Alaska (U.S. Geological Survey, 2005). However, natural gas in northern Alaska is described as "stranded" until a gas-transportation system to outside markets is constructed. At the present time, a large-diameter gas pipeline seems to be the most likely project, with the earliest startup date in 2015. However, various plans to transport North Slope gas to market have been circulating for decades, and there still is no gas-transportation system. Until a future system is installed and has available capacity, it is unrealistic to assume that natural gas will be produced from the Chukchi Sea program area. Therefore, gas production is not included in the reasonably foreseeable scenario.

Chukchi Sea Sale 193 Scenario. The proposed action includes the entire program area. The following scenario assumes active leasing and exploration by industry followed by development. The scenario represents a possible set of circumstances, but the specific location and scale of offshore development will not be known for many years. This analysis reflects the current data and knowledge of MMS.

The scenario assumed for this biological evaluation involves the discovery, development, and production of the first offshore oil field in the Chukchi Sea. Industry groups could have a much different view of the oil potential in various parts of the Chukchi Sea. The scale of future activities will be controlled largely by industry perceptions of the Chukchi program area relative to other worldwide exploration opportunities. Industry decisions primarily are influenced by their opinions regarding the petroleum potential, future market prices, and the regulatory regime. Individual companies could have widely varying views of these factors, and these views could change (positive or negative) through time. It is not possible to accurately define where the first commercial development will occur because the locations cannot be determined without drilling (after leasing), and we cannot predict industry strategies to lease and drill specific tracts.

Petroleum-resource assessments of the Chukchi Sea Sale 193 area give a broad view of the potential for future commercial development. The assessments are based on geologic and engineering analysis assuming that the entire area is open to leasing; industry will completely explore the area in a very short timeframe (<20 years); and all economically viable resources will be developed, even if they are only marginally profitable. These obviously are unrealistic assumptions and, therefore, future development is more likely to be at a lesser scale and over a longer time period than suggested by economically recoverable resource estimates.

As previously discussed, offshore natural gas discoveries are not likely to be developed until a gas transportation system from the North Slope to outside markets is operational and has capacity to accept additional gas supplies from new fields. Other gas transportation strategies (liquefied natural gas) were not considered to be as feasible or economically attractive as an overland pipeline system to U.S. markets.

b. Exploration Activities.

(1) Marine Streamer 3D and 2D Seismic Surveys. The oil and gas industry conducts marine seismic surveys to locate geological structures potentially capable of containing petroleum accumulations. Airguns are the typical acoustic (sound) source for 2-dimensional and 3-dimensional (2D and 3D) seismic surveys. An outgoing sound signal is created by the venting of high-pressure air from the airguns into the water to produce an air-filled cavity (a bubble) that expands and contracts. The size of individual airguns can range from tens to several hundred cubic inches (in^3). A group of airguns is usually deployed in an array to produce a more downward-focused sound signal. Airgun array volumes for both 2D and 3D seismic surveys are expected to range from 1,800-4,000 in^3, but may range up to 6,000 in^3. The airguns are fired at short, regular intervals, so the arrays emit pulsed rather than continuous sound. While most of the energy is focused downward and the short duration of each pulse limits the total energy into the water column, the sound can propagate horizontally for several kilometers.

Marine-streamer 3D seismic surveys vary markedly from typical 2D seismic surveys, because the survey lines are closer spaced and are more concentrated in a particular area. The specifications of a 3D survey depend on client needs, the subsurface geology, water depth, and geological target. A 3D source array typically consists of two to three subarrays of six to nine airguns each, and is about 12.5-18 m long and 16-36 m wide. The size of the source-array size can vary during the seismic survey to optimize the resolution of the geophysical data collected at any particular site. The energy output of the array is determined more by the number of guns than by the total array volume. Vessels usually tow up to three source arrays, depending on the survey-design specifications. Most operations use a single source vessel; however, in a few instances, more than one source vessel is used. The vessels conducting these surveys generally are 70-90 m long. The sound-source level (zero-to-peak) associated with typical 3D seismic surveys ranges between 233 and 240 decibels re 1 microPascal at 1 meter (dB re 1 µPa at 1 m). Marine 3D surveys are acquired at typical vessel speeds of 4.5 knots (kn) (8.3 km/hour). A source array is activated approximately every 10-15 seconds, depending on vessel speed. The timing between outgoing sound signals can vary for different surveys to achieve the desired “shot point” spacing to meet the geological objectives of the survey; typical spacing is either 25 or 37.5 m.

The receiving arrays could include multiple (4-16) streamer-receiver cables towed behind the source array. Streamer cables contain numerous hydrophone elements at fixed distances within each cable. Each streamer can be 3-8 km long with an overall array width of up to 1,500 m between outermost streamer cables. Biodegradable liquid paraffin is used to fill the streamer and provide buoyancy. Solid/gel streamer cables also are used.

The wide extent of this towed equipment limits both the turning speed and the area a vessel covers with a single pass over a geologic target. It is, therefore, common practice to acquire data using an offset racetrack pattern, whereby the each acquisition line is several kilometers away from and traversed in the opposite direction of the track line just completed. Acquiring a single track line may take several hours, depending on the size of the survey area. The vessel then takes 2-3 hours to turn around at the end of the track line and starts acquiring data along the next track line. Adjacent transit lines for a modern 3D survey generally are spaced several hundred meters apart and are parallel to each other across the survey area.

Seismic surveys are conducted day and night when ocean conditions are favorable, and one survey effort may continue for weeks or months, depending on the size of the survey. Data-acquisition is affected by the arrays towed by the survey vessel and weather conditions. Typically, data are only collected between 25% and 30% of the time (or 6-8 hours a day) because of equipment or weather problems. In addition to downtime due to weather, sea conditions, turning between lines, and equipment maintenance, surveys could be suspended for biological reasons (proximity to protected species). Individual surveys could last 20-30 days (with downtime) to cover a 200 mi^2 area.

Marine-streamer 2D surveys use similar geophysical-survey techniques as 3D surveys, but both the mode of operation and general vessel type used are different. The 2D surveys provide a less-detailed subsurface image because the survey lines are spaced farther apart, but they cover wider areas to image geologic structure on more of a regional basis. Large prospects are easily identified on 2D seismic data, but detailed images of the prospective areas within a large prospect can only be seen using 3D data.

The 2D seismic-survey vessels generally are smaller than modern 3D-survey vessels, although larger 3D-survey vessels are able to conduct 2D surveys. The 2D source array typically consists of three or more subarrays of six to eight airgun sources each. The sound-source level (zero-to-peak) associated with 2D marine seismic surveys are the same as 3D marine seismic surveys (233-240 dB re 1 μPa at 1 m). Typically, a single hydrophone streamer cable approximately 8-12 km long is towed behind the survey vessel. The 2D surveys acquire data along single track lines that are spread more widely apart (usually several miles) than are track lines for 3D surveys (usually several hundred meters).

Marine seismic vessels are designed to operate for several months without refueling or resupply. A guard or chase boat probably would be used for safety considerations, general support, maintenance, and resupply of the main vessel, but it would not be directly involved with the collection of seismic data. Helicopters also may be used, when available, for vessel support and crew changes.

Marine-streamer surveys require a largely ice-free environment to allow effective operation and maneuvering of the airgun arrays and long streamers. In the Arctic, the timing and areas of the surveys will be dictated by ice conditions. The data-acquisition season in the Chukchi Sea could start sometime in June and end sometime in early November. Even during the short summer season, there are periodic incursions of sea ice, so there is no guarantee that any given location will be ice free throughout the survey.

Marine seismic-exploration work is expected to begin before the sale to identify prospective tracts for bidding. This work is likely to include 3D seismic surveys but will not include exploration drilling. Approximately 100,000 line-miles of 2D seismic surveys already have been collected in the Chukchi Sea program area, so we assume that additional geophysical surveys will be 3D surveys focusing on specific leasing targets. The 3D surveys are likely to continue during the early phase of exploration when wells are drilled; however, the number of surveys should decrease over time as data is collected over the prime prospects and these prospects are tested by drilling. We assume that up to four surveys could be conducted during each summer open-water season (June to November). Seismic surveys in the Chukchi OCS probably will be coordinated with surveys in the Beaufort OCS to use the same vessels. Typical 3D-survey operations will consist of a large seismic vessel that tows the airgun and receiving cable arrays and a smaller support boat.

(2) High-Resolution Site-Clearance Surveys. A high-resolution seismic survey usually is conducted by the oil and gas industry to provide the required permit information to MMS about the site of proposed exploration and development activities. High-resolution surveys locate shallow hazards; obtain engineering data for placement of structures (e.g., proposed platform locations and pipeline routes); and detect geohazards, archaeological resources, and certain types of benthic communities.

A typical operation consists of a vessel towing an acoustic source (airgun) about 25 m behind the ship and a 600-m streamer cable with a tail buoy. The source array usually is a single array composed of one or more airguns. A 2D high-resolution site-clearance survey usually has a single airgun, while a 3D high-resolution site survey usually tows an array of airguns. The ships travel at 3-3.5 kn (5.6-6.5 km/hour), and the source is activated every 7-8 seconds (or about every 12.5 m). All vessel operations are designed to be ultra-quiet, as the higher frequencies used in high-resolution work are easily are easily masked by the vessel noise.

Typical surveys cover one OCS block at a time. The MMS regulations require information be gathered on a 300- by 900-meter grid, which amounts to about 129 line-kilometers of data per lease block. If there is a high probability of archeological resources, the north-south lines are 50 m apart and the 900 m remains the same. Including line turns, the time to survey a lease block is approximately 36 hours. Airgun volumes for high-resolution surveys typically are 90-150 in^3, and the output of a 90-in^3 airgun ranges from 229-233 dB high-resolution re 1μPa at 1m. Airgun pressures typically are 2,000 psi (pounds per square inch), although they can be used at 3,000 psi for higher signal strength to collect data from deep in the subsurface.

(3) Drilling Operations. Based on mapping of the subsurface structures using 2D and 3D seismic data, several well locations will be proposed. Prior to drilling deep test wells, high-resolution site clearance seismic surveys and geotechnical studies will examine the proposed exploration drilling locations for geologic hazards, archeological features, and biological populations. Site clearance and studies required for exploration will be conducted during the open water season before the drill rig is mobilized to the site.

Considering water depth and the remoteness of this area, drilling operations are likely to employ drillships with ice-breaker support vessels. Water depths greater than 100 feet and possible pack-ice incursions during the open water season will preclude the use of bottom-founded platforms as exploration drilling rigs. Using drillships allows the operator to temporarily move off the drill site, if sea or ice conditions require it, and the suspended well is controlled by so-called blowout-prevention equipment installed on wellheads on the seabed. Drilling operations are expected to range between 30 and 90 days at different well sites, depending on the depth to the target formation, difficulties during drilling, and logging/testing operations. Considering the relatively short open-water season in the Chukchi (June-November), we estimate that up to four wells could be started by one rig each drilling season. However, it is more likely that only one to two wells could be drilled, tested, and abandoned during a single season, leaving work on the other wells to the next summer season. A total of 5 exploration wells have been drilled on the Chukchi shelf, and we estimate that 7-14 additional wells will be needed to discover and delineate the first commercial field.

c. Development Activities. When a large oil discovery is tested and defined by additional delineation wells, several project designs will be considered as alternatives for development. Because we have no knowledge of the site-specific conditions, we can only offer a general description of a possible future project and a hypothetical timeline for development.

Water depth and sea conditions are the two main factors in selecting a platform type. Because the continental shelf is relatively deep in the Chukchi (mostly deeper than 100 feet [ft]) and affected by ice movements most of the year, a large bottom-founded platform is likely be used as a central facility. The platform would hold one to two drilling rigs, production and service (injection) wells, processing equipment, fuel- and production-storage capacity, and quarters for personnel. Although bottom-founded platforms have been used in high-latitude settings worldwide, no platform is has operated in environmental conditions equivalent to the Chukchi shelf. Conceptual designs have been proposed that typically are circular in cross-section with wide bases and constructed out of concrete. The platform could be constructed in several component sections which would be transported to the site and then mated together. The seafloor is expected to be relatively firm, so a prepared berm may not be required. The platform base is pinned to the seafloor and stabilized by its wide base, anchoring system, and ballast in cavities in the concrete structure to resist ice forces.

Because of limited topside space on the platform and the assumed widespread area of the oil pool, approximately half of all development wells could be subsea wells. The subsea wells would be completed in templates (4 wells per template) and production would be gathered to the central platform by flowlines. Subsea well templates would be located within about 15 miles (miles) from the central platform. Pending the information collected by site-specific surveys, the subsea equipment and pipelines could be installed below the seafloor surface for protection against possible deep-keeled ice masses. Drilling on the platform would occur year-round, while subsea wells would be drilled by drillships during the summer open-water season.

The production slurry (oil, gas, water) will be gathered on the central platform where gas and produced water will be separated and the produced water reinjected into the subsurface. Associated and solution gas recovered with oil production will be used as fuel for the facility or reinjected into the main reservoir to increase oil recovery. Shallow disposal wells will handle waste water and treated well cuttings for on-platform wells. Drilling cuttings and mud wastes from subsea wells could also be barged to an onshore treatment and disposal facility located at the shore base.

Installation of the flowlines from subsea templates to the hub platform and installation of the main oil pipeline from the platform to landfall will occur during summer open-water seasons. These pipeline operations would occur during the same timeframe as platform construction and installation. We assume that the offshore sales-oil pipeline will be larger than 18 inches (in) in diameter to handle production rates ranging from 200,000-250,000 barrels per day (bpd). The offshore pipeline runs 30-150 mi between the offshore platform and landfall and will be trenched in the seafloor as a protective measure against damage by floating ice masses. At the coast, a new facility will be constructed to support the offshore operations and will also serve as the first pump station. A likely location for the shore base would be between Icy Cape and Point Belcher, preferably near a community that has an airport. The size of this shore base is assumed to be 50 acres in size. A 50-acre staging area would also be needed to stage equipment and materials to construct the shore base.

The overland pipeline to the Trans-Alaska Pipeline System (TAPS) or a nearer gathering point will require coordination of different land managers and oil-field owners along the route through the National Petroleum Reserve Alaska (NPR-A). In contrast to offshore pipelines, the new onshore pipeline will be installed during winter months. Various pipeline and communication lines will be installed on vertical supports above the tundra in a corridor stretching eastward up to 300 mi to connect to the North Slope gathering system. The gravel road is assumed to be about 65 ft wide. This road would be offset from the pipeline and the two features (road and pipeline) would make a transportation “corridor” of an estimated 100 feet in width. As many as 4 pump stations (40 ac each) may be required along the onshore corridor.

Material to construct the road, shore base, and other facilities would come from upland gravel pits, if practicable, or from coastal areas (intertidal areas, barrier islands, etc.) if no feasible and prudent noncoastal alternative is available. The locations of gravel sources near a future alignment are unknown, however it is likely that some known gravel sources (identified in Northeast NPR-A, presently undeveloped) or existing gravel pits would be utilized/expanded for material construct fill for the development facilities.

The time from leasing to production startup is expected to be 10-15 years. MMS assumes a time lag of 3 years from the lease sale (2007) to the discovery well (2010). Delineation drilling would take 3 years, followed by a Development EIS and associated permitting activities for the project. When the project is approved, the design, fabrication and installation of the central platform could take another 4-5 years. Offshore and onshore pipeline permitting and construction would occur simultaneously with the offshore work. Drilling of subsea wells could start before platform installation to allow a quicker ramp up of production. Drilling on the platform and subsea wells would take 6 years. A new shore base would be constructed (2015) to support offshore work and then serve as the pipeline landfall.

d. Production Activities. The total lifecycle (exploration through abandonment) of the offshore project could last 30-40 years with oil production for at least 25 years. When the oil resources are depleted, the platform and wells could be used for gas production, if a future North Slope gas pipeline is built. However, considering that a North Slope gas pipeline is not likely to be operational until at least 2015, and there are large proven gas reserves closer to this future pipeline, full-scale gas production from the Chukchi OCS is not expected before 2025 at the earliest.

After the offshore project is constructed, operations will largely involve resupply of materials and personnel, inspection of various systems, and maintenance and repair. Little maintenance and repair work is expected on the platform itself, but it is likely that processing equipment might be upgraded to remove bottlenecks in production systems. Well workovers will be made at intervals of 5-10 years to restore flow rates in production wells. Pipelines will be inspected and cleaned regularly by internal devices ("pigs"). Crew changes are usually at weekly intervals.

Transportation Activities. Operations at remote locations in the Chukchi Sale 193 area would require transportation of materials, supplies, and personnel by different means, depending on seasonal constraints and phase of the operations.

During exploration seismic surveys, the vessels are largely self-contained, so there would be a minimum amount of helicopter flights (assume 1 per day) to transport personnel, seismic data, and light supplies. As previously discussed, seismic operations would be in the summer open-water season. The smaller support vessel would make occasional trips (once every 2 weeks) to refuel and resupply (probably at Barrow).

During exploration drilling, operations would be supported by both helicopters and supply vessels. Helicopters probably would fly from Barrow at a frequency of one to three flights per day. Support-vessel traffic would be one to three trips per week, also out of Barrow. For exploration-drilling operations that occur after a new shore base is established near Point Belcher, both helicopter and vessel traffic would be out of either Barrow or the new shore base.

Construction of a new shore base would begin after a commercial discovery is made. Heavy equipment and materials would be moved to the coastal site using barges, aircraft, and perhaps winter roads made on the sea ice. Transportation activities would be more frequent during the construction phase, beginning about 3 years after the discovery is made and will take another 3 years for completion of the new facility. During this construction phase, there could be one to two barge trips (probably from either West Dock or Nome) in the summer open-water season. Aircraft (C-130 Hercules or larger) trips could be up to five per day during peak periods. The overall level of transportation in and out of the shore base would drop significantly after construction is completed for both the shore base and offshore field area. During production operations, aircraft generally would be smaller with less-frequent flights (2 per day). Traffic on roads made on the sea ice would be intermittent during the winter months.

Offshore construction (platform and pipeline installation) and development drilling operations would be supported by both helicopters and supply vessels from the new shore base. Helicopters probably would fly from either Barrow or the new shore base at a frequency of one to three flights per day during development operations. Support-vessel traffic would be one to three trips per week from either Barrow of the new shore base. During normal production operations, the frequency of helicopter flights offshore would remain the same (1-3 per day), but marine traffic would drop to about one trip every 1-2 weeks to the production platform. Marine traffic would occur during the open-water season and possibly during periods of broken ice. Assuming that barges will be used to transport drill cuttings and spent mud from subsea wells to an onshore disposal facility, MMS estimates one barge trip per subsea template (4 wells). This means that there could be two summer barge trips to the new onshore facility over a period of 6 years.

f. Abandonment Activities. After the oil reservoir is depleted and income from production does not cover operating expenses, operations will begin to shut-down the facility. In a typical situation, wells will be permanently plugged with cement and wellhead equipment removed. Processing modules will be moved off the platform. Pipelines will be decommissioned, which involves cleaning the pipeline, plugging both ends, and leaving it in place buried in the seabed. The overland oil pipeline is likely to be used by other oil fields in the NPR-A so it will remain in operation. Lastly, the platform will be disassembled and removed from the area and the seafloor site will be restored to some practicable, predevelopment condition. Post abandonment surveys would be required to confirm that no debris remains following abandonment or that materials (pipeline) that remain were abandoned property.

Other options are possible but more speculative. The platform might be converted to a gas production facility to recover the gas reinjected during oil production. This option will depend on construction of a future North Slope gas pipeline with capacity for new gas supplies from the Chukchi. Conversion of the offshore platform to a gas production facility could delay abandonment activities for several decades. Another option is that the platform and pipeline systems could serve as a hub for smaller satellite fields in the surrounding area. As a third option, the platform and partially dismantled topside facilities could be used for civilian or military purposes. For each option, abandonment activities would be delayed for many decades. Considering the cost of installing this offshore infrastructure (several billion dollars), it is unlikely that total abandonment of the facility would be considered as a cost-effective alternative.

g. Estimates of Drilling Wastes and their Disposal. Geologic studies indicate that exploration usually will test prospects from 3,000-15,000 ft in the subsurface. Based on the characteristics of the geologic plays, we assume that exploration wells will average 8,000 ft. Production and service wells are assumed to average 10,000 ft (drilled depth), because they will include deviated wells. MMS assumes that from 25-33% of the total wells will be service wells that are used for waste disposal and reservoir pressure maintenance.

For the assumed drilling depths, a typical exploration well will use 475 tons of dry mud and produce 600 tons of dry rock cuttings. Considering the cost of synthetic drilling fluids now commonly used, we assume that 80% of the drilling mud will be reconditioned and reused. Only 20% (or 95 tons) of “spent mud” per well will be discharged at the exploration site. All of the rock cuttings will be discharged at the exploration site. A typical 10,000-ft production well will use approximately 625 tons of dry mud and produce approximately 825 tons of rock cuttings. We assume that 80% of the drilling mud will be recycled in the development drilling program, so 125 dry tons per well will be waste product. All waste products (drilling mud, rock cuttings, and produced water) for on-platform wells will be treated and then disposed of in shallow wells on the production platform. For the outlying subsea wells, drilling waste products could be barged to the coastal facility for treatment and disposal.

Endangered Species Act (ESA) Section 7 Consultation Process

The U.S. Department of the Interior, Fish and Wildlife Service (FWS), Ecological Services Alaska, provides the following description of the Endangered Species Act, Section 7 consultation process.

> When development occurs within the range of threatened or endangered (T&E) species, the agency proposing development is expected to consult with the Service regarding the activity. The process begins informally with a request for a list of T&E species in the area of interest. If T&E species are present, then informal consultation begins. Should the informal consultation determine that a listed species might be affected by the proposed activity, the action agency prepares a biological evaluation of T&E species within the action area. If it is then determined that a listed species is likely to be adversely affected, formal consultation results. During the formal consultation, the Service prepares a biological opinion, complete with a list of reasonable and prudent measures that the action agency is bound to adhere to. An incidental take document accompanies the biological opinion, and details how many individuals may be taken as a consequence of the action before consultation is re-initiated.

Species considered by the MMS include the threatened Steller's and spectacled eiders and the candidate Kittlitz's murrelet. These species are known to seasonally occupy the Chukchi Sea OCS. The MMS initiated informal consultation with the FWS by requesting a list of T&E species present in the Chukchi Sea OCS action area. The FWS responded with their determination of T&E and candidate species, and listed Steller's and spectacled eiders and the candidate Kittlitz's murrelet as occurring in the Chukchi Sea action area (USFWS 2006). A biological evaluation for candidate species, such as the Kittlitz's murrelet, is not required under the ESA, however the Kittlitz's murrelet is treated here as if it were listed as threatened or endangered in the event it becomes listed and for the purpose of minimizing potential negative effects the proposed action could have on this species.

A biological evaluation of Steller's and spectacled eiders and Kittlitz's murrelet follows. Biological descriptions in the following sections were taken from information found in the Federal Register listing actions for Steller's and spectacled eiders (USFWS 1993, 1997) and Kittlitz's murrelet (USFWS 2004), biological opinions for similar projects, personal communications, and scientific literature.

Biological Status of Steller's Eider (*Polysticta stelleri*)

Worldwide setting

Historic worldwide population estimates for Steller's eider ranged from 400,000-500,000 (Palmer 1976). Population estimates in the 1990's were about 200,000 (Fredrickson 2001). The worldwide population of Steller's eiders was more recently estimated to number between 100,000 and 150,000 birds (Quakenbush 2006). Three breeding populations of Steller's eider comprise the worldwide population; Russian-Atlantic, Russian-Pacific, and Alaskan (USFWS 1999, 2002a).

Russian-Atlantic and Russian-Pacific Breeding Populations

Both the Russian-Atlantic and Russian-Pacific breeding populations of Steller's eiders nest on the Taimyr Peninsula with the line delimiting the 2 groups being along the meridian 200km west of Khatanga (Solovieva 1999).

Russian-Atlantic Breeding Population

The Atlantic population ranges from northern Europe to about the Khatanga River in western Arctic Russia. The Russian-Atlantic breeding population is estimated to be between 30,000-50,000 eiders. The population nests west of the Khatanga River on the western Yamal and western Taimyr (Nygard et al. 1995, Solovieva 1999) and winter in the Barents and Baltic Seas (Solovieva 1999). Wintering Steller's eiders in Europe, presumably the Russian-Atlantic breeding population, have apparently increased since the 1960's (Nygard et al. 1995).

Russian-Pacific Breeding Population

The Pacific population ranges from about Cook Inlet, Alaska to the Kuril Islands, Russia during winter, and from about the Yamal Peninsula, Russia to about Prudhoe Bay, Alaska during summer (USFWS 2002a, Quakenbush et al. 2002). The Pacific population is composed of two sub-populations: an Alaskan breeding population and a Russian-Pacific breeding population. Most Steller's eiders from these two sub-populations winter together in Alaska.

The Russian-Pacific breeding population nests east of the Khatanga River, wintering in the Bering Sea and north Pacific Ocean where it overlaps with the Alaskan breeding population. The nesting and molting ecology of the Russian-Pacific breeding population of Steller's eiders is relatively well documented, compared to the Russian-Atlantic breeding population, partly owing to their use of staging, molting, and wintering areas along the Alaska Peninsula and in the Bering Sea (Petersen 1981, Dau et al. 2000, Flint et al. 2000, Pearce et al. 2005, P. Martin in prep.). About 30,000 of the Pacific population winters in Russia and the remainder winters in Alaska. Steller's eiders from this population mostly nest in Siberia, but a small portion of them nest in Alaska (USFWS 2002a).

Alaskan Breeding Population

About 5% of the world population of Steller's eiders annually breeds in Alaska. The Alaska nesting population is divided into two sub-populations depending on where they nest: the Arctic Coastal Plain and the Yukon-Kuskokwim Delta (YKD). Over 95% of the Alaskan breeding Steller's eiders occurring on the Arctic Coastal Plain (ACP) near Barrow (USFWS 1999, 2002b, Quakenbush et al. 2004). Historical data suggest Steller's eiders occurred across much of the ACP and into northwestern Canada; although it appears they once ranged from Wainwright to

Cape Halkett in Alaska with additional records extending east as far as Herschel Island, Canada (Quakenbush et al. 2002). The FWS believes the ACP nesting population numbers in the hundreds or low thousands.

Very limited Steller's eider nesting occurs on the YKD, where it historically occurred in relatively sizeable numbers (Fredrickson 2001, USFWS 2002c). Historically, the YKD apparently supported the greatest numbers of Steller's eiders breeding in western Alaska, and nesting was thought to occur from Kokechik Bay south to possibly Nelson Island (Quakenbush et al. 2002). The FWS believes the YKD nesting population numbers in the tens or hundreds.

This biological evaluation focuses on whether and to what extent the proposed project may affect those Steller's eiders breeding on the Alaskan Arctic Coastal Plain.

Species Description

The Steller's eider is the smallest of four northern eider species. The average weight of adult Steller's eiders is 1.94 pounds (Bellrose 1980). Adult male Steller's eiders in breeding plumage have a black back, white shoulders, and a chestnut brown breast and belly. The males have a white head with black eye patches; they also have a black chin patch and a small greenish patch on the back of the head. Females and juvenile males are mottled dark brown.

<u>Life-history Strategy</u>

Many life history aspects of Steller's eiders (e.g., timing of pair formation, duration of pair bonds, dispersal rates, sex-specific seasonal site fidelity, first-year survival, etc.) are poorly understood.

Longevity

Banding studies indicate that Steller's eiders can be long lived and are known to live at least 21 years and 4 months in the wild (Dau et al. 2000).

Age to Maturity

Steller's eiders reach sexual maturity at two years (Bellrose 1980).

Reproductive Strategy

Johnsgard (1994) indicated that pair formation for most sea ducks occurs in fall and spring. Metzner (1993) hypothesized that Steller's eiders at Izembek Lagoon and Cold Bay paired in the spring because they were apparently too preoccupied with feeding during the fall and winter to form pair bonds. Long-term pair bonds have been documented in other waterfowl (Savard 1985), but the length of time that Steller's eiders remain paired is unknown.

In Alaska, pairs of Steller's eiders arrive at their nesting areas as early as June 5 (Bent 1987). Steller's eiders often nest on coastal wetland tundra, but some nest near shallow ponds or lakes well inland on the Arctic Coastal Plain (Bent 1987, Quakenbush et al. 1995, Solovieva 1997).

Initiation of nests monitored near Barrow was from 6 June-17 June and initiation did not appear to be synchronous among females within years; laying period covered ~21 days (range 15-28 days) (Quakenbush et al. 2004). Initiation for 6 nests on the YKD was in early June (Flint and

Herzog 1999). Egg-laying intervals for 5 Steller's eiders nesting near Barrow averaged 23 hours (SD ± 1.67; range 20.9-24.7 hours) (Quakenbush et al. 2004).

Clutch size ranges from two to ten eggs, but averages about five eggs near Barrow, Alaska (Quakenbush et al. 1995, Bent 1987, Bellrose 1980). The average number of eggs in Russia is slightly higher at about six eggs per nest. Nesting success is variable. Clutch size (± SE) calculated during the first half of incubation was 6.31 + 1.15 eggs (n = 74 nests; range 4-8 eggs) and at hatch was 4.76 ± 1.72 eggs (n = 30; range 1-7) (Solovieva 1999). Apparent nest success on Sagastyr Island was 21.6% (1993), 37.5% (1996), and 11.4% (1999) and in other years (1994-1995, 1997-1998) not a single nest hatched due to predation by herring (*Larus argentatus*) and glaucous gulls, and pomarine (*Stercorarius pomarinus*) and parasitic (*S. parasiticus*) jaegers (Solovieva 1999). Over a 2 day period, 40-45 gulls attracted by fish offal destroyed 63 Steller's eider nests. Abandonment was relatively common during the egg laying stage particularly for those nests not 'protected' by territorial pomarine jaegers and abandonment was high (7.1-11.1%) even in favorable years (Solovieva 1999). In this study, successful reproduction tended to occur in 3-year cycles which tracked pomarine jaeger nesting activity which the author linked to high lemming numbers. In this same study, ducklings were brooded in the nest for ~41 hours and brood departure from the nest almost always occurred between 0900-1200 and brood size at hatch was 4.89 ± 0.35 ducklings/brood (n = 18; range 1-7). Though Steller's eiders were observed being attacked regularly by gulls and parasitic jaegers, Solovieva (1999) did not document declines in brood size over the brood-rearing period. However, broods were not marked, so actual estimates of brood/duckling survival could not be generated.

Clutch size for Steller's eiders on the ACP near Barrow averaged 5.4 eggs/clutch (range 4.8-5.9) with apparent nest success estimates ranging from 0-27% and a hatchability estimate of 24%; depredation accounted for 62-100% of annual egg loss (Quakenbush et al. 2004). On the YKD, two of five (40%) known-fate nests were successful (Flint and Herzog 1999). Near Barrow, fledging success (15%) appeared to be low, as only two of 13 marked broods fledged young during the study (1992-1999) with roughly 67% of duckling mortality occurring within the first 7d post-hatch (Quakenbush et al. 2004). Of the seven instrumented adult females with broods two (28% mortality) were confirmed killed by snowy owls (*Nyctea scandiaca*) (Quakenbush et al. 2004). In this same study, brood adoption was confirmed in two instances, one due to the death of the female and in another case where the female abandoned the brood.

Egg hatch occurred from 14-28 July (avg. 19 July) for three nests monitored near Barrow with an incubation period of about 24 days (Quakenbush et al. 2004).

Steller's eiders nest with greatest frequency (and highest density) near Barrow. The Northwest Planning Area of the National Petroleum Reserve - Alaska may include over 90% of breeding Steller's eiders on the Arctic Coastal Plain (ACP) (USFWS 2005). Quakenbush et al. (2002) determined that reduction in both occurrence and breeding frequency for the ACP was not uniform, i.e., Steller's eider data near Barrow were not suggestive of declines, whereas data excluding Barrow was indicative of declines. Through 1990, the Steller's eider was thought to have been extirpated from the YKD since no nests had been found there since 1975 (Kertell 1991). However, 6 nests were found between 1991-1998 providing some indication that nesting still occurred there in very low numbers, and particularly in the vicinity of the Kashunuk, Tutakoke, and Opagyarak Rivers (Flint and Herzog 1999).

The Arctic Coastal Plain aerial breeding pair survey, initiated in 1986, conducted from late June through early July is generally considered to occur too late for an accurate assessment of eiders. Data from this survey indicate an average of 860 Steller's eiders (1986-2003; range 0-2,543) across the survey area (61,645.2 km^2); from the northwest coast of Alaska east to the Canadian border (Mallek et al. 2005). In 1992, a survey was initiated to target eiders and estimates from this survey averaged 157 Steller's eiders (1993-2005; range 0-785), but the sampling intensity is considered inadequate for this species (Larned et al. 2005). More intensive aerial surveys in the Barrow Study Area (1999-2005) indicated much variation in Steller's eider breeding effort as indexed from this survey with estimates ranging from a low of 8 in 2002 to a high of 224 in 1999 (Ritchie et al. 2005). In general, breeding effort for Steller's eiders on the ACP varies annually (Quakenbush et al. 2004) and nest density varies spatially within a given year particularly within the 'Barrow Triangle' (north of 70º 50'N) between Dease Inlet and the Chukchi Sea.

In recent years, the number of nests near Barrow that produced ducklings seems to be declining and ranged from 83% in 1991 to 15% in 2000 (USFWS 2002b). In other years, Steller's eiders did not attempt to nest near Barrow (Quakenbush et al. 1995). Periodic non-nesting is common in Steller's eiders, but it remains unresolved whether non-breeding Steller's eiders near Barrow forego nesting in a given year or may attempt to nest in Russia. The reason for relatively low nesting success or failure to nest by the Alaska nesting population is unknown, but may be related to predators switching to alternate prey when lemmings are in low abundance (Quakenbush and Suydam 1999). Qualitative information on nesting effort in Alaska has indicated apparent declines on the YKD (Kertell 1991, Flint and Herzog 1999) and the ACP (Quakenbush et al. 2002, 2004).

Brood-rearing occurred in mid-late July near Barrow with ducklings from marked broods flight-capable 36 days after hatch. Of 13 monitored broods near Barrow, females with broods remained within 700m of their nests up to 35 days post-hatch with broods being found most often on ponds and canals with emergent *Arctophila fulva* (Quakenbush et al. 2004).

Survival and Recruitment
Survival estimates (% $\pm$ SE) for adult male (0.87 ± 0.06, 0.76 ± 0.05) and adult female Steller's eider (0.95 ± 0.06, 0.83 ± 0.02) banded at Izembek Lagoon declined over the periods studied (1975-1981, 1991-1997) (Flint et al. 2000). Steller's eider recruitment rates are unknown (USFWS 2002b).

Seasonal Distribution Patterns

Spring Migration
In the spring, Steller's eiders form large flocks along the north side of the Alaska Peninsula and generally move east and north. Spring migration usually includes movement along the coast, although birds may take shortcuts across large water bodies such as Bristol Bay and Kotzebue Sound. Steller's eiders show strong site fidelity for certain habitats during migration, where they congregate in large numbers to feed before continuing their northward migration. Steller's eiders show strong fidelity to several areas along the southeastern Bering Sea/Bristol Bay coastline. These areas include: Bechevin Bay, Morzhovoi Bay, Izembek Lagoon, Nelson Lagoon/Port Moller Complex, Cape Seniavin, Seal Islands, Port Heiden, Cinder River-Hook

Lagoon area, Ugashik Bay, Egegik Bay, Kulukak Bay, Togiak Bay, Nanwak Bay, Kuskokwim Bay, Goodnews Bay, and the south side of Nunivak Island.

Steller's eiders are paired within flocks when they arrive on the Arctic Coastal Plain near Barrow, typically from early to mid-June (Quakenbush et al. 2004). This time-frame is likely two weeks earlier on the YKD (Flint and Herzog 1999).

Breeding Distribution
The historical breeding range of the Alaskan nesting population of Steller's eiders is not clear (USFWS 2002a). The historical nesting range may have extended discontinuously from the eastern Aleutian Islands to the western and northern Alaskan coasts, possibly east as far as the Canadian border. More recently, nesting occurs in two general areas–the Arctic Coastal Plain and the Yukon-Kuskokwim Delta (YKD). Currently, Steller's eiders nest in relatively low numbers on the Alaskan Arctic Coastal Plain from Point Lay east to Prudhoe Bay and in extremely low numbers on the YKD. Female Steller's eiders, like females of many other waterfowl species, likely have strong fidelity to nesting areas and return to the same nesting site or vicinity every year.

Post-breeding Distribution, Fall Migration, and Molting
Departure from the ACP to molting areas is poorly documented, but males probably begin departing as early as late June, followed by non- and failed nesting females presumably from late July – late August, and finally successful females and fledged young. The timing of departure and arrival of Steller's eiders at known staging points within their range was well documented by historical observation, but until the advent of satellite technology, little was known of how Steller's eiders used marine waters during their late summer and fall migration.

From about 2000 through 2003, several Steller's eiders from the Alaskan nesting population were instrumented with satellite transmitters while they were on nesting areas near Barrow. Subsequent tracking through the summer and fall indicated that Steller's eiders from the Alaskan nesting population ranged as far west as the Russian Arctic coastline before gathering at known molting areas in bays along the coast of the southeastern Bering Sea (P. Martin in prep.).

In late summer and fall, large numbers of Steller's eiders from the Russian-Pacific and Alaskan populations gather to molt in a few lagoons on the north side of the Alaska Peninsula. Fewer numbers of eiders also apparently molt farther north in Kuskokwim Bay and near the southern tip of the Kamchatka Peninsula and the Commander Islands in the western Bering Sea (USFWS 2002a). High fidelity to molting areas as well as mixing of Russian-Pacific and Alaskan populations has been documented for Steller's eiders molting at Izembek and Nelson Lagoons (Dau et al. 2000, Flint et al. 2000). Arrival of Steller's eiders to Nelson Lagoon varied annually and is probably related to sex, age, and reproductive status with sub-adults arriving first (peak = 4 August), followed by adult males (11 August), adult females (27 September), and young (27 September) (Petersen 1981).

Several Steller's eider molting areas in Alaska were designated as critical habitat on 6 February 2001 (USFWS 2001a).

Winter Distribution
Following the molt in Alaska most Steller's eiders disperse from major molting areas to other parts of the Alaska Peninsula and Aleutian Islands. Winter ice formation often temporarily forces birds out of shallow protected areas such as Izembek and Nelson lagoons. During the winter, Steller's eiders congregate in select near-shore waters throughout the Alaska Peninsula and the Aleutian Islands, around Nunivak Island, the Pribilof Islands, the Kodiak Archipelago, and in Kachemak Bay. Although overall abundance in specific wintering areas on the south side of the Alaska Peninsula may depend on ice conditions along the north side of the Alaska Peninsula, Steller's eiders show strong fidelity to specific wintering areas on the south side, with some birds occupying these areas during winter regardless of conditions on the north side. The Alaska wintering Steller's eiders concentrate in large flocks along the southwestern Alaska coast in spring (Larned 2002).

<u>Population Structure</u>
It seems reasonable to assume that based on the high probability for site fidelity by nesting females and the distance between breeding populations on the YKD and the ACP (805 km/500 miles), the Alaska breeding population of Steller's eiders may represent two predominantly genetically isolated sub-populations with limited maternal gene flow between sub-populations.

Recent work by Pearce et al. (2005) provides evidence that there is little genetic divergence among breeding populations of Steller's eiders using either traditional *F*-statistics or Bayesian clustering methods. These authors suggested there was some evidence for a greater level of dispersal by males compared to females. Evidence suggests that Russian-Atlantic, Russian-Pacific, and Alaskan breeding populations overlap during winter in both Norway and Alaska (Dau et al. 2000, Pearce et al. 2005, Petersen et al. 2006). Thus, as breeding populations share wintering areas, where pair formation is believed to occur, males may pair with females that have fidelity to a certain nesting area. Thus, some males may be in different breeding areas from year to year.

<u>Food Habits and Bioenergetics</u>
Steller's eiders are shallow-diving sea ducks that mostly feed in shallow water near shore, but they sometimes gather in small flocks over deeper waters. Steller's eiders are mostly a near-shore species that employ a variety of foraging strategies that include diving to a maximum depth of about 9m (30ft) and gleaning from the surface of water, plants, and mud (USFWS 2002b). Steller's eiders food in freshwater nesting areas is believed to be mostly the relatively large, benthic larvae of the C*hironomid* midge common in arctic tundra ponds. During the fall and winter, Steller's eiders opportunistically forage on a variety of invertebrates that are found in near-shore marine waters. Mussels comprise much of their diet in some molting lagoons.

Steller's eiders winter at northern latitudes. They use coastal habitats that are subject to extreme weather (cold, winds, wave action) and short day length. As they cannot forage during periods of darkness, they must optimize foraging opportunities by concentrating on high-energy foods. As daily energy demands may approach energy intake, Steller's eiders are believed to spend the winter near the limits of their energetic threshold (Goudie and Ankney 1986), with little ability to accumulate stored energy reserves. A lack of stored energy reserves necessitates that eiders continue to feed upon reaching their nesting areas and initiating egg-laying. Female Steller's eiders continue to feed during incubation.

Steller's eiders are vulnerable to perturbations within their winter or molting habitats. If they are disturbed from a preferred wintering area, the area the eiders are displaced to may be of lesser quality due to decreased protection from wind, cold, wave action or provide less opportunity for obtaining high-energy prey. Similarly, as feather replacement is an energetically demanding period, eiders must focus on obtaining high-energy foods in an area where they are flightless and vulnerable to predation. If disturbed at or displaced from primary molting areas, eiders may experience decreased survivorship. No Steller's eiders molting or wintering areas are found in the action area.

Predators

Predators of Steller's eiders include snowy owls, short-eared owls, peregrine falcons, gyrfalcons, pomarine and long-tailed jaegers, rough-legged hawks, common ravens, glaucous gulls, arctic fox, and red fox. Owls, falcons, and hawks kill mostly ducklings and adult eiders, while gulls, ravens and jeagers prey on eggs and ducklings. Foxes will eat any eggs, ducklings, or nesting females they can acquire.

Man must also be considered a Steller's eider predator. Sport and subsistence hunting of Steller's eiders is prohibited in the United States, but small numbers of Steller's eiders continue to be killed with firearms (USFWS 2002c).

Population Status

Population Variability

Variability in the abundance of the Alaskan breeding population of Steller's eiders is not well understood. The sampling errors around population estimates are large enough to obscure large annual population fluctuations, but ground surveys in the Barrow area suggest that the local breeding populations there fluctuate substantially, with no Steller's eiders nesting during some years (Quakenbush et al. 1995, Quakenbush 1999).

Population Stability

The population of Steller's eiders molting and wintering along the Alaska Peninsula appears to be declining (USFWS 1999, 2002a). Long-lived species like Steller's eiders typically do not have highly variable populations and mortality factors may be undermining their ability to maintain a stable population. The 2005 Steller's eider spring migration survey estimate of 79,022 was 6% below the long-term average (84,458) (Larned 2005). For the same year, larger declines in Steller's eider estimates were documented during the spring (22.3%; n = 41,095) and fall (50%; n = 36,373) emperor goose (*Chen canagica*) aerial surveys, respectively (Dau and Mallek 2005, Mallek and Dau 2005).

The causes of decline could be varied and are largely unknown, but if the cause of the decline is within the marine environment, it is reasonable to conclude that the Alaska and Russia nesting populations are being affected similarly because a large portion of the Russian population winters with the Alaskan population.

Endangered Species Act Status of the Steller's Eider

The Steller's eider was petitioned in December 1990 to be listed as endangered under the Endangered Species Act. Listing range-wide did not appear to be warranted given the relatively large number (~138,000) of Steller's eiders observed on the wintering area(s) in southwest Alaska. However, the Alaskan breeding population was listed as threatened on 11 June 1997 based on an apparent contraction of the species' breeding range in Alaska and due to a perceived increase in its vulnerability to extirpation (USFWS 1997).

Reasons for Listing

The Alaska nesting population of Steller's eiders was listed because of (1) its recognition as a distinct vertebrate population segment, (2) a substantial decrease in the species' nesting range in Alaska, (3) a reduction in the number of Steller's eiders nesting in Alaska, and (4) the vulnerability of the remaining breeding population to extirpation. Specific reasons the FWS listed the Alaskan nesting population are:

Habitat Loss. The direct and indirect effects of future oil and gas development within the National Petroleum Reserve-Alaska, and future village expansion (e.g., at Barrow), were cited as potential threats to the Steller's eider. Within the marine distribution of Steller's eiders, perceived threats include marine transport, commercial fishing, and environmental pollutants.

Hunting. Although not cited as a cause in the decline of Steller's eiders, the take of this species by subsistence hunters was cited as a threat to the population of Steller's eiders near Barrow in the final rule. Steller's eiders from the Alaska population are known to use marine waters off the Russian coast suggesting that Steller's eiders from the Alaska population could possibly be shot in Russia. Hunters from four Russian villages are reported to have shot from 3,000 to 4,500 Steller's eiders annually in the 1990's (Syroechkovski and Zockler 1997).

Predation. Increased predation by arctic foxes (*Alopex lagopus*) resulting from the concurrent crash of goose populations is cited as a possible contributing factor to the decline of the Steller's eider on the Yukon-Kuskokwim Delta (YKD). The potential for increased predation near villages resulting from the villages' associated gull and raven populations was also cited as a potential threat to this species.

Lead Poisoning. The presence of lead shot in the nesting environment on the YKD was cited as a continuing potential threat to the Steller's eider. Regulations requiring the use of non-toxic shot for hunting waterfowl, cranes, and snipe in Alaska were implemented during the 1991-1992 migratory bird-hunting season (USFWS 1991). Local problems with lead in the Arctic still exist, particularly in areas where lead shot was or still is widely used for hunting. Lead pellets will continue to be eaten by birds as long as they remain in the environment. Effects of lead poisoning are apparent in some birds, such as the Steller's eider in Alaska (AMAP 2002).

Ecosystem Change. The Service cites direct and indirect changes in the marine ecosystem caused by increasing populations of Pacific walrus, gray whale, and sea otter, as potential causes of the decline of Steller's eiders (USFWS 1997). Subsequent declines in sea otter populations (USFWS 2000a) and continuing declines in Steller's eider populations suggest that otters were not responsible for a decline in eider numbers. In addition, changes in the commercial fishing industry were also cited as perhaps causing a change in the marine ecosystem with possible effects upon eiders. However, the FWS (2002c) is unaware of any link between changes in the marine environment and contraction of the eider's breeding range in Alaska.

Overall, one or more of these factors/threats could reduce survivorship and/or recruitment and, over time, be the underlying cause of Steller's eider decline.

Range-wide Population Trend

Populations of Steller's eiders molting and wintering along the Alaska Peninsula have declined since the 1960s (Kertell 1991) and appear to be in continued decline (Flint et al. 2000, Larned 2004). The imprecision of breeding ground estimates precludes detection of any but the most obvious population trends. However, if a marine-based threat is causing a decline in the world population of Steller's eiders, then it seems reasonable to conclude that the Alaska breeding population may also be affected by such a threat.

Critical Habitat

Critical habitat was designated for the Steller's eider on 10 January 2001 (USFWS 2001a). Designated critical habitat includes the Yukon-Kuskokwim Delta nesting areas and the Kuskokwim Shoals fall molting and spring staging area. Other critical habitat includes molting and staging lagoons along the north coast of the Alaska Peninsula including the Seal Islands, Nelson Lagoon and Port Moller, and Izembek Lagoon. The nesting area around Barrow and specific wintering areas south of the Alaska Peninsula and in the Aleutian Islands are not designated as critical habitat.

Steller's Eiders in the Proposed Action Area

Steller's eiders are currently found in relatively low numbers within the proposed action areas. Although the historical range is believed to have once extended east past the Canadian border (Quakenbush et al. 2002), the current Arctic Coastal Plain nesting population is apparently centered near Barrow (Larned et al. 2001a, b, 2003).

Traditional Knowledge

Migratory field notes were collected at Kivalina, Alaska, during November 1997 (Georgette 2000). Kivalina is about 60 miles southeast of Point Hope, the southernmost point of the survey area. A comment on the occurrence of Steller's eiders at Point Hope was also made at Kivalina (Georgette 2000). Traditional knowledge is that there are not too many Steller's eiders around Point Hope. According to traditional knowledge, Steller's eiders come around Point Hope in June and July (including males) and again in the fall (females and juveniles). Steller's eiders rounding Point Hope on their way to Alaska nesting areas near Barrow likely number in the hundreds or low thousands, and are composed of the current Alaskan breeding population in addition to unknown numbers of non-breeding birds that may occupy lagoons and near-shore waters of the northeastern Chukchi and Beaufort seas.

Previous Studies

Williamson et al. (1966) listed Steller's eiders as occurring in the Cape Thompson area 25 miles southeast Point Hope during surveys for Project Chariot at Ogotoruk Creek. Steller's eiders were listed as occupying marine littoral, lacustrine, and beach environments in order of affinity. In this study, marine littoral waters extended seaward 2 miles from shore. Steller's eiders were listed as present from June 1 through October 4 and uncommon, but possibly breeding in the area. It is not known if Steller's eiders still nest in this area.

Johnson et al. (1992) reported on the use of Kasegaluk Lagoon by marine birds. Kasegaluk Lagoon is in the eastern Chukchi Sea and adjacent to the proposed lease sale area. Three sightings of 30 Steller's eiders were mentioned in the report. The mean density of Steller's eiders occupying the Kasegaluk Lagoon survey area in 1991 was 0.04 (SD $\pm$ 0.17) Steller's eiders per km^2.

Perhaps the most important study relative to the proposed seismic surveys is the recent telemetry tagging of Steller's eiders (P. Martin in prep.). During this study, ten transponder tags were implanted in breeding Steller's eiders near Barrow and their movements tracked by satellite. Steller's eiders began leaving the Arctic Coastal Plain nesting areas on 23 June. After leaving the ACP, there was considerable use of coastal marine waters from Wainwright to Dease Inlet, and some use of coastal waters in the vicinity of Cape Beaufort (between Cape Lisburne and Point Lay). At least eight individual Steller's eiders were tracked from Point Barrow across the Chukchi Sea to Siberia and back to Alaska.

Quakenbush et al. (2002) summarized the historical and present breeding season distribution of Steller's eider in Alaska to define the historical and recent breeding range on the Arctic Coastal Plain, and determined the center of recent breeding abundance to be in the region of Barrow.

Aerial surveys were conducted in near-shore waters along barrier islands of the ACP from the southern end of Kasegaluk Lagoon to the Canadian border and summarized sighting of Steller's eiders from 1999 through 2004 (Dau and Larned 2004). Steller's eiders are apparently rare along these coastal waters in June because only three Steller's eiders are reported over the five years summarized (Dau and Larned 2004).

The breeding biology of Steller's eiders near Barrow is well documented. Quakenbush (2004) studied the breeding biology of Steller's eiders during a ten-year study near Barrow that confirmed low survival and the effects of predation on broods.

Biological Status of Spectacled Eider (*Somateria fischeri*)

Worldwide setting
The world population of spectacled eiders, based on winter surveys, is about 375,000 birds (USFWS 2001b). The worldwide population consists of three breeding populations: Yukon-Kuskokwim Delta (YKD), North Slope, and Arctic Russia (USFWS 1996, Petersen et al. 2000).

Breeding Populations
Arctic Russian Breeding Population
The spectacled eider nests along the coast of Arctic Russia, west to about the Lena River. Dau and Kistchinski (1977) estimated the Indigirka River Delta (IRD) supported 17,000-18,000 pairs and the remainder of the Siberian coastal habitat supported an estimated at 30,000-40,000 pairs for a total Arctic Russia population estimate of 94,000-116,000. Population estimates in Arctic Russia based on aerial surveys completed over a 3-year period was >140,000 and should be considered a minimum estimate (Hodges and Eldridge 2001, Petersen et al. 2000). The Chaun, Kolyma, Yana and Indigirka deltas in Siberia are considered to be high-density breeding grounds. Even though Arctic Russia supports the largest known breeding population of spectacled eiders, relatively little research has been conducted there (but see Kistchinski and Flint 1974, Kondratyev and Zadorina 1992, Pearce et al. 1998a, 1998b).

Yukon-Kuskokwim Delta Breeding Population
Spectacled eiders breed discontinuously along the coast of Alaska from the Nushagak Peninsula on Bristol Bay north to Barrow and east nearly to the Yukon border (USFWS 1999). From 1990 to 1992, the FWS estimated that 2,000 to 3,000 pairs nested on the YKD. The YKD is considered a high-density breeding ground. In their review of published and unpublished sources through 1975, Dau and Kistchinski (1977) estimated that the YKD supported as many as 50,000 spectacled eider pairs in an average year, but up to 70,000 pairs in a year of high productivity. Using extrapolations of nest densities in various broadly defined habitat types, Dau and Kistchinski (1977) estimated 47,740 nests on the YKD.

Using long-term monitoring of nesting plots at Onumtuk and Old Chevak on the YKD, Ely et al. (1994) documented an 8% annual decline in spectacled eider nesting population. These authors documented clutch size (4.66 ± 0.07 eggs/clutch) and apparent nest success (55.1 ± 7.2%) that are within the range of values reported elsewhere. These authors suggested that local breeding population of spectacled eiders exhibiting low productivity due to depredation primarily by Arctic foxes could be extirpated at specific breeding areas.

Initiated in 1985, the YKD aerial survey provides an index to the breeding population for spectacled eiders. The 18-year mean (1985-2005) for spectacled eiders is 2,552 (SD ± 928) and the population appears to be stable or increasing (+6.5%/yr) with the 2005 index of 4,170 birds (Platte and Stehn 2005) which is somewhat lower than the estimate (4,541 uncorrected for nest detection rate; 5,822 corrected) using ground plot samples of nests (Fischer et al., 2005). Over the last 7 years adjusted for survey timing, the growth rate is lower (+1.6%/yr), but still indicative of a stable or increasing population (Platte and Stehn, 2005).

Arctic Coastal Plain Breeding Population

Spectacled eiders on the North Slope breed across the Alaskan Arctic Coastal Plain, east to about the Canadian border. As many as a few thousand pairs might nest on the North Slope. Aerial surveys of spectacled eiders conducted in summer June 2005 on the Arctic Coastal Plain resulted in a population index of 7,820, which was above the 2004 index of 5,985 and the long-term average of 6,916 (Larned et al. 2005). The 13-year trend has remained level, but the mean annual population growth rate for the last 7 years was not significantly different than 1.0 (a stable population = 1.00) (Larned et al. 2005). For 2005, one can extrapolate crude estimates of relative contributions (%) for each of the breeding populations. Using North Slope (n = 7,820) aerial survey estimates (Larned et al. 2005) and corrected YKD nest estimates from ground plots (n = 5,822) (Platte and Stehn 2005) and dividing by the Arctic Russian population estimate of 146,000 (USFWS 1999), roughly 5.1% and 3.8% of the world spectacled eiders nested on the North Slope and YKD, respectively ($\leq$2% if one considers estimates in Petersen et al. 1999).

This biological evaluation focuses on those spectacled eiders breeding on the Alaskan Arctic Coastal Plain and molting along the Chukchi Sea coast.

Species Description

The spectacled eider is a large-bodied sea duck at 20 to 22 inches long. The adult male spectacled eider has a green head with a long, sloping forehead and large, distinctive white-eye patches, a black chest and a white back during the breeding season, but is mottled brown during the late summer and fall molt. Juvenile males and adult females are brown with less distinct spectacled eye patches.

Life History Strategy

Longevity

Few data are available on the overall longevity of spectacled eiders, but if similar to other eiders, they would likely be long-lived.

Age to Maturity

Typical age at first breeding of wild spectacled eiders has not been determined but probably occurs most often in the third year for females and the third or fourth year for males, coinciding with the acquisition of definitive plumage (USFWS 1999). Wild and captive spectacled eiders have been documented to breed as early as two years of age.

Reproductive Strategy

In general, population demography for this species and in particular breeding information (i.e., timing of pair formation and duration of pair bonds, timing of mating, male and female dispersal rates, sex-specific estimates for natal, breeding, and molt-site fidelity, breeding propensity, non-breeding component, duckling/brood and first-year survival, etc.) is poorly understood due to a lack of long-term marking/monitoring programs and/or low resighting/recapture/recovery rates.

Most spectacled eiders are believed to form pair bonds before reaching the nesting grounds (USFWS 1999). Spectacled eiders start arriving on the North Slope breeding grounds in late May with most pairs arriving by mid-June (Johnson et al. 2000; Anderson et al. 2004).

Female spectacled eiders show strong fidelity to nesting areas and often return to within 0.6km (1mi) of the same nesting site. They nest in sedge meadow tundra, on peninsulas in lakes and on islands in lakes up to 3-6km (5-10mi) inland from the coast. The nests of spectacled eiders are typically dispersed and are in nesting habitats also preferred by other waterfowl species. Nests are constructed by the female and consist of a shallow depression in the vegetation covered with grasses and down.

Spectacled eiders near Prudhoe Bay nest initiation varied from 7-16 June (1982-96) (TERA 1997). Spectacled eiders lay one egg per day and begin incubation with the last egg. North Slope spectacled eider clutch size estimates have ranged from 3.8-4.3 eggs/clutch (Warnock and Troy 1992, Anderson and Cooper 1994, Smith et al. 1994). Hatch occurs in mid-late July after about 24 days of incubation (Warnock and Troy 1992). North Slope nest success estimates generated from 143 nests in the Kuparuk oilfield over an 11-year period ranging from 12-64% (avg. = 40%) (Anderson et al. 2004). Mayfield nest success estimates (n = 91 nests) for spectacled eiders in the Prudhoe Bay oilfield ranged from 7% (1993) to 36% (1994) and averaged 22% overall (TERA 1997).

Dau and Kistchinski (1977) elucidated an important point in their discussion, that non-breeding adults represent a large component of the population and this cohort remains primarily in offshore waters during the breeding season. Beginning in 1985, closely spaced aerial survey transects were flown over much of the coastal YKD. Using these aerial survey data (and earlier aerial survey data) in conjunction with randomly located ground nest plots, Stehn et al. (1993) documented estimated annual declines of 7% (exponential rate = 0.93) and 14% (exponential rate = 0.86), respectively. Stehn et al. (1993) compared average clutch size data for 1986-1992 to 1965-1976 and found a significant increase in frequency distribution of clutch sizes over time (5.10 v. 4.68). They concluded that production of young did not appear to be low on the YKD.

Kistchinski and Flint (1974) concluded that only 10-15% of the females nesting on the Indigirka River Delta successfully incubated their clutches. They described variation in nest success as a function of distance from a ‘host’ gull pair even though there was some potential for depredation by the host gull pair the potential for success was probably greater within the host territory as gulls (and terns) actively defended their nest site from other gulls and more importantly Arctic foxes and jaegers.

The nesting success of spectacled eiders is variable, but varies from 20% to 95% depending on the year and location (Bowman et al. 2002).

Nest success and number of ducklings leaving the nest (considered to be good measures of productivity) were within the range of values reported elsewhere suggesting that productivity for nesting spectacled eider on the YKD was relatively high (Grand and Flint (1997). These authors attributed the large variation (18-76%) in annual estimates of nest success to changes in Mew gull (*Larus canus*) populations, an important avian predator.

Quakenbush et al. (2004) reported that eiders may nest near snowy owl and jeager nests for protection from fox predation.

Average brood size (unknown ages) documented in the Alpine oilfield was 3.3 ducklings/brood (*n* = 33 broods; 1993-2003) with all but one brood observed on the Colville Delta North study area (Burgess et al. 2000, Johnson et al. 2004, 2000). Estimates of duckling survival have not been done for North Slope spectacled eiders, but are probably within the range of estimates (34%; 95% CI 25-47%) obtained for spectacled eider ducklings on the YKD (Flint and Grand 1997). Females with broods may disperse up to 14km, but most use freshwater lakes within 5km of nest sites, eventually moving to coastal areas in late August or September (Harwood and Moran 1993, Moran and Harwood 1994). Fledging occurs approximately 50 days after hatching. Males take no part in incubation or brood rearing.

Pearce et al. (1998b) proposed that smaller clutch sizes documented for spectacled eiders nesting in Arctic Russia as compared to the YKD, may be due to latitudinal differences (shorter window of opportunity) in spring break-up (and higher energetic demands associated with longer migration) and its potential effects on female nutrient reserves through reduced foraging opportunities for females or increased energy requirements during clutch formation and incubation.

Survival and Recruitment

Annual adult female survival can average 93% and duckling survival can average 34% (Flint and Grand 1997). Recruitment rate of spectacled eiders is unknown (USFWS 1999).

Using radio-marked females in the Kashunuk River study area (1993-1995), Flint and Grand (1997) determined that pooled (across years) daily survival rate of marked females and ducklings (<30 days of age) was 92% and 34%, respectively. Most duckling mortality occurred within the first 10 days after hatch and nearly 50% of radio-marked females lost their entire brood by 30 days post-hatch. Duckling survival estimates from this study were similar to or greater than those reported elsewhere, however, adult female survival estimates were lower. Flint and Grand (1997) concluded that poor duckling survival did not appear to be the cause of the general population decline, but that low adult female survival may be an important factor contributing to the decline of the spectacled eider.

Seasonal Distribution Patterns

Spring Migration

Migration routes in the spring are not well known, but breeding adults are believed to fly directly between the wintering area south of Saint Lawrence Island and the nesting grounds on the YKD, Arctic slope, or Russia (USFWS 1999, 2002b).

Breeding Distribution

Spectacled eiders were known to nest on St. Lawrence Island, Alaska. Spectacled eiders nesting on the North Slope are distributed along a west-east density gradient (highest densities in west) from roughly the Utukok River south of Icy Cape in the west to the Canning River in the east. In particular, the area extending from Dease Inlet south for ~70km and west to Wainwright and north to Barrow encompasses a significant portion of the highest breeding densities of spectacled eiders (Larned et al. 2005). Smaller high density 'hotspots' include that area south of Smith Bay extending for roughly 30km, an area extending from the northeast end of Teshekpuk Lake to the Beaufort Sea coast at Cape Halkett (Dau and Kistchinski 1977), the area from roughly the major inland fork in the Kaparuk River north to the Beaufort Sea coast and west to the Colville River

Delta, and in the Sagavanirktok and Canning River Deltas. Greater than 40% of ACP spectacled eider nests west of Barrow and another 40% nests between Harrison Bay and Barrow (Troy 2003). Since 1993, mean number of spectacled eiders was 6,916 (SD $\pm$ 1251) with the 3rd highest estimate (7,802) occurring in 2005 (Larned et al. 2005). Spectacled eider population estimates generated from this aerial survey indicate a stable to slightly declining trend over the 13-year survey period with a slight increasing trend (~2.5%/yr.) over the most recent 7 years (Larned et al. 2005).

The summer range of non-breeding eiders is not known, but these birds are believed to congregate in small flocks in coastal waters throughout their range (USFWS 2002b).

Post-breeding Distribution, Fall Migration, and Molting

Breeding males leave the nesting grounds for the marine environment by mid- to late June (Troy 2003). Failed females departed the breeding area from mid July-early August with most initiating molt migration in mid-late July (Petersen et al. 1999, Troy 2003). Successful females and their broods departed breeding areas between 26 August and 4 September (Petersen et al. 1999).

Spectacled eiders congregate to molt in large flocks along coastal areas during late summer. Three principal molting areas are known: Ledyard Bay in the northeastern Chukchi Sea, Norton Sound in the Northeastern Bering Sea, Mechigmenskiy Bay in Russia. North Slope males used each of three molting (staging) areas: Ledyard Bay, Alaska and Mechigmenskiy Bay and Indigirka/Kolyma Deltas, Russia (Petersen et al. 1999). Petersen et al. (1999) reported that males from the YKD used each of three molting (staging) areas: Mechigmenskiy Bay and Indigirka/Kolyma Deltas, Russia, and Ledyard Bay, Alaska. Petersen et al. (1999) also reported males from the Russian breeding population used three molting (staging) areas (in order); Indigirka/Kolyma Deltas and Mechigmenskiy Bay, Russia, and Ledyard Bay, Alaska. Although a few females marked on the North Slope molted at Mechigmenskiy Bay, Russia, and off of St. Lawrence Island (Petersen et al. 1999), most of the Arctic Coastal Plain breeding population of spectacled eiders likely molts on the 14,000 km^2 (5,400 mi^2) Ledyard Bay critical habitat area. Up to 33,200 spectacled eiders are known to molt in Ledyard Bay (USFWS 2000b).

Winter Distribution

The only known spectacled eider wintering area is in offshore waters from 50 to 61 meters (165 to 200 feet) deep about 105 km (65 miles) south of Saint Lawrence Island (USFWS 2002b). Thousands of spectacled eiders congregate in open areas in pack ice. The open areas are kept ice-free by the sheer numbers of eiders present.

<u>Population Structure</u>

It seems reasonable to assume that based on the high probability for site fidelity by nesting females and the distance between breeding populations on the YKD and the Arctic Coastal Plain (802 km/500 mi), the Alaska breeding population of spectacled eiders may contain unique geographic sub-populations. However, distinct mitochondrial DNA markers imply there is limited maternal gene flow between these two areas (Scribner et al. 2000).

Recent work by Scribner et al. (2001) indicates there is some evidence for genetic differentiation among the three breeding populations with a higher rate of gene flow documented between the

North Slope and Russian groups than between the YKD and the other two areas. These authors suggest that females are philopatric to breeding areas (other research also indicates some level of natal and breeding site fidelity) and that female-biased gene flow was not sufficient to homogenize haplotype frequencies at regional or local scales. Though pairing is thought to occur on the wintering area (St. Lawrence Island) where breeding populations are mixed, Scribner et al. (2001) estimated that approximately 84% of the breeding adults were expected to pair with individuals from the same natal population even assuming random pairing.

Food Habits and Bioenergetics

The diet of spectacled eiders has been studied only within their breeding grounds and the associated near-shore marine environment. In the littoral marine environment, Dau and Kistchinski (1977) suggest that they feed primarily on benthic mollusks and crustaceans in shallow waters less than about 30.5 meters (100 feet) deep. Kessel (1989) hypothesized that they also may forage on pelagic amphipods that are concentrated along the sea water-pack ice interface. On their coastal breeding grounds, spectacled eiders feed on aquatic crustaceans, aquatic insects, and plant materials.

Spectacled eiders gather in large flocks to molt. One of these molting areas is Ledyard Bay in the northeastern Chukchi Sea (Figure 2). Food habits of spectacled eiders in the Ledyard Bay molting area remain unknown. Benthic biomass is not especially high at <10 gCm^{-2} in Ledyard Bay (Grebmeier and Dunton 2000), consequently pelagic amphipods may be important to their diet during the molt in Ledyard Bay.

The world population of spectacled eiders winters in large flocks in open water in the pack ice south of Saint Lawrence Island (USFWS 2002b). Shifts in the abundance or distribution of prey species (e.g., benthic bivalves) on this wintering area may have long-reaching effects on the world population of spectacled eiders. Although the food habits of wintering spectacled eiders are undocumented it appears they forage for benthic bivalves under the shifting pack ice of the Bering Sea (Lovvorn et al. 2000; Richman and Lovvorn 2003). This energetically expensive method of foraging requires high food densities and intake rates necessary to build up fat reserves vital for spring migration and breeding. High densities of clams are present in the over-wintering area. Sampling over several decades suggests that the benthic community in the over-wintering area has shifted from larger to smaller species of clams (Lovvorn et al. 2000, Richman and Lovvorn 2003).

Spectacled eiders apparently do not exist so close to their energetic threshold as do Steller’s eiders because they arrive on the nesting grounds fit enough to fast through egg laying and incubation (USFWS 1993), but changes in the spectacled eider prey base in the over-wintering area could be affecting the over-winter survival and ability of spectacled eiders to maintain the body condition necessary for spring migration and breeding.

Spectacled eiders winter in the Bering Sea (Petersen et al. 1999). Bump and Lovvorn (2004) evaluated the potential for changing lead structure to alter flight costs for wintering spectacled eiders. Increased flight costs beyond a certain threshold could be a source of population change in spectacled eiders. Bump and Lovvorn concluded that there were leads available to eiders under most conditions in the Bering Sea and that long-term trends in the extent and timing of Bering Sea pack ice may have altered food webs involving the spectacled eider.

Changes in benthic habitats of the wintering area have also been suggested as one cause of population changes in spectacled eiders. Petersen and Douglas (2004) developed annual indices based on historic remotely-sensed ice conditions and weather patterns and literature-based descriptions of benthic communities. In general, Petersen and Douglas (2004) found that annual population estimates on the breeding grounds can be negatively impacted by extended periods of dense sea ice and weather during the previous winter, but the examination of population indices did not support the hypothesis that changes in the benthic community on the wintering grounds has contributed to the decline or inhibited the recovery of spectacled eiders breeding in western Alaska.

Predators

Predation is believed to be a principal cause for nesting failure in many waterfowl species including spectacled eiders. Predators of spectacled eiders include snowy owls, peregrine falcons, gyrfalcon, pomarine and long-tailed jaegers, rough-legged hawks, common raven, glaucous gulls, Arctic fox, and red fox. Owls, falcons, and hawks kill mostly ducklings and adult eiders, while gulls, ravens, and jeagers prey on eggs and ducklings. Foxes eat eggs, ducklings, and will kill nesting females if given the opportunity. Excessive predation of nesting hens by foxes and other predators can result in imbalanced sex ratios within populations.

Substantive depredations of waterfowl eggs and young in the Arctic region can occur, especially where predator populations have increased because of access to human developments and increased access to food/garbage and nesting or denning sites. The greatest impact on waterfowl populations often occurs when Arctic fox densities are high and densities of nesting waterfowl are low. Man must also still be considered a predator of Steller’s eiders.

Population Status

Population Variability

Variability in the abundance of the Alaska breeding population of spectacled eiders is not well understood (USFWS 1999). The sampling errors around population estimates are large enough to obscure large annual population fluctuations, but ground surveys in the Barrow area suggest that the local breeding populations there fluctuate with fewer spectacled eiders nesting during some years. Breeding populations on the Yukon-Kuskokwim Delta may currently have stabilized at around 2,000 to 3,000 pairs nesting annually.

Population Stability

The world population of spectacled eiders has declined substantially during the past 30 years, and may be continuing to decline (USFWS 1999, 2002b). Long-lived species like spectacled eiders typically do not have highly variable populations and unknown mortality factors may be undermining their ability to maintain a stable population. The causes of decline could be varied and are largely unknown, but if the cause of the decline is within the marine environment, it is reasonable to conclude that the Alaska nesting population and the Russia nesting population are being affected similarly because the Russian population and the Alaska population winter together in the Bering Sea.

Endangered Species Act Status of the Spectacled Eider

The spectacled eider was listed throughout its range as a threatened species on 10 May 1993 (USFWS 1993). The primary reason for listing was the rather dramatic decline (from ~50,000 pairs in 1971 to an estimated 1,721 pairs in 1992) documented for the YKD breeding population as well as the apparent decline in the NS breeding population (Stehn et al. 1993, Ely et al. 1994). At the time of listing, the YKD breeding population was considered to represent roughly half of the world population (Stehn et al. 1993, USFWS 1999, 1996). An estimated 363,000 (95% CI 333,526 – 392,532) spectacled eiders were later discovered south of St. Lawrence Island, Alaska, during late winter (March; 1996 and 1997) aerial surveys in the Bering Sea (Larned and Tiplady 1997, Petersen et al. 1999) which apparently represents the entire world population. For 2005, one can extrapolate crude estimates of relative contributions (%) for each of the breeding populations. Using North Slope (n = 7,820) aerial survey estimates (Larned et al. 2005) and corrected YKD nest estimates from ground plots (n = 5,822) (in Platte and Stehn 2005) and dividing by the Arctic Russian population estimate (146,000; USFWS 1999), roughly 5.1% and 3.8% of the world spectacled eiders nested on the North Slope and YKD, respectively ($\leq$2% if one considers Petersen et al. 1999 estimates).

Reasons for Listing

The Alaskan and Russian populations of spectacled eider were listed as a threatened species on 9 June 1993 (USFWS 1993). Although the factors that caused these declines are unknown, a number of potential contributory factors have been identified. These, or other still-unidentified threats, have increased mortality above the rate of reproductive replacements. No data are available to show whether similar trends have affected the breeding population in Russia where as many as 40,000 pairs traditionally nested. Contributing factors for listing identified by the FWS (1993) are:

Habitat Loss

The physical loss of habitat is not known to be a factor in the decline of the spectacled eider, but habitat continues to be degraded by lead pellets deposited from subsistence hunting on the YKD and the Arctic Coastal Plain nesting grounds (see Hunting and Lead Poisoning sections below). Spectacled eider habitats or important habitat components (e.g., prey base, ice distribution, etc.) may be physically modified by climate change.

Hunting

Alaskan and Siberian Natives have traditionally harvested eiders and eggs during migration and nesting. The subsistence harvest, both in Alaska and in northern Russia remains poorly quantified and its effects throughout the species range remains unclear (Stehn et al. 1993, USFWS 1996). The estimated, annual subsistence harvest on the YKD from 1985 to 1992 averaged about 5% local nesting population. Low numbers of spectacled eiders are also harvested on the Alaskan Arctic Coastal Plain, however, harvest estimates as high as 10% have been cited for both YKD and Arctic Russian spectacled eider breeding population (USFWS 1996). This harvest did not include unretrieved kill or crippling losses, which can exceed retrieved kill). Several thousand are believed killed annually in Russia (Shevchenko and Klokov 2001).

Predation

Mammalian and avian predators, particularly Arctic fox, glaucous gulls, and parasitic jaegers all eat eider eggs, young, and occasionally adults.

Eiders historically nested in association with geese possibly as a strategy to reduce predation losses, but when the numbers of geese declined sharply during the past few decades in Alaska, fox predation on eider eggs may have increased. Numbers of gulls and ravens may also have increased in Alaska, resulting in increased predation on eider eggs and hatchlings. Spectacled eiders' nest and brood survival are sometimes high near gull colonies on the YKD, but increasing populations of gulls, ravens, and foxes due to increased access to food/garbage and creation of nesting/denning sites near human developments may put increasing pressure on spectacled eiders.

Lead Poisoning

Regulations requiring the use of non-toxic shot for hunting waterfowl, cranes, and snipe in Alaska were implemented during the 1991-1992 migratory bird-hunting season (USFWS 1991). Lead shot is still used by some coastal residents of Alaska and Russia for hunting waterfowl and residual lead shot remains on the tundra or in shallow ponds for years, posing a prolonged risk to eiders. Deposition of lead shot in foraging habitats used by spectacled eiders remains a serious threat to the recovery of this species (USFWS 1999, 1996).

Confirmed mortalities of spectacled eiders were documented on the YKD (1992-1994) (Franson et al. 1995). Thirteen of 112 (~12%) spectacled eiders X-rayed had shot in their gizzards (Flint et al. 1997). Based on blood-lead levels, ~7% and 13% of spectacled eiders captured prior to nesting has been exposed to lead and lead exposure of females increased with date (from nesting through brood-rearing) (Flint et al. 1997). Approximately 21% of the 43 spectacled eider broods monitored using blood-lead levels included <1 duckling exposed to lead by 30 days post-hatch or roughly 12% of all ducklings sampled. Though the level of lead exposure appeared to be at sublethal levels, exposure seemed to be greatest for successfully breeding females, or the most productive segment of the population (Flint et al. 1997).

Flint and Grand (1997) estimated that 40-60% of observed female mortality of radio-marked individuals resulted from exposure to lead, which has probably increased from historic levels. Follow-up work by Grand et al. (1998) indicated that adult female survival estimates for unexposed versus exposed (before hatch) spectacled eiders were 78% and 44%, respectively. Exposure to lead can lower the annual female survival rate by 34%. They suggested that the majority of mortality likely occurred after brood-rearing away from the breeding grounds and that lead exposure may be limiting the recovery potential of spectacled eiders on the YKD. Exposure to lead shot may similarly affect spectacled eiders in some areas of the Arctic Coastal Plain.

Ecosystem Change

At least 13,400 km^2 (5,172 mi^2) of Alaskan Arctic Coastal Plain may be spectacled eider nesting habitat, of which less than 3,240 km^2 (1,250 mi^2) have been developed as oil production fields. No more than 168 km^2 (65 mi^2, 1 %) of the tundra wetlands within the oil fields have been altered by development. Spectacled eiders nest in low numbers in active oil fields and breeding pair densities in Prudhoe Bay are comparable to those in undeveloped regions of the Arctic Coastal Plain.

Marine spectacled eider habitat in the United States may include some or all of the Northern Bering Sea, the Chukchi Sea, and the western Beaufort Sea. Changes in the Arctic ecosystem that may be affecting spectacled eiders are evident (AMAP 2002). For example, research indicates that the size of clams available to the worlds' population of wintering spectacled eiders has shifted to a smaller species, possibly affecting population energetics necessary for subsequent breeding and nesting (Lovvorn et al. 2003).

Range-wide Population Trend

The FWS estimated that the YKD nesting population of spectacled declined approximately 96% since the 1970's (USFWS 1993). The FWS believes that the geographically separate breeding segment in Prudhoe Bay, Alaska, may have declined at a similar annual rate.

The world population of spectacled eiders has declined substantially during the past 30 years and may be continuing to decline (USFWS 2002b, 1999). In 2001 the breeding index of 7,370 spectacled eiders on the Arctic Coastal Plain was slightly above the long-term average of 7,072 spectacled eiders, and there was still a non-significant downward trend in annual growth rate (0.982) of the population (Larned et al. 2001b). The 2002 breeding survey index of 6,662 spectacled eiders was closer to the long-term average of 6,896 spectacled eiders, and the population growth rate was not significantly different from 1.0 (Larned et al. 2003).

Critical Habitat

Critical habitat was designated for the spectacled eider on February 6, 2001 (USFWS 2001b) (Figure 2). Designated critical habitat includes the YKD nesting area, the Ledyard Bay and eastern Norton Sound fall molting areas, and the Saint Matthew/Saint Lawrence Island wintering area. Nesting areas on the Arctic Coastal Plain were not designated as critical habitat.

Spectacled Eiders in the Proposed Action Area

Spectacled eiders are currently found in relatively moderate numbers within the lease sale area (Larned et al. 2001a; 2001b). The historical range of the spectacled eider extends east past the Canadian border, but the Arctic Coastal Plain nesting population appears to be currently centered in the National Petroleum Reserve-Alaska, south and west of Barrow (Larned et al. 2001a, TERA 2002, Larned et al. 2001b). Some of the more definitive records of presence within the lease area are summarized below.

Traditional Knowledge

There is a general consensus among Iñupiaq Natives in the Barrow area that there are far fewer eiders in the Barrow area, especially spectacled and Steller's eiders, than there were a few generations ago. Older hunters on the Chukchi Sea and Beaufort Sea coasts can recall thousands of eiders nesting and gathering along the shoreline (BLM 1982). The cause of the noted decline is not apparent, but speculation ranges from starvation to pollution to there being too many seagulls today. Observations made at Kivalina, Alaska, in November 1997 suggested that few spectacled eiders are around Point Hope (Georgette 2000). According to local traditional ecological knowledge, spectacled eiders that molt in Ledyard Bay do not use near-shore habitat within about 2 km from shore (USFWS 2001b).

Previous Studies
Williamson et al. (1966) listed spectacled eiders as occurring in the Cape Thompson area, 30 miles southeast of Point Hope. Spectacled eiders were listed as occupying pelagic, marine littoral, lacustrine, and beach environments. Primary affinity was for marine littoral waters, followed by pelagic waters, lacustrine waters, and beach environments in order of affinity. In this study, pelagic waters extended seaward from 2 miles offshore. Spectacled eiders were listed as present from 21 May through 26 September and uncommon but breeding in the Cape Thompson area.

Divoky (1987) surveyed the relative abundance and distribution of king, common, and spectacled eiders in the eastern Chukchi Sea from July 16 through October 17. Divoky found that eiders were mostly near shore early in the summer, but moved father offshore later in the summer. The center of relative abundance early in the summer was near Point Hope and from Icy Cape to Point Belcher, in mid-summer near Icy Cape, and in late summer farther offshore in the Ledyard Bay molting area.

The FWS has conducted systematic aerial surveys of water birds on the Arctic Coastal Plain of Alaska since 1992. One of the objectives of the surveys is to determine the breeding range and relative abundance of the threatened spectacled eider on the North Slope. Spectacled eider nesting distribution on the Arctic Coastal Plain from aerial survey data (Larned et al. 2001a) is included in a report on the distribution of spectacled eiders in the vicinity of Point Thompson, near Prudhoe Bay (TERA 2002).

The movements of 34 Alaskan and 30 Russian spectacled eiders were tracked by satellite from 1993 through 1996 (Petersen 1996, Petersen et al. 1999). Eiders were tracked to molting areas at two locations in Russia and several molting areas in western and northwestern Alaska, including a molting area in Ledyard Bay between Cape Lisburne and Icy Cape. The over-wintering area south of Saint Lawrence Island was also discovered during this study.

Biological Status of Kittlitz's Murrelet (*Brachyramphus brevirostris*)

Though the survey data vary in quality, population trend modeling efforts indicate substantial declines (varied by area, but ≥18%/yr.) for each of the 4 population 'centers' (i.e., Prince William Sound, Glacier Bay, Kenai Fjords, and Malaspina Forelands) (USFWS 2004).

Worldwide Setting
The Kittlitz's murrelet (*Brachyramphus brevirostris*) is found in discontinuous populations in both the east and west North Pacific Ocean and adjacent Arctic waters. In east Pacific and Arctic waters it ranges from about Taku Inlet in Southeast Alaska north to about Point Barrow in the Chukchi Sea. Major population centers are Prince William Sound and Glacier Bay.

Species Description
The Kittlitz's murrelet is a small alcid seabird about 25 cm long with no distinct sexual differences in size or coloration, but breeding and winter plumage is distinct. Juvenile plumage is similar to the basic plumage with exception of faint barring visible in the throat and breast areas. Basic coloration in adults is white on the underside with speckled gray and brown plumage topside. Upper wing plumage is dark gray or brown. Kittlitz's murrelet is easily confused with the similar appearing marbled murrelet (*Brachyramphus marmoratus*).

<u>Life History Strategy</u>
The Kittlitz's murrelet (*Brachyramphus brevirostris*) is one of the rarest and least understood seabirds in North America. There is limited life history information on the Kittlitz's murrelet (i.e., age at first breeding, nest success, hatching success, fledging success, first-year survival, survival to breeding age, proportion of breeding females, proportion of non-breeders, periodic non-breeding, etc.) and mechanisms of population regulation. The limited information available for this species and research on the closely-related marbled murrelet suggests a *K*-selected life-history strategy.

Longevity
The longevity of the Kittlitz's murrelet is unknown, but may be similar to the closely related marbled murrelet. Cooke (1999) reported that two adult marbled murrelets tagged in 1991 were at least 8 years old when recaptured in 1997. Based on predicted survivorship curves, marbled murrelets could live about 30 or 40 years (see Burger 2002).

Age to Maturity
Age to maturity in Kittlitz's murrelets is unknown, but if similar to that estimated for other alcids of similar size, it is between 2 and 5 years, with 3 years as a likely average (DeSanto and Nelson 1995, Beissinger and Nur 1997, Boulanger et al. 1999). Presumably, a large portion of the Kittlitz's murrelet population in Alaska is composed of reproductively immature (< 3yrs of age) birds.

Reproductive Strategy
Little is known about the reproductive strategy of Kittlitz's murrelet because nesting sites are difficult to find (Day et al. 1999). Only 25 nests have ever been found (Kuletz 2004). Birds appear to be paired upon arrival to the breeding grounds. Annual breeding effort is poorly understood, but is considered highly variable. Periodic non-nesting has been documented and

females may forego nesting the year following a successful nesting attempt. Egg-laying ranges from mid-May to mid-June depending on the population and range. One egg per clutch with one clutch per year is speculated. Both parents incubate and feed their young. Fledging in northern populations is generally during August.

Survival and Recruitment

Little is known about Kittlitz's murrelet recruitment and, as in some long-lived species, recruitment may be dependant on periodic nesting success after an extended period of non-breeding (Day et al. 1999). Annual adult survival has not been estimated, but is thought to be high (>85%; see Beissinger 1995, DeSanto and Nelson 1995). Modeling efforts indicate this species is extremely sensitive to changes in adult survival and that even minor mortality events (e.g., *EVOS* oil spill, loss estimated >500; Piatt et al. 1990, Van Vliet 1993) which results in the direct loss of individuals (in particular breeding age individuals) can result in long-term population declines with extremely low potential for recovery (Beissinger 1995, Day et al. 1999, USFWS 2004).

All of the North American and apparently the majority (~95%) of the world population of Kittlitz's murrelet breed, molt, and winter in Alaska (Day et al. 1999, USFWS 2004). In Alaska, this species occurs in coastal waters discontinuously from roughly Cape Beaufort south to northern portions of southeast Alaska (Day et al. 1999, USFWS 2004). In eastern Russia, distribution is poorly documented, but thought to occur from Okhotsk Sea to Chukchi Sea (Day et al. 1999). Winter distribution and numbers are poorly quantified, but thought to occur in Bering and Chukchi Sea (refer to Day et al. 1999). Current world population estimates vary widely from 18,300 (van Vliet 1993) to 25,000-100,000 (Ewins et al. 1993), though the latter estimates have been viewed with some scrutiny. USFWS (2002b) have estimated the Alaska segment of the world population to be 9,000-25,000 and more recent estimates are 9,505-26,767 (USFWS 2004, see also AKNHP 2005). Though there is some evidence for long-term population declines for *Brachyramphus* murrelets (van Vliet and McAllister 1994, Ralph et al. 1995, Kuletz et al. 2003), Day et al. (1999) argued that evidence for major population declines for the Kittlitz's murrelet was equivocal. In large part, their conclusion stems from the fact that historical population estimates are lacking (but see Isleib and Kessel 1973, Agler et al. 1998, Kendall and Agler 1998).

Seasonal Distribution Patterns

Spring Migration

Spring migration for Kittlitz's murrelets in the Chukchi Sea is unknown, but it could be assumed they follow the retreating ice front in spring. Kittlitz's murrelets may follow offshore leads north to take advantage of the abundant under ice plankton blooms and the large biomass of forage species associated with those blooms.

On most parts of their range Kittlitz's murrelets are typically associated with glacially influenced inlets (Day et al. 1999, USFWS 2004) where they prefer waters within about 200 meters of shore. There are no glacial inlets along the northeast Chukchi Sea coastline and open-water distribution there is based on the surveys of Divoky (1987). Sub-adults may occupy different habitats, at least seasonally.

Breeding Distribution
Breeding distribution is discontinuous within the range in areas believed associated with past glaciations. Kittlitz's murrelets nest at higher elevations (on mountains) and on nunataks. Median elevation of nests is about 760 meters on the southern range and about 335 meters on the northern range. Nests are generally found on scree or talus slopes of about 15 to 25 degrees. Nest construction varies from a small depression in gravel to bare rock or even on snow. Nest are often associated with a nearby large rock or boulder that might give protection from wind.

Nests have been found at the distal end of the Delong Mountains south near Cape Thompson (USFWS 2004). The Center for Biological Diversity believes the species nests as far north as Cape Beaufort between Cape Lisburne and Point Lay (CBD 2001). Information regarding fidelity to nesting sites is not available (Day et al. 1999).

Post-breeding Distribution, Fall Migration, and Molting
Post-breeding distribution is poorly understood, but is likely farther offshore than pre-breeding season. Juveniles fledge in about 24 days by fluttering down hill or using streams to assist passage to marine waters. Divoky found Kittlitz's murrelets had pelagic distribution from approximately 21 km to 213 km offshore, with the farthest distance offshore found during the 24 August-22 September survey period. Fall migration in the Chukchi Sea population is unknown, but is likely ahead of the advancing ice front. Juvenile Kittlitz's murrelets do not associate with adults or other juveniles at sea after fledging. Kittlitz's murrelets molt twice each year.

Winter Distribution
Winter distribution is poorly understood, but is probably pelagic. Populations along the Gulf of Alaska probably spend the winter over the continental shelf (Day et al. 1999). A few birds have been seen near the edge of pack ice in the Bering Sea and in polynyas south of the Chukotka Peninsula (Konyukhov 1990). Kittlitz's murrelets seen along the Chukchi Sea coast in summer probably move south with the advancing ice front and spend winter in the Bering Sea.

Food Habits and Bioenergetics
Summer foods are primarily forage fishes including sand lance (*Ammodytes hexapterus*) and Pacific herring (*Clupea pallasii*), but also include macro-zooplankton and other mid-water crustaceans (Day et al. 1999). The diet of the Chukchi Sea summer residents is unknown, but Kittlitz's murrelets along the Chukchi Sea coast during summer may be feeding on Arctic cod (*Boreogadus saida*), Pacific sand lance, capelin (*Mallotus villosus*), or euphausiids that are relatively abundant in some localities.

Winter foods are unknown, but may consist mostly of pelagic euphausiids or other macro-invertebrates. Day et al. (2003) considered this species to be a food generalist, but a habitat specialist with its distribution and abundance strongly associated to glacial waters with high sediment loads (see also Day et al. 2000, Kuletz et al. 2003). Similar to other small seabirds, Kittlitz's murrelets may be living close to their bioenergetic threshold most of the year and must forage with regularity to survive.

Predators
Predator species vary by locality. In some Gulf of Alaska populations, bald eagles (*Haliaeetus leucocephalus*), peregrine falcons (*Falco peregrinus*), and ravens (*Corvus corax*) are known

predators (Day et al. 1999, USFWS 2004). In Arctic populations, where there are few eagles and ravens, primary predators of eggs or nesting or juvenile murrelets likely include foxes, peregrine falcons, rough-legged hawks (*Buteo lagopus*), jaegers (*Stercorarius* spp.), glaucous gulls (*Larus hyperboreus*) or Arctic ground squirrels (*Spermophilus parryii*).

Population Status

Recent population estimates for more southern populations are available (USFWS 2004), but estimates are dated for the Chukchi Sea population. Divoky (1987) surveyed the Chukchi Sea from Bering Strait to Point Barrow (Figure 3) between 16 July and 17 October 1987 and estimated the abundance of Kittlitz's murrelets at 15,000 during August and October. Divoky attributed this high estimate of Kittlitz's murrelets to an atypically large influx of Bering Sea water to the Chukchi Sea in 1987. More recent estimates are not available (USFWS 2004), but if the Chukchi Sea population has declined at a rate similar to that believed for other populations, it is likely there are far fewer Kittlitz's murrelets in the northeast Chukchi Sea today. The Center for Biological Diversity estimates the Kittlitz's murrelet population along the Chukchi Sea coastline (including Wrangel Island) was 450 in 1993 and 171 in 2000 (CBD 2001).

Endangered Species Act Status of the Kittlitz's Murrelet

The Kittlitz's murrelet is proposed for listing as threatened or endangered under the Endangered Species Act (ESA) of 1973, as amended. The Center for Biological Diversity (CBD) petitioned the Secretary of the Department of the Interior to list the Kittlitz's murrelet as endangered under the ESA on 9 May 2001 (CBD 2001). The FWS reviewed the status of the Kittlitz's murrelet in 2004 (USFWS 2004) and determined the following:

> Kittlitz's murrelet (*Brachyramphus brevirostris*)--Kittlitz's murrelet is a small diving seabird whose entire North American population, and most of the world's population, inhabits Alaskan coastal waters discontinuously from Point Lay south to northern portions of Southeast Alaska. Kittlitz's murrelet is a relatively rare seabird. Most recent population estimates indicate that it has the smallest population of any seabird considered a regular breeder in Alaska (9,000 to 25,000 birds). This species appears to have undergone significant population declines in three of its core population centers -- Prince William Sound, Malaspina Forelands, and Glacier Bay. As populations become smaller, they become increasingly vulnerable to events that may result in extirpation. Causes for the declines are not well known, but likely include: habitat loss or degradation, increased adult and juvenile mortality, and low recruitment, and we believe that glacial retreat and oceanic regime shifts are the factors that are most likely causing population-level declines in this species. Existing regulatory mechanisms appear inadequate to stop or reverse population declines or to reduce the threats to this species.

Reason for Petition to List

The Kittlitz's murrelet was petitioned to be listed under the Endangered Species Act by the Center for Biological Diversity on 10 May 2001. The petition cited climate change, oil spills, vessel traffic, and other factors including dramatic population declines and periodic reproductive failures as reasons for listing (CBD 2001). The relatively small population size, limited distribution, apparent periodic breeding failures and low reproductive potential (Beissinger 1995), in conjunction with the above factors has led to Kittlitz's listing (USFWS 2004) as a candidate species (priority 5) under the Endangered Species Act. Clearly, there is cause for concern regarding the long-term survival of the species and the potential negative impacts of offshore oil and gas development; however, management decisions are difficult given the lack of available information. Kendall and Agler (1998) generated summer (June-July) population estimates from boat surveys in lower Cook Inlet, Prince William Sound, and southeastern Alaska to be 3,353 ± 1,718, 3,368 ± 4,073, and 5,408 ± 7,039, respectively (total = 12,130 ± 8,312). An apparent 18-24% decline (Kuletz et al. 2003) was documented for the Kittlitz's Murrelet in Prince William Sound with a change in their distribution over time; 78% of sightings occurred within the Harriman and College Fjords and seemed to be related to the number and condition of the glaciers. The USFWS (2004) considered the point estimate of 14,000 to be statistically valid, with >50% occurring in waters of Glacier Bay, Icy Bay, and Prince William Sound.

The Chukchi Sea Kittlitz's murrelet population, being far from centers of abundance, occupies marginal habitat at the fringe of its geographical range. During a normal year the density of Kittlitz's murrelets in the northeast Chukchi Sea is probably very low, and it would be infrequently encountered. If Divoky (1987) is correct, there might be years of higher abundance due to larger than normal influxes of Bering Sea water and associated higher than normal abundance of prey species.

Factors such as disturbance due to increased boat traffic related to wildlife cruises and offshore oil and gas development and impacts related to oil spills (Kittlitz's Oil Vulnerability Index of 88; King and Sanger 1979) make this species particularly vulnerable to population declines. Though impacts of oil spills have been documented (van Vliet and McAllister 1994, Carter and Kuletz 1995), little is known of potential impacts of disturbance on courtship behavior, foraging ecology and feeding, or energetics (Day et al. 1999).

Consequences of the Proposed Action on Listed or Candidate Species

The proposed action area is represented on maps in Appendix A. There are two alternatives to the proposed action area (Corridors 1 and 2), that would exclude some areas of the lease sale to protect certain resources, but the decision to adopt one of these deferrals will be made during the NEPA process. The following consequences are based on the assumption that neither deferral alternative will be adopted.

The proposed leasing activities could affect Steller's and spectacled eiders when they are in near-shore marine waters. Male and failed female spectacled eiders typically leave the inland coastal nesting areas for near-shore marine waters by late June where they may join non-breeders to stage for migration to molting areas. Most spectacled eiders that nest on the Arctic Coastal Plain probably migrate to Ledyard Bay inshore of the 20 m (65 ft) isobath to molt. At Ledyard Bay they tend to concentrate in waters from between 5 to 25 m (16.4 to 82 ft) deep and from 19 to 48 km (12 to 30 mi) offshore (Petersen et al. 1999).

Steller's eiders migrate to the Bering Sea to molt. Successful females and their broods leave the nesting grounds later in the summer and in early fall.

This section includes an analysis of the direct and indirect effects of the proposed action on threatened spectacled and Steller's eiders and critical habitat and Kittlitz's murrelet (a candidate species) and its interrelated and inter-dependent activities: disturbance, collisions, habitat loss, increased subsistence activity, increased predator populations, oil spills, and toxics contamination.

Disturbance

Disturbance impacts to Kittlitz's murrelets and listed eiders could arise from aircraft presence and noise, vessel presence and seismic airgun noise, and activity associated with exploration and production facilities.

Aircraft Presence and Noise

Nesting Steller's and spectacled eiders could be disturbed by helicopter overflights related to exploration and delineation activities. The number of helicopter trips flown in support of exploration- and delineation-well drilling is assumed to range from about 90 to 270 per year, during years that drilling occurs and depending on the number of wells (1-3) that are drilled. For each drilling operation, it is assumed that there would be one flight per day of drilling. The time required to drill and test a well is about 90 days. Most flights will transport employees between Barrow and as yet unspecified exploration sites in the Chukchi Sea.

Helicopter traffic could adversely affect spectacled eiders by: 1) displacing adults and/or broods from preferred habitats during pre-nesting, nesting, and brood rearing and migration; 2) displacing females from nests, exposing eggs or small young to inclement weather or predators; and 3) reducing foraging efficiency and feeding time. The behavioral response of eiders to aircraft overflights is unknown; some spectacled eiders nest and rear broods near the Deadhorse airport indicating that some individuals tolerate frequent aircraft noise. Individual tolerances are expected to vary, however, and the intensity of disturbance associated with the proposed action would, in most cases, be less than that experienced by birds at the Deadhorse airport. Some birds may be displaced, with unknown physiological and reproductive consequences.

However, disturbance to nesting spectacled and Steller's eiders is unlikely due to their extremely low densities across the North Slope. Across the Arctic Coastal Plain of the North Slope, breeding season density averages approximately one pair per 8 km^2 for spectacled eiders (Larned et al. 2002a). Steller's eiders are so rare in some years that they are not detected al all by aerial survey methods. in the core of the Steller's eider breeding area near Barrow, the highest nesting density recorded during 4 years of aerial surveys was estimated as approximately one pair per 12.5 km^2 (Ritchie and King 2002). Densities elsewhere on the Arctic Coastal Plain are much lower. The number of nesting eiders that would be exposed to helicopter overflights is low, however, because the potential direct flight from Barrow or Wainwright/new shore base to offshore drilling sites within the lease area would primarily be over coastal waters.

Spectacled eiders using coastal waters could be disturbed if helicopters or other aircraft were to fly over eiders staging in offshore areas before they migrate to molting areas or are molting in the Ledyard Bay Critical Habitat Area. Ward and Sharp (1974) assessed the impacts of helicopter overflights on molting long-tailed ducks and surf scoters at Herschel Island, Yukon Territory in August 1973. They found that all but 8% of long-tailed ducks and 2% of surf scoters reacted to the helicopter disturbance. While most molting ducks swam away from the helicopter, the rest that reacted dove underwater in response to helicopter approach. The reaction of these seaducks to low level flights indicated an interruption of normal behavior (such as cessation of foraging or sleeping) or displacement from foraging areas.

Low-level flights could force large numbers of spectacled eiders to interrupt feeding to either dive or move away from an important foraging site to a site of lower prey availability in response to the approaching aircraft, either of which would result in an expenditure of energy during a physiologically-demanding period of feather growth and accumulation of energy reserves for migration to the wintering area.

Disturbance is most likely to have an impact during those periods of the annual cycle when birds have difficulty in meeting their daily energy requirements, especially when food intake needs to be high to enable birds to build up nutrient reserves in advance of periods of high demand. Frequent disturbance could result in energy expenditures that prolong the molt beyond the ice-free period or decrease the amount of stored energy reserves available for winter survival. The condition of spectacled eiders during the winter period likely influences subsequent reproduction. Madsen (1994) studied the long-term effects of hunting disturbance on pink-footed geese (*Anser brachyrhynchus*) and found that geese that had used undisturbed sites reproduced better than geese from disturbed sites.

Altitude restrictions have been used to separate birds and aircraft to reduce the potential to harm eiders (MMS 2006). Similar restrictions on aircraft supporting activities resulting from the proposed lease sale could minimize impacts to spectacled and Steller's eiders staging in nearshore coastal areas or spectacled eiders molting in the Ledyard Bay Critical Habitat Area. The proposed action includes a restriction on overflight activity during seismic operations associated with the proposed lease sale, specifically:

> Seismic-survey support aircraft must avoid overflights of Ledyard Bay Critical Habitat Area after July 1 of each year; unless aircraft are at an altitude in excess of 1,500 feet or human safety requires deviation (e.g., a medical emergency).

No altitude restrictions are imposed for any subsequent exploration or development activities.

Altitude restrictions are often impracticable in Arctic coastal areas, however, due to frequent inclement weather. Evidence suggests that some birds may habituate to certain sources of disturbance or avoid impacts associated with certain areas (USFWS 2005). The use of designated flight paths could allow many birds, especially those in a specific area over several weeks or returning to a specific area year after year, to habituate to or use alternative areas to avoid aircraft impacts. The designation of fixed flight routes is not included in the proposed action.

Vessel Presence and Seismic Airgun Noise

Vessel presence and noise

How waterfowl and marine birds respond to disturbances can vary widely depending on the species, time of year, disturbance source, habituation, and other factors (Fox and Madsen 1997). It seems that in some species of waterfowl, the distance at which disturbances will be tolerated varies depending on flock size, because larger flocks react at greater distances than smaller flocks (Madsen 1985). There is an energetic cost to moving away from a disturbance as well as a cost in terms of lost foraging opportunities or displacement to an area of lower prey availability. Seismic survey vessels would be limited to blocks within the lease sale area, remaining at least 10 mi offshore, so they would not come close to nesting areas for any waterfowl or marine birds. It is more likely that vessels might disturb waterfowl and marine birds that are foraging or resting at sea or, in the case of a few species, molting at sea.

A mitigation measure to avoid direct disturbance effect of seismic vessels on molting spectacled and Steller's eiders in the Ledyard Bay Critical Habitat Area is included in the proposed action, specifically:

> Seismic-survey activities are not permitted within the Ledyard Bay spectacled eider critical-habitat area.

Restrictions on vessel activity within the Ledyard Bay Critical Habitat Area during exploration and development are not part of the proposed action.

Seismic airgun noise
Seismic surveying with airgun arrays results in both vertical and horizontal sound propagation. Horizontal propagation is a relevant issue, because it is less likely that marine birds would be under the array. Although there is variation in attenuation rates depending on bottom slope and composition, sound from airgun arrays can be detected using hydrophones at ranges of 50-75 km in water 25-50 m deep (Richardson et al. 1995).

Very few studies have assessed the effects of seismic surveys on marine birds and waterfowl. Stemp (1985) observed responses of northern fulmars, black-legged kittiwakes, and thick-billed murres to seismic activities in Davis Strait offshore of Baffin Island. The first 2 years of the study involved the use of explosives (dynamite gel or slurry explosives) and, therefore, are not relevant as use of underwater explosives are not anticipated being used for seismic surveys in the lease sale area. The final year of the study involved airguns, but the study locations were never in sight of colonies, feeding concentrations, or flightless murres. The results of this study did not indicate that seabirds were disturbed by seismic surveys using airguns. This conclusion, however, was due in part to natural variation in abundance. Nevertheless, Stemp concluded that negative effects from seismic surveys were not anticipated as long as activities were conducted away from colonies, feeding concentrations, and flightless murres. This implies, however, that conducting these activities near colonies, feeding concentrations or molting birds could result in negative effects to birds.

Lacroix et al. (2003) investigated the effects of seismic surveys on molting long-tailed ducks in the Beaufort Sea. These ducks molt in and near coastal lagoons on the North Slope, primarily during August, during which time they are flightless for 3-4 weeks. The molt is an energetically costly period. Long-tailed ducks are small sea ducks with higher metabolic rates and lower capacity to store energy than larger ducks (Goudie and Ankney 1986). Consequently long-tailed ducks need to actively feed during the molt period because their energy reserves cannot sustain them during this period (Flint et al. 2003). Lacroix et al. (2003) stated there was no clear response by the ducks to seismic surveying, even when the seismic vessels were in visual range. However, there may be effects that were too subtle to be detected by this study. The presence of long-tailed ducks within several 2.5-km radii of the sound source was monitored, but it was not possible to determine short-distance movements in response to seismic activities. Diving behavior of long-tailed ducks also was monitored by radio-telemetry, because direct observations may have induced bias due to the presence of observers. Therefore, it is unclear whether changes in diving frequency were due to disturbance from seismic vessels or local abundance of prey items. For instance, ducks may dive more in response to disturbances from vessels or they may dive less to avoid underwater noises related to airguns. Further behavioral observations would be necessary to characterize the response of long-tailed ducks and other birds to seismic surveys, even though the Lacroix et al. (2003) study found no effect of seismic surveying activity on movements or diving behavior of long-tailed ducks.

While seismic airguns have the potential to alter the availability of marine bird prey, Vella et al. (2001) concluded that there are generally few behavioral or physiological effects unless the organisms are very close (within meters) to a powerful noise source. Consequently, noises from seismic airguns are not likely to decrease the availability invertebrate crustaceans, bivalves, or mollusks.

It is possible that seismic surveys might affect fish and invertebrates in proximity to the airgun array. However, the effects of seismic surveys on marine fish that might change their availability to marine birds have not been documented under field operating conditions (CDFO 2004).   If forage fishes are displaced by airgun noise, birds feeding on those resources might be temporarily displaced and stop feeding within a few kilometers of the survey activities.

It is possible, during the course of normal feeding or escape behavior that some birds could be near enough to an airgun to be injured by a pulse. The threshold for physiological damage, namely to the auditory system, for marine birds is unknown. Although MMS has no information about the circumstances where this might occur, the reactions of birds to airgun noise suggest that a bird would have to be very close to the airgun to receive a pulse strong enough to cause injury, if that were possible at all. “Ramping-up,” a gradual increase in decibel level as the seismic activities begin, can allow diving birds to hear the start-up of the seismic survey and help disperse them before harm occurs. During on-going seismic surveys, diving birds would likely hear the advance of the slow-moving survey vessel and associated airgun operations and move away. A conservation measure requiring the ramping-up of airguns prior to use is part of the proposed action.

Additional information on the response of diving birds to approaching seismic survey vessels is essential to verify assumptions that there is a low potential for seabirds, including Kittlitz’s murrelets, to be harmed by airgun noises.

<u>Activity Associated with Exploration and Production Facilities</u>
Potential avenues of disturbance associated with the proposed action include the use of drillships; construction of a production platform, an onshore support base, pipelines, and roads; gravel mining/transport; pipeline maintenance; and oil spill response training. The location of these facilities and activities is unknown. Exploratory/delineation drilling, seismic work, and support activities within the sale area would generally occur primarily during the ice-free, open water period.

The proposed action includes lease sale blocks within the spectacled eider Critical Habitat Area. The construction of a production platform within or in close proximity to the Ledyard Bay Critical Habitat Area could result in disturbance impacts to molting spectacled eiders from various sources of noise and human activity associated with support vessels and aircraft. The construction of a pipeline between a production platform and an onshore base could cross the

Ledyard Bay Critical Habitat Area. Depending on the construction season, the construction of a pipeline could displace and/or disturb spectacled eiders within the Ledyard Bay Critical Habitat Area. It is unclear, however, if exploration or development could proceed in the Critical Habitat Area if seismic surveys are not permitted within that area.

Long-term disturbances that result in displacement of Steller's and spectacled eiders can technically be considered a loss of eider habitat. For example, regular vehicle traffic on pipeline maintenance roads could result in the permanent displacement of eiders in a zone of influence around this development.

Many of these disturbing activities could have fewer impacts to spectacled and Steller's eiders if they were to occur during the winter, when eiders are not present, but environmental and operational conditions prohibit this option for many of the activities. Conservation measures to avoid or minimize disturbance from activities associated with onshore bases and pipelines are not included in the proposed action. Disturbances associated with oil or gas production would be evaluated in future NEPA documents and reinitiation of formal consultation under the ESA.

Collisions

Collisions could result from aircraft striking eiders and murrelets, birds striking vessels supporting seismic surveys, drilling operations, and construction activities, and birds striking offshore and onshore oil or gas production facilities.

Aircraft striking eiders and murrelets

Helicopter and fixed-wing aircraft would be used during the exploration and delineation phase to support seismic surveys and offshore drilling activities. Aircraft operating at low altitudes have the potential to flush birds into the path of the aircraft where a collision could occur. Approximately 90% of aircraft/bird collisions occur less that 1,500 ft above ground (Sodhi 2002). Larned and Tiplady (1997) reported that flocks of wintering eiders often took flight during fixed-wing aircraft approaches of 150 to 200 m. An aircraft flight over a flock of about 30,000 eiders in the Ledyard Bay Critical habitat Area would likely contain an unknown number of flight-capable (pre- or post-molt birds) that may flush upon close approach. While such strikes are relatively rare, aircraft/bird collisions could threaten the safety of aircraft/passengers and result in deaths of spectacled and Steller's eiders.

Altitude restrictions have been used to separate birds and aircraft to reduce the potential harm to aircraft and eiders (MMS 2006). While many eiders using the Ledyard Bay Critical Habitat Area during the late June through late October period would be flightless, some would be expected to be flight-capable having either just arrived or having completed the molt, and are staging in preparation for migration to the wintering ground. Altitude restrictions on aircraft supporting activities resulting from the proposed lease sale could reduce potential impacts to spectacled and Steller's eiders staging in nearshore coastal areas or spectacled eiders molting in the Ledyard Bay Critical Habitat Area. Altitude restrictions (no flights below 1,500 ft ASL during seismic except for safety/emergency) are in place for overflights associated with seismic surveys, but are not proposed for subsequent exploration and development.

Altitude restrictions alone are often impracticable in Arctic coastal areas, however, due to frequent inclement weather. Evidence suggests that some birds may habituate to certain sources of disturbance or avoid impacts associated with certain areas (USFWS 2005). The use of designated flight paths could allow many birds, especially those in a specific area over several weeks or returning to a specific area year after year, to habituate to or use alternative areas to avoid aircraft impacts. The designation of fixed flight routes when the weather ceiling is below 1,500 ft ASL, however, are not included in the proposed action.

The risk of aircraft disturbance and aircraft/bird strikes associated with oil production would be evaluated in future NEPA documents and reinitiation of formal consultation under the ESA.

Birds striking vessels

Migrating birds colliding into manmade structures, including vessels, have been well documented. Weather conditions such as storms associated with rain, snow, icing, and fog or low clouds at the time of the occurrences often are attributed as causal factors (Weir, 1976; Brown, 1993). Lighting of structures, which can be intensified by fog or rain, also has been identified as a factor (Avery et al. 1980, Brown 1993, Jehl 1993). Birds are attracted to the lights, become disoriented, and may collide with the light support structure (e.g., pole, tower, or vessel hull or superstructure).

Lights on fishing vessels at sea have been known to attract large numbers of seabirds during storms (Dick and Donaldson 1978). Black (2005) reported a collision of about 900 birds, mostly a variety of petrel species and Antarctic prion, with a 75-m fishing trawler near South Georgia. The collisions took place over a 6-hour period at night, when visibility was less than 1 nm due to fog and rain. Of the 900 birds on deck, 215 were dead. Most of the remaining birds were released alive after being allowed to dry off in boxes stored in a protected area on deck. Waterfowl and shorebirds also have been documented as colliding with lighted structures and boats at sea (Schorger 1952, Day et al. 2003).

Marine birds risk collisions with vessels at night due to attraction and subsequent disorientation from high-intensity lights. Sea ducks are vulnerable to collisions with vessels, primarily because they tend to fly low over the water. Johnson and Richardson (1982) documented that 88% of eiders migrating to molting areas along the Beaufort Sea coast flew below an estimated 10 m (32 ft) and over 50% flew below 5 m (16 ft). Eiders leaving the North Slope travel day or night. Movement rates (birds/hour) did not differ between night and day, but movement rates and velocities were higher on nights with good visibility (Day et al. 2004).

High-intensity lights are needed by vessels during some nighttime operations or when visibility is hampered by rain or fog. MMS has recommended that vessels associated with subsequent lease sale activities (during the migration season) avoid using high-intensity lights when not needed to reduce the potential that marine birds would be attracted to and strike vessels conducting seismic surveys or supporting exploration/delineation/production drilling operations, but this is not included as a required mitigation measure under the proposed action.

Birds striking other facilities

Spectacled or Steller's eiders can be killed by collisions with onshore and offshore structures (i.e., drilling structures, communication towers with support cables, overhead power lines, etc.).

Eiders may be particularly vulnerable due to their flight behavior; travel in relatively large flocks (~110 birds/flock), they fly fast (~83 km/h), they fly low (5-12 m above sea level), and they tend to migrate in straight lines (~98% of observed flocks) (Day et al. 2005, 2004). A number of factors may actually reduce the height at which eiders migrate including wind speed and direction, and weather (i.e., fog or rain) and lighting (day vs. night) conditions (Day et al. 2005).

Day et al. (2005) completed a four-year study of bird migration and collision avoidance at Northstar Island. The authors used bird radar to assess the reaction of migrating eiders and other birds to collision avoidance lights located on the structure. The authors reported that the lights were not so strong that they disrupted eider migration, but the lights caused eiders to slow down and alter their flight paths away from the island.

Collision-related mortality to eiders on the North Slope is not known and is difficult to estimate due to factors including: habitat effects, number of birds actually recovered likely vary relative to habitat; observer bias, different observers have different probabilities of actually recovering carcasses; scavenging bias, carcass longevity likely varies relative to local predator composition and abundance; and crippling bias, injured birds may walk or fly away from the collision site and die. Thirty common eiders, 6 king eiders, and 13 long-tailed ducks were killed due to collisions with Northstar and Endicott Islands in the Alaskan Beaufort Sea during fall migration, 2001-2004 (Day et al. 2005). This total was collected over a relatively narrow window (80 days total spread over 4 years) of the fall migration, and thus probably underestimates total collision loss during fall migration.

The greatest potential for collision impacts would occur if structures were within the nearshore areas where spectacled eiders are known to migrate (Figure 1). The proposed action includes the opportunity for leasing areas as close as 10 miles from shore, within the Steller's and spectacled eider migration corridor. The construction of a production platform within or in close proximity to the Ledyard Bay Critical Habitat Area could result in significant adverse impacts to migrating Steller's and spectacled eiders. While it may be possible to devise leasing stipulations that could be implemented to restrict drilling during certain time periods and/or limit surface occupancy in the Critical Habitat Area to avoid or minimize significant adverse impacts to migrating Steller's eiders and migrating/molting spectacled eiders, these conservation measures are not considered part of the proposed action. As previously noted, exploration and development within the Critical Habitat Area may be impractical so long as seismic activities are not permitted within that area.

Formal Section 7 consultations on previous lease sales and resultant Terms and Conditions from USFWS Biological Opinions have resulted in a lease stipulation that requires lighting of lease structures to be designed in such a manner that minimizes spectacled and Steller's eider collisions. There appear to be two important aspects of collision avoidance to consider in implementing this stipulation. Light radiated upward and outward from the structure could disorient flocks of eiders and other birds during periods of darkness or inclement weather when the moon is obscured. If migrating eiders were not disoriented by radiated light, they could still encounter structures in their flight paths. Making surfaces visible to approaching birds may slow flight speed, allowing them to maneuver past collision hazards. Inward-directed lighting would illuminate these surfaces, but surface textures that absorb, rather than reflect, light could maximize visibility to closely-approaching birds and minimize disorientation of distant birds during periods of darkness or inclement weather when the moon is obscured. The proposed lease sale includes Stipulation 7, stating:

> **Stipulation No. 7 – Lighting of Lease Structures to Minimize Effects to Spectacled and Steller's Eiders.** Lessees must adhere to lighting requirements for all exploration or delineation structures so as to minimize the likelihood that migrating spectacled or Steller's eiders, or other coastal and marine birds, will strike these structures.
>
> Lessees are required to implement lighting requirements aimed at minimizing the radiation of light outward from exploration/delineation structures to minimize the likelihood that migrating spectacled or Steller's eiders, or other coastal and marine birds, will strike those structures. These requirements establish a coordinated process for a performance-based objective rather than pre-determined prescriptive requirements. The performance-based objective is to minimize the radiation of light outward from exploration/delineation structures. Measures to be considered include but need not be limited to the following:
>
> - Shading and/or light fixture placement to direct light inward and downward to living and work structures while minimizing light radiating upward and outward;
> - Types of lights;
> - Adjustment of the number and intensity of lights as needed during specific activities;
> - Dark paint colors for selected surfaces;
> - Low-reflecting finishes or coverings for selected surfaces; and
> - Facility or equipment configuration.
>
> Lessees are encouraged to consider other technical, operational and management approaches that could be applied to their specific facility and operation to reduce outward light radiation.
>
> If further information on bird-avoidance measures becomes available that suggests modification to this lighting protocol is warranted to implement the reasonable and prudent measures of the Biological Opinion issued by the U.S. Fish and Wildlife Service (FWS) under the Endangered Species Act, MMS will issue further requirements, based on guidance from the FWS. Lessees will be required to adhere to such modifications of this protocol. The MMS will promptly notify lessees of any changes to lighting required under this stipulation.
>
> These requirements apply to all new Outer Continental Shelf oil and gas leases issued pursuant to Chukchi Sea OCS Lease Sale 193 and for activities conducted between May 1 and October 31 of each year.
>
> Nothing in this protocol is intended to reduce personnel safety or prevent compliance with other regulatory requirements (e.g., U.S. Coast Guard or Occupational Safety and Health Administration) for marking or lighting of equipment and work areas.
>
> Lessees are required to report all birds, including spectacled and Steller's eiders, injured or killed through collisions with lease structures to the Fairbanks Fish and Wildlife Service Field Office, Endangered Species Branch, Fairbanks, Alaska at (907) 456-0499. The MMS recommends that operators call that office for instruction on the handling and disposal of injured or dead birds.
>
> Lessees must provide MMS with a written statement of measures that will be or that have been taken to meet the objective of this stipulation. Lessees must also include a plan for recording and reporting to the MMS bird strikes that occur during approved activities. This information must be included with an Exploration Plan when it is submitted for regulatory review and approval pursuant to 30 CFR 250.211. Lessees are encouraged to discuss their proposed measures in a pre-submittal meeting with the MMS and FWS.

Summary of the Effectiveness of Stipulation No. 7. This stipulation was developed jointly by MMS and FWS in accordance with the Biological Opinion for the Beaufort Sea Lease Sale 186 issued by FWS on October 22, 2002, and FWS's subsequent amendment of the Incidental Take Statement on September 21, 2004.

The stipulation above may be modified as a result of the ESA Section 7 consultation with FWS on proposed Chukchi Sale 193. The Biological Opinion issued by FWS will specify reasonable and prudent measures necessary and appropriate to minimize potential adverse impacts to threatened eiders. To be exempt from the prohibitions of Section 9 of ESA, the MMS must comply with the terms and conditions identified in the Biological Opinion. Correspondence related to this ESA consultation can be found in Appendix B. The MMS Biological Evaluation submitted to FWS in support of this consultation can be found at the MMS website.

Comparable measures for permanent structures related to development and production activities would be identified by FWS during ESA consultations on specific Development and Production Plans.

Note that due to similarities in appearance of female eiders, MMS responsibilities under the Migratory Bird Treaty Act, and a general interest in gathering more specific information about bird collisions, MMS modified the stipulation to include the reporting of all birds believe killed by striking a vessel or structure, including the recovery of threatened species if it is safe to do so. Few reports of bird strikes could be an indication that Stipulation 7 is effective in minimizing incidental take of listed eiders from collisions.

MMS presently cannot assume that recommendations for the design and implementation of lighting of structures would result in no strikes by threatened eiders. For this reason, we have estimated the take of listed species using variables used in the Biological Opinion (BO) for the Beaufort Sea Lease Sale 186 (USFWS 2002). This BO acknowledged that estimating incidental take of listed eiders is extremely difficult due to a lack of available information. The MMS adopted this methodology despite some apparent differences between the proposed project and the Beaufort Sea Lease Sale 186, as well as differences between the Northstar project and potential locations of future structures associated with the proposed action. For the purposes of estimating incidental take and lacking specific information on quantifying changes in the variables or factors used, MMS assumed these differences cancel or balance out.

The 2002 BO used common eider strikes from the Northstar development to generate a crude "generic strike rate" in terms of seaducks strikes per well-year. The results of this methodology indicated the 0.4 spectacled and 0.02 Steller's eiders would be taken per well-year as a result of colliding with drill rigs and/or other exploratory and delineation structures.

The scenario proposes that a drillship/rig could drill 1-2 wells per season, that 2 rigs would be operating at one time, and that up to 14 wells are needed. The two rigs could drill an average of 3 wells per year. Exploration/delineation drilling is estimated to take place over 3 years, but could take as long as 5 year, generating 10 well-years. These 10 well-years would result in an estimated take of 4 spectacled eiders and one (0.2) Steller's eider during delineation drilling.

Following exploration, production may occur. For the purpose of estimating the incidental take associated with a production platform, we assumed that the platform would take 4-5 years to build and would be in production for at least 25 years. The scenario states that some production wells could be started up to 6 years before production and while the platform is being constructed. We assume that two rigs would be used at one time, for a total of 12 well-years.

Another 30 well-years would accrue from construction and operation of the platform. These 42 well-years would generate an estimated take of 17 spectacled eiders and one (0.84) Steller's eider during the production phase of the project.

Overall, using the methodology, collisions with structures that could result from this lease sale total an incidental take of 21 spectacled eiders and one (1.04) Steller's eider.

Habitat Loss

Direct habitat loss of Steller's and spectacled eider habitats could arise during the exploration/delineation phase (drilling wells into the seafloor) and during the production phase (construction of an offshore platform, a pipeline, a pipeline landfall to an onshore base, and a pipeline linking to infrastructure to the east. Indirect habitat losses could result from eiders and murrelets not using habitats near sites of industrial activity.

<u>Direct Habitat Losses</u>

Direct habitat loss could occur if physical features are located in areas used by Steller's and spectacled eiders. In the exploratory and delineation phase, habitat loss could occur if wells were drilled in offshore habitats used by eiders staging for migration to molting areas or within molting areas, including the Ledyard Bay Critical Habitat Area. Staging areas for Steller's and spectacled eiders have not been clearly identified, but could be widespread across offshore areas.

The Ledyard Bay Critical Habitat Area was established because of the areas' importance to molting spectacled eiders. As many as 33,192 spectacled eiders have been observed using this area at any one time (Petersen et al. 1999). Post-breeding spectacled eiders molt and replenish/build energy reserves in preparation for migration to the wintering area and winter survival in the Bering Sea. Biologists concur that eiders must make use of high-energy foods in this area to support these physiologically-demanding activities, but the specific prey resources have not been identified. The loss of seafloor habitats due to exploration or delineation drilling cannot be quantified at this time, but could be in important staging or molt migration areas. The importance of these areas relative to the timing of molt, survival during the molting period, and condition after molting is unknown, however, the availability and quality of key resources in those areas during the prolonged migration period ultimately may influence the survival of the spectacled eiders (Petersen et al. 1999). Restrictions on drilling seasons or surface occupancy, if practicable, may avoid most direct impacts to spectacled eider molting habitats during the exploration and delineation phase, but are not included in the proposed action. Nonetheless, without additional information on habitat quality or seasonal patterns of eider use in the Critical Habitat Area, MMS considers it of little practical utility to estimate the potential incidental take of eiders associated with the hypothetical physical placement of offshore developments.

Impacts to spectacled and Steller's eiders arise from direct (facility footprint/nesting habitat change). The size and location of permanent onshore developments associated with a future phase of oil production are unknown, but can be estimated from the most likely development scenario. Onshore developments would originate at a pipeline landfall at an onshore base close to the existing airport at Barrow or Wainwright. The pipeline and associated developments would then be the shortest, most cost-effective route east to connect with pre-existing support infrastructure near the Colville River. Airstrip construction or use of overland ice roads/pads is not proposed.

For the purposes of consistency in estimating the incidental take of spectacled and Steller's eiders associated with direct loss of nesting habitat, MMS decided to adopt the methodology used by recent similar projects for NPR-A (BLM 2003, USFWS 2005). The rational for these calculations and the biological basis for nesting density estimates are detailed in those biological assessments and resultant biological opinions and are not repeated here. As with previous calculations, our calculations used nesting densities of 1.1 nests/km^2 for spectacled eiders and 0.06 nests/km^2 for Steller's eiders.

As a pipeline is expected to be placed on elevated structures or, less frequently, buried near, but not immediately adjacent to, the 19.8-meter-wide (65-foot-wide) road, the pipeline "footprint" was integrated with the road footprint into a 0.03 km-wide (100-foot-wide) road/pipeline development "corridor". The road/pipeline corridor was assumed to be 482.8 km (300 miles) long. Consequently, direct impacts from pipeline/road construction are estimated to affect 14.72 km^2 (3,636 ac) of eider nesting habitat (Table 1).

The shore base and staging facilities were assumed to each have gravel footprints of 0.2 km^2 (50 ac) on eider nesting habitat. Up to four pump stations would be needed to move oil eastward and these stations are estimated to each have a gravel footprint of 0.16 km^2 (395 ac total).

Material to construct the road, shore base, and other facilities would likely come from upland gravel pits, if practicable, or from coastal areas (intertidal areas, barrier islands, etc.) if no feasible and prudent noncoastal alternative is available. The locations of gravel sources near a future alignment are unknown, however it is likely that some known gravel sources (identified in NPR-A, presently undeveloped) or existing gravel pits would be utilized/expanded for material construct fill for the development facilities. For the purposes of analysis, we estimated that 1.60 km^2 of eider nesting habitat would be affected by gravel extraction.

Overall, these developments have a footprint of 17.37 km^2 (4,291 ac) in eider nesting habitats, resulting in an estimated direct take of 19 spectacled eiders and 1 Steller's eider (Table 1).

<u>Indirect habitat losses</u>
Secondary or indirect effects to nesting eiders would arise from habitat modifications (drainage, flooding, dust impacts to vegetation, changes in thermokarst) and disturbances from traffic and human activities. For the purposes of consistency in estimating the incidental take of spectacled and Steller's eiders associated with indirect loss of nesting habitat, MMS decided to adopt the methodology used by recent similar projects for NPR-A (BLM 2003, USFWS 2005). The rational for these calculations and the biological basis for a "zone of influence" are detailed in those biological assessments and resultant biological opinions and are not repeated here. As with previous calculations, our calculations used a zone of influence away from developments measuring 200 meters (656 ft). Our calculations did not take into account the amount of overlap in the secondary effects zone that would occur where certain facilities meet.

Many long-term disturbing activities could have fewer impacts to spectacled and Steller's eiders if they were to occur during the winter, when eiders are not present. Material extraction activities were assumed to occur during the winter, when eiders would not be present, and a secondary zone of influence from these areas was considered not applicable.

Overall, these zones of influence associated with development facilities developments have a collective areal extent of 196.13 km^2 (48,464 ac) in eider nesting habitats, resulting in an estimated direct take of 216 spectacled eiders and 12 Steller's eider (Table 1).

Table 1: Estimated areal extent of direct and indirect effects on eider nesting habitats and associated incidental take of spectacled and Steller's eiders during development of oil resources following Lease Sale 193.

Facility	Gravel Footprint in km^2 (acres)	200 meter Influence Zone in km^2 (acres)	Total Area in km^2 (acres)
Staging Area	0.20 (50)	0.51 (126)	0.71 (175)
Shore Base	0.20 (50)	0.51 (126)	0.71 (175)
Road/pipeline corridor (0.03 km x 483 km)	14.72 (3,636)	193.20 (47,740)	208.00 (51,397)
Gravel Extraction Sites (8 at 0.2 km^2 ea)	1.60 (395)	n/a (winter operation)	1.60 (395)
Pump Stations (4 at 40 acres each)	0.65 (160)	1.91 (472)	2.56 (632)
total	17.37 (4,291)	196.13 (48,464)	213.58 (52,774)
Spectacled Eiders Affected at 1.1/km^2	19	216	235
Steller's Eiders Affected at 0.06/km^2	1	12	13

Increased Subsistence Activity

Alaska Natives have traditionally harvested listed eiders and their eggs in coastal villages during spring and fall. Subsistence harvest surveys for the North Slope indicate that an average of 155 spectacled eiders were taken at Wainwright during 1988-1989 and only 2 spectacled eiders were reported taken in Barrow during 1987-1990 (Braund et al. 1993a, b). The proposed action assumes that if recoverable amounts of oil are discovered and produced, that delivery systems (pipelines) would carry products eastward to pre-existing infrastructure for transport to processing facilities. The pipelines would need associated roads for periodic maintenance and these roads could increase access of local hunters to previously inaccessible areas. Waterfowl hunters would likely access pipeline roads during the period immediately following spring breakup to hunt geese and eiders.

The FWS has made an effort to educate the local hunting public about the plight of spectacled and Steller's eiders, and has stated that the prohibition against harvest of these species would be enforced, but some level of harvest may be continuing. It is unknown what that level of harvest is, or whether the increased access scenario depicted here would result in an increased harvest of spectacled or Steller's eiders following the creation of roads along a pipeline constructed across the NRR-A. This road could essentially allow for travel between Wainwright to the Prudhoe Bay area and beyond, and vice versa. The long-term consequences of these developments would be further evaluated in future NEPA documents and reinitiation of formal consultation under the ESA, but at the present time are not believed to result in an incidental take of listed eiders.

Increased Predator Populations
Several North Slope predators that prey on waterfowl eggs and young concentrate in areas where human-use foods and garbage are available. Examples include gulls, ravens, and arctic foxes that are abundant near camps, roads, oilfields and villages. For ravens and foxes, there is evidence indicating population increases and range expansion due to increased availability of nesting or denning sites on these developments where they did not previously exist. The predation pressure that foxes, gulls, and ravens exert on nesting eiders and other waterfowl is well documented, and in some areas predation is the predominant factor affecting nest success.

Spectacled eiders may be adversely affected by increased numbers or increased distribution of predators. Ravens apparently never nested in Barrow until 1991 when a pair began nesting on a man-made structure (Quakenbush et al. 1995). These ravens were observed preying on eider nests. Ravens have expanded onto other oil developments/infrastructure and have the potential to impact nesting eiders. Several raptors could also make use of artificial nesting sites and predate on eiders or their young. Similarly, new fill pads could provide additional denning sites which could allow foxes to expand their range/density and increase predation on nesting spectacled and Steller's eiders. Increased predation poses a potentially significant adverse impact to spectacled eiders.

The only anticipated situation where the proposed action could artificially enhance predator populations would include new infrastructure or other support structures that lead from a pipeline landfall as part of oil development from developed leases in the action area. Implementation of a lease stipulation requiring that new infrastructure links to pre-existing infrastructure would avoid the artificial enhancement of predator populations. Similar projects have required a stipulation similar to:

> The lessee shall utilize best available technology to prevent facilities from providing nesting, denning, or shelter sites for ravens, raptors and foxes. The lessee shall provide the MMS an annual report on the use of oil and gas facilities by ravens, raptors, and foxes as nesting, denning, and shelter sites. Attracting wildlife to food and garbage is prohibited. All feasible precautions shall be taken to avoid attracting wildlife to food and garbage.

Implementation and enforcement of a leasing stipulation could be expected to minimize any effects of increased predator populations resulting from the proposed action, however, as implementation of this stipulation would be at the discretion of the Secretary of the Interior, it is not part of the proposed action.

It is extremely difficult to estimate the amount of harm or incidental take that could accrue to listed eiders if predator populations were to increase as a direct result of potential developments resulting from the proposed lease sale. For the purposes of this biological assessment we assume that a future Development EIS and associated reinitiation of Section 7 consultation will result in a fairly standard or industry-acceptable mitigation measure/term or condition to prevent an increase in predator populations that could result in impacts to threatened eiders. For this reason, no incidental take of eiders from increased predator populations is anticipated to occur.

Toxics Contamination
Oil activity may also result in increasing contamination of marine habitats, due to the disposal of drilling muds and cuttings, or accidental eruption of oil from test wells during a blowout. Such contamination may impact individual eiders or murrelets either directly through contact or indirectly as a result of effects on prey populations or important habitats. To mitigate potential contaminant releases, the proposed action requires several design/activity standards aimed at minimizing the impact of contaminants on eiders and murrelets and their habitats, including marine waters as a result of fuel, crude oil and other liquid chemical spills.

The proposed action assumes that 7-14 new wells would be needed to delineate the first production field. An unknown number of production wells would be drilled over the life of the lease sale. A maximum of 2 drilling rigs would be operable on the platform in any one year.

Discharges as a result of these wells are regulated by the Environmental Protection Agency (EPA) through a National Pollution Discharge Elimination System. The EPA would need to initiate consultation with the FWS to determine the likelihood that the proposed discharges associated with exploration and production activities would adversely affect listed species.

Oil Spills
Exposure of Steller's and spectacled eiders and Kittlitz's murrelets to petroleum could occur during seismic surveys and during exploration drilling and full oil production.

<u>Petroleum exposure during seismic surveys</u>
Spectacled and Steller's eiders and Kittlitz's murrelets could be affected by a seismic survey vessel accident resulting in a petroleum spill. The potential for a spill is low, given that the vessels will be operating at least 10 mi from shore and away from obstructions. During seismic surveys, vessels will be operating at about 4.5 kn, so speeds generally will be slow except for movements between survey areas. Surveys need to be conducted in a relatively ice-free environment, so there is only a small chance of damage to survey vessels from ice.

Older streamer cables may contain 100-200 L of a kerosene-like fluid to provide buoyancy. Breaks in cables are rare and typically only occur when currents whip cables around a structure such as an oil platform. Seismic surveys in the Chukchi Sea would be done in open water, far away from structures that would present a risk of entanglement and a spill. Newer generation streamer cables are filled with foam and, if used, they would eliminate any risk of a spill presented by fluid-filled cables.

Direct oiling of eiders and murrelets would likely result in loss of feather insulation and acute and chronic toxicity from ingestion and absorption. Oiled birds could also carry oil to nests where eggs and young could be oiled.

Both Kittlitz's murrelet parents incubate eggs and bring fish for their young. Lightly oiled murrelets could bring oil contamination back to their nest where eggs and young could be contaminated. Lightly oiled birds could also bring contaminated food to the nest. Heavily oiled birds would be prevented from returning to the nest resulting in the young dying of starvation.

According to oil spill records, most accidental spills in Alaska happen in harbors or during groundings; consequently, spills from vessels on the high seas where pelagic murrelets are mostly found in the Chukchi Sea would be a rare occurrence. The risk of incidents involving the release of oil and fuel from vessels during seismic survey activities will likely be small. This conclusion is based on the assumption that there would be no unauthorized discharges from the seismic vessel, such as the discharge of engine oil, etc. Therefore, any effects would be due to accidental discharges, such as a spill of fuel oil during a fuel transfer from a support vessel to a seismic vessel. It is further assumed that the operators would be cautious and vigilant during fuel transfers; for example, if a fuel hose broke, the fuel valves would be shut off quickly. Given that the risk of incidents is likely small and that future seismic surveys will typically be working more than 10 miles from shore, petroleum exposure from seismic survey activities is not considered a threat to Steller's and spectacled eiders and Kittlitz's murrelets

<u>Petroleum exposure during exploration drilling and oil or gas production</u>
Spilled oil in the Chukchi Sea would be a serious threat to seabirds because of its properties of forming a thin liquid layer on the water surface. Seabird deaths due to oil spills arise from exposure from wetting and loss of thermoregulatory ability, loss of buoyancy, or from matted plumage and inability to fly or forage (Fry and Lowenstine 1985). Alcids and seaducks are highly vulnerable to oil spills because they spend most of their time on the sea surface and aggregate in dense flocks. In the event of an oil spill in spectacled or Steller's eiders and Kittlitz's murrelet habitats, some of these birds could die due to the following effects:

Covering of skin or feathers
Fouled plumage is the primary cause of mortality and stress in oiled birds (Burger and Fry 1993). The hydrophobic nature of petroleum hydrocarbons makes them interactive with the hydrophobic properties of bird feathers. Oil causes marked loss of insulation, waterproofing, and buoyancy in the plumage. Oiled feathers lose their ability to keep body heat in and cold water out and resultant hypothermia can kill birds. Waterlogging and loss of buoyancy can rapidly lead to drowning.

Inhaling hydrocarbon vapors
Birds have the most efficient respiratory system of all vertebrates (Welty 1975) and could be more susceptible to harm from inhaling hydrocarbon vapors than mammals. The following conclusions are based on Geraci and St. Aubin (1982) as applied to birds. Inhaled petroleum vapors are absorbed into the bloodstream and carried throughout the body. Inhalation of highly concentrated petroleum vapors can lead to inflammation and damage of the mucous membranes of the airways, lung congestion, emphysema, pneumonia, hemorrhage, and death. It is unlikely that vapor concentrations can reach critical levels for more than a few hours. If a bird were unable to leave the immediate area of the source of the spill or were confined to a contaminated lead or bay, it could inhale enough vapors to cause some damage. Birds away from the immediate spill area or exposed to weathered or residual oils would not be expected to suffer any adverse effects from vapor inhalation.

Ingesting oil or contaminated prey
Petroleum oils contain many toxic compounds which can have fatal or debilitating effects on seabirds. The major route by which eiders would be expected to ingest oils is by preening it off their feathers after exposure. These same toxic compounds could be absorbed through the skin.

Most petroleum oils contain compounds that are highly toxic birds and cause damage and sometimes death to birds when ingested (Burger and Fry 1993). Both crude and bunker oils produced intestinal irritation in birds. Oils with high polyaromatic hydrocarbon contents are known to cause precipitation of hemoglobin leading to anemia. In experiments with two species of marine birds, Leighton et al. (1983) found that severe hemolytic anemias occurred from ingestion of large amounts of crude oil.

There are numerous other routes of injury to birds from ingested oil (Burger and Fry (1993). The osmotic regulation of blood and tissue fluids is influenced by several organs, including intestines, kidneys, and salt glands, which might be susceptible to oil toxicity. Osmotic stress can be fatal, or can exacerbate the effects of shock and cold stress in oiled birds. Significant changes in the size of the adrenal glands and levels of corticosteroids have been found in several studies where small amounts of oil were fed to birds. Liver and kidney damage were reported as direct effects of crude and fuel oil ingestion in several studies on birds. Ingestion of oils can reduce the functions of the immune system and reduce resistance to infectious diseases.

Additionally, food may be contaminated either directly or by hydrocarbons within the food chain.

Reproductive effects
Ingested oil causes short- and long-term reproductive failure in birds, indicative of severe physiological problems. These include delayed maturation of ovaries, altered hormone levels, thinning of eggshells, reduced egg productivity, reduced survival of embryos and chicks, reduced chick growth, and abandonment of nests by adults (Burger and Fry 1993). Cassin’s auklets experienced reduced reproduction after exposure to Prudhoe Bay crude oil (Ainley et al. 1981). It is unknown if exposed adults could become permanently sterilized.

If adults engaged in a futile attempt to hatch a dead embryo, their reproductive effort for that year would be lost. Even if they were to attempt to renest later in the season, it is doubtful that their late-hatching young would survive. Kittlitz’s murrelets typically raise only one chick per year.

Both Kittlitz’s murrelet parents incubate eggs and bring fish for their young. Lightly oiled birds could bring oil contamination back to their nest where eggs and young could be contaminated. Lightly oiled birds could also bring contaminated food to the nest. Heavily oiled birds would be prevented from returning to the nest resulting in the young dying of starvation.

Reduced food sources
Food resources used by eiders or murrelets could be displaced from eider and murrelet habitats or reduced following an oil spill. Benthic habitats that support marine invertebrates, however, would not be expected to experience substantial adverse effects following an oil spill.

Displacement from feeding or molting areas
The presence of substantial numbers of workers, boats, and aircraft activity between the spill site and support facilities is likely to displace eiders foraging in affected offshore or nearshore habitats during open-water periods for one to several seasons. Disturbance during the initial

response season, possibly lasting as long as 6 months, is likely to be frequent. Clean-up in coastal areas late in the breeding season may disturb brood-rearing, juvenile, or staging eiders.

Summary of oil spill effects: The synergetic effects of oiled plumage, osmotic and thermal stress, and anemia could greatly increase the mortality of eiders and murrelets under adverse environmental conditions.

Oil Spill Analysis

Whether spectacled or Steller's eiders or Kittlitz's murrelets would come into contact with oil would depend on the location, timing, and magnitude of the spill; the presence and extent of landfast ice and broken ice; and the effectiveness of clean-up activities.

Lease Sale 193 Conditional Probabilities

This section discusses the chance that a large oil spill from the Lease Sale 193 area would contact specific environmental resource areas that are important to Steller's and spectacled eiders and Kittlitz's murrelets, assuming a large spill occurs. No large oil spills are assumed to occur during exploration activities.

The spill rate of large platform and pipeline spills during production is 0.51 (95% confidence interval = 0.32-0.77) per Bbbl with a 41% chance (range = 27-54%) of a spill occurring over the life of the project (Appendix A, Table A.1-25). For the development and production phases, the fate and behavior of a 1,500-barrel spill from a platform and a 4,600-barrel spill from a pipeline were evaluated using the Sintef Oil Weathering Model (Appendix A). The 1,500-barrel spill would cover a smaller area (577 km^2) (Appendix A, Table A.1-9) than a 4,600-barrel spill (1,008 km^2) (Appendix A, Table A.1-10) after 30 days. The OSRA uses the center of the spill mass as the contact point, so the probabilities of either spill contacting specific environmental resource areas would be the same. Because of this similarity, only the 4,600-barrel spill is analyzed in this biological evaluation.

A 4,600-barrel spill could contact environmental resource areas where Steller's and spectacled eiders and Kittlitz's murrelets may be present (Appendix A). Approximately 44% of a 4,600-barrel spill during the open water period would remain after 30 days, covering a discontinuous area of 1,008 km^2. A spill during broken ice in the fall or under ice in the winter would melt out in the following summer. Approximately 55% of a 4,600-barrel spill during the broken-ice/solid-ice period would remain after 30 days, covering a discontinuous area of 332 km^2.

The following section presents conditional probabilities (expressed as a percent chance) estimated by the OSRA model of a spill contacting Steller's and spectacled eider and Kittlitz's murrelet habitats. Conditional probabilities are based on the assumption that a spill occurred (see definition and applications, Appendix A, page A.1-19).

Summer Spill

For conditional probabilities, the OSRA model estimates that a less than 0.5-71% chance that an oil spill starting at Launch Areas (LA) 1-13 will contact Environmental Resource Areas (ERA) 1-83 within 180 days during the summer, assuming a spill occurs, and a less than 0.5-67%, assuming a spill starts at Pipeline Segments (P) P1-11 (Appendix A, Table A.2-29). The greatest percent chance of contact from a launch area occurs at ERA 56, which has a 57% chance of contact from a spill occurring at LA 12. The chance of contact in this ERA is highest, because the OSRA model's launch area and the ERA are in close proximity to or overlap each other (maps, Appendix A). The greatest percent chance of contact from a pipeline segment occurs at ERA 56 and ERA 6, which have a 67% chance of contact from a spill occurring at P8 and P11, respectively (Appendix A). As with the launch areas, the chance of contact in these ERAs is highest, because the OSRA model's pipeline segment and the ERA are in close proximity to or overlap each other (Appendix A).

Spectacled eiders must stage offshore in the spring if their breeding habitats are unavailable. ERAs 21-23 and ERA 24/64 are spring leads (April – June) used by spectacled eiders during the spring and the highest percent chance of contacting these ERAs is 4% from LA 12 within 180 days during the summer, assuming a spill occurs. Similarly, spills originating from LA8 and LA13 have a 9 and 8% chance, respectively, of contacting spectacled eiders staging offshore Barrow in the Plover Islands.

Most post-breeding spectacled eiders move offshore and then migrate west to the Ledyard Bay Critical Habitat Area (ERA 10). Spills originating from LA 12 and 13 have a 38% chance of contacting spectacled eiders in the Critical Habitat Area during the May-October open water period.

Winter Spill

For conditional probabilities, the OSRA model estimates that a less than 0.5-54% chance that an oil spill starting at Launch Areas (LA) 1-13 will contact Environmental Resource Areas (ERA) 1-83 within 180 days during the winter, assuming a spill occurs, and a less than 0.5- 73%, assuming a spill starts at Pipeline Segments (P) 1-11 (Appendix A, Table A.2-53, maps). The greatest percent chance of contact from a launch area occurs at ERA 49, which has a 54% chance of contact from a spill occurring at LA 7. ERA 49 is the Hanna Shoal polynya. The chance of contact in this ERA is highest, because the OSRA model's launch area and the ERA are in close proximity to or overlap each other (maps, Appendix A). The greatest percent chance of contact from a pipeline segment occurs at ERA 48, which has a 73% chance of contact from a spill occurring at P8 (Appendix A, maps). As with the launch areas, the chance of contact in this ERA is highest, because the OSRA model's pipeline segment and the ERA are in close proximity to or overlap each other (Appendix A, maps).

Spectacled and Steller's eiders must stage offshore in the spring if their breeding habitats are unavailable. ERAs 21-23 and ERA 24/64 are spring leads (April – June) used by eiders during the spring and the highest percent chance of contacting these ERAs is 4% from LA 12 within 180 days during the summer, assuming a spill occurs. Similarly, spills originating from LA 8 and 13 have a 9% and 8% chance, respectively, of contacting eiders staging offshore Barrow in the Plover Islands.

Most post-breeding spectacled eiders move offshore and then migrate west to the Ledyard Bay Critical Habitat Area (ERA 10). A spill originating from LA 10 or Pipeline 6 has a 16% or 19% chance, respectively, of contacting the Critical Habitat Area during the winter, melting out in the spring.

On an annual basis, a spill originating at LA 10 or P 11 would have a 25% and 47% chance, respectively, of contacting the Ledyard Bay Critical Habitat Area (ERA 10) within 180 days (Appendix A, Table A.2-5).

Lease Sale 193 Combined Probabilities
Combined probabilities differ from conditional probabilities in that they do not assume that a spill has occurred and consolidate non-uniform weighting of launch probabilities into one unit probability. The risk that a large spill would occur is multiplied by the area-wide probability that spilled oil would reach a particular environmental resource area (ERA) to calculate a combined probability that both would occur simultaneously. Combined probabilities are defined in Appendix A (page A.1-24). The combined probabilities for a large spill occurring and reaching ERAs of most concern to threatened and candidate bird species are in Table 2. These probabilities are broken into different periods to indicate volatility, weathering, and movement of the spill over time.

Table 2: Combined probabilities (expressed as percent chance) of one or more spills greater than or equal to 1,000 barrels and the estimated mean number of spills occurring and contacting a certain environmental resource area (see maps, Appendix A) over the assumed production life of the lease sale area within varying time periods, Chukchi Sea Lease Sale 193 (from Appendix A).

	3-days	10-days	30-days	60-days	180-days	360-days
ERA 10 Ledyard Bay Critical Habitat Area	4	5	7	8	8	8
ERA 20 Spring Lead System	1	1	1	2	2	2
ERA 21 Spring Lead System	<0.5	1	2	2	2	2
ERA 22 Spring Lead System	<0.5	1	1	2	3	3
ERA 23 Spring Lead System	<0.5	<0.5	<0.5	<0.5	1	1

Oil Spill Response
None of the conditional or combined probabilities factor in the effectiveness of oil spill response activities to large spills, which range from highly effective under ideal conditions to largely ineffective during unfavorable or broken-ice conditions. An Oil Spill Response Plan would be required prior to oil production.

Activities such as hazing and other human activities (boat and air traffic) could impact threatened eiders and Kittlitz's murrelets. Hazing may have limited success during spring when migrants occupy open water ice leads. The hazing effect of cleanup activity or actively hazing birds out of ice leads that oil is expected to enter may be counterproductive, because there are few alternative habitats that flushed birds can occupy. Cleanup activities in leads during May and open water in July through September are likely to adversely affect listed eiders.

Oil spill response could originate from as far away as Deadhorse, about 150 mi east of Barrow. Specific animal deterrence activities would be employed as the situation requires and would be modified as needed to meet the current needs. The response contractor would be expected to work with USFWS and state officials on wildlife management activities in the event of a spill. In an actual spill the two aforementioned groups would most likely have a presence at the Incident Command Post to review and approve proposed hazing activities and monitor their impact on birds. As a member of the team, USFWS personnel would be largely responsible for providing critical information affecting response activities to protect listed birds in the event of a spill.

Oil spill response plans do not typically spell out specific wildlife response actions. Oil spill response plans typically identify the resources at risk and refer to the appropriate tactics. The response contractor can also contract with other response organizations to augment animal hazing and response activities. The response contractor would be expected to have an inventory of bird scare devices in addition to the Breco buoys (air cannons, guns, pyrotechnics, visual devices, vessels) to deter birds from entering the spill area and would be assumed to cycle their use to ensure that the birds don't habituate to their effect.

For the purposes of evaluating the potential impact of a large spill on threatened or candidate bird species, oil spill response in the Chukchi Sea is assumed to be ineffective due to the unpredictability of response time, proximity of the launch site(s) to bird habitats, known ineffectiveness of any response during certain environmental conditions (e.g., broken-ice), and the large number of birds that could be impacted in a brief time period (<36 hours).

<u>Chronic Low-volume Spills</u>

Beached bird surveys have demonstrated that low-volume, chronic oil pollution is an ongoing source of mortality in coastal regions (Burger and Fry 1993). Small volumes of oil may be released from leaking tanks and valves, accidents during loading and offloading, and flushing of tanks and bilges. In cold climates, an oil spot the size of a square inch is enough to compromise water repellency of plumage, possibly leading to the death of a bird. In some places, low-volume, chronic oiling is a major cause of seabird mortality.

For proposed Lease Sale 193, small or low-volume spills are defined as being less than 1,000 bbl. The average crude-oil spill size is 113.4 gallons (2.7 bbl). An estimated 178 small crude oil spills would occur during the 25-year oil production period (Appendix A, page A.1-26, Table A.1-29), an average of over 7 per year. The average refined-oil spill size is 29 gallons (0.7 bbl) and an estimated 440 refined-oil spills would occur during the 25-year oil production period (Appendix A, page A.1-26, Table A.1-32), an average of 17.6 per year. Overall, an estimated 25 small-volume oil spills would occur each year of production.

It is unknown how many small-volume spills or what total volume would reach areas used by Steller’s or spectacled eiders or Kittlitz’s murrelets. If these small-volume spills were in close proximity to or within the Ledyard Bay Critical Habitat Area, a large number of molting spectacled eiders could be contacted and injured or killed. Kittlitz’s murrelets or Steller’s eiders close to the source of these spills could also be affected, but these birds are at lower densities and substantial adverse effects would not be expected to occur.

Summary of spill effects

Chronic low-level spills are not modeled by the trajectory analysis, but could adversely affect small numbers of Steller's eiders and Kittlitz's murrelets. Although difficult to state with any certainty, a small volume spill in close proximity to a large dense flock of molting spectacled eiders could result in adverse impacts to perhaps several hundred eiders, maybe more. Depending on the chronic nature of small spills, this situation could occur repeatedly.

The trajectory analysis model predicts the percent chance that an oil spill would make contact with an ERA polygon during a certain time period. The size and shape of these polygons are based on scientific literature documenting use by important resources. Spectacled or Steller's eiders use the lead system (ERAs 20-23) as they moved east to breeding areas or staged offshore if breeding habitats were unavailable. The percent chance of contact with these ERAs increases later in the season as post-breeding eiders leave the nesting grounds and stage offshore and begin migration to the molting area at Ledyard Bay.

An oil spill contacting the Ledyard Bay Critical Habitat Area (ERA 10) during the open water period could contact tens of thousands of molting eiders. As many as 33,000 eiders, including the entire cohort of successfully breeding females and their young, use the Ledyard Bay molting area at one time. The loss of all or part of the breeding female spectacled eiders of the Arctic Coastal Plain would result in large-scale adverse population-level effects. Oil spill modeling, however, indicates that the risk of a spill of a magnitude to jeopardize the continued existence of spectacled eiders a moderately probability event.

For many of the same reasons, a spill contacting the spring lead system could affect a relatively large proportion of the Steller's eider population staging to the breeding grounds. A spill of this magnitude would result in a large-scale adverse population-level effect on this species. For a declining population, these effects would be negative and would not be recoverable. Oil spill modeling, however, indicates that the risk of a spill of this magnitude is a relatively low probability event.

To put the risk of a large spill having population-level impacts in perspective, one has to consider several variables. First of all, to ever have an oil spill, a blow-out during exploration (an unlikely event) or general production would have to occur. The most likely scenario states the probability of a successful commercial find is in the range of 10%, indicating that production is unlikely. Secondly, the location of the oil find and subsequent development platform could influence the probability that a spill would occur as well as the probability that it would reach resource areas important to threatened or candidate bird species when the species are present, or, in the case of a winter spill, when those birds return. Finally, the number and sex/age of threatened or candidate birds affected would have differing degrees of population-level effects, from a few birds in an area to all birds in an area during particular time periods. A large spill in the wrong place at the wrong time could effectively jeopardize the continued existence of the spectacled eider from the North Slope of Alaska. Given the stated low probability for successful oil field development, the probability that a large spill would occur, and the probability that a large spill would reach a resource area important to threatened eiders and murrelets, an adverse effect of this magnitude appears to be an unlikely event.

Cumulative Effects

Human development in coastal areas of the Chukchi Sea is sparse and limited to several small communities that include Point Hope, Point Lay, Wainwright, and Barrow. The closest industrial development of size southwest of the proposed lease area is the Red Dog Mine Portsite near Kivalina and the closest industrial development east of Teshekpuk Lake is the Kuparuk (Alpine) and Prudhoe Bay oil fields.

The State of Alaska is considering leasing additional state-owned tide and submerged lands lying between the Canadian border and Point Barrow. Oil development of near-shore waters under state jurisdiction could add to disturbance potential, habitat loss, and collision potential experienced by Steller's and spectacled eiders in the Beaufort and Chukchi Sea regions.

Arctic ice is thinning due to global climate change, and both commercial and military large-vessel traffic in the Northeastern Chukchi and Beaufort seas might increase as shipping lanes stay ice-free for longer periods of time. Global climatic change, however, would likely have significant stochastic impacts on Steller's eiders that surpass the impacts of increasing large-vessel traffic in the Arctic. Increasing large-vessel traffic in the Arctic would increase the risk that Steller's and spectacled eiders could be exposed to oil spills resulting from vessels sinking and grounding. The probability of increased traffic by large vessels, however, is difficult to predict and is likely to be more than 50 years in the future.

Although lease sales are proposed for off-shore areas of the Beaufort Sea, there are no specific projects to evaluate, and future consultations under the ESA for these federally-permitted activities are expected to occur. Similarly, recent or proposed leasing activity in NPR-A could be made more economical if a developable find is located in the Chukchi Sea because cost of infrastructure and other economies of scale could be shared between projects. These synergistic effects could increase the likelihood that anticipated effects on spectacled and Steller's eiders would occur. Each of these federal projects will have undergone Section 7 consultation, however, such consultations may be evaluated individually and not from the standpoint of occurring relatively simultaneously to pro-actively ensure the continued existence of the Steller's and spectacled eiders breeding on the Arctic Coastal Plain. Such an analysis is outside the scope of this biological evaluation for the proposed project.

Summary of Effects

Exploration and Delineation Phase

This phase includes activities that could result in periodic or chronic disturbance and/or displacement of Steller's and spectacled eiders and Kittlitz's murrelets using coastal areas of the Chukchi Sea. Habitat loss and increased mortality could also occur.

The primary sources of disturbance and/or displacement include:

- Seismic vessel presence and noise
- Support aircraft presence and noise
- Airgun noise

Spectacled and Steller's eiders could experience direct mortality through collisions with vessels, aircraft, or drilling structures.

A well blow-out and other oil spills/toxics contamination could result in the deaths of spectacled or Steller's eiders or Kittlitz's murrelets, but these are modeled as low probability events during this phase and it is improbable that significant adverse effects to these species would occur.

Stellers Eider
The overall effects on Steller's eiders include the periodic interruption of migrating post-breeding eiders and a risk that an eider would collide with a vessel or drilling structure or be struck by an aircraft. As Steller's eiders occur in the proposed lease sale area in low numbers, relatively few individual eiders would be harmed or killed. An incidental take of one Steller's eider was calculated to occur from a collision with structures during the exploration/delineation phase.

Spectacled Eider
The overall effects on spectacled eiders include the periodic interruption of migrating post-breeding and molting eiders. As most spectacled eiders breeding on the Arctic Coastal Plain make regular use of the proposed lease sale area, each sex/age cohort could be affected differently, depending on the time and location. For example, an estimated 33,200 spectacled eiders have been counted in the Ledyard Bay Critical Habitat Area during the latter portion of the molting season. As most of these are believed to be either successfully-breeding females or their hatch-year broods, even a seemingly trivial incremental degree of adverse effect to individual fitness applied to such a large number of birds could result in decreased winter survival with resultant decreased population size, productivity, and recruitment. Vessels associated with seismic activity would not be permitted to enter the Ledyard Bay Critical Habitat Area after July 1 of each year.

The exploration and delineation phase also presents a risk that spectacled eiders would collide with a vessel or drilling structure or be struck by an aircraft. An incidental take of four spectacled eiders was calculated to be killed by collision with drilling structures during the exploration and delineation phase.

These adverse impacts are difficult to state with any certainty, but could be mitigated to a certain extent by requiring aircraft associated with seismic activity to maintain >1,500 ft ASL over the Ledyard Bay Critical Habitat Area when weather conditions and concerns for human safety allow. Additional avoidance of disturbance could be achieved by designating aircraft flight routes for situations when aircraft associated with seismic activity cannot maintain >1,500 ft ASL over the Ledyard Bay Critical Habitat Area, but this is not part of the proposed action.

Benthic habitats in the Ledyard Bay Critical Habitat Area could be disturbed and/or altered by drilling exploratory or delineation wells in the seafloor.

Kittlitz's Murrelet
The overall effects on Kittlitz's murrelets include the periodic interruption of murrelet foraging. Kittlitz's murrelets tend to dive when disturbed, which could place murrelets in close proximity to an active airgun array, but it is assumed they will move away prior to this occurrence. This

diving behavior makes the risk of getting struck by aircraft very low. As Kittlitz's murrelet occur in the proposed lease sale area in low numbers, no individual murrelets are expected to be appreciably harmed or killed during the exploration and delineation phase. Kittlitz's murrelets would benefit from conservation measures intended to reduce disturbance to listed eiders in coastal areas.

Production Phase

The production phase includes activities that could result in increased disturbance/displacement and habitat loss that could affect Steller's and spectacled eiders and Kittlitz's murrelets and their coastal marine and nesting habitats. The production phase also includes activities that could result in increased mortality to these species.

The primary sources of disturbance and/or displacement include:

- Vessel and aircraft presence and noise
- Airgun noise associated with any further seismic survey
- The operation and maintenance of on-shore structures in nesting habitats

The potential sources of habitat loss include:

- The placement of a drilling platform and pipelines within the Ledyard Bay Critical Habitat Area
- The construction of pipelines, maintenance roads, and other facilities through nesting habitats

The potential for increased mortality over the life of the project include:

- Collisions with vessels, aircraft, or drilling structures
- Oil spill mortality associated with a large platform or pipeline spill
- Oil spill mortality associated with chronic low-volume spills
- Increased in predator populations
- Increased subsistence activity

<u>Steller's Eider</u>

The overall effects on Steller's eiders include the periodic interruption of post-breeding eiders migrating in nearshore coastal areas. Similarly, activity associated with the operation and maintenance of on-shore facilities (pipelines, roads, etc) would likely result in eiders nesting outside a zone of influence around these sites.

There is a risk that a Steller's eider would collide with a vessel or drilling structure or be struck by an aircraft. As Steller's eiders occur in the proposed lease sale area in low numbers, relatively few individual eiders would be harmed or killed during collisions with structures or would be struck by an aircraft. An estimated incidental take of one Steller's eider could occur from collisions with production structures.

There is some potential that Steller's eider nesting habitat would be lost during the construction of on-shore pipelines, maintenance roads, and other associated facilities. An estimated incidental take of one Steller's eider would occur from direct loss of Steller's eider nesting habitat. Secondary or indirect effects were calculated to result in an estimate take of 12 Steller's eiders in Steller's eider nesting habitat.

Mortality to Steller's eiders from chronic low-volume spills or a large platform or pipeline spill would be dependent upon the timing and location of the spills. Steller's eiders occur in the proposed lease sale area in low numbers during a small portion of the year. If Steller's eiders were concentrated in the spring lead system when a spill event occurred, a large proportion of the entire Steller's eider population could be affected. The magnitude of these mortality events could result in adverse population-level impacts to Steller's eiders breeding on the Arctic Coastal Plain. Combined probabilities from oil spill risk analysis modeling predict these are low risk events.

Spectacled Eider

The overall effects on Steller's eiders include the periodic interruption of post-breeding and molting spectacled eiders migrating in nearshore coastal areas. Up to several tens of thousands of eiders using the Ledyard Bay Critical Habitat Area could be repeatedly disturbed and/or displaced to less productive habitats during the molt period. Similarly, activity associated with the operation and maintenance of on-shore facilities (pipelines, roads, etc) would likely result in eiders nesting outside a zone of influence around these sites. Given a lack of specific information, MMS did not estimate the potential estimated incidental take from this offshore activity.

Reduction in some of the adverse effects associated with disturbance could be achieved if vessels and aircraft associated with non-seismic activities (e.g., drill rig support) were managed to avoid conflicts with eiders. For example, vessels would not disturb molting eiders if they were not permitted in the Ledyard Bay Critical Habitat Area after July 1 of each year. Similar reductions in disturbance to spectacled eiders could be achieved if aircraft associated with production activity were required to maintain >1,500 ft ASL or follow designated flight routes after July 1 of each year. These conservation measures are not part of the proposed action.

There is a risk that spectacled eiders would collide with a vessel or drilling structure or be struck by an aircraft. As spectacled eiders occur in or pass through the proposed lease sale area in large numbers, a relatively large number of eiders could be harmed or killed during collisions with structures. Stipulation 7 of the proposed action attempts to avoid or minimize the risk of eider collisions with drilling platforms only during the exploration phase. An estimated incidental take of 17 spectacled eiders was calculated to occur from collisions with production structures.

Wells could be drilled in benthic habitats within the Ledyard Bay Critical Habitat Area, but negative effects are difficult to assess as high value habitats are not described and specific locations of future features are unknown. Developments within the Critical Habitat Area are likely less probable because seismic activities, which may be important to siting further developments, are not permitted within this area after July 1 of each year following the lease sale.

There is a high potential that spectacled eider nesting habitat would be lost during the construction of on-shore pipelines, maintenance roads, and other associated facilities. An estimated incidental take of 19 spectacled eiders would occur from direct loss of spectacled eider nesting habitat. Secondary or indirect effects were calculated to result in an estimate take of 216 spectacled eiders in spectacled eider nesting habitat. Increased predator populations and subsistence hunter harvest are not currently believed to result in incidental take of spectacled eiders on the Arctic Coastal Plain following the lease sale.

Additional mortality to spectacled eiders from chronic low-volume spills or a large platform or pipeline spill would be dependent upon the timing and location of the spills. As spectacled eiders are concentrated in certain areas of the proposed lease sale area during most of the open-water period, a large proportion of the spectacled eider population would be harmed or killed at any one time or fewer numbers killed during multiple, smaller events. The magnitude of these mortality events could result in adverse population-level impacts to spectacled eiders breeding on the Arctic Coastal Plain. The conditional probabilities from the oil spill risk analysis modeling predict a relatively high risk that spilled oil would contact concentrated groups of spectacled eiders in the Ledyard Bay Critical Habitat Area. The combined probabilities from oil spill risk analysis modeling, however, predict the risk of these events is lower.

Kittlitz's Murrelet

The periodic interruption of Kittlitz's murrelet foraging would occur during the production phase. Kittlitz's murrelets tend to dive when disturbed, so the risk of getting struck by aircraft would be very low. Chronic low-volume spills or a large platform or pipeline spill could result in the deaths of some Kittlitz's murrelets, but the number affected depends on the time and location of the spills. Furthermore, because the Kittlitz's murrelet occurs in the proposed lease sale area in low numbers, few individual murrelets are expected to be appreciably harmed or killed, but this could be a high proportion of the Kittlitz's murrelet population in the region. Most conservation measures that benefit threatened eiders benefit murrelets as well.

Determination of Effects

Because the Steller's and spectacled eiders are listed as threatened under Section 7 of the Endangered Species Act, this section considers the following categories.

- The proposed actions would have *no effect* on the listed species,
- The proposed actions *may affect* the listed species.
- The proposed action is *likely to adversely affect* the listed species.
- The proposed action is *not likely to adversely affect* the listed species.
- The proposed actions are *likely to adversely modify* critical habitat for a listed species.
- The proposed actions are *not likely to adversely modify* critical habitat for a listed species.

It is determined through this biological evaluation that the proposed Chukchi Sea Lease Sale 193 would likely have the following effects on Steller's and spectacled eiders and Kittlitz's murrelets:

- Listed and Candidate Species
    - Lease Sale 193 could present new sources of disturbance, collision hazards, and oil/toxic pollution that could result in the taking of Steller's and spectacled eiders. Without comprehensive mitigation measures to avoid or minimize potential impacts, these activities *are likely to adversely affect* Steller's and spectacled eiders.

- Lease Sale 193 could present new sources of disturbance and oil/toxic pollution that could result in the taking of Kittlitz's murrelet. Without comprehensive mitigation measures to avoid or minimize potential impacts, these activities *may affect* the Kittlitz's murrelet.

- Ledyard Bay Critical Habitat Area
  - Lease Sale 193 could present new activities that could result in the physical modification of seafloor habitats and decrease use of the Ledyard Bay Critical Habitat Area by molting spectacled eiders. Without comprehensive mitigation measures to avoid or minimize potential impacts, these activities are *likely to adversely modify* the Ledyard Bay Critical Habitat Area.

References

Agler, B. A., S. J. Kendall, and D. B. Irons. 1998. Abundance and distribution of marbled and Kittlitz's Murrelets in southcentral and southeast Alaska. Condor 100: 254-265.

Ainley, D. G., C. R. Grau, T. E. Roudybush, S. H. Morrell, and J. M. Utts. 1981. Petroleum ingestion reduces reproduction in Cassin's auklets. Marine Pollution Bulletin 12(9): 314-317.

Alaska Natural Heritage Program (AKNHP). 2005. Kittlitz's Murrelet. Available at http://aknhp.uaa.alaska.edu/zoology/species_ADFG/status_reports/ADFG_PDFs/Birds/Kittlitz%27s_murrelet_ADFG_web_060105.pdf. Version dated 18 May 2005.

AMAP. 2004 Arctic Monitoring and Assessment Programme (AMAP) Assessment 2002: Heavy metals in the Arctic. Second AMAP International Symposium on Pollution of the Arctic, Oslo, Norway. Available at http://www.amap.no/

Anderson, B. A. and B. A. Cooper. 1994. Distribution and abundance of spectacled eiders in the Kuparuk and Milne Point oilfields, Alaska, 1993. Unpublished report for ARCO Alaska, Inc., Fairbanks, Alaska. 71 pp.

Anderson, B. A., R. J. Ritchie, A. A. Stickney, J. E. Shook, J. P. Parrett, and L. B. Attanas. 2004. Avian studies in the Kuparuk Oilfield, Alaska, 2003. Unpublished report for ConocoPhillips Alaska, Inc., Anchorage, Alaska. 83 pp.

Avery, M. L., P. F. Springer, and N. S. Dailey. 1980. Avian mortality at man-made structures: an annotated bibliography (revised). U.S. Department of the Interior, Fish and Wildlife Service, Office of Biological Services, National Power Plant Team, Washington, D.C. FWS/OBS-80/54. 152 pp.

BLM. 1982. Traditional knlwledge comments in transcripts of hearing proceedings before the Bureau of Land Management, Department of the Interior, Alaska Outer Continental Shelf Office. Available on compact disk from the Minerals Management Service, Anchorage Alaska.

BLM. 2003. Biological assessment for threatened and endangered species with respect to the proposed Northwest National Petroleum Reserve-Alaska Integrated Activity Plan. U.S. Department of the Interior, Bureau of Land Management, Alaska State Office, Anchorage, Alaska.

Beissinger, S. R. 1995. Population trends of the marbled murrelet projected from demographic analyses. Pages 385-393 *in* C. J. Ralph, G. L. Hunt, Jr., M. G. Raphael, and J. G. Piatt, eds. Ecology and conservation of the marbled murrelet. U.S. Department of Agriculture, Forest Service, General Technical Report PSW-GTR-152. 420 pp.

Beissinger, S. R. and N. Nur. 1997. Appendix B: Population trends of the Marbled Murrelet projected from demographic analysis. Pages B1-B35 *in* Recovery plan for the threatened marbled murrelet (*Brachyramphus marmoratus*) in Washington, Oregon and California. U.S. Department of the Interior, Fish and Wildlife Service, Portland, Oregon.

Bellrose, F. C. 1980. Ducks, geese, and swans of North America. 3rd Edition. Stackpole Books, Harrisburg, Pennsylvania.

Bent, A. C. 1987. Life Histories of North American waterfowl. Dover Publications, Inc., New York.

Black, A. 2005. Light-induced seabird mortality on vessels operating in the southern ocean: incidents and mitigation measures. Antarctic Science 171: 67-68.

Boulanger, J., K. Martin, G. Kaiser, and A. E. Derocher. 1999. Evaluating uncertainty in estimating population trends of marbled murrelets. Pages 53-63 *in* A.W. Diamond and D.N. Nettleship, eds., Biology and conservation of forest birds. Society of Canadian Ornithologists Special Publication No. 1, Fredericton, New Brunswick.

Bowman, T. J., J. Fischer, R. Stehn, and G. Walters. 2002. Population size and production of geese and eiders nesting on the Yukon-Kuskokwim Delta, Alaska, in 2002. Field report 18 July 2002. U.S. Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska.

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

Braund, S. (and Associates) 1993. North slope subsistence study, Wainwright 1987 and 1988. Submitted to U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region, OCS Study MMS 91-0073, Technical Report No. 147. 236 pp.

Brown, W. 1993. Avian collisions with utility structures, biological perspectives. Pages 12-13 *in* EPRI, Proceedings: Avian interactions with utility structures, International Workshop.

Bump, J. K. and J. R. Lovvorn. 2004. Effects of lead structure in Bering Sea pack ice on the flight costs of wintering spectacled eiders. Journal of Marine Systems 50: 113-139.

Burger, A. E. 2002. Conservation assessment of marbled murrelets in British Columbia: a review of the biology, populations, habitat associations, and conservation. Technical Report Series No. 387. Canadian Wildlife Service, Pacific and Yukon Region, British Columbia.

Burger, A.E. and D. M. Fry. 1993. Effects of oil pollution on seabirds in the northeast Pacific. Pages 254-263 *in* K. Vermeer, K. T. Briggs, K. H. Morgan, and D. Siegel-Causey, eds. The status, ecology, and conservation of marine birds of the North Pacific. Proceedings of a symposium sponsored by the Pacific Seabird Group, the Canadian Wildlife Service and British Columbia Ministry of Environment, Lands and Parks. Victoria, B.C., 22-23 February 1990.

Canadian Department of Fisheries and Oceans (CDFO). 2004. Review of scientific information on impacts of seismic sound on fish, invertebrates, marine turtles, and marine mammals. Habitat Status Report 2004/002. Canadian Science Advisory Section, Ottawa, Ontario, Canada.

Carter, H. R. and K. J. Kuletz. 1995. Mortality of marbled murrelets due to oil pollution in North America. Pages 261-269 *in* C. J. Ralph, G. L. Hunt, Jr., M. G. Raphael, and J. G. Piatt, eds. Ecology and conservation of the marbled murrelet. U.S. Department of Agriculture, Forest Service, General Technical Report PSW-GTR-152. 420 pp.

Center for Biological Diversity (CBD). 2001. Petition to add Kittlitz's murrelet to endangered species list. Available at http://www.biologicaldiversity.org/swcbd/press/kimu.html

Cooke, F. 1999. Population studies of marbled murrelets (*Brachyramphus marmoratus*) in British Columbia. Pages 43-51 *in* A.W. Diamond and D.N. Nettleship, eds. Biology and conservation of forest birds. Society of Canadian Ornithologists, Special Publication No. 1, Fredericton, New Brunswick.

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

Dau, C. P., P. L. Flint, and M. R. Petersen. 2000. Distribution of recoveries of Steller's eiders banded on the lower Alaska Peninsula, Alaska. Journal of Field Ornithology 71(3): 541-548.

Dau, C. P. and W. W. Larned. 2004. Aerial population survey of common eiders and other waterbirds in near shore waters and along barrier islands of the Arctic Coastal Plain of Alaska, 24-27 June 2004. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Dau, C. P. and E. J. Mallek. 2005. Aerial survey of Emperor geese and other waterbirds in southwestern Alaska, spring 2005. Unpublished report, U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. 18 pp.

Day, R.H., K. J. Kuletz, and D. A. Nigro. 1999. Kittlitz's Murrelet *Brachyramphus brevirostris*. Order: Charadriiformes, Family: Alcidae. The Birds of North America, No. 435. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Day, R. H., D. A. Nigro, and A. K. Prichard. 2000. At-sea habitat use by the Kittlitz's murrelet *Brachyramphus brevirostris* in nearshore waters of Prince William Sound, Alaska. Marine Ornithology 28: 105-114.

Day, R. H., A. K. Prichard, and D. A. Nigro. 2003. Ecological specialization and overlap of *Brachyramphus* murrelets in Prince William Sound, Alaska. Auk 120: 680-699.

Day, R. H., J. R. Rose, B. A. Cooper, and R. J. Blaha. 2004. Environmental effects on the fall migration of eiders at Barrow, Alaska. Marine Ornithology 32: 13-24.

Day, R. H., A. K. Pritchard, and J. R. Rose. 2005. Migration and collision avoidance of eiders and other birds at Northstar Island, Alaska, 2001-2004: final report. Unpublished report for BP Exploration - Alaska, Anchorage, Alaska. 154 pp.

DeSanto, T. L. and S. K. Nelson. 1995. Comparative reproductive ecology of the Auks (Family Alcidae) with emphasis on the Marbled Murrelet. Pages 33-47 *in* C. J. Ralph, G. L. Hunt, Jr., M. G. Raphael, and J. G. Piatt, eds. Ecology and conservation of the Marbled Murrelet. U.S. Department of Agriculture, Forest Service, General Technical Report PSW-GTR-152. 420 pp.

Dick, M. H. and W. Donaldson. 1978. Fishing vessel endangered by crested auklet landings. Condor 32: 13-24.

Divoky, G. J. 1987. The distribution and abundance of birds in the eastern Chukchi Sea in late summer and early fall. Final report. Outer Continental Shelf Environmental Assessment Program, Research Unit 196.

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

Fischer, J. B., R. A. Stehn, T. D. Bowman, and G. Walters. 2005. Nest population size and potential production of geese and spectacled eiders on the Yukon-Kuskokwim Delta, Alaska, 2005. U.S. Department of the Interior, Fish and Wildlife Service, Anchorage, Alaska. 28 pp.

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

Flint, P. L., M. R. Petersen, and J. B. Grand. 1997. Exposure of spectacled eiders and other diving ducks to lead in western Alaska. Canadian Journal of Zoology 75: 439-443.

Flint, P. L. and M. P. Herzog. 1999. Breeding of Steller's eiders, *Polysticta stelleri*, on the Yukon-Kuskokwim Delta, Alaska. Canadian Field-Naturalist 113: 306-308.

Flint, P. L., M. R. Petersen, C. P. Dau, J. E. Hines, and J. D. Nichols. 2000. Annual survival and site fidelity of Steller's eiders molting along the Alaska Peninsula. Journal of Wildlife Management 64: 261-268.

Flint, P. L., J. A. Reed, J. C. Franson, T. E. Hollmen, J. B. Grand, M. D. Howell, R. B. Lanctot, D. L. Lacroix, and C. P. Dau. 2003. Monitoring Beaufort Sea waterfowl and marine birds. U.S. Department of the Interior, Minerals Management Service, Alaska Outer Continental Shelf Region. OCS Study, MMS 2003-037. 125 pp.

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

Fredrickson, L. H. 2001. Steller's Eider *Polysticta stelleri. In* A. Poole and F. Gill, eds. The Birds of North America, No. 571. The Birds of North America, Inc., Philadelphia, Pennsylvania.

Georgette, S. 2000. Subsistence use of birds in the Northwest Arctic Region, Alaska. Technical Paper No. 260, Alaska Department of Fish and Game, Division of Subsistence, Juneau, Alaska. 226 pp.

Geraci, J. R. and D. J. St. Aubin. 1982. Study of the effects of oil on cetaceans. U.S. Department of the Interior, Bureau of Land Management. Washington, D.C. Contract Report #AA 551-CT9-29. 274 pp.

Goudie, R. I. and C. D. Ankney. 1986. Body size, activity budgets, and diets of sea ducks wintering in Newfoundland. Ecology 67: 1475-1482.

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

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

Grebmeier, J. M. and K. H. Dunton. 2000. Benthic processes in the northern Bering/Chukchi Seas: status of global change. Pages 61-71 *in* Impacts of changes in sea ice and other environmental parameters in the Arctic. Report of the Marine Mammal Commission workshop, Feb. 2000. Girdwood, Alaska.

Harwood, C. M. and T. Moran. 1993. Productivity, brood survival, and mortality factors for spectacled eiders on Kigigak Island, Yukon Delta NWR, Alaska, 1992. Unpublished report, U.S. Department of the Interior, Fish and Wildlife Service, Bethel, Alaska. 56 pp.

Hodges, J. I., and W. D. Eldridge. 2001. Aerial surveys of eiders and other waterbirds on the eastern Arctic coast of Russia. Wildfowl 52: 127-142.

Isleib, M. E., and B. Kessel. 1973. Birds of the north-gulf coast Prince William Sound Region, Alaska. Biological Papers University of Alaska 14: 1-149.

Jehl, J. R., Jr. 1993. Observations on the fall migration of eared grebes, based on evidence from a mass drowning in Utah. Condor 95: 470-473.

Johnson, S. R. and W. J. Richardson. 1982. Waterbird migration near the Yukon and Alaskan coast of the Beaufort Sea. II. Moult migration of seaducks. Arctic 35: 291-301.

Johnson, S. R., D. A. Wiggins, and P. F. Wainwright. 1992. Use of Kasegaluk Lagoon, Chukchi Sea, Alaska, by marine birds and mammals, II: marine birds. Pages 57-510 *in* Use of Kasegaluk Lagoon, Chukchi Sea, Alaska, by marine birds and mammals. LGL Alaska Research Associates, Inc. and Alaska Department of Fish and Game, Anchorage, Alaska. 627 pp.

Johnson, C. B., R. M. Burgess, B. E. Lawhead, J. R. Rose, A. A. Stickney, and A. M. Wildman. 2000. Wildlife studies in the CD north study area, 2000. Unpublished report for Phillips Alaska Inc., Anchorage, Alaska. 96 pp.

Johnson, C. B., R. M. Burgess, A. M. Wildman, A. A. Stickney, P. E. Seiser, B. E. Lawhead, T. J. Mabee, J. R. Rose, and J. E. Shook. 2004. Wildlife studies for the Alpine Satellite Development Project, 2003. Unpublished report for ConocoPhillips Alaska Inc., Anchorage, Alaska. 155 pp.

Kertell, K. 1991. Disappearance of the Steller's eider from the Yukon-Kuskokwim Delta, Alaska. Arctic 44: 177-187.

Kessel, B. 1989. Birds of the Seward Peninsula, Alaska: their biogeography, seasonality, and natural history. Univ. Alaska Press, Fairbanks, Alaska.

King, J. R. and G. A. Sanger. 1979. Oil vulnerability index for marine oriented birds. Pages 227-239 *in* J. C. Bartonek, and D. N. Nettleship, eds. Conservation of marine birds of North America. U.S. Department of the Interior, Fish and Wildlife Service, Wildlife Research Report No. 11, Washington, D.C.

Kistchinski, A. A. and V. E. Flint. 1974. On the biology of the spectacled eider. Wildfowl 25: 5-15.

Kondratiev, A. V. and L. V. Zadorina. 1992. Comparative ecology of the king eider (*Somateria spectabilis*) and the spectacled eider (*S. fischeri*) in Chaun tundra. Zoological Journal 71:99-108 (in Russian with English summary).

Konyukhov, N. B. 1990. Wintering Seabirds on Sirenikovskoi Polynya. Pages 36-39 *in* Study of colonial seabirds in the USSR. Problems of the North, Far Eastern Branch, Academy of Science of USSR. Magadan, Russia. As cited *in* Day et al. 1999.

Kuletz, K. J. 2004. Kittlitz's Murrelet- a glacier bird in retreat. Available at http://alaska.fws.gov/media/murrelet/overview.pdf

Kuletz, K. J., S. W. Stephenson, D. B. Irons, E. A. Labunski, and K. M. Brenneman. 2003. Changes in distribution and abundance of Kittlitz's murrelet *Brachyramphus brevirostris* relative to glacial recession in Prince William Sound, Alaska. Marine Ornithology 31: 133-140.

Lacroix, D. I., R. B. Lanctot, J. A. Reed, and T. L. McDonald. 2003. Effect of underwater seismic surveys on moulting male long-tailed ducks in the Beaufort Sea, Alaska. Canadian Journal of Zoology 81: 1862-1875.

Larned, W. W. 2002. Steller's eider spring migration surveys, southwest Alaska, 2001. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management. Anchorage, Alaska.

Larned, W. W. 2004. Steller's eider spring migration surveys, southwest Alaska, 2004. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larned, W. W. 2005. Steller's Eider spring migration surveys- southwest Alaska, 2005. U.S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. 23 pp.

Larned, W. W., R. Platte, and R. Stehn. 2001a. Eider breeding population survey, Arctic Coastal Plain, Alaska, 1999-2000. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larned, W. W., R. Stehn, J. Fischer, and R. Platte. 2001b. Eider breeding population survey Arctic Coastal Plain, Alaska, 2001. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larned, W. W., R. Stehn, and R. Platte. 2003. Eider breeding population survey, Arctic Coastal Plain, Alaska, 2002. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

Larned, W. W., R. A. Stehn, and R. M. Platte. 2005. Eider breeding population survey, Arctic Coastal Plain, Alaska, 2005. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. 49 pp.

Larned, W. W. and T. Tiplady. 1997. Late winter population and distribution of spectacled eiders (*Somateria fischeri*) in the Bering Sea, 1996-97. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. 11 pp.

Lovvorn, J. R., Grebmeier, J. M. and L.W. Cooper. 2000. Effects of possible changes in the St. Lawrence Island polynya on a top benthic predator, the spectacled eider. Arctic Forum 2000 information. Abstract at http://www.arcus.org.

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

Madsen, J. 1985. Impact of disturbance on field utilization of pink-footed geese in West Jutland, Denmark. Biological Conservation 33: 53-63.

Mallek, E. J. and C. P. Dau. 2005. Aerial survey of Emperor geese and other waterbirds in southwestern Alaska, fall 2005. U.S. department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. 16 pp.

Mallek, E. J., R. M. Platte, and R. A. Stehn. 2005. Aerial breeding pair surveys of the Arctic Coastal Plain, Alaska - 2004. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. 25 pp.

Martin, P. In preparation. Satellite tagging of Steller's eider on the Arctic Coastal Plain. U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services, Fairbanks, Alaska.

Metzner, K. A. 1993. Ecological strategies of wintering Steller's eiders on Izembek Lagoon and Cold Bay, Alaska. Master's Thesis, University of Missouri, Columbia.

MMS. 2003. Final Environmental Impact Statement, Beaufort Sea Planning Area, Oil and Gas Lease Sales 186, 195, and 202. Department of the Interior, Minerals Management Service, Alaska Region. OCS EIS/EA MMS 2003-001.

MMS. 2006. Programmatic Environmental Assessment for Arctic Ocean Outer Continental Shelf Seismic Surveys – 2006. U.S. Department of the Interior, Minerals Management Service, Alaska OCS Region.

Moran, T. and C. M. Harwood. 1994. Nesting ecology, brood survival, and movements of Spectacled Eiders on Kigigak Island, Yukon Delta NWR, Alaska, 1993. U.S. Department of the Interior, Fish and Wildlife Service, Bethel, Alaska. 44 pp.

Palmer, R. S. 1976. Handbook of North American birds: volume 3. Yale University Press, New Haven, Connecticut.

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

Pearce, J. M., D. Esler, and A. G. Degtyarev. 1998b. Nesting ecology of Spectacled Eiders *Somateria fischeri* on the Indigirka River Delta, Russia. Wildfowl 49: 110-123.

Pearce, J. M., S. L. Talbot, M. R. Petersen, and J. R. Rearick. 2005. Limited genetic differentiation among breeding, molting, and wintering groups of the threatened Steller's eider: the role of historic and contemporary factors. Conservation Genetics 6: 743-757.

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

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

Petersen, M. R., J. O. Bustnes, and G. H. Systad. 2006. Breeding and moulting locations and migration patterns of the Atlantic population of Steller's eiders *Polysticta stelleri* as determined from satellite telemetry. Journal of Avian Biology 37: 58-68.

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

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

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

Piatt, J. F., C. J. Lensink, W. Butler, M. Kendziorek, and D. R. Nysewander. 1990. Immediate impacts of the '*Exxon Valdez*' oil spill on marine birds. Auk 107: 387-397.

Platte, R. M., and R. A. Stehn. 2005. Abundance and trend of waterbirds on Alaska's Yukon-Kuskokwim Delta Coast based on 1988 to 2005 aerial surveys. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska. 39 pp.

Quakenbush, L. 2006. Steller's eider: species of concern. Alaska Department of Fish and Game, Division of Wildlife Conservation. Anchorage, Alaska. Available at http:www.wildlife.alaska.gov/index.cfm?adfg=concern.st-eider

Quakenbush, L. T., R. S. Suydam, K. M. Fluetsch, and C. L. Donaldson. 1995. Breeding biology of Steller's eiders nesting near Barrow, Alaska, 1991-1994. Technical Report, U.S. Department of the Interior, Fish and Wildlife Service and North Slope Borough, Department of Wildlife Management.

Quakenbush, L. and R. Suydam. 1999. Does the Steller's eider depend on lemmings? Endangered Species Bulletin 24(2): 12-13.

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

Quakenbush, L. T., R. Suydam, T. Obritschkewitsch, and M. Deering. 2004. Breeding biology of Steller's eiders (*Polysticta stelleri*) near Barrow, Alaska, 1991-99. Arctic 57: 166-182.

Ralph, C. J., G. L. Hunt, Jr., M. G. Raphael, and J. G. Piatt. 1995. Ecology and conservation of the marbled murrelet. U.S. Department of Agriculture, Forest Service, General Technical Report PSW-GTR-152. 420 pp.

Richardson, W. J., Jr., C. R. Greene, C. I. Malme, and D.H. Thomson. 1995. Man-made Noise. Pages 1-576 *in* Marine Mammals and Noise. Academic Press, Inc., San Diego, California.

Richman, S. E. and J. R. Lovvorn. 2003. Effects of clam species dominance on nutrient and energy acquisition by spectacled eiders in the Bering Sea. Marine Ecological Progress Series 261: 283-297.

Ritchie, R. J. and J. G. King. 2002. Steller's eider surveys near Barrow, Alaska, 2004. Annual report. ABR, Inc, Fairbanks, Alaska. 15 pp.

Ritchie, R. J., T. Obritschkewitsch, and J. King. 2005. Steller's eider surveys near Barrow, Alaska, 2005. U.S. Department of the Interior, Bureau of Land Management, Fairbanks, Alaska. 10 pp.

Savard, J. P. L. 1985. Evidence of long-term pair bonds in Barrow's goldeneye (*Bucephala islandica*). Auk 102: 389-291.

Schorger, A. W. 1952. Ducks killed at Hot Springs, South Dakota. Wilson Bulletin 64: 113-114.

Scribner, K. T., M. R. Petersen, R. L. Fields, S. L. Talbot, J. M. Pearce, and R. K. Chesser. 2001. Sex-biased gene flow in spectacled eiders (Anatida): inferences from molecular markers with contrasting modes of inheritance. Evolution 55: 2105-2115.

Smith, L. N., L. C. Byrne, C. B. Johnson, and A. A. Stickney. 1994. Wildlife studies on the Colville River Delta, Alaska, 1993. Unpublished report for ARCO Alaska Inc., Anchorage, Alaska. 95 pp.

Sodhi, N. S. 2002. Competition in the air: birds versus aircraft. The Auk (3): 587-595.

Solovieva, D. V. 1997. Timing, habitat use, and breeding biology of Steller's eider in the Lena Delta, Russia. Wetlands International Seaduck Specialist Group Bulletin 7: 35-39.

Solovieva, D. V. 1999. Biology and bioenergetics of the Steller's eider (*Polysticta stelleri*). Ph.D. Dissertation, University of Saint Petersburg, Saint Petersburg, Russia. 161 pp.

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

Stemp, R. 1985. Observations on the effects of seismic exploration on seabirds. Pages 217-233 *in* G. D. Greene, F. R. Engelhardt, and R. J. Paterson, eds. Proceedings of the workshop on effects of explosives use in the marine environment. Energy, Mines and Resources Canada and Indian and Northern Affairs, Halifax, Nova Scotia, Canada.

Syroechkovski E. E., Jr. and C. Zockler. 1997. Threatened waterfowl in the lower Yana River, Yakutia, Russia. Waterfowl and Wetland Trust, UK, Threatened Species Department, Threatened Waterfowl Specialist Group. TWSG News 10. Available at http://www.wwt.org.uk/threatsp/twsg/bulletins/10/articl11.htm. Accessed 28 June 2006.

Troy, D. M. 2003. Molt migration of spectacled eiders in the Beaufort Sea region. Unpublished report for BP Exploration (Alaska), Inc., Anchorage, Alaska. 17 pp.

Troy Ecological Research Associates. 1997. Distribution and abundance of spectacled eiders in the vicinity of Prudhoe Bay, Alaska: 1996 Status report for BP Exploration (Alaska), Inc., Anchorage, Alaska. 11 pp.

Troy Ecological Research Associates. 2002. The distribution of spectacled eiders in the vicinity of the Point Thompson Unit: 1998-2001. Status report for BP Exploration (Alaska) Inc. Anchorage, Alaska.

USFWS. 1991. Migratory Bird Hunting; nontoxic hunting zones. U.S. Department of the Interior, Fish and Wildlife Service. 56 CFR Part 20.108. May 13, 1991.

USFWS. 1993. Endangered and Threatened Wildlife and Plants; Final Rule to List Spectacled Eider as Threatened. U.S. Department of the Interior, Fish and Wildlife Service. 50 CFR Part 17. May 10, 1993.

USFWS. 1996. Spectacled Eider Recovery Plan. U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services, Anchorage, Alaska. 157 pp.

USFWS. 1997. Endangered and Threatened Wildlife and Plants; Threatened Status for the Alaska Breeding Population of the Steller’s Eider. U.S. Department of the Interior, Fish and Wildlife Service. 50 CFR Part 17. June 11, 1997.

USFWS. 1999. Population Status and Trends of Sea Ducks in Alaska. U.S. Department of the Interior, Fish and Wildlife Service, Migratory Bird Management, Anchorage, Alaska.

USFWS. 2000a. Endangered and Threatened Wildlife and Plants; Notice of Designation of the Northern Sea Otter in the Aleutian Islands as a Candidate Species. U.S. Department of the Interior, Fish and Wildlife Service. 50 CFR Part 17 65(218): 67343-67345.

USFWS. 2000b. Endangered and threatened wildlife and plants; proposed designation of critical habitat for the spectacled eider. U.S. Department of the Interior, Fish and Wildlife Service. 50 CFR Part 17 65(8): 6114-6131.

USFWS. 2001a. Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Alaska-Breeding Population of the Steller's Eider. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C. January 10, 2001.

USFWS. 2001b. Endangered and Threatened Wildlife and Plants; Final Determination of Critical Habitat for the Spectacled Eider; Final Rule. 50 CFR Part 17. U.S. Department of the Interior, Fish and Wildlife Service, Washington D.C.

USFWS. 2002a. Steller's eider fact Sheet. U.S. Department of the Interior, Fish and Wildlife Service. Ecological Services, Endangered Species Branch, Anchorage, Alaska.

USFWS. 2002b. Spectacled eider fact sheet. U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services, Endangered Species Branch, Anchorage, Alaska.

USFWS. 2002c. Steller's Eider Recovery Plan. U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services, Endangered Species Branch, Fairbanks, Alaska. 27pp.

USFWS. 2004. Endangered and Threatened Wildlife and Plants; Review of species that are candidates or proposed for listing as endangered or threatened; annual notice of findings on resubmitted petitions; annual description of progress on listing actions; notice of review; Proposed Rule. U.S. Department of the Interior, Fish and Wildlife Service. 50 CFR Part 17. 69(86), May 4, 2004. Available at http://ecos.fws.gov/docs/candforms_pdf/r7/B0AP_V01.pdf

USFWS. 2005. Final Biological Opinion (1-12-2005) on a biological assessment covering the proposed Amendment to the Integrated Activity Plan/Environmental Impact Statement for the Northeast National Petroleum Reserve-Alaska and its effects on Steller's eiders (*Polysticta stelleri*) and spectacled eiders (*Somateria fischeri*). U.S. Department of the Interior, Fish and Wildlife Service, Ecological Services, Endangered Species Branch, Fairbanks, Alaska. 71 pp.

USFWS. 2006. Fish and Wildlife Service ESA Section 7 informal consultation letter to the Minerals Management Service, received January 2006.

van Vliet, G. B. and M. McAllister. 1994. Kittlitz's murrelet: the species most impacted by direct mortality from the *Exxon Valdez* oil spill? Pacific Seabirds 21(2): 4-6.

Vella, G., I. Rushforth, E. Mason, A. Hough, R. England, P Styles, T. Holt and P. Thorne. 2001. Assessment of the effects of noise and vibration from offshore wind farms on marine wildlife. Energy Technology Support Unit W/13/00566/REP. University of Liverpool, Coastal Marine Studies, UK.

Warnock, N. D., and D. M. Troy. 1992. Distribution and abundance of spectacled eiders at Prudhoe Bay, Alaska, 1991. BP Exploration (Alaska), Inc., Anchorage, Alaska. 21 pp.

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

Welty, J. C. 1975. The Life of Birds. W.B. Saunders Company. Philadelphia, Pennsylvania. 623 pp.

Williamson, F. S. L., M. C. Thompson, and J. Q. Hines. 1966. Avifaunal Investigations. Chapter 18 *in* Wilimovsky and Wolfe, eds. Environment of the Cape Thompson Region, Alaska. U.S. Atomic Energy Commission. Washington D.C.

Figure 1: Proposed Lease Sale 193 boundaries and approximate spectacled eider molt migration pathways in the Chukchi Sea (20 m isobath).

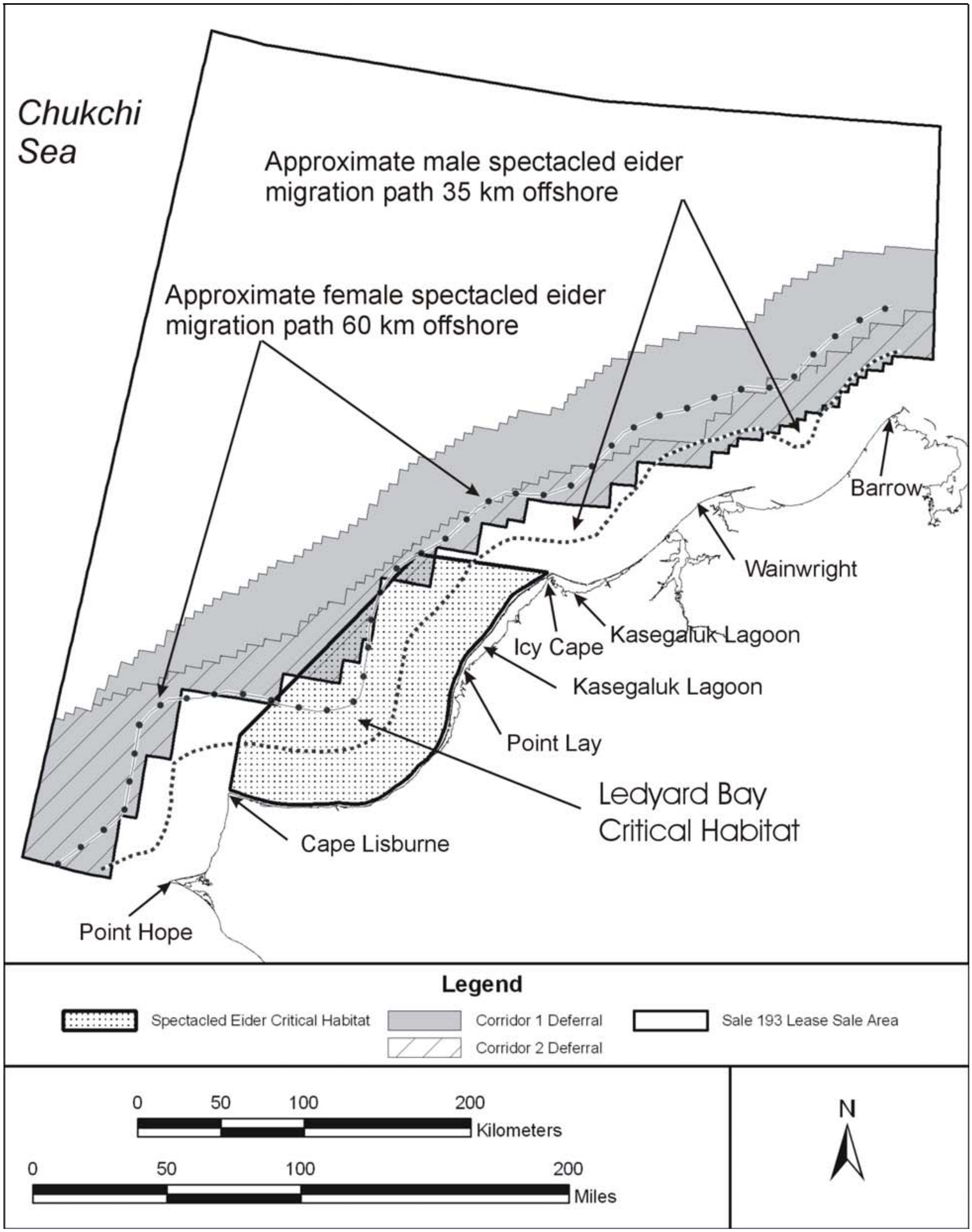


Figure 2: Location of Ledyard Bay spectacled eider Critical Habitat Area (USFWS 2001b).

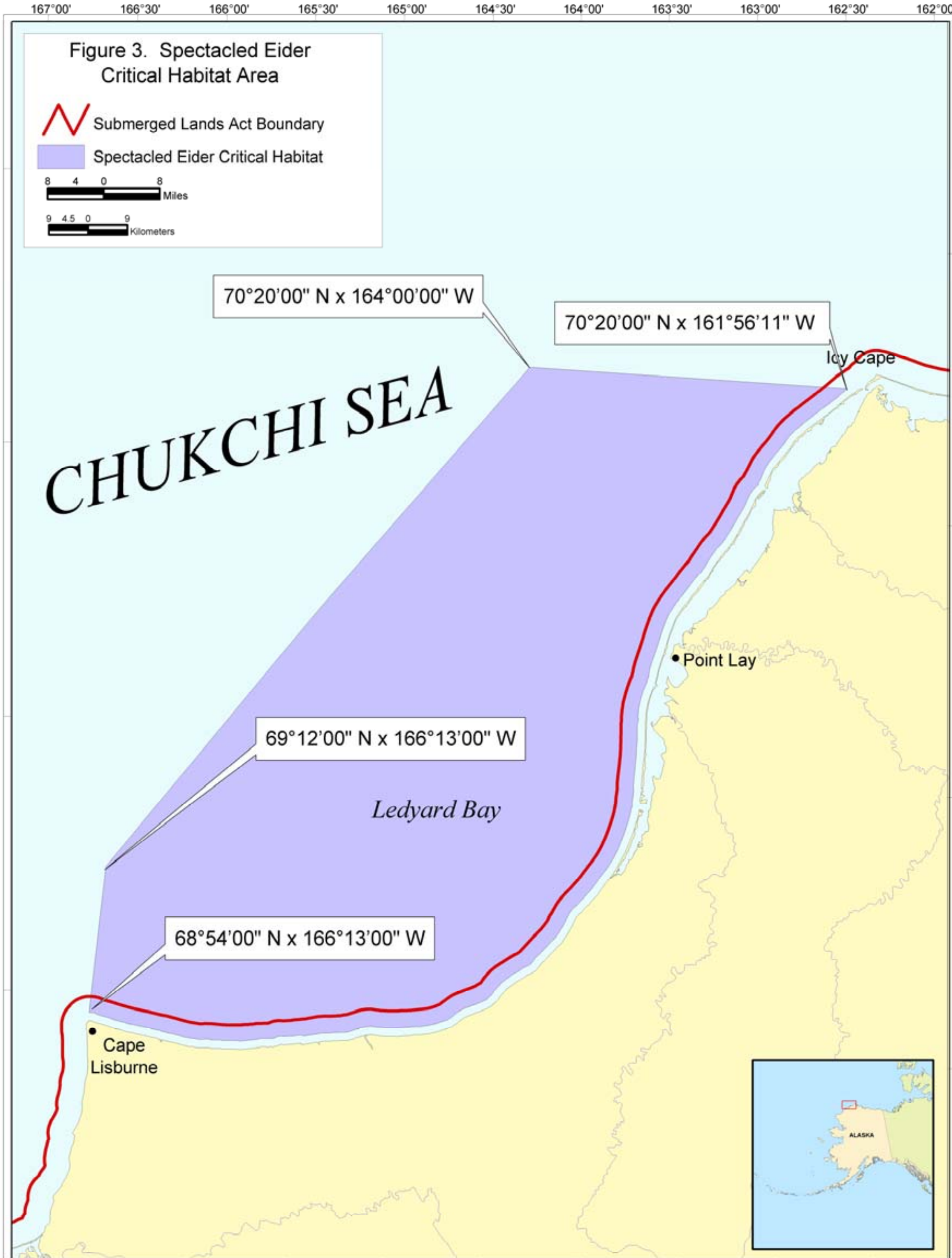
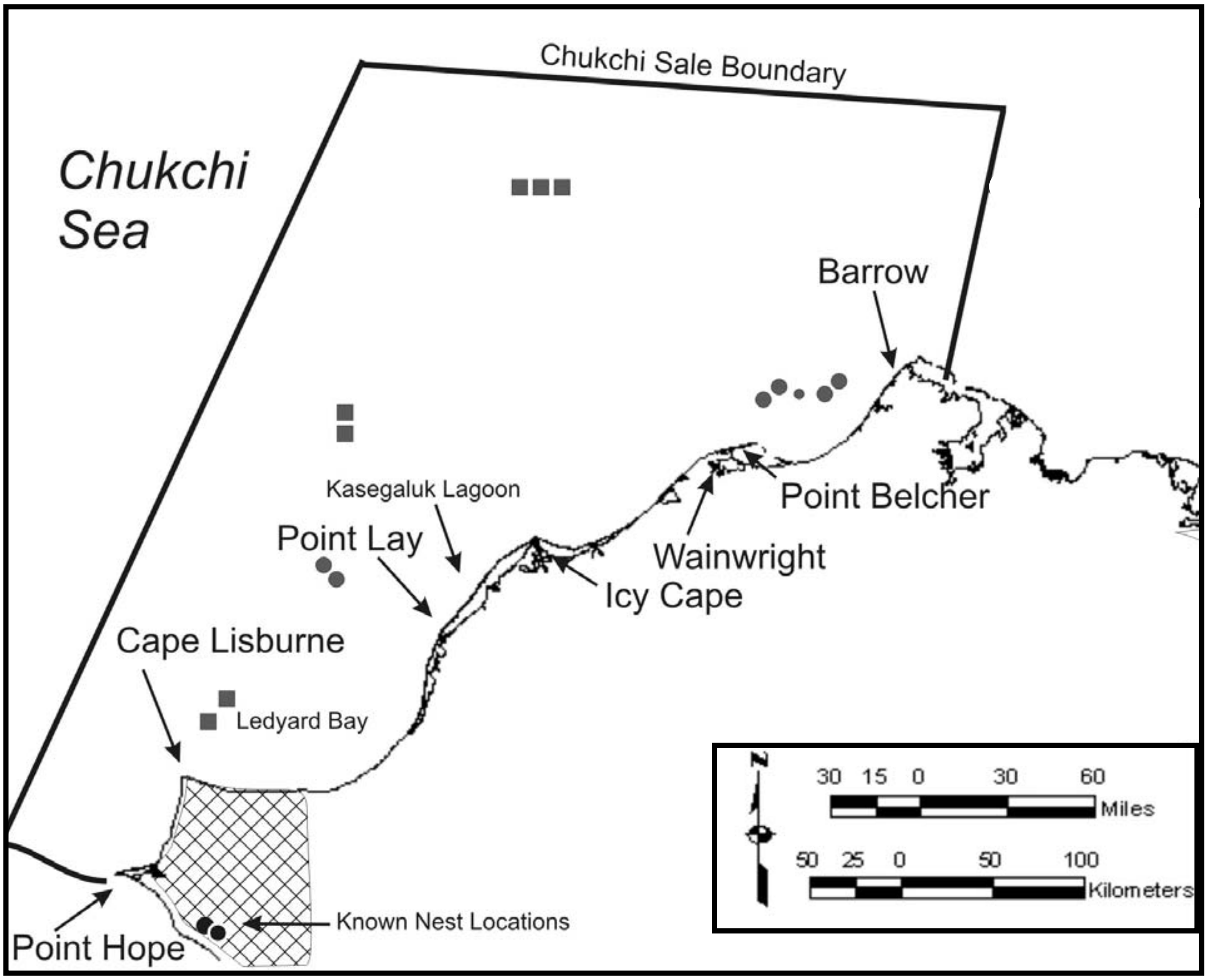


Figure 3: Kittlitz's murrelet offshore observations and nesting information. Potential nesting area based on Day et al. (1999). Nest locations based on USFWS (2004). Offshore observations are designated as blocks (24 August – 22 September) and dots (22 September – 17 October) (Divoky 1987).



Addendum to Biological Evaluation for Chukchi Sea Lease Sale 193: February 6, 2007

The MMS 2002-2007 5-year plan identified Lease Sale 193 in the Chukchi Sea. The proposed sale area included 46 complete or partial lease blocks within the area designated the Ledyard Bay Critical Habitat unit for the spectacled eider in 2001. The draft Environmental Impact Statement (DEIS) for Chukchi Sea Lease Sale 193 included a Biological Evaluation that assessed the potential impacts of the lease sale on birds listed under the Endangered Species Act (ESA). The MMS is completing a National Environmental Policy Act (NEPA) review under a two-tier process with the first phase including seismic surveys and exploration activities. The second phase would evaluate future development plans, with additional ESA Section 7 consultation at that time.

The Chukchi Sea Lease Sale 193 DEIS included specific mitigation measures that allowed seismic surveys within the Ledyard Bay Critical Habitat Area before July 1 of each year when eiders are largely absent. Stipulation 7 of the DEIS also required implementation of a lighting protocol to reduce light radiating from exploration structures. The DEIS, however, did not include conservation measures to reduce the potential adverse effects that exploration and delineation drilling could have on those 46 partial or complete lease blocks within the Ledyard Bay Critical Habitat Area.

Page 6 of the Biological Evaluation (Appendix C, Lease Sale 193 EIS) briefly describes an exploration drilling operation for the Chukchi Sea. A typical exploration plan includes paired drilling vessels, two ice breakers, and about 7 other vessels for support/resupply, anchor handling, and oil spill response. The drill rigs typically remain on-site for about 4 months and each rig could drill, test, and abandon 4 wells per summer, likely fewer. The MMS estimates 7-14 new wells are needed to delineate the first commercial field, which means multiple exploration seasons would be necessary.

Support aircraft during an exploratory drilling program includes fixed-wing aircraft to complete marine mammal surveys. Survey flights would occur on a daily basis, weather permitting. As many as three fixed-wing aircraft could be in the area at any one time. Helicopters would be used for crew changes to each of the drill rigs, estimated to occur twice per day. A search and rescue helicopter could also be present, for a combined maximum of three helicopters in the area at any one time.

The MMS will update the EIS to include modifications to Stipulation 7 to address three types of potential impacts from exploration drilling programs that could occur within the Ledyard Bay Critical Habitat Area. The following are likely to adversely affect spectacled eiders: effects of noise and physical presence of exploration program vessels, effects of noise and physical presence of exploration program support aircraft, and effects from an accidental oil spill. Each of these potential impacts on threatened eiders and other coastal and marine birds are described in the Lease Sale 193 DEIS and Biological Evaluation (Appendix C of DEIS).

The following measures would avoid or minimize adverse effects on spectacled eiders in the Ledyard Bay Critical Habitat Area:

Any exploration and delineation drilling operations in the Ledyard Bay Critical Habitat Area will be completed between November 15 and July 1 unless the following three conditions are met:

a) 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.

Rationale: Noise and physical presence effects on spectacled eiders from vessels are greatest near the source. Requiring support vessels to minimize transit to the drilling sites within the Critical Habitat Area reduces the spatial distribution of this impact when eiders are in the Critical Habitat Area. The requirement that support vessels remain in close proximity to the drilling rig also reduces the overall noise/presence footprint as much as is safely practicable. The disturbance radius from the drilling operation is unknown. Temporal and spatial use patterns for eiders within the Critical Habitat Area are also largely unknown. We assume that most eiders would not intentionally approach the drilling operation and, as a consequence, some eiders may be displaced from using a portion of the Critical Habitat Area during exploration drilling activity. The MMS also assumes that the displacement area is a small portion at the deepwater margin of a much larger area. MMS concludes no incidental take of eiders is anticipated.

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 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 USDOI, FWS, during review of the Exploration Plan.

Rationale: Similar to vessel activity, the effects of noise and physical presence on spectacled eiders are greatest near low-flying aircraft. Altitude restrictions would decrease disturbance impacts to eiders from low-flying aircraft. When aircraft are unable to attain this altitude due to weather, aircraft would use established flight paths at the margin of the Critical Habitat Area that eiders may, over time, chose to avoid or become accustomed to. The MMS concludes that implementation of these measures would decrease disturbance to the maximum extent practicable and no incidental take of spectacled eiders is anticipated.

c) 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.

Rationale: A well blow-out or large (≥ 1,000 bbl) oil spill are considered very low probability events. If either were to occur, whether originating from a lease within the Critical Habitat Area or a lease outside it, the effects have the potential to result in long-term adverse effects on the North Slope spectacled eider population. The lessee, following state and federal guidelines, must take a series of precautions to prevent these incidents.

A more typical event during an exploration drilling program is a small (≤ 50 bbl) spill. Despite precautions to prevent these events, even a small spill could impact a large numbers of molting eiders if they were in close proximity to the source of the spill. A small spill of this size is likely to persist for a two-day period. The requirement that an Oil Spill Response Vessel be on-site during any drilling operations within the Critical Habitat Area would ensure a faster spill response compared to a response from another area, such as Deadhorse or Barrow. Furthermore, a spill response that specifically includes the capability to haze birds away from a spill area could also minimize harm to large flocks of flightless spectacled eiders that may be in the spill vicinity. The MMS concludes that implementation of these measures would further decrease the potential that spilled oil would contact eiders and an incidental take of spectacled eiders is improbable.

Additional Considerations:
Lease Sale 193 has not taken place and it is unknown if the 46 partial or complete lease blocks within the Ledyard Bay Critical Habitat Area will be leased. If these blocks are leased, it would be 2009 at the earliest that exploration drilling could begin.

Re-consultation under Section 7 would be initiated if there is new relevant biological information. For example, industry-sponsored surveys of spectacled eider use of the Ledyard Bay Critical Habitat Area may provide scientific support for modifying mitigation measures. Credible monitoring of eider locations in response to operation of a drilling rig during year-one may also help justify changes in conservations measures for subsequent years. MMS will continue to encourage industry to coordinate survey activities with the USDOI, FWS.

Conclusion:
Exploration and delineation drilling operations on lease blocks within the Ledyard Bay Critical Habitat Area could present new sources of disturbance and oil/toxic pollution that could result in the taking of spectacled eiders. Without implementation of comprehensive mitigation measures to avoid or minimize potential impacts, these activities are *likely to adversely affect* spectacled eiders.

Exploration and delineation drilling operations on lease blocks within the Ledyard Bay Critical Habitat Area could present new sources of disturbance that could decrease use of the critical habitat area by molting spectacled eiders. Without implementation of comprehensive mitigation measures to avoid or minimize potential impacts, these activities are *likely to adversely modify* the Ledyard Bay Critical Habitat Area.