United States Department of the Interior

U.S. FISH AND WILDLIFE SERVICE
Anchorage Fish and Wildlife Conservation Office
4700 BLM Road
Anchorage, Alaska 99507-2546

IN REPLY REFER TO:
FWS/AFES/AFWCO

May 26, 2017

Memorandum

To: Dr. James Kendall, Bureau of Ocean Energy Management, Anchorage, Alaska

From: ***for*** Stewart Cogswell, Anchorage Fish and Wildlife Conservation Office, U.S. Fish and Wildlife Service, Anchorage, Alaska

Subject: Biological Opinion on Lease Sale 244 (Consultation 2016-F-0226)

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the Bureau of Ocean Energy Management's (BOEM) proposed oil and gas Lease Sale 244 and its effects on the federally threatened Alaska breeding Steller's eider (*Polysticta stelleri*), the federally threatened southwest Alaska distinct population segment (DPS) of northern sea otter (*Enhydra lutris kenyoni*), and designated critical habitat for the southwest Alaska DPS of northern sea otter, in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 et seq.). We received your July 13, 2016, request for formal consultation on July 26, 2016.

We have based this biological opinion on information that accompanied your July 13, 2016, request for consultation, including the Draft Environmental Impact Statement (BOEM 2016a) and biological assessment (BOEM 2016b) for oil and gas activities associated with Lease Sale 244. We can make available a record of this consultation at the Anchorage Fish and Wildlife Office.

Consultation History

The following is a summary of the consultation history for this project:

- July 26, 2016, the Service received a Biological Assessment and request from BOEM to initiate formal consultation for effects caused by activities from oil and gas lease sale 244 in lower Cook Inlet.
- August 25, 2016, the Service requested, by letter, additional information from BOEM.

- September 7, 2016, Service staff met with BOEM staff to discuss additional information needs.
- October 7, 2016, the Service received from BOEM a revised Biological Assessment, which addressed the Service's August 25th request for additional information.
- December 21, 2016, the Service received additional information from BOEM as revisions to the October 7th Biological Assessment. BOEM submitted to the Service their Preferred Alternative from the Cook Inlet LS 244 Final Environmental Impact Statement.
- January 10, 2017, the Service acknowledged receipt of BOEM's additional information, and indicated that this receipt of information on December 21, 2016, constituted the official initiation of formal consultation.

Thank you for your cooperation in meeting our joint responsibilities under section 7 of the ESA. If you have questions, please contact Mr. Kevin Foley of our office at kevin_foley@fws.gov or (907) 271-2788.

Attachment: Biological Opinion

BIOLOGICAL OPINION

For the

Oil and Gas Activities associated with Lease Sale 244

Consultation with
Bureau of Ocean Energy Management and
Bureau of Safety and Environmental Enforcement


Prepared by:
Anchorage Fish and Wildlife Conservation Office
U. S. Fish and Wildlife Service
4700 BLM Rd
Anchorage, AK 99507

26 May 2017

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1 INTRODUCTION

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion in accordance with section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq*., ESA), on the Bureau of Ocean Energy Management's (BOEM) proposed oil and gas Lease Sale 244 and its effects on the federally threatened Alaska breeding Steller's eider (*Polysticta stelleri*), the federally threatened southwest Alaska distinct population segment (DPS) of northern sea otter (*Enhydra lutris kenyoni*), and designated critical habitat for the southwest Alaska DPS of northern sea otter.

As described in the document, the proposed Action involves exploration, development, production, and decommissioning of 244 leased blocks associated with BOEM and the Bureau of Safety and Environmental Enforcement (BSEE) Lease Sale 244 (LS 244) in lower Cook Inlet.

The BOEM and BSEE have statutory authority (under 43 USC 1331 *et seq*.) to complete their respective Outer Continental Shelf (OCS) energy development actions in a tiered approach for review under the National Environmental Policy Act (NEPA) and to use an incremental step consultation process under the ESA as described in regulations at 50 CFR 402.14(k). The regulations at 50 CFR 402.14(k) state:

When the action is authorized by a statute that allows the agency to take incremental steps towards the completion of the action, the Service will, if requested by the Federal agency, issue a biological opinion on the incremental step being considered, including its views on the entire action. Upon the issuance of such a biological opinion, the Federal agency may proceed with, or authorize the incremental steps of the action if:

- The biological opinion does not conclude that the incremental step would violate section 7(a)(c);
- The Federal agency continues consultation with respect to the entire action and obtains biological opinions, as required, for each incremental step;
- The Federal agency fulfills its continuing obligation to obtain sufficient data upon which to base the final biological opinion on the entire action;
- The incremental step does not violate section 7(d) of the ESA concerning irreversible or irretrievable commitment of resources; and
- There is reasonable likelihood that the entire action will not violate section 7(a)(2) of the ESA.

At BOEM's and BSEE's request, we are conducting an incremental step consultation. Therefore, this biological opinion examines activities in the First Incremental Step that may result from the proposed Action. The First Incremental Step includes all activities associated with the exploration and delineation activities up to submission of a Development and Production Plan (DPP). Future Incremental Steps include all subsequent steps, including development, production, decommissioning, and all associated activities.

This biological opinion has two components. The first component provides analyses and conclusions as to whether the First Incremental Step would violate section 7(a)(2) of the ESA (i.e., whether this step would likely jeopardize listed species or destroy or adversely modify designated critical habitat) and provides incidental take exemptions for listed Alaska breeding Steller's eider and the southwest Alaska DPS of northern sea otter. In addition, because the First Incremental Step could lead to development, production, and decommissioning, in the second component we also analyze whether there is reasonable likelihood that the entire proposed Action, based on an Exploration and Development Scenario (EDS) prepared by BOEM and BSEE for activities that may result from LS 244, will jeopardize listed species or destroy or adversely modify designated critical habitat. This section 7 consultation and BO, including the *Incidental Take Statement* (ITS) with *Terms and Conditions*, applies to activities associated with Lease Sale 244.

We prepared this biological opinion using BOEM's and BSEE's Draft Environmental Impact Statement (BOEM 2016a), Biological Assessment (BA; BOEM 2016b) and published literature, agency consultation and biological survey reports, other information in our files, and personal communication with experts in the Service.

<ins>Summary</ins>

Based on the limited number of individuals of listed species likely to be affected, and the minor impacts to designated critical habitat combined with the mitigation measures required and/or to be enforced by BOEM and BSEE during the First Incremental Step of the proposed Action, the Service concludes that activities that may occur during the First Incremental Step are not likely to jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat.

We also conclude, based on the best available information at this time, the entire proposed Action, including future incremental steps, is not reasonably likely to jeopardize the continued existence of listed species or to destroy or adversely modify designated critical habitat. However, BOEM and BSEE have an on-going responsibility to ensure that future activities that may result from this action will not jeopardize the continued existence of listed species or destroy or adversely modify designated critical habitat.

As BOEM proposes to authorize specific activities in future increments (e.g., development projects) these proposals will require re-initiation of section 7 consultations. At that time additional information about the nature, location, and timing of proposed oil and gas activities will be available. The Service will evaluate the proposed activities (e.g., Development and Production Plan) and at that time will make a new analysis and conclusion of whether the additional proposed activities are likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat.

2 THE PROPOSED ACTION

This section describes the Proposed Action and includes descriptions of the Action Area, associated assumptions, and mitigation measures proposed by BOEM and BSEE for the proposed oil and gas activities.

2.1 Action Area

The Action Area is the geographic extent in which direct and indirect effects of the Proposed Action may occur. Exploration and development is assumed to occur as a result of activities on the 224 Outer Coastal Shelf (OCS) leased blocks (the Leased Area). The Leased Area is in the northern portion of Cook Inlet and is a small subset of the approximately 5.3 million acre Cook Inlet Planning Area that is located offshore of the State of Alaska just south of Kalgin Island and the Barren Islands and continues south through Shelikof Straight to just above the northern tip of Kodiak Island (Figure 1). The Lease Area consists of approximately 442,875 hectares (ha) (1.09 million acres (ac)), representing approximately 20 percent of the total Cook Inlet Planning Area. The Action Area includes all waters and shorelines of lower Cook Inlet and the Shelikof Straight and is broader than the Lease Area, as structures resulting from the Proposed Action could be constructed in marine waters outside the Leased Area (e.g., platform-to-shore pipelines) and on land for shore facilities (e.g., land pipeline(s) connections).

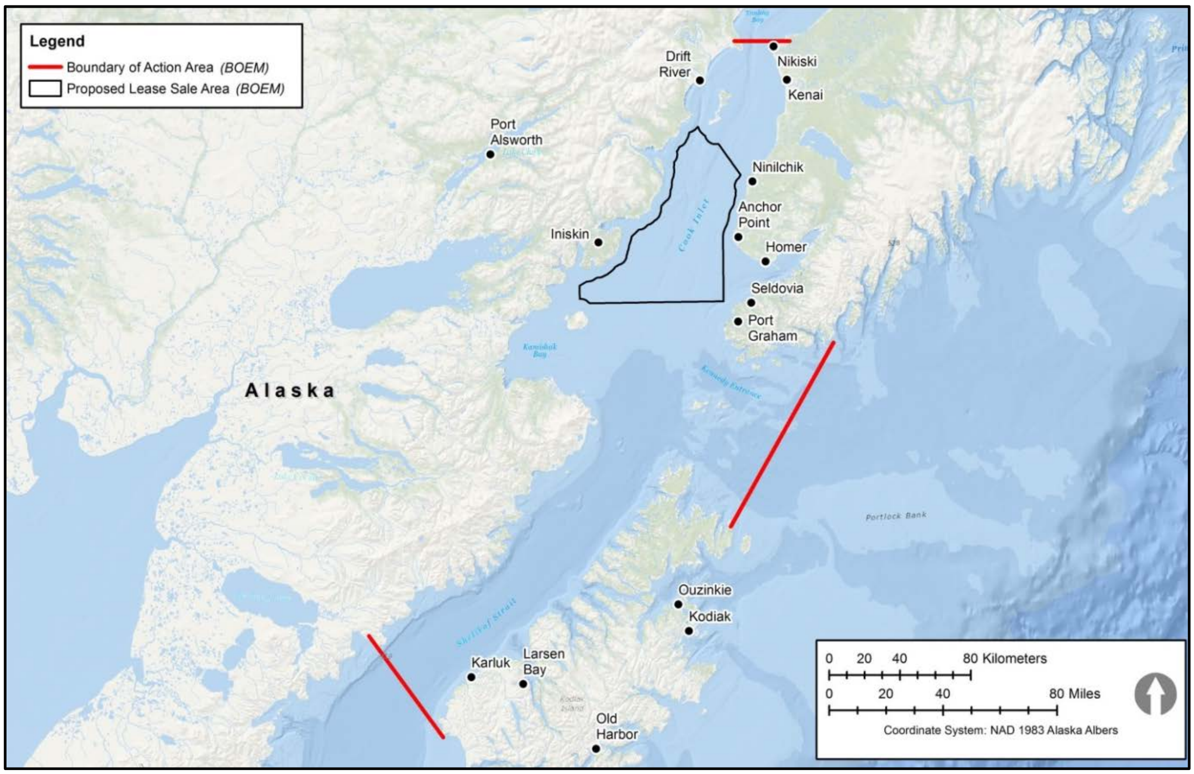

Figure 1. Proposed Action Area.

2.2 Description of the Proposed Action

The Proposed Action entails oil and gas exploration, development, production, and decommissioning in connection with the leases issued through Lease Sale 244. The activities comprising the Proposed Action are further described in the detailed hypothetical EDS that BOEM and BSEE presented in the BA (BOEM 2016b). The EDS considers both development and exploration, and while it is not specific to any existing Exploration Plan (EP), it uses the best available information from previously submitted EPs and previous development elsewhere on the U.S. OCS.

Under the Proposed Action, a large prospect would be discovered, developed, and produced from the Leased Area. It is estimated that approximately 215 million barrels of oil and 571 billion cubic feet of natural gas in two fields within the proposed Lease Sale Area could be discovered and developed as result of Lease Sale 244 (BOEM 2016a). Producing this volume of oil and associated natural gas would require 3 platforms of a steel-caisson design and drilling approximately 160 total wells (exploration, delineation, production, and service). The Proposed Action assumes that oil and gas would be transported from offshore platforms via subsea pipelines to shore where pipelines would continue over land to an existing terrestrial oil pipeline. The Proposed Action also assumes that infrastructure for a liquid natural gas (LNG) pipeline and gas processing would be available and accessible.

For the purposes of section 7 consultation, BOEM and BSEE's Proposed Action is divided into incremental steps. The First Incremental Step includes only exploration activities up to submission of a Development and Production Plan (DPP). Activities associated with the First Incremental Step includes marine seismic, geohazard, and geotechnical surveys, and drill exploration and delineation wells. Future Incremental Steps would include all subsequent development, production, and decommissioning activities including installing platforms, drilling production and service wells, installing onshore gas and oil pipelines, installing offshore gas and oil pipelines, and producing oil and gas (Table 1). The BOEM's and BSEE's request for incremental step consultation is appropriate because of the long-term, multistage nature of BOEM and BSEE decision making under the Outer Continental Shelf Lands Act, as amended (OCSLA; 43 U.S.C. 1331 *et seq*.). Incremental step consultation provides BOEM and BSEE the authority to conduct formal consultation in increments to maximize the opportunity to more accurately evaluate potential effects of the proposed action on listed species and designated critical habitat by considering specific details of activities closer to the time that they become viable (such as through the submission of a DPP to BOEM).

We note, however, that while the Proposed Action represents a reasonably foreseeable suite of exploration, development, production, and decommissioning activities that could potentially occur, considerable uncertainty exists as to what activities will actually be proposed in the future. As specific projects are proposed in this multi-staged oil and gas program, more precise information about the nature and extent of the activities – including the scale and location of the activities and a description of the particular technologies to be employed – will be considered and evaluated in additional ESA consultations and other analyses (such as NEPA) as appropriate. Through this multi-stage process, a dynamic analysis of the potential effects of oil and gas activities is ensured, and additional mitigation measures may be developed and at any stage based on the specific details of the particular projects.

Table 1. Schedule for the Exploration and Development Scenario.

Exploration and Development Scenario Schedule Cook Inlet Lease Sale 244			
Activity	**Beginning Year**	**Ending Year**	**Total Years**
First Incremental Step			
Perform Marine Seismic Surveys	1	2	2
Perform Geohazard Surveys	1	3	3
Perform Geotechnical Surveys	1	3	3
Drill Exploration and Delineation Wells	2	5	4
Future Incremental Steps			
Install Platforms	7	10	4
Drill Production and Service Wells	7	13	7
Install Onshore Oil Pipeline	6	6	1
Install Onshore Gas Pipeline	6	6	1
Install Offshore Oil Pipelines	6	9	2
Install Offshore Gas Pipelines	6	9	3
Oil Production	7	34	28
Gas Production	7	39	33
Decommissioning	35	40	6

2.3 First Incremental Step

The First Incremental Step includes all activities associated with exploration and delineation of oil and gas resources in the proposed Lease Sale Area. Table 2 lists the First Incremental Step activities based on the EDS, including associated vessel and aircraft activity.

The EDS considers two types of on-lease seismic surveys: 1) marine seismic surveys, which generally cover a larger area of leased acreage, and 2) geohazard surveys, which will include side-scan sonar and shallow-penetrating reflection-seismic profiling conducted on a more specific site to detect archeological resources or seafloor features that might be problematic for operations, such as drilling a well, or installing a platform or pipeline. Geohazard surveys often are accompanied by geotechnical surveys, which involve sampling or measuring mechanical properties or stability of near-seafloor sediments.

2.3.1 Marine Seismic Surveys

During the exploration phase, lessees would conduct deep penetration marine seismic surveys to search for and define the prospective areas on lease that could contain hydrocarbon deposits. Two-dimensional (2D) deep penetration seismic surveying techniques would provide broad-scale information over a relatively large area intended for pre-lease exploration, or to provide area-wide geologic information. Three-dimensional (3D) deep penetration seismic surveys would be conducted on a closely spaced grid pattern to provide a more detailed image of the prospect that would then be used to select proposed drilling locations.

Table 2. First Incremental Step Activities Estimated for the Cook Inlet Lease Sale 244 Exploration and Development Scenario.

Activity	**Year(s)**	**Activity Period**	**Estimated Operations**	**Associated Transportation**
Geophysical and Geotechnical Surveys				
3D marine seismic surveys	1-2	Any time without ice formation, generally Mar-Dec	1-2 surveys total. Survey methods could include towed streamer, ocean bottom node (OBN), and ocean bottom cable (OBC).	For towed streamer: 1+ vessel. For OBN: 2 node layout/pick up vessels, 1-2 source vessels, possibly 1-3 smaller utility boats. For OBC: Same as OBN plus 1 vessel for recording. For all survey types an additional vessel for protected species monitoring may be needed. No aircraft.
Geohazard surveys	1-3	Any time without ice formation, generally Mar-Dec	4-5 surveys total. Equipment/methods could include: echosounders, side scan sonar, subbottom profilers, bubble pulsers or boomers, controlled source electromagnetic sounding.	1 survey vessel. An additional vessel for marine protected species monitoring may be needed. No aircraft.
Geotechnical surveys	1-3	Any time without ice formation, generally Mar-Dec	4-5 surveys total.	1 vessel or drilling barge. No aircraft.
Exploratory Drilling Operations				
Exploration and delineation drilling	2-5	Year-Round	A maximum of 3 wells per drilling rig could be drilled, tested, and plugged per drilling season. Drilling would take 30-60 days per well. A total of 7-10 exploration and delineation wells would be drilled (including dry holes and additional unsuccessful wells from other Cook Inlet OCS prospects).	1-2 drilling rigs with a maximum of 1 drilling rig per prospect. 1-2 resupply vessel trips per week per drilling rig during exploration drilling. 1-2 trips total per week (likely from Nikiski or Homer). 1-3 helicopter flights per day per drilling rig while on location. 7-21 trips total per week (helicopters likely traveling from Nikiski or Homer).

Activity	Year(s)	Activity Period	Estimated Operations	Associated Transportation
Government-initiated oil spill response exercises	2-5	Year-Round	1-3 exercises per year, each lasting no more than 1 day. Exercises could involve offshore and shoreline-based equipment deployment. Equipment could include containment boom, temporary storage devices (bladders towed in water or placed on the beach, fast tanks placed on the beach).	The number and types of transportation would vary dependent on the exercise. A likely scenario could include: Vessels (including OSRVs, M/Vs, Class 2, 3, 5, 6, and 8 vessels, containment barges, skiffs). Helicopters for personnel transport, area overflights. Fixed-wing aircraft for area overflights. Landing craft, all-terrain vehicles, and motor vehicles.

Two marine seismic surveys would be conducted during the first two years of the EDS. The support base for seismic exploration would be Kenai/Nikiski, or Homer. The OCS seismic surveys will occur from March to mid-December.

2.3.1.1 2D/3D Open-water Seismic Surveys

Airguns would be the typical acoustic source for marine seismic surveys. To create outgoing sound signals, a high-pressure air pulse from the airguns is released into the water to produce an air-filled cavity (a bubble) that expands and contracts. The size of the individual airgun could range from tens to several hundred cubic inches (in^3). Airguns are usually deployed in an array to produce a more downward-focused sound signal, and airgun array volumes for marine seismic surveys are expected to range from 1,800 to 5,000 in^3, but may range up to 6,000 in^3. Airguns would be fired at short, regular intervals to 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 miles (mi) (Greene and Richardson 1988, Hall et al. 1994).

Marine 3D seismic surveys differ from typical 2D seismic surveys in that survey lines are more closely spaced and concentrated in a particular area. Specifications of a 3D survey depend on client needs, subsurface geology, water depth, and geological targets. A 3D and 2D source array typically consists of two or more subarrays of six to nine airguns each. Source-array size may vary during seismic surveys to optimize resolution of the geophysical data collected at any particular site. Energy output of the array is determined more by the number of guns than by the total array volume (Fontana 2003, pers. communication, as cited in BOEM 2016a). Vessels would usually tow up to three source arrays, depending on survey design specifications. Most operations would use a single source vessel; however in a few instances, more than one source vessel would be used. Vessels conducting seismic surveys would generally be 230 to 394 feet (ft) (70 to 120 meters [m]) long.

The sound-source level (zero-to-peak) associated with typical marine seismic surveys ranges between 233 and 255 decibels re 1 microPascal at 1 m (dB re 1 μPa @ 1 m), with most of the energy emitted between 10 and 120 hertz (Hz). Marine 3D surveys are acquired at typical vessel speeds of 4.5 knots (kn) (8.3 km/hour), and a source array would be activated at approximately 10-15 second intervals, depending on vessel speed. The timing between outgoing source signals may vary for different surveys in order to achieve the desired “shot point” spacing to meet geological objectives; typical spacing is either 82 or 123 feet (25 or 37.5 m).

Sound receivers for a 3D survey would include multiple, four to six streamer-receiver cables, towed behind the source-array. The sound receivers may be towed streamers which consist of multiple hydrophone elements normally towed behind the vessel, or ocean bottom nodes (OBN) that are placed on the seafloor. The OBN contains the geophone and data storage which is downloaded when the string of OBNs is retrieved. Biodegradable liquid paraffin would fill the streamer to provide buoyancy. Solid/gel streamers would also be used. The wide path needed to tow this equipment affects both turning speed, and the area covered in a single pass over a geologic target. Therefore, it is common practice to acquire data using an offset racetrack pattern, whereby each acquisition line is several kilometers (km) away from, and traversed in the opposite direction, of the previously completed track. Vessel transit speeds are highly variable, ranging from 8 to 20 kn (14.8 to 37.0 km/hour) depending on a number of factors including, but not limited to, the vessel itself, sea state, and urgency (the need to run at top speed versus normal cruising speed). Vessel operation time includes data collection, deployment and retrieval of gear, line turns between survey lines, equipment repair, and other planned or unplanned operations. Seismic vessels operate day and night, and a single survey effort may continue for days, weeks, or months, depending on the size of the survey.

Marine 2D seismic surveys would use similar geophysical-survey techniques to those of 3D seismic surveys; however mode of operation and vessel type would be different. The 2D seismic survey vessels generally are smaller than 3D vessels; however larger 3D survey vessels also are able to conduct 2D surveys. Seismic vessels acquiring 2D data are able to acquire data at 4 to 5 kn (7.4 to 9.3 km/hour) and collect between 85 and 110 line miles (137 and 177 line km) per day, depending on the distance between line changes, weather conditions, and downtime for equipment problems. Only one streamer is towed during 2D operations.

Ocean bottom node (OBN) and ocean bottom cable (OBC) seismic surveys would be used to acquire seismic data where water in Cook Inlet is too shallow or where tides make 3D acquisition with streamers difficult. Use of OBN for surveys requires the use of multiple vessels. A typical survey includes: (a) two vessels for cable or node layout/pickup; (b) one vessel for recording (ocean bottom cable (OBC) only); (c) one or two source vessels; and (d) possibly one to three smaller [33 to 49 ft. (10 to 15 m)] utility boats. It is unlikely that helicopters would be used for vessel support and crew changes unless vessel transport poses safety concerns. An additional support vessel may be used to monitor for marine mammals ahead of the survey vessel. Receiver cable lengths for OBN and OBC seismic surveys are typically 2.5 to 5 mi (4 to 8 km) but can be up to 7.5 mi (12 km). Lines seismic-survey nodal receivers are attached to the rope in intervals typically of 131 to 197 ft. (40 to 60 m). Multiple lines of nodes or cables are laid on the seafloor parallel to each other, with a cable spacing of between hundreds of meters to several kilometers, depending on the geophysical objective of the seismic survey. Timing between outgoing source signals with OBN or OBC seismic activities would typically be every 82 or 123 feet (25 or 37.5 m). The source may be a single array, or an array of multiple airguns, which is similar to the 2D and 3D marine seismic surveys.

The OBN surveys may use an acoustical positioning system (or "pinger" system) to position and locate nodes placed on the seafloor. The pinger system consists of a vessel-mounted transceiver and transponders that attached to nodes. The transceiver uses sonar to communicate with the transponders, which in turn emit a response pulse. A pinger system recently used by SAE in Cook Inlet consisted of a transceiver that generated sonar at transmission source levels of 197 dB re 1 µPa (rms) at frequencies between 35 and 55 kilohertz (kHz) and a transponder that produced short pulses of 184-187 dB re 1 µPa (rms) at frequencies also between 35 and 35 kHz (NMFS 2015a).

Under the Proposed Action, BOEM assumes that four to five geohazard surveys could be conducted during the first three years of the EDS. Surveys could occur during any period without ice formation but likely would occur between March and mid-December.

2.3.2 Geohazard Surveys

Prior to submitting an exploration or development plan, oil and gas industry operators are required, pursuant to 30 CFR 550, to evaluate any potential geologic hazards or cultural resources and document the type of benthic community present. The BOEM, Alaska OCS Region, has provided guidelines (Notice to Lessees 05-A01, 5-A02, and 5-A03) that require high-resolution shallow hazard surveys to ensure safe conduct and operations in the OCS at drill sites and along pipeline corridors, unless the operator can demonstrate there is enough previously collected data of good quality to evaluate the site. These data are vital not only when planning for the design and construction of a facility, but also to ensure that all associated activities are completed safely.

Under the Proposed Action, four to five geohazard surveys could be conducted during the First Incremental Step (within first three years) of the EDS (Table 2). Surveys could occur during any period without ice formation but likely would occur between March and mid-December. These surveys would utilize airgun arrays or other sound generating equipment smaller in size and lower in sound level output that those described for 2D and 3D seismic surveys. Ancillary geohazard surveys would be used to:

- Locate shallow water hazards (less than 6,562 ft/2,000 m water depth);
- 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.

Geohazard surveys would employ various geophysical methods (e.g., water depths, seafloor morphology) designed to identify and map hazards (e.g., faults and gas pockets), and potentially collect oceanographic data. Basic components of a geophysical system would include: 1) a sound source, to emit acoustic impulse or pressure waves; 2) a hydrophone or receiver, to receive and interpret the acoustic signal; and 3) a recorder/processor to document the data.

The suite of equipment used during a typical shallow hazard survey consists of:

- *Seismic Systems*. Seismic systems produce sound waves which penetrate the seafloor. The waves then reflect at the boundary between two layers with different acoustic impedances, producing a cross sectional image. The data are then interpreted to infer geologic structure of the area. Seismic energy can be produced by several different sources; they will be discussed briefly below.
- *Single channel high-resolution seismic reflection profilers.* High-resolution seismic reflection profilers, including sub-bottom profilers, boomers, and bubble pulsers, consist of an electromechanical transducer that sends a sound pulse down to the seafloor. Sparkers discharge an electrical pulse in seawater to generate an acoustic pulse. The energy reflects back from the shallow geological layers to a receiver on the sub-bottom profiler or a small single channel streamer. Sub-bottom profilers are usually hull mounted or pole mounted; the other systems are towed behind the survey vessel. Typical acoustic characteristics of sub-bottom profilers are summarized in Richardson et al. (1995) as follows:
    - Sub-bottom profiler: 200 to 230 dB re 1 µPa @ 1 m between 400 Hz and 30 kHz
    - Bubble pulser or boomer: 200 dB re 1 µPa @ 1 m below 1 kHz
- *Multichannel high-resolution seismic reflection systems*. The multichannel seismic system consists of an acoustic source which may be a single small gun (air, water, Generator-Injector, etc.) of 10 to 65 in^3 (0.16 to 1.1 L), or in an array of small airguns usually two or four guns of 10 in^3 (0.16 L). The source array is towed about 9.8 ft (3 m) behind the vessel with a firing interval of approximately 41 ft (12.5 m) or every 7 to 8 seconds. A single 984 to 1,969 ft (300 to 600 m), 12 to 48 channel streamer with a 41 ft (12.5 m) hydrophone spacing and tail buoy is the passive receiver for the reflected seismic waves.

Seismic survey ships are designed to minimize vessel noise because the higher frequencies used in higher resolution work are easily masked by vessel noise. Seismic surveys are site specific, and may cover less than one lease block. Survey extent is determined by the number of potential drill sites in an area. Typical survey vessels travel at 3 to 4.5 kn (5.6 to 8.3 km/hour). A single vertical well site survey may collect about 46 line-miles (74 line-km) of data per site and take approximately 24 hours. If there is a high probability of archeological resources, the 492 by 984 ft (150 by 300 m) grid must extend to 3,937 feet (1,200 m) from the drill site.

1. *Echosounder*. Echosounders measure the time it takes for sound to travel from a transducer, to the seafloor, and back to a receiver. Travel time is converted to a depth value by multiplying it by the sound velocity of the water column. Single beam echosounders measure the distance of a vertical beam below the transducer. The frequency of the individual single beam echosounders can range from 12 and 60 kilohertz (kHz) with source levels between 180 to 200 dB re 1 µPa @ 1 m (rms).
2. *Side scan sonar*. Side scan sonar is a sideward-looking, narrow-beam instrument that emits a sound pulse and ‘listens” for its return. Side scan sonar can be a two- or multi-channel system with single frequency monotonic or multiple frequency Compressed High Intensity Radar Pulse (CHIRP) sonar acoustic signals. The frequency of individual side

scan sonars can range from 50 to 500 kHz with sonde source levels between 220 to 230 dB re 1 μPa @ 1 m (rms).

2.3.3 Geotechnical Surveys

In addition to geohazard surveys, other ancillary activities may provide more detailed information about a prospective site. These are important for understanding such site characteristics as sediment structures and a variety of hazard information.

Geotechnical surveys are conducted to collect bottom samples to obtain physical and chemical data on surface and near sub-surface sediments. Sediment samples typically are collected using a gravity/piston corer, grab sampler, or dredge sampler. Shallow coring 1 to 500 ft. (0.3 to 152 m depth), using conventional rotary drilling from a boat or drilling barge, is another method used to collect physical and chemical data on sub-surface geology.

Under the proposed action, four to five geotechnical surveys may be conducted during the first three years of the EDS. Surveys may occur during any period without ice-formation but are likely to occur in March to mid-December (Table 2).

2.3.4 Exploration and Delineation Drilling

During the First Incremental Step BOEM and BSEE anticipate exploration drilling operations would employ the use of Mobile Offshore Drilling Units (MODUs) with support vessels and aircraft. Examples of MODUs include drillships and jackup rigs.

Drillships are maritime vessels that are equipped with a drilling apparatus. Most are built to the design specifications of the company, but some are modified tanker hulls that have been equipped with a dynamic positioning system. One example of a drillship that has been used on the Alaska OCS is the *M/V Discoverer* (also known as the *Noble Discoverer*). Shell Oil has proposed, in prior applications, to use the *Discoverer* for drilling in the Chukchi and Beaufort Seas and used the vessel in their 2012 exploratory drilling in the leased area (Shell offshore Inc. 2010; Bisson et al. 2013). The *Discoverer* is a drillship, built in 1976, that has been retrofitted for operating in Arctic waters. It is a 512 ft. (156 m) conventionally-moored drillship with drilling equipment on a turret. It mobilizes under its own power, and can therefore be moved off the drill site with help from an anchor handler.

Depending on the circumstances, the procedure and time required to move off a drill site can change. In extreme emergencies, this process can be completed in less than 1 hour, although the process could take 4 to 12 hours in other situations (e.g., operations are temporarily curtailed in response to a hazard such as sea ice). Typical transit speed of the *M/V Discoverer* is 8 kn (14.8 km/hr). Sounds produced by the *Discoverer* were measured in the Chukchi Sea during 2012 activities, and the broadband source level of the *Discoverer* while drilling was 182 dB re 1 μPa (rms) (Bisson et al. 2013).

Support vessels would be used to assist the drillship with anchor handling, oil spill response, refueling, resupply, and servicing. Resupplies would also potentially occur via a support helicopter from the shore to the drill site. The total number of support vessels and aircraft would depend on local conditions and the design of the exploration plan, however BOEM and BSEE estimate up 1 to 2 vessel resupply trips per week and 7 to 21 helicopter flight trips per week for 1 to 2 drilling rigs (Table 2).

Jack-up rigs are offshore structures composed of a hull, support legs, and a lifting system that allow them to be towed to a site, lower the legs into the seabed while elevating the hull to provide a stable work deck. Because jack-up rigs are supported by the seabed, they are preloaded when they arrive onsite to simulate maximum expected support leg load and ensure that, after being jacked to full airgap (maximum height above the water), and experiencing operating loads, the supporting soil would provide a reliable foundation. Actual dimensions of a jack-up rig would depend on the environment in which the unit would operate and the maximum operating water depth. A typical jack up rig with a maximum operating depth of 164 feet (50 m) is approximately 164 feet (50 m) in length, 144 feet (44 m) in beam, and 23 feet (7 m) in depth.

Noise levels from jack-up rigs have not been measured in the Arctic or elsewhere (Wyatt 2008). However, because jack-up rigs use the same general drilling machinery as drillships, they are expected to produce noise levels similar to those produced by drillships (discussed above). Furthermore, noise levels transmitted into the water from bottom-founded structures are expected to be less than levels produced by drillships because a jack-up rig's vibrating machinery is not in direct contact with the water. As with drillships, support vessels would be used to assist with oil spill response, refueling, resupply, and servicing. There is also the potential for re-supply to occur via support helicopters from the shore as described previously (Table 2).

Exploration and delineation drilling will disturb an area of the seafloor. The total area of seafloor disturbance will depend on the number of wells drilled from jack-up rigs. The area of disturbance will also vary based on ocean currents and other environmental factors, but in general includes disturbance from the mud cellar, the anchoring system for legs of the jack up rig, displacement of sediments, and discharges from the drill hole. It is estimated that each set-up of a jack-up rig disturbs a seafloor area of approximately 2.5 ac (1 ha) (BOEM 2012). Assuming 10 exploration and delineation wells will be drilled with a jack-up rig, a total of approximately 25 ac (10 ha) of seafloor could be disturbed.

Drilling operations in Cook Inlet are anticipated to range between 30 and 60 days per well at different well sites depending on a number of factors including the depth of the well, delays during drilling, and time needed for well logging and testing operations. The BOEM anticipates three wells per drilling rig could be drilled, tested, and plugged during a single drilling season using one drilling rig. Assuming a discovery is made by an exploratory well; delineation wells may be drilled to determine the areal extent of economic production. The BOEM assumes as many as 10 wells may be associated with exploring and delineating a prospect well.

2.3.4.1 Discharges

2.3.4.1.1 Authorized Discharges

During the First Incremental Step, drilling fluids would be reconditioned and reused with 80 percent efficiency. All drilling wastes (mud and rock) will be discharged at the exploration site. Discharges from exploratory operations in Cook Inlet would be permitted under a National Pollutant Discharge Elimination System (NPDES) General Permit issued by the Environmental Protection Agency (EPA) with a term of 5 years. Discharges under a General Permit for exploration would include sanitary waste, domestic waste, drilling fluids, drilling cuttings, and deck drainage. Detailed information on the types and properties of anticipated discharges from routine oil and gas activities is contained in BOEM’S Draft Environmental Impact Stement (DEIS; BOEM 2016a). The BOEM and BSEE estimate the average exploration or delineation well will produce approximately 435 tons of mud and 747 tons of dry rock cuttings. The current National Pollutant Discharge Elimination System (NPDES) in the action area is the 2015-2020 NDPES General Permit for Oil and Gas Exploration Facilities on the OCS in Cook Inlet (AKG 28-5100) (USEPA 2015).

2.3.4.1.2 Unauthorized Discharges

Small Spills

During the First Incremental Step, small numbers of low volume refined oil spills (less than 1,000 barrels (bbl)) would be likely to occur. These small spills would be limited to refined oils because crude and condensate oils would not be produced during the First Incremental Step. Refined oils are used in exploratory drilling activity for refueling and equipment operations. Small refined oil spills during seismic, geophysical and geotechnical surveys would occur during the First Incremental Step from March through December; small spills from exploratory drilling may occur year-round.

The estimated total numbers and volumes of small refined oil spills during the First Incremental Step activities are presented in Table 3. The BOEM and BSEE estimate that approximately 0 to 10 spills of diesel and other refined products, of low volume (less than 1,000 bbl), and largely recoverable, could occur during the First Incremental Step (BOEM 2016a, Appendix A, Section A-5). The BOEM and BSEE estimate 0 to 6 spills during the Proposed Action’s geological and

Table 3. Cook Inlet Lease Sale 244 Action Area Oil Spill Estimates: ESA First Incremental Step.

ESA Step	Phase	Exploration Activity	Source of Spill	Number of Spill(s)	Size of Spill(s) (in bbl)	Estimated Total Spill Volume	Frequency of Occurrence
First Incremental Step	Exploration	**Small Spills (Diesel and other Refined Products)**					
		Geological and Geophysical Activities[1]	Offshore	0-6	<1 or one up to13 bbl	0-<18 bbl	>99.5 percent chance of a small spill
		Exploration Drilling Activities	Offshore and/or Onshore Operational Spills from All Sources	0-4	5 bbl or one up to 50 bbl	0-65 bbl	
		Large Spills (Diesel or Crude)					
		Exploration Drilling Activities					Not estimated to occur
		Very Large Oil Spills (Crude)					
		Exploration Drilling Activities					Not estimated to occur

Note: [1] ‘Geological and Geophysical Activities’ include marine Government-initiated seismic surveys, geohazard surveys and geotechnical surveys.
Source: BOEM (2016a), Appendix A, Table A.1-1 and Section A.1.2.3.

geophysical activities would be less than 1 bbl; one would be up to 13 bbl (BOEM 2016a, Appendix A). The BOEM and BSEE estimate that most spills originating from the Proposed Action's exploration and delineation drilling activities would range up to 5 bbl; one would be up to 50 bbl. For the purpose of analysis, BOEM and BSEE assume that one 13 bbl spill and one 50 bbl spill would occur during the First Incremental Step. Refined spills of the assumed spill sizes (less than 13 bbl and 50 bbl) evaporate and disperse within 24 and 48 hours, respectively (BOEM 2016a, Appendix A, Table A.1-23).

Large Spills

The BOEM and BSEE estimate that large spills, greater than 1,000 to 120,000 bbl, would not occur during the First Incremental Step based on historical oil spill data. In the course of drilling over 15,000 exploration wells on the OCS from 1971 to 2010, no crude oil spills greater than or equal to 1,000 bbl have occurred during exploration, with the exception of the Deepwater Horizon (DWH) incident. Furthermore, no large spills are expected to occur during the First Incremental Step because a very small fraction of spills are estimated during the relatively short exploration and delineation phase compared to the total spill frequency for future incremental steps (which include development and production).

Very Large Oil Spills

During the First Incremental Step, BOEM and BSEE anticipate it would be highly unlikely (but the risk cannot be wholly eliminated) that a very large oil spill (VLOS; defined by spills greater than 120,000 bbl) could occur from a loss of well control followed by a long duration flow. A VLOS is extremely unlikely because the frequency of such spills from loss of well control is extremely low. Therefore, while the potential impacts of a VLOS would be substantial if one were to occur, and such effects were analyzed in Appendix A, Section A-7 and Appendix B of the Draft EIS (BOEM 2016a) for the purpose of evaluating a low-probability, high impact event, the effects of a VLOS are not considered reasonably certain to occur. Therefore, a VLOS is not considered a direct or indirect effect of the First Incremental Step and is beyond the scope of analysis here.

2.3.5 Oil Spill Response Drills

Government initiated oil spill response exercises or spill response practice activities may occur and could include oil spill response equipment deployment, vessels and/or aircraft traffic, unmanned aerial surveillance, and personnel or vehicle movement. Typical deployment exercises last only a few hours and are rarely longer that a day (USDOI, BSEE official communication 2015). Deployment exercises are generally limited to a single skimming system involving from one to six vessels, but can also be scaled up to require the operator to demonstrate their ability to carry out a larger scale response in accordance with their Oil Spill Response Plan (OSRP).

2.3.6 Transportation

Under the Proposed Action, marine vessels would be the primary form of transportation during the First Incremental Step (Table 2). Aircraft would support exploratory drilling activities and would likely be used during government-initiated oil spill response exercises. The number of vessels deployed for seismic surveys would be dependent on the type of survey. Vessels used during exploration surveys would be largely self-contained; therefore, helicopters would not be used for routine support of operations. Under the Proposed Action, smaller support vessels likely operating out of Homer or Nikiski would make occasional trips (one to two round-trips per week) to refuel and resupply survey vessels. Additionally, a mitigation vessel may accompany the seismic survey vessel as part of observer protocol to mitigate harassment of marine mammals or other wildlife.

Operations at remote locations in the Lease Sale Area would require transportation of supplies and personnel by different means, depending on seasonal constraints and phase of the operations. While lower Cook Inlet remains relatively ice-free during winter months, water conditions may prevent supply vessels from tying up safely at a platform. Under these conditions, helicopters would be used for basic resupply and crew rotation operations.

During exploration drilling, operations would be supported by both helicopters and supply vessels (Table 2). Helicopters would likely fly from Nikiski or Homer at a frequency of one to three flights per day per drilling rig. Support-vessel marine traffic, also likely from Homer or Nikiski, would occur at a frequency of one to two trips per week per drilling rig.

The numbers and types of transportation used during government-initiated oil spill response exercises would vary dependent on the exercise but would likely include vessels (e.g., OSRVs, M/Vs, containment barges, skiffs), helicopters, fixed-wing aircraft, and terrestrial transportation (Table 2).

2.4 Future Incremental Steps

Future Incremental Steps include all activities that would occur after exploration and delineation, and the approval of a DPP. These activities include development, production, and decommissioning. Table 4 details the activities anticipated during Future Incremental Steps, including associated transportation.

Development of the field would begin in the sixth year after exploration starts, and BOEM and BSEE assume that most development activities would occur through the ninth year. The BOEM and BSEE anticipate that production activities would begin in approximately the seventh year and continue through the 39th year. Decommissioning would commence after oil and gas reserves at a given platform are depleted, and income from production no longer pays operating expenses. To comply with BSEE regulations (30 CFR 250.1710—wellheads/casings and 30 CFR 250.1725— platforms and other facilities), lessees are required to remove all seafloor obstructions from their leases within 1 year of lease termination or relinquishment. The BOEM and BSEE estimate that decommissioning would begin in the 35th year and continue through the 40th year (Table 1). The BOEM (2016a) states that the schedule of activities is compressed and ambitious, assumes no delays of any kind, and assumes immediate commitment from operator(s) after a successful exploration program.

2.4.1 Development Activities

Development activities include installing production platforms and pipelines, drilling production wells, and installing tie-ins to existing shore-based infrastructure. Figure 2 shows the schedule of platform installation and well drilling from the EDS.

Table 4. Future Incremental Step Activities Estimated for the Cook Inlet Lease Sale 244 Exploration and Development Scenario.

Activity	Year(s)	Activity Period	Estimated Operations	Associated Transportation
Development and Production				
Onshore oil pipeline installation	6	Year-Round	50 mi of oil pipeline from landfall to existing processing facility (likely between Nikiski and Homer). Longer distances may be required for rerouting.	5 terrestrial vehicles. No vessels or aircraft.
Onshore gas pipeline installation	6	Year-Round	50 mi of gas pipeline from landfall to existing processing facility (likely between Nikiski and Homer). Longer distances may be required for rerouting.	5 terrestrial vehicles. No vessels or aircraft.
Offshore oil pipelines installation	6-9	May-Sept	60-85 mi of oil pipelines from the initial platform to shore and between platforms (distance will vary within this range based on actual prospect locations). Where subsea soil conditions allow, pipelines will be trenched using a subsea trenching jet. If burial is not possible anchors may be used to support and stabilize the pipeline.	2 vessels. 2 terrestrial vehicles. No aircraft.
Offshore gas pipeline installation	6-9	May-Sept	60-115 mi of gas pipelines from the initial platform to shore and between platforms (distance will vary within this range based on actual prospect locations). Where subsea soil conditions allow, pipelines will be trenched using a subsea trenching jet. If burial is not possible anchors may be used to support and stabilize the pipeline.	Gas pipeline installation will utilize the same 2 vessels and 2 terrestrial vehicles as oil pipeline installation.
Platform installation	7-10	Year-Round	A total of 3 platforms, each with 24 well slots, would be installed.	1-3 supply vessel trips per platform per week. 3-9 supply vessel trips total per week. Vessels needed for platform installation would be dependent on the type of platform installed. Installation typically requires 2 barges with cranes for platform stabilization/positioning and hoisting of modules topside of the platform. Tug boats also could be used for stabilization & positioning depending on structure type. Helicopters - 1-3 flights per platform per day. 21-63 flights total per week.

Activity	Year(s)	Activity Period	Estimated Operations	Associated Transportation
Drill production and service wells	7-13	Year-Round	A total of 55 to 66 production and service wells would be drilled at a maximum rate of 6 wells per platform per year. Service wells would make up 15 to 23 percent of wells (i.e., 10 to 12 service wells are anticipated). During production/service drilling both drilling fluids and cuttings will be disposed of in service wells and/or barged to shore.	1-3 flights per platform per day. 21-63 flights total per week. 1-2 vessel trips per platform per week. 3-6 vessel trips total per week. 1-2 barge trips per platform per week for disposal. A maximum of 5-6 trips per week would be possible during the brief period when all 3 platforms could be drilling production and service wells, however, the number of barge trips generally would be <5-6 per week.
Oil production	7-34	Year-Round		1-3 flights per platform per day. 21-63 flights total per week. 1-2 vessel trips per platform per week. 3-6 vessel trips total per week.
Gas production	7-39	Year-Round		Transportation is included in "oil production," above. Transportation for gas production would continue at the same levels for years 35-39 (i.e., after the end of oil production is anticipated).

Activity	Year(s)	Activity Period	Estimated Operations	Associated Transportation
Government-initiated oil spill response exercises	7-39	Year-Round	1 exercise per operator every 1-3 years, each lasting no more than 1 day. Exercises could involve offshore and shoreline-based equipment deployment. Equipment could include containment boom, temporary storage devices (bladders towed in water or placed on the beach, fast tanks placed on the beach).	The number and types of vessels, aircraft, and onshore transportation would vary dependent upon the exercise. A likely scenario could include: Up to 30 vessels (including OSRVs, M/V, Class 2, 3, 5, 6, and 8 vessels, containment barges, skiffs). Helicopters for BSEE personnel transport, area overflights. Fixed-wing aircraft for area overflights. Landing craft, all-terrain vehicles, and motor vehicles for personnel transport.
Decommissioning				
Decommissioning	35-40	Year-Round	When income from production no longer pays operating expenses, the operator will begin to shut down facilities. Typical decommissioning includes the following: Wells will be permanently plugged with cement. Wellhead equipment will be removed. Processing modules will be removed from platforms. Subsea pipelines will be cleaned, plugged at both ends, and left buried in the seabed. Platforms will be disassembled and removed from the area. Seafloor will be restored to pre-activity conditions.	The number and types of vessels, aircraft, and onshore transportation would vary dependent upon the decommissioning activities. Use of vessels, including barges with cranes and tugs for platform removal, is anticipated. Terrestrial transportation and equipment for onshore decommissioning would be similar to that used during installation. Aircraft and terrestrial transportation to support decommissioning efforts and possible post-decommissioning surveys likely would occur.

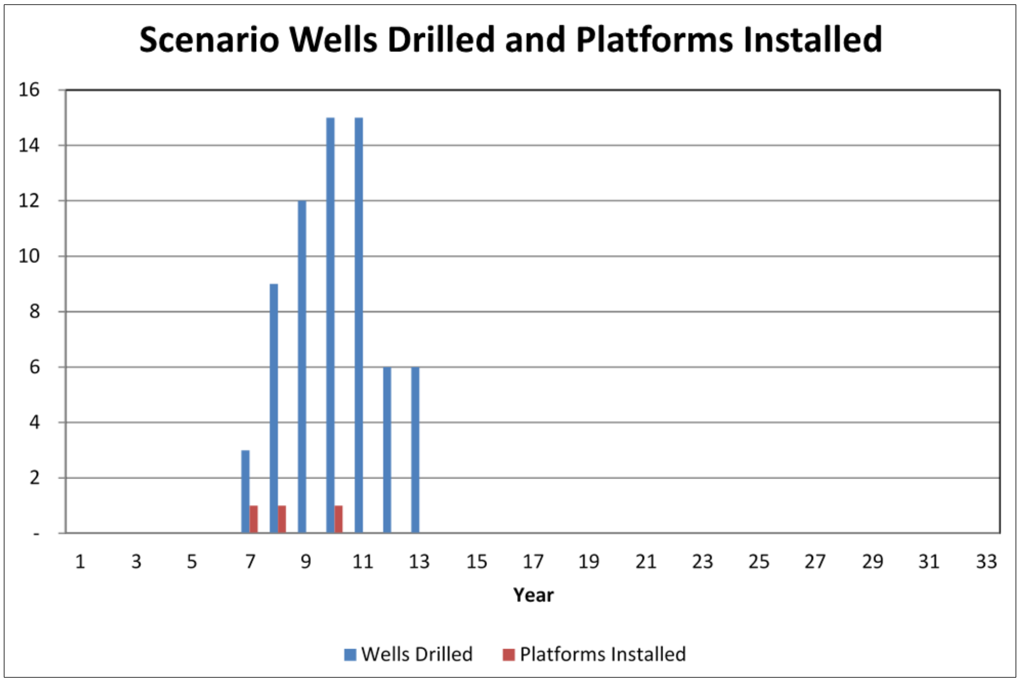

Figure 2. Production and service well drilling and platform installation schedule (BOEM 2016b).

2.4.2 Infrastructure Development

2.4.2.1 Pipelines

In the EDS, development would begin in the sixth year with the installation of oil and gas pipelines (on- and offshore). Pipeline installation is expected to continue through the ninth year (Tables 1 and 4). Construction of the pipelines is anticipated to occur between the beginning of May and the end of September. The lessee would coordinate with landowner(s) and relevant government agencies to obtain all necessary permits and authorizations for onshore activities, which may include separate ESA consultation processes. The BOEM and BSEE assume that existing onshore facilities will be used as shore bases.

The preferred method to transport oil and gas to shore would be via subsea pipelines from the initial platform to the nearest landfall location, probably on the Kenai Peninsula between Homer and Nikiski, depending upon where the first commercial oil discovery is located. The second and third platforms would have pipelines linking them to the initial platform. Offshore oil and gas pipelines are estimated to be 60 to 85 mi (96.6 to 136.8 km) and 60 to 115 mi (96.6 to 185.1 km) in length, respectively, although the actual distance is expected to vary within this range based on actual prospect locations. The maximum estimated offshore gas pipeline length differs from the maximum extent estimated for the offshore oil pipelines because EDS considers the possible development of a gas-only field that is farther from the potential shore base locations. Based upon the distance from pipelines already in place in upper Cook Inlet, it is not anticipated that any of the production platforms from new discoveries in the lower Cook Inlet will be able to utilize any existing pipelines.

The primary pipeline carrying produced oil from the initial platform to shore would be a 12-in (30-cm) diameter pipeline, based upon the anticipated production rates from the discovered prospects. Where subsea soil conditions allow, the pipelines would be trenched using a subsea trenching jet similar to the method employed for the proposed Trans-Foreland pipeline to be installed between the Kustatan Production Facility on the west side of Cook Inlet to the Kenai Pipeline Company Tank Farm near Nikiski. If soils are not conducive to pipeline burial, anchors may be used to provide support and stability for the pipeline necessary to resist tidal movements.

Seafloor disturbance as a result of pipeline construction, trenching, or associated anchors would depend on the final length of the pipelines and whether trenching occurs. It is estimated that placement disturbs between 1.25 and 2.5 ac (0.5 and 1 ha) of seafloor per 0.6 mi (1 km) of pipeline, with the uncertainty depending on whether trenching is required (Cranswick 2001). The BOEM estimates that the total length of the offshore oil pipelines would range from 60 to 85 mi (96 to 137 km), and the total length of the offshore gas pipelines will range from 60 to 115 mi (96 to 185 km), depending on the actual platform and landfall locations. For the total potential pipeline length of 200 mi (322 km), BOEM estimates that 398 to 796 ac (161 to 322 ha) of seafloor could be disturbed, depending on the amount of trenched and buried pipe.

2.4.2.2 Production Platforms

In the EDS, BOEM and BSEE anticipate platform installation would commence in the seventh year (Tables 1 and 4). Three steel-caisson production platforms would be installed over the course of 4 years and it is assumed that installation activities would occur year-round. Each of the three platforms in the Scenario would house production and service (injection) wells, processing equipment, fuel, and quarters for personnel. The first platform would serve as a hub, connecting pipelines from other platforms to the main pipelines to shore. The 2012 Leasing Programmatic Environmental Impact Study (EIS) estimates each production platform will disturb approximately 3.7 ac (1.5 ha) of seafloor (BOEM 2012).

2.4.2.3 Production and Service Wells

Each platform would contain up to 24 well slots. A maximum of six wells per year per platform may be drilled. Production and service well drilling is expected to begin in the seventh year and continue through the 13th year (Table 1). A total of 55 to 66 production wells would be drilled with 10 to 12 of these (15-23 percent) being service wells. No additional area of surface disturbance from drilling multiple development wells from production platforms is expected.

2.4.3 Transportation

Table 4 presents transportation types and trip frequencies estimated to occur during future incremental steps by activity type.

The OCS construction (i.e., platform and pipeline installation) and development drilling operations would be supported by both helicopters and supply vessels from existing facilities located in either Homer or Nikiski. The BOEM and BSEE estimate up to three helicopter flights per day during development operations. Support-vessel traffic is estimated to consist of one to three trips per platform per week from either Homer or Nikiski (Table 4).

Pipeline installation would occur between May and September during years 6 through 9 (Table 4). Both oil and gas pipelines would be installed simultaneously. Two vessels, a laying vessel and a trenching vessel, likely would be used for installation.

Platform installation would occur year-round during years 7 through 10 (Table 4). Transport and placement of platforms would require the short-term use of vessels for transport and placement. Installations typically require two barges with cranes and one or more tugs to help tow, position, and stabilize platforms and to hoist modules topside.

During the drilling of production and service wells, drilling fluid and cuttings may be disposed of in service wells and/or barged to shore for disposal. Transportation of cuttings for onshore disposal is estimated to require one to two barge trips per platform per week. A maximum of five to six trips per week would be possible during the brief period when all three platforms could be drilling production and service wells, however, the number of barge trips generally would be less than five to six per week (Table 4).

During Future Incremental Steps government initiated oil spill response exercises would occur every 1 to 3 years. The numbers and types of transportation used during government-initiated oil spill response exercises would vary dependent on the exercise but would likely include vessels (e.g., OSRVs, M/Vs, containment barges, skiffs), helicopters, fixed-wing aircraft, and terrestrial transportation (Table 4).

2.4.4 Production Activities

In the EDS, BOEM and BSEE estimate that oil and gas production would begin in the seventh year (Table 4). Oil production would continue through the 34th year and gas production would continue through the 39th year.

During normal production operations, the frequency of helicopter flights offshore would remain the same as during development (one to three per platform per day), but marine traffic would drop to about one to two trips per week to each platform. Marine traffic would occur year round since this area remains ice free during the winter. If barges are used to transport the drill cuttings and spent mud from production wells during drilling operations, a dedicated barge could make one to two trips per platform per week to an onshore disposal facility.

2.4.5 Decommissioning Activities

The BOEM and BSEE estimate that decommissioning activities would begin in the 35th year (Table 2). Decommissioning would commence after oil and gas resources are depleted and income from production no longer pays operating expenses. The MODUs would be used to permanently plug wells with cement. Wellhead equipment would be removed, and processing modules would be moved off platforms. Subsea pipelines and flowlines would be decommissioned by cleaning the line, plugging both ends, and leaving it in place buried in the seabed. Lastly, the platforms would be disassembled and removed using vessels, and the seafloor site would be cleared of all obstructions and restored to some practicable predevelopment condition. Post-decommissioning surveys would be required to confirm that no debris remains.

The number and types of vessels, aircraft, and onshore transportation would vary depending upon the decommissioning activities. Use of vessels, including barges with cranes and tugs for platform removal, is anticipated. Terrestrial transportation and equipment for onshore decommissioning would be similar to that used during installation. Aircraft and terrestrial transportation to support decommissioning efforts and possible post-decommissioning surveys likely would occur (Table 2).

2.4.6 Discharges

2.4.6.1 Authorized Discharges

Discharges from development, production, and decommissioning operations in Cook Inlet would be permitted under a National Pollutant Discharge Elimination System (NPDES) General Permit issued by EPA with a term of 5 years. Discharges under a General Permit for exploration would include sanitary waste, domestic waste, drilling fluids, drilling cuttings, and deck drainage. The production fluids (oil, gas, and water) would be gathered on the platforms where gas and produced water would be separated, and gas and water reinjected into the reservoir using service wells. During the later gas sales phase, only water would continue to be reinjected. Disposal wells would handle wastewater from the crew quarters on the platforms. As with discharges from other Future Incremental Steps, discharges from decommissioning activities would also include sanitary waste, domestic waste, deck drainage, desalination unit waste, cooling water, ballast and bilge water, and other miscellaneous effluents.

2.4.6.2 Unauthorized Discharges

The BOEM and BSEE's estimate of the chance of spills occurring assumes that the exploration and development activities described in the EDS will occur, and 215 million barrels of crude oil, natural gas liquid condensate and natural gas will be produced. For the purposes of analysis under the Proposed Action, BOEM and BSEE estimate that approximately 450 small spills (less than 1,000 bbl) could occur during Future Incremental Steps. BOEM and BSEE also estimate the mean number of large (greater than or equal to 1,000 bbl) spills is less than one large spill (0.24 [about a quarter of a large spill]) and the most likely number of large spills over the development life of the Proposed Action is zero.

2.4.6.3 Small Spills

Small spills (less than 1,000 barrels) of refined oils and crude and condensate oils could occur onshore and offshore during future incremental steps. The estimated total numbers and volumes of small oil spills resulting from Future Incremental Step activities are presented in Table 5. BOEM and BSEE estimate approximately 450 spills of refined oil and crude or condensate oil could occur during future incremental steps. BOEM and BSEE anticipate that these spills would be 3 gallons on average. BOEM and BSEE estimate 16 spills of 1 to 50 bbl, and up to two spills of 50 to 500 bbl, could occur.

2.4.6.4 Large Spills (greater than or equal to 1,000 bbl) or Gas Release

Large spills (less than 1,000 barrels) could occur during future incremental steps. We provide an overview of BOEM and BSEE's oil spill scenario (BOEM 2016b) in a later section of this BO.

Table 5. Cook Inlet Lease Sale 244 Action Area Oil Spill Estimates: ESA Future Incremental Step. From BOEM (2016b)

ESA Step	Phase	Activity	Source of Spill	Number of Spill(s)[1]		Size of Spill(s) (in bbl)	Estimated Total Spill Volume	Frequency of Occurrence
Future Incremental Steps	Development, Production and Decommissioning	Small Spills (Crude, Condensate, or Diesel and other Refined Products)						
		Development Plan Activities (Development, Production, Decommissioning)	Offshore and/or Onshore Operational Spills from All Sources	~450[1] Total			~300[1] bbl	>99.5% of a small spill
				<1 bbl	432[1]	3 gallons	10 bbl	
				1-<50 bbl	16	3 bbl	48 bbl	
				50-<500 bbl	2	126 bbl	252 bbl	
				500-<1,000 bbl	0	0 bbl	0 bbl	
		Large Spill or Gas Release (Crude, Condensate, Diesel or Refined, or Natural Gas)						
		Development Plan Activities (Production)	Onshore Pipeline, or Offshore Pipeline, or Offshore Platform/ Storage Tank/Well	0.24 Total NEPA and BA analysis assumes up to 1 from either		2,500 bbl, or 1,700 bbl, or 5,100 bbl	2,500 bbl, or 1,700 bbl, or 5,100 bbl	78%[2] chance of no large spills occurring; 22% chance of one or more large spills over the entire life.
			Offshore Platform/Well	1 gas release		8 million ft^3	8 million ft^3	3.6 $x10^{-4}$ per well
		Very Large Oil Spills (Crude)						
		Development Plan Activities						Not estimated to occur $>10^{-4}$ to $<10^{-5}$

2.5 Mitigation Measures

The following describe a variety of mitigation measures typically required for the types of activities comprising the Proposed Action. As described below, at the lease sale stage, these mitigations typically take the form of lease stipulations; post-lease activities may have mitigation imposed through conditions of approval of plans, permit conditions, or other mechanisms. We note, however, that while the Proposed Action represents a reasonably foreseeable suite of exploration, development, production, and decommissioning activities that could potentially occur, considerable uncertainty exists as to what activities will eventually be proposed in the future. As specific projects are proposed in this multi-stage oil and gas program, more precise information about the nature and extent of the activities – including the scale and location of the activities and a description of the particular technologies to be employed – will be considered and evaluated in additional ESA consultations and other analyses (such as NEPA) as appropriate. Through this multi-stage process, a dynamic analysis of the potential effects of oil and gas activities is ensured, and additional mitigation measures and protections may be developed and at any stage based on specific details of the particular project.

In the following sections BOEM and BSEE discuss the kinds of mitigation measures that are typically applied to the types of activities comprising the First Incremental Step and then those specific to future incremental step activities. The final section addresses two new technologies with potential for ameliorating effects of airguns, as well as several new technologies with potential for replacing airguns as a means of reducing potential adverse effects on marine mammals.

2.5.1 Lease Sale 244 Stipulations

Mitigation measures are associated with each lease sale in the form of lease stipulations. Stipulations are requirements added to the lease that become contractual obligations that the lessee must follow. The four stipulations that apply to the leases pursuant to Cook Inlet Oil and Gas Lease Sale 244 are set forth in section 2.6 of the DEIS (BOEM 2016a). The list of lease stipulations below remains comprehensive.

Stipulation No. 1 - Protection of Fisheries
Stipulation No. 2 - Protection of Biological Resources
Stipulation No. 3 - Orientation Program
Stipulation No. 4 - Transportation of Hydrocarbons

Of particular relevance to the Proposed Action is lease stipulation 2. Lease stipulation 2 gives BOEM and BSEE additional authority when a previously unidentified biological population or habitat is discovered in the lease area, including the authority to require that the lessee conduct biological surveys to determine the presence, extent, and composition of the biological population(s) or habitat(s), and relocate and/or modify the types and timing of operations to minimize the impacts to the biological population(s) and/or habitat(s).

In addition to stipulations, lease sales may also have Information to Lessees (ITLs) and Notice to Lessees (NTLs) associated with them. Certain ITLs and NTLs provide additional information to the lessees on the best practices or ways to further mitigate the potential for impacts.

2.5.1.1 Stipulation No. 1 – Protection of Fisheries

Stipulation No. 1 is designed to avoid conflicts with the fishing community and their gear and is therefore not relevant to this BO. The other three stipulations are listed below.

2.5.1.2 Stipulation No. 2 – Protection of Biological Resources

If biological populations or habitats that may require additional protection are identified in the leased area by BOEM, the BOEM Regional Supervisor, Leasing and Plans (RSLP) may require the lessee to conduct biological surveys to determine the extent and composition of such biological populations or habitats.

Based on any surveys that the RSLP may require of the lessee or on other information available to the RSLP about special biological resources, the RSLP may require the lessee to:

- Relocate the site of operations.
- Establish to the satisfaction of the RSLP, on the basis of a site-specific survey, either that such operations will not have a significant adverse effect upon the resource identified or that a special biological resource does not exist.
- Operate during those periods of time, as established by the RSLP, that do not adversely affect the biological resources.
- Modify operations to ensure that significant biological populations or habitats deserving protection are not adversely affected.

If any area of biological significance should be discovered during the conduct of any operations on the lease, the lessee will immediately report such findings to the RSLP and make every reasonable effort to preserve and protect the biological resource from damage until the RSLP has given the lessee direction with respect to its protection. The lessee will submit all data obtained in the course of biological surveys to the RSLP with the locational information for drilling or other activity. The lessee may take no action that might affect the biological populations or habitats surveyed until the RSLP provides written directions to the lessee with regard to permissible actions.

2.5.1.3 Stipulation No. 3 – Orientation Program

The lessee will include in any exploration plans (EPs) or development and production plans (DPPs) submitted under 30 Code of Federal Regulations (CFR) 550.211 and 550.241, a proposed orientation program for all personnel involved in exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors), for review and approval by BOEM’s RSLP.

The program will be designed in sufficient detail to inform individuals working on the project of specific types of environmental, social, and cultural concerns that relate to the area that could be affected by the operation or its employees. The program will address the importance of not disturbing archaeological and biological resources and habitats, including endangered species, fisheries, bird colonies, and marine mammals, and provide guidance on how to avoid disturbance. The program will be designed to increase the sensitivity and understanding of personnel to community values, customs, and lifestyles in areas where such personnel will be operating. The orientation program also will include information concerning avoidance of conflicts with subsistence, sport, and commercial fishing activities.

The program will be attended at least once a year by all personnel involved in onsite exploration or development and production activities (including personnel of the lessee's agents, contractors, and subcontractors) and all supervisory and managerial personnel involved in lease activities of the lessee and its agents, contractors, and subcontractors.

The lessee will maintain a record of all personnel who attend the program onsite for so long as the site is active, not to exceed 5 years. This record will include the name and date(s) of attendance of each attendee.

2.5.1.4 Stipulation No. 4 – Transportation of Hydrocarbons

Pipelines will be required if BOEM determines that: (a) pipeline rights-of-way can be determined and obtained; (b) laying such pipelines is technologically feasible and environmentally preferable, and (c) pipelines can be laid without net social loss, taking into account any incremental costs of pipelines over alternative methods of transportation and any incremental benefits in the form of increased environmental protection or reduced multiple-use conflicts.

The BOEM may require that any pipeline used for transporting production to shore be placed in certain designated management areas. In selecting the means of transportation, consideration will be given to recommendations of any advisory groups, the Federal Government, State of Alaska Government, local governments, and industry.

Following the development of sufficient pipeline capacity, no crude oil production will be transported by surface vessels from Outer Continental Shelf (OCS) production sites, except in the case of an emergency. Determinations as to emergency conditions and appropriate responses to these conditions will be made by the Bureau of Safety and Environmental Enforcement (BSEE) Regional Supervisor for Field Operations (RS/FO).

2.6 Mitigation Measures Associated with First and Future Incremental Step Activities

Mitigation measures are specific to the type and phase of oil and gas development. A variety of typical design features and operational procedures are used to mitigate potential impacts of petroleum from these activities. Our analysis of the Effects of the Action assumes all mitigation measures identified in the BA (BOEM 2016b) will be implemented and compliance ensured. Mitigation measures and typical monitoring protocols for exploratory seismic operations and exploratory and delineation drilling are presented. Mitigation measures for vessel, aircraft, and terrestrial vehicle operations and onshore development activities are also presented.

If First Incremental Step activities delineate oil and gas reserves of sufficient size and companies choose to move into production, additional consultation would take place when BOEM receives a DPP. The DPP describes development and production activities proposed by an operator for a lease or group of leases. The description includes the timing of these activities, information concerning drilling vessels, the location of each proposed well or production platform or other structure, and an analysis of both offshore and onshore impacts that may occur as a result of the plan's implementation. The DPP would identify the precise location of the production well and associated facilities such as pipelines to shore and onshore processing facilities, providing BOEM, BSEE, and the Service with project-specific details of future incremental step activities that enable the agencies to evaluate impacts on listed species at a more detailed level and to identify potential mitigations of such impacts.

2.6.1 Seismic Operations

Seismic operations include deep penetration (primarily marine 2D and 3D surveys; see *Proposed Action*) and ancillary activities (high-resolution surveys). Monitoring is conducted by on-board Protected Species Observers (PSOs) to activate appropriate mitigation measures to protect ESA-listed species during completion of specific activities. Therefore, monitoring protocols are discussed first, followed by mitigation measures by category of seismic survey.

2.6.1.1 Seismic Survey Mitigation

The monitoring protocols below are important for ensuring that the following mitigation measures are implemented as appropriate. Mitigations measures vary with the specific category of seismic survey being utilized. Seismic survey categories are discussed below.

2.6.1.2 Vessel-based Seismic Surveys

The BOEM and BESS's geological and geophysical (G&G) permit stipulations for vessel-based surveys include:

Timing and location: Timing and locating survey activities to reduce the potential for disturbing marine mammals, protected species, and fisheries.

Minimized energy: Selecting and configuring the energy source array in such a way that it minimizes the amount of energy introduced into the marine environment by using the lowest sound levels feasible to accomplish data collection needs.

Established Safety Zones: Early season field assessment to establish and refine (as necessary) the appropriate 180-dB and 190-dB safety zones, and other radii relevant to behavioral disturbance.

Minimized Lighting: In an effort to reduce collision risk resulting from bird attraction to lighted structures, BOEM and BSEE will require that seismic survey vessels minimize the use of high-intensity work lights and minimized lighting, such as the use of down-shielded lights or the avoidance of spotlights and special use lighting when not necessary for special operations and safety. Lessees may also be required by BOEM to implement lighting protocols aimed at minimizing outward-radiating light from exploratory drilling structures.

The potential disturbance of marine mammals during seismic survey operations is minimized further through the typical implementation of several ship-based mitigation measures, which include establishing and monitoring safety and disturbance zones; speed and course alterations; ramp-up (or soft start), power-down, and shutdown procedures; and provisions for poor visibility conditions.

Safety and disturbance zones: The Service generally defines several radii for sea otters around airgun arrays: a "disturbance zone" - the area within which received underwater sound pressure levels are greater than or equal to 180 dB re 1 μPa (root-mean-square (rms)) and an "exclusion zone" – the area within which received underwater sound pressure levels are greater than or equal to 190 dB re 1 μPa (rms). Operators are required to use trained and qualified observers onboard the survey (and often support) vessels to monitor the 180-dB and 190-dB (rms) safety radii for sea otters and to implement other appropriate mitigation measures such as ramp-up (see below).

Ramp-up: A ramp-up (or "soft start") of a sound source array provides a gradual increase in sound levels, and involves a step-wise increase in the number and total volume of airguns until the desired operating level of the full array is attained. The purpose of a ramp-up is to alert marine mammals in the vicinity to the presence of the sound source and to provide them time to leave the area and thus avoid any potential injury or impairment of their hearing abilities. During a survey program, the operator is required to ramp up sound sources slowly (if the sound source being utilized generates sound energy within the frequency spectrum of marine mammal hearing). The 180-dB disturbance zone and adjacent waters are monitored by observers during the 30 minute lead-in to a full ramp-up. If no sea otters are detected, then ramp-up procedures may be initiated. Full ramp-ups (i.e., from a cold start after a shutdown, when no airguns have been firing) begin by firing one small airgun (preferably the smallest gun in terms of energy output (dB) and volume (cubic inches). The sound energy is gradually increased over a period of at least 20 but not more than 40 minutes.

Power-downs and shut-downs: A power-down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shutdown is the immediate cessation of firing of all energy sources. The arrays will be immediately powered down whenever a marine mammal is sighted approaching near or close to, the applicable safety zone of the full arrays but is outside the applicable safety zone of the single source. If a marine mammal(s) is sighted within the applicable safety zone of the single energy source, the entire array will be shut down (i.e., no sources firing). The arrays will immediately be powered down whenever one or more sea otters are sighted within the 180-dB disturbance zone. If the power-down procedure cannot reduce the sound pressure level to less than or equal to 160-dB, then the sound sources must immediately be shut down. A shut-down will occur if one or more sea otters are sighted within the 190-dB exclusion zone.

Following a power-down or shutdown: Operation of the airgun array will not resume until the marine mammal has cleared the zone. The vessel operator and observers will maintain records of the times when ramp-ups start and when the airgun arrays reach full power.

During periods of transit between survey transects and turns, one airgun (or sound source) will remain operational. The ramp-up procedure still must be followed when increasing the source levels from one gun to the full array. Keeping an air gun firing avoids the prohibition of a cold start during darkness or other periods of poor visibility. Survey operations can resume upon entry to a new transect without a full ramp-up and the associated 30 minute lead-in observations as long as the safety zones are free of marine mammals.

Operations at night and in poor visibility: Most operators conduct seismic operations 24 hours per day. When operating under conditions of reduced visibility attributable to darkness or to adverse weather conditions, infrared or night-vision binoculars will be available for use. It is recognized, however, that their effectiveness is limited. For that reason, observers will not routinely be on watch at night, except in periods before and during ramp-ups. As stated earlier, if the entire safety zone is not visible for at least 30 minutes prior to ramp-up from a cold start, then ramp-up may not proceed. It should be noted that if one small airgun has remained firing, the rest of the array can be ramped up during darkness or in periods of low visibility. Survey operations may continue under conditions of darkness or reduced visibility.

Speed and course alterations: If a marine mammal (in water) is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, the vessel's speed and/or direct course will be changed in a manner that does not compromise safety requirements. The animal's activities and movements relative to the source vessel will be closely monitored to ensure that the individual does not approach within the safety radius. If the mammal is sighted approaching near or close to the applicable safety radius, further mitigation actions may be taken (i.e., either further course alterations, or power-down or shut-down the airgun use). The BOEM will require that vessels reduce speed and maintain a distance of 328 ft

(100 m) from all sea otters when practicable and must not operate in such a way as to separate members of a group of sea otters from other members of the group.

If observations are made or credible reports are received that one or more sea otters within the vicinity of the project are displaying indications of acute distress all sound sources will immediately be shut down and the Service contacted. Sound sources will not be restarted until review and approval by the Service.

2.6.1.3 Protected Species Monitoring

Monitoring for protected species during seismic surveys will be conducted throughout the period of survey operations by PSOs. The observers are stationed aboard the survey source vessel and may also be stationed on support vessels. Duties of the observers include watching for and identifying protected species; recording their numbers, distances, and reactions to the survey operations; initiating mitigation measures; and reporting the results.

The observers must be on watch during all daylight periods when the energy sources are in operation and when energy source operations are to start up at night. A shift does not exceed 4 consecutive hours, and no observer works more than three shifts in a 24-hour period (i.e., 12-hour total per day) in order to avoid fatigue. Observers are biologists/local experts who have previous protected species observation experience, and field crew leaders experienced with previous vessel-based monitoring projects. Qualifications for these individuals are typically provided to protected species management agencies for review and acceptance. All observers complete a training session on protected species monitoring shortly before the start of their season.

2.6.1.3.1 Monitoring Methods

The following are standard monitoring methods utilized to ensure that appropriate mitigation measures are initiated at the appropriate times.

Vantage point: The observer(s) will watch for protected species from the best available vantage point on the operating source vessel, which is usually the bridge or flying bridge. Personnel on the bridge will assist the PSOs in watching for marine mammals.

Observer equipment: The observer(s) will scan systematically with the naked eye and 7 x 50 reticle binoculars, supplemented with 20 x 50 image stabilized binoculars, and night-vision equipment when needed.

Safety zones: The observer(s) will give particular attention to the areas within the safety zones around the source vessel. When a marine mammal is seen within the applicable safety radius, the geophysical crew will be notified immediately so that the required mitigation measures can be implemented. It is expected that the airgun arrays will be shut down or powered down within several seconds, often before the next shot would be fired, and almost always before more than one additional shot is fired. The observer then will maintain a watch to determine when the mammal is outside the safety zone such that airgun operations can resume.

2.6.1.3.2 Sighting Information

Marine mammals: When a marine mammal sighting is made, the following information is recorded: (1) species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the source vessel, apparent reaction to the source vessel (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace; (2) time, location, heading, speed, activity of the vessel, and operational state (e.g., operating airguns, ramp-up, etc.), sea state, ice cover, visibility, and sun glare; and (3) the positions of other vessel(s) in the vicinity of the source vessel. This information will be recorded by the observers at times of marine mammal sightings.

Birds: Complete daily deck searches for grounded birds will be conducted, preferably prior to 8:00 am or after a period of low visibility (i.e., heavy fog, snow, etc.). Any birds located on the vessel, alive or dead, will be noted, along with the following information: species, condition, location on vessel, time of discovery, time of grounding (if known), possible reason for grounding (e.g., any indication of light or lighted window above bird, entanglement, etc.), vessel activity at time of grounding, ambient visibility at time of grounding, vessel light conditions (standard vessel lights on, standard vessel lights off, spot/flood lights on, safety deck lights on for special operations, shades open, etc.), Beaufort wind force, Beaufort sea state, percent ice conditions, and vessel location/distance from shore. In addition, a minimum of two photographs will be taken, if safety allows, of the bird *in situ;* more if the species is not readily identifiable. Photos that include the bill and tail, and, if dead, of open wing, above and underside, should be included. At least one photo should assist with identifying size scale if carcass is difficult to identify. Live birds should be allowed to depart the boat unassisted.

General information: The ship’s position, heading, and speed; the operational state (e.g., number and size of operating energy sources); and the water temperature (if available), water depth, sea state, ice cover, visibility, and sun glare will also be recorded at the start and end of each observation watch, every 30 minutes during a watch, and whenever there is a substantial change in one or more of those variables.

Estimated distances: Distances to nearby marine mammals (e.g., those within or near the safety zones) will be estimated with 7 x 50 binoculars containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon. Observers will use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water.

2.6.1.3.3 Acoustic Sound Source Verification Measurements

The operator or leaseholder is typically required by the Service and National Marine Fisheries Service (NMFS) to conduct acoustic measurements of their equipment (including source arrays) at the source. These underwater sound source verification tests will be utilized to determine safety radii for the airgun array. A report on the preliminary results of the acoustic verification measurements, including as a minimum the measured 190-, 180-, and 160-dB re 1 μPa (rms) radii of the airgun sources, will be submitted within 5 days after collection and analysis of those measurements. This report will specify the distances of the safety zones that were adopted for the survey. The measurements are made at the start of the field season so that the measured radii can be used for the remainder of the survey period.

2.6.1.3.4 Field Data Recording and Verification Measurements

The following procedures for data recording and verification allow initial summaries of data to be prepared during and shortly after the field season, and will facilitate transfer of the data to statistical, graphical, or other programs for further processing. Quality control of the data will be facilitated by the start-of-season training session, subsequent supervision by the onboard field crew leader, and ongoing data checks during the field season.

- Recording: The observers will record their observations onto datasheets or directly into handheld computers.
- Database: During periods between watches and periods when operations are suspended, data will be entered into a laptop computer running a custom computer database.
- Verification: The accuracy of the data entry will be verified in the field by computerized validity checks as the data are entered and by subsequent manual checking of the database printouts.

2.6.1.3.5 Reporting

Observation reports typically are submitted to the Service on a weekly basis and include the general information, sighting information, and estimated distances described previously. Reports must be filed with the Service within 24 hours when any lethal take or injury to a sea otter occurs due to project activities or when sea otters are observed within the 180-dB disturbance or 190-dB exclusion zone. A report that summarizes the monitoring results and operations as specified in the Incidental Harassment Authorization (IHA) or Letter of Authorization (LOA) must be received no later than 90 days after completion of the project. The reports include:

- Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through study period versus operational state, sea state, and other factors affecting visibility and detectability of marine mammals).
- Summaries of the occurrence of power-downs, shutdowns, ramp-ups, and ramp-up delays.
- Analyses of the effects of various factors, influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare).
- Species composition, occurrence, and distribution of marine mammals, including date, water depth, mammal numbers, age/size/gender categories (if determinable), group sizes, and ice cover.
- Sighting rates of marine mammals versus operational state (and other variables that could affect detectability).
- Initial sighting distances versus operational state.
- Closest point of approach versus operational state.
- Observed behaviors and types of movements versus operational state.
- Numbers of sightings/individuals seen versus operational state.
- Distribution around the acoustic source vessel versus operational state.
- Estimates of take by harassment.

The take estimates are calculated using two different methods to provide both minimal and maximal estimates. The minimum estimate is based on the numbers of marine mammals directly seen within the relevant radii (160, 180, and 190 dB (rms)) by observers on the source vessel during survey activities. The maximal estimate is calculated using densities of marine mammals determined for non-acoustic areas and times. These density estimates are calculated from data collected during (a) vessel based surveys in non-operational areas, or (b) observations from the source vessel or supply boats during non-operational periods. The estimated densities in areas without data acquisition activity are applied to the amount of area exposed to the relevant levels of sound to calculate the maximal number of animals potentially exposed or deflected. These reports are due 90 days after termination of the survey season.

2.6.2 Exploration and Delineation Drilling

Unlike the impulsive and transitory characteristics of noise generated by seismic surveys, drilling activities generate continuous non-pulse sounds that are generally stationary in nature (with the exception of support vessels and aircraft). These qualities decrease the likelihood that a marine mammal could be disturbed or injured by sudden noise during exploration and delineation drilling and increase the opportunity for animals to avoid areas near drilling where underwater sound pressure levels are heightened. As described previously for seismic surveys, operators may be required to delineate and monitor marine mammal disturbance and exclusion zones around drilling rigs if the underwater sound pressure exceeds 160 dB re 1μPa (rms). Operators may also be subject to vessel, aircraft, and MODU mitigation, such as that described in the sections that follow.

2.6.2.1 Vessel Operations

There are a wide variety of vessels of different types and sizes that operate in support of exploration activities. These vessels typically conform to the following operational procedures with respect to sea otters, as stipulated in IHAs or LOAs:

Maximum distance: Operators of vessels should, at all times, take every precaution to avoid harassment to sea otters when operating near these animals. Vessels will maintain a distance of 328 ft (100 m) from sea otters, except when it would interfere with health and safety.

Changes in speed: Vessels should reduce speed when near sea otters or when weather conditions require (e.g., during periods of poor visibility), to reduce the potential for collisions.

Groups of sea otters: Vessels must not be operated in such a way as to separate members of a group of sea otters from other members of the group.

2.6.2.2 Aircraft Operations

Aircraft are typically required to operate within specific height and distance parameters with respect to marine mammals and birds. These include the following:

All aircraft: Support aircraft must, at all times, conduct their activities at the maximum distance possible from sea otters.

Fixed-wing aircraft: Fixed-wing aircraft must operate at an altitude no lower than 300 ft (91 m) in the vicinity of sea otters, except for an emergency or navigational safety.

Helicopters: Helicopters may not hover or circle above marine mammals or flocks of birds. Helicopters must operate at an altitude no lower than 1,000 ft (305 m) in the vicinity of sea otters, except for an emergency or navigational safety.

Inclement weather: When aircraft are operated below the required minimum flying altitude, such as during storms or when cloud cover is low, the operator must avoid known sea otter locations and take precautions to avoid flying directly over these areas.

2.6.2.3 Drilling Rig Operations

In order to minimize attraction to birds, a light monitoring program for lease structures may be required that includes such parameters as:

Minimization of upward and outward lighting levels. Wherever human safety and operations allow, exterior lights must be shielded so that they do not radiate upward or seaward.

2.6.2.4 Onshore Operations

2.6.2.4.1 First Incremental Step

Onshore activities during the First Incremental Step are limited to support operations, which are assumed to use existing facilities between Homer and Nikiski. All onshore activities during the First Incremental Step would be subject to permits, authorizations, stipulations, required operating procedures (ROPs), and best management practices (BMPs) as recommended or required by the appropriate land-based resource and management agencies.

2.6.2.4.2 Future Incremental Step

Future Incremental Steps are expected to include two pipeline landfalls (one oil and one gas), likely to occur on the southern Kenai Peninsula near Homer or Nikiski. There will be onshore oil and gas pipelines 50 mi (80 km) constructed. Locations of pipeline routes and landfalls will depend on where a commercial discovery is made, but are expected to be within the Action Area. All onshore activities during Future Incremental Steps would be subject to permits, authorizations, stipulations, ROPs, and BMPs as recommended or required by the appropriate land-based resource and management agencies.

2.6.3 Opportunities for Intervention and Spill Response

In the event of an accidental oil spill, lessees would initiate oil spill response and cleanup operations in order to reduce the spread of spilled oil and decrease the environmental effects of the spill. The various spill response and cleanup methods that a lessee could employ are not mutually exclusive, and several techniques may be employed contemporaneously. The availability and effectiveness of each technique may vary with environmental conditions and oil characteristics. For example, offshore intervention activities may be hampered during winter months by low temperatures, the presence of ice, unfavorable seas and weather, darkness, and other factors.

Mechanical Recovery: Physical removal of oil from the sea surface, typically accomplished using containment booms and skimmers. Booms would be deployed on the sea surface and positioned within or around an oil slick to contain and concentrate the oil into a pool thick enough to permit collection by a skimmer. The recovered oil would be transferred to a storage vessel (e.g., barge or tanker) and subsequently transferred to shore for appropriate recycling or disposal.

Dispersants: Chemical dispersants are a combination of solvents and surfactants that are applied to oil to promote the dispersion process and form smaller droplets. Smaller droplets may then remain submerged rather than rising to the sea surface, spreading, and potentially contacting land. Dispersion into smaller droplets results in greater surface areas available for microbial degradation, and eventual dissolution. Dispersant use is generally limited to waters greater than 32 ft (10 m) in depth. To receive authorization to use dispersants, a Dispersant Use Request must be submitted by the Responsible Party to the Federal On-Scene Coordinator (FOSC), as described in the Alaska Unified Plan. The FOSC, in consultation with DOC, Department of the Interior (DOI), and the Environmental Protection Agency (EPA) ARRT representatives, and the State On-Scene Coordinator, will review the Dispersant Use Request and grant authorization, if warranted. Dispersants may be aerially applied using low-flying aircraft (i.e., aircraft flying less than 150 ft (46 m) above the sea surface), or from offshore vessels. Dispersants also may be applied directly at the subsea source of the release using a remotely operated vehicle.

In Situ Burning: Intentional ignition of floating oil at the sea surface is conducted to enhance volatilization of the lighter compounds in oil. Burning causes temperatures to increase at the sea surface, temporary air quality issues, and generates residues that may float or sink.

3 ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

3.1 Jeopardy Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of listed species. "Jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02).

The jeopardy analysis in this biological opinion relies on four components: (1) the Status of the Species, which describes the range-wide condition of the Alaska-breeding Steller's eider, and the southwest Alaska DPS of the northern sea otter**,** the factors responsible for that condition, and its survival and recovery needs; (2) the Environmental Baseline, which analyzes the condition of the Alaska-breeding Steller's eider, and the southwest Alaska DPS of the northern sea otter in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the Alaska-breeding Steller's eider, and the southwest Alaska DPS of the northern sea otter; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the Alaska-breeding Steller's eider, and the southwest Alaska DPS of the northern sea otter; and (4) the Cumulative Effects, which evaluates the effects of future, non-Federal activities, that are reasonably certain to occur in the action area, on the Alaska-breeding Steller's eider, and the southwest Alaska DPS of the northern sea otter

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the current status of the Alaska-breeding Steller's eider, and the southwest Alaska DPS of the northern sea otter, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to reduce appreciably the likelihood of both the survival and recovery of the Alaska-breeding Steller's eider, and the southwest Alaska DPS of the northern sea otter in the wild by reducing the reproduction, numbers, and distribution of that species.

3.2 Adverse Modification Determination

Section 7(a)(2) of the Endangered Species Act requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to result in the destruction or adverse modification of designated critical habitat. A final rule revising the original definition of "destruction or adverse modification of critical habitat" was published on February 11, 2016, (81 FR 7214). The revised definition states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features."

The revised "destruction or adverse modification" definition focuses on how Federal actions affect the quantity and quality of the physical or biological features in the designated critical habitat for a listed species and, especially in the case of unoccupied habitat, on any impacts to the critical habitat itself. Specifically, the Service will generally conclude that a Federal action is likely to "destroy or adversely modify" designated critical habitat if the action results in an alteration of the quantity or quality of the essential physical or biological features of designated critical habitat, or that precludes or significantly delays the capacity of that habitat to develop those features over time, and if the effect of the alteration is to appreciably diminish the value of critical habitat for the conservation of the species.

The Service may consider other kinds of impacts to designated critical habitat. For example, some areas that are currently in a degraded condition may have been designated as critical habitat for their potential to develop or improve and eventually provide the needed ecological functions to support species' recovery. Under these circumstances, the Service generally concludes that an action is likely to "destroy or adversely modify" the designated critical habitat if the action alters it to prevent it from improving over time relative to its pre-action condition. The "destruction or adverse modification" definition applies to all physical or biological features; as described in the proposed revision to the current definition of "physical or biological features" (50 CFR 424.12), "[f]eatures may include habitat characteristics that support ephemeral or dynamic habitat conditions" (79 FR 27066).

The adverse modification analysis in this biological opinion relies on four components: (1) the Status of Critical Habitat, which describes the range-wide condition of designated critical habitat for the southwest Alaska DPS of the northern sea otter in terms of the essential physical and biological features, the factors responsible for that condition, and the intended recovery function of the critical habitat overall; (2) the Environmental Baseline, which analyzes the condition of the critical habitat in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated and interdependent activities on the essential physical and biological features and how that will influence the recovery role of the affected critical habitat units; and (4) Cumulative Effects, which evaluates the effects of future non-Federal activities, that are reasonably certain to occur in the action area, on the essential physical and biological features and how that will influence the recovery role of affected critical habitat units.

4 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

4.1 Alaska-Breeding Steller's Eider

The Steller's eider (*Polysticta stelleri*) is a small sea duck with circumpolar distribution and the sole member of the genus *Polysticta*. Males are in breeding plumage from early winter through mid-summer. Females are dark mottled brown with a white-bordered blue wing speculum (Figure 3). Juveniles are dark mottled brown until fall of their second year, when they acquire breeding plumage. The Alaska-breeding population of Steller's eiders was listed as threatened on June 11, 1997 (62 FR 3174; June 11, 1997), based on:

1) Substantial contraction of the species' breeding range on the Arctic Coastal Plain (ACP) and Yukon-Kuskokwim (Y-K) Delta; Steller's eider on the North Slope historically occurred east to the Canada border (Brooks 1915), but have not been observed on the eastern North Slope in recent decades (Service 2002).
2) Reduced numbers breeding in Alaska.
3) Resulting vulnerability of the remaining Alaska-breeding population to extirpation (62 FR 31748).

In 2001, the Service designated 2,830 mi^2 (7,330 km^2) of critical habitat for the Alaska-breeding population of Steller's eiders, including historical breeding areas on the Y-K Delta, molting and staging areas in the Kuskokwim Shoals and Seal Islands, molting wintering, and staging areas at Nelson Lagoon, and Izembek Lagoon (Service 2001, 66 FR 8850; February 2, 2001). These areas total approximately 2,830 mi^2 (7,330 km^2) and 852 (1,363 km) of shoreline. No critical habitat for Steller's eiders has been designated on the ACP. Critical habitat for Steller's eider does not occur within the Action Area and is not discussed further.

Steller's eiders are divided into Atlantic and Pacific populations; the Pacific population is further divided into the Russia-breeding population, which nests along the Russian eastern arctic coastal plain, and the Alaska-breeding population. In Alaska, Steller's eiders breed almost exclusively on the ACP and winter, along with the majority of the Russian-breeding population, in southwest Alaska (Figure 4). While they historically nested on the Y-K Delta, only a few nests have been found there in recent years. During the molt and over winter, they mix with the majority of the Russia-breeding population in southcentral Alaska. Periodic non-breeding of Steller's eider, along with low nesting and fledgling success, has resulted in very low species productivity (Quakenbush et al. 2004).

Figure 3. Male and female Steller's eider's in breeding plumage.

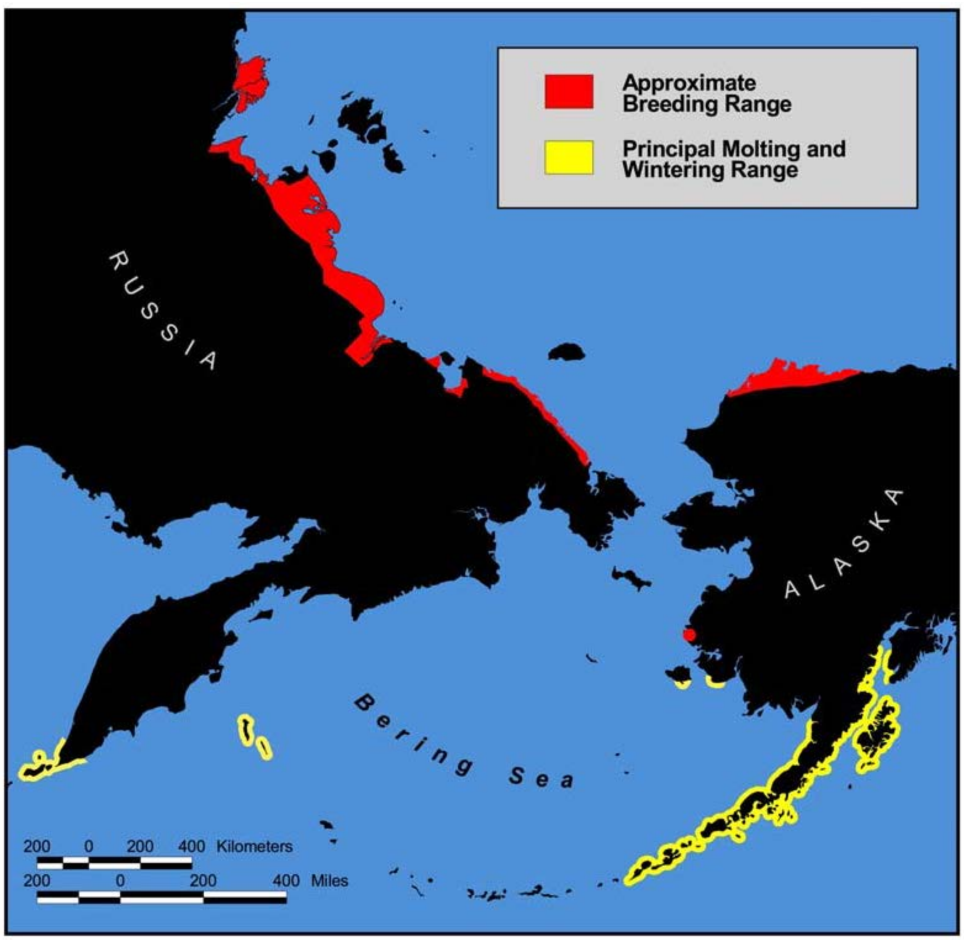

Figure 4. Distribution of the Pacific population of the Steller's eider (Service 2002).

4.1.1 Range-wide Trends

The population of Pacific wintering Steller's eiders molting and wintering along the Alaska Peninsula has declined since the 1960s (Kertell 1991). The long-term trend from annual spring aerial surveys (1992-2011) indicates a 2.3 percent decline per year (Larned 2012a). Counts of Steller's eiders conducted during fall surveys for emperor geese indicate a 1.6 percent annual increase from 1979-2010. Banding data from 1975 to1981 and 1991to 1997 indicates a reduction in Pacific wintering Steller's eider survival over time (Flint et al. 2000). Population models for other waterfowl, applied to this species, indicate that reductions in annual survival would have a substantial negative effect on populations (Schmutz et al. 1997, Flint et al. 2000).

While current distribution on the North Slope breeding range has been reduced compared to the historical distribution (Quakenbush et al. 2002), the population trajectory for the North Slope population remains ambiguous (Stehn and Platte 2009). Data from the 1989 to 2006 The ACP aerial surveys indicate that North American breeding Steller's eiders are in decline (Mallek et al. 2007), while the 1992 to 2008 North Slope Eider (NSE) survey data suggest that the population is increasing (Larned et al. 2008). Aerial survey data from 1999 to 2007 suggest a declining growth rate (Obrischkewitsch et al. 2008). Analysis of a subset of data from the NSE aerial survey (1993 to 2008) estimates that growth is stable (Stehn and Platte 2009).

Aerial surveys that included the Y-K Delta, but did not include the ACP, indicated that the Y-K Delta population of eiders has declined by 90 percent since 1957 (Hodges and Eldridge 1996). For the 1950s and early 1960s, the upper limit of the population, excluding the North Slope, had been estimated to be approximately 3,500 pairs (Kertell 1991). Kertell (1991) concluded that the Steller's eider had been extirpated from the Y-K Delta prior to 1990; however, low numbers of birds have been found breeding on the YK Delta since 1991, although not in sufficient numbers to sustain a breeding population. The numbers of birds currently breeding on the Y-K Delta are not likely to be sufficient to sustain a breeding population (Kertell 1991, Quakenbush 2002). This population is most likely dependent on immigration from the Alaska-breeding or Russian breeding populations. If there is no permanent immigration or emigration between Russian breeding and Alaska-breeding Steller's eiders, if declining trends continue, and if the available estimates of vital rates are accurate and precise, the listed Steller's eiders have a high probability of extinction in the foreseeable future (Swem and Matz 2008).

4.1.2 Population Size

Population sizes are only imprecisely known. The Pacific wintering population is estimated to be about 74,369 birds (Larned 2012a). The threatened Alaska-breeding population is thought to number approximately 500 individuals on the ACP (Stehn and Platte 2009), and possibly tens on the Y-K Delta (Service, unpublished data).

Arctic Coastal Plain (ACP)/North Slope

Steller's eider population and trends have been obtained from the following three aerial surveys on the ACP: the Service ACP survey, 1989 to 2006 (Mallek et al. 2007) and 2007 to 2008 (new ACP survey design; Larned et al. 2008, 2009); the Service's North Slope eider survey 1992 to 2008 (Larned et al. 2009) and 2007 to 2008 (NSE strata of new ACP survey; Larned et al. 2008, 2009); and the Barrow Triangle (ABR, Inc.,) survey, 1999 to 2007 (Obrishkewitsch et al. 2008). In 2007, the ACP and NSE surveys were combined under a new ACP survey design.

The aerial survey efforts provide a range of estimates of the North Slope breeding population size. Estimates, including results from previous analyses of the ACP and NSE survey data, are summarized in Table 6. Caution must be used when interpreting the survey results. Neither the surveys conducted by Mallek et al. (2006) nor Larned et al. (2010) were originally designed to estimate Steller's eider populations. Surveys differed in spatial extent, seasonal timing, sampling intensity, and duration. Most observations of Steller's eider from both surveys occurred within the boundaries of the NSE survey.

Following an assessment of potential biases inherent in the two Service surveys, Stehn and Platte (2009) identified a subset of the NSE survey data (1993 to 2008) that they determined was "least confounded by changes in survey timing and observers." Based on this subset of the NSE survey, the average geographically-extrapolated population index total for Steller's eiders was 173 (90 percent confidence interval (CI) 88–258) with an estimated population growth rate of 1.011 (90 percent CI 0.857–1.193). The average population size of Steller's eiders breeding in the ACP was estimated at 576 (292–859, 90 percent CI; Stehn and Platte 2009), assuming a detection probability of 30 percent. The 30 percent detection probability and associated visibility correction factor of 3.33 was selected based on evaluation of estimates for similar species and habitats (Stehn and Platte 2009).

Currently, this analysis provides the best available estimate of the Alaska-breeding Steller's eider population size and growth rate from the ACP. Surveys of the northernmost portion of the ACP conducted annually by ABR, Inc., provide more intensive coverage of the nesting area (50 percent from 1999 to 2004; 25 to 50 percent from 2005 to 2010; Obritschkewitsch and Ritchie 2011). Based on ABR survey data, Stehn and Platte (2009) estimated that the average population index for Steller's eiders residing within the Barrow Triangle was 99.6 (90 percent CI =55.5–143.7) with an estimated population growth rate of 0.934 (90 percent CI =0.686–1.272). If we also assume the same 30 percent detection probability, the average population size of Steller's eiders breeding in the Barrow Triangle survey area would be 332 (90 percent CI =185–479).

Table 6. Aerial population estimates for Steller's eiders, from the North Slope.

Year	Population Estimate	Nesting Status Near Barrow	Year	Population Estimate	Nesting Status Near Barrow
1986	0[4]	Non-nesting	1998	281[4]/0[5]	Non-nesting[1]
1987	0[4]	Non-nesting	1999	1,250[4]/785[5]	Nesting[1]
1988	0[4]	Non-nesting	2000	563[4]/0[5]	Nesting[2]
1989	2,002[4]	Nesting	2001	176[4]/288[5]	Non-nesting[2]
1990	534[4]	Nesting	2002	0[4]/0[5]	Non-nesting[2]
1991	1,118[4]	Nesting[1]	2003	0[4]/93[5]	Non-nesting[2]
1992	954[4] /0[5]	Non-nesting[1]	2004	0[4]/48[5]	Non-nesting[2]
1993	1,313[4]/262[5]	Nesting[1]	2005	110[4]/99[5]	Nesting[2]
1994	2,524[4]/47[5]	Non-nesting[1]	2006	96[3]/112[5]	Nesting[2]
1995	931[4]/281[5]	Nesting[1]	2007	96[6]	Nesting[2]
1996	2,543[4]/0[5]	Nesting[1]	2008	576[7]	Nesting[2]
1997	1,295[4]/189[5]	Nesting[1]			

[1] Quakenbush et al. 2001; [2] Nora Rojek, Service, pers. comm.; [3] Ritchie et al. 2006; [4] Mallek et al. 2005; [5] Larned et al. 2009; [6]Obritschkewitsch et al. 2008; [7]Stehn and Platte 2009

4.1.3 Population Structure

There are often genetic gradients or differences that correspond to the geographic distribution of the species (Lande and Barrowclough 1987). The Alaska-breeding population of Steller's eiders may contain unique geographic sub-populations arising from: 1) the distance between breeding populations on the Y-K Delta and the ACP [about 500 miles (804 km)], and 2) the anticipated site fidelity of nesting adult females (Anderson et al.1992). In contrast, the similarly distributed North Slope and Y-K Delta populations of spectacled eiders possess distinct mitochondrial DNA markers, implying limited maternal gene flow between these two areas for that species (Scribner et al. 2001). However, genetic analyses by Pearce et al. (2005) found little evidence for differentiation among and between nesting groups of Steller's eiders across their range using both nuclear and mitochondrial DNA. Pearce et al. (2005) also observed little evidence for genetic differentiation within the Pacific breeding distribution (Russia vs. Alaska) of Steller's eiders, suggesting that female gene flow is sufficiently high between the two locales, or that divergence of Russian and Alaskan breeding groups has occurred relatively recently.

Pearce and Talbot (2009) observed that the mean level and variance of genetic relatedness among 19 nests at Barrow in 1999 was nearly identical to the mean for 45 samples collected from Steller's eiders molting along the Alaska Peninsula. The molting samples represent the broadest possible distribution of relatedness values since molting groups of Steller's eiders are thought to contain birds from multiple breeding areas (Dau et al. 2000). These findings corroborate conclusions by Pearce et al. (2005) of limited genetic differentiation among breeding areas. Greater differentiation would be expected if Barrow females were more closely related genetically in comparison to a larger group composed of multiple breeding areas, such as those molting and overwinter along the Alaska Peninsula.

4.1.4 Seasonal Distribution Patterns

4.1.4.1 Breeding Distribution

Steller's eiders breed on the western ACP in northern Alaska, from approximately Point Lay east to Prudhoe Bay, and in extremely low numbers on the Y-K Delta. On the ACP, anecdotal historical records indicate that the species occurred from Wainwright east, nearly to the Alaska-Canada border (Anderson 1913, Brooks 1915). There are very few nesting records from the eastern ACP, however, so it is unknown if the species commonly nested there or not. Currently, the species predominantly breeds on the western ACP, in the northern half of the National Petroleum Reserve-Alaska. The majority of sightings in the last decade have occurred east of the mouth of the Utukok River, west of the Colville River, and within approximately 56 miles (90 km) of the coast.

Steller's eiders were considered locally "common" in the central Y-K Delta by naturalists early in the 1900s (Murie 1924, Conover 1926, Gillham 1941, Brandt 1943), but nesting was reported in only a few locations. By the 1960's or 70's, the species had become extremely rare on the Y-K Delta; only six nests were found in the 1990s (Flint and Herzog 1999). Given the paucity of early-recorded observations, only subjective estimates can be made of the Steller's eider's historical abundance or distribution on the Y-K Delta. A few Steller's eiders were reportedly found nesting in other locations in western Alaska, including the Aleutian Islands in the 1870s and 1880s (Gabrielson and Lincoln 1959), Alaska Peninsula in the 1880s or 1890s (Murie and

Scheffer 1959), Seward Peninsula in the 1870s (Portenko 1972), and on Saint Lawrence Island in the 1950s (Fay and Cade 1959).

4.1.4.2 Post-Breeding Distribution

Prior to migration in both nesting and non-nesting years, some Steller's eiders rest and forage in Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the Chukchi Sea in the vicinity of the northern most point of the Barrow spit. Males depart the nesting grounds soon after incubation begins, but females linger longer. From mid-July through September single hens, hens with broods, and small groups of two to three birds have been observed in North Saltwater Lagoon, Elson Lagoon and near shore on the Chukchi Sea.

4.1.4.3 Molt Distribution

After breeding, Steller's eiders move to marine waters where they mix with birds from the Russian breeding population and undergo a 3-week flightless molt. After the populations mix on the molting and wintering areas, there is no way to confirm whether an individual belongs to the Alaskan breeding population. We therefore assume that 0.8 percent of all Steller's eiders occurring on the molting and wintering grounds in Alaska are from the listed Alaska breeding population. This estimate is derived by taking the most recent North Slope breeding bird estimate (576; Stehn and Platte 2009), adding 1 for the Y-K Delta population (for a total of 577), and then dividing by the population estimate of Pacific-wintering Steller's eiders from 2010 (74,369; Larned 2012a). Thus, 577 ÷ 74,369 = (0.0078 x 100) = 0.8 percent.

The Pacific-wintering population molts in several main areas along the Alaska Peninsula: Izembek Lagoon (Dau 1991, Metzner 1993, Laubhan and Metzner 1999), Nelson Lagoon, Herendeen Bay, and Port Moller (Gill et al. 1981, Petersen 1981). Over 15,000 Steller's eiders have also been observed in Kuskokwim Bay (Larned and Tiplady 1996). Smaller numbers of molting Steller's eiders have been reported around islands in the Bering Sea, along the coast of Bristol Bay, and in smaller lagoons along the Alaska Peninsula (e.g., Dick and Dick 1971, Petersen and Sigman 1977, Wilk et al. 1986, Dau 1987, Petersen et al. 1991). Larned (2005) reported greater than 2,000 eiders molting in lower Cook Inlet near the Douglas River Delta.

A few band recoveries indicate that the Alaska-breeding birds molt in Izembek Lagoon and Kuskokwim Shoals. The best available information is from the satellite telemetry studies described in Martin (2001) and Rosenberg et al. (2011). Martin (2001) marked 14 birds near Barrow, Alaska (within the range of the listed Alaska-breeding population) in 2000 and 2001. Although samples sizes were small, results suggested disproportionately high use of Kuskokwim Shoals by Alaska-breeding Steller's eiders during wing molt compared to the Pacific population as a whole, but Alaska-breeding birds were not found to preferentially use specific wintering areas. The second study marked Steller's eiders wintering near Kodiak Island, Alaska and followed birds through the subsequent spring (n = 24) and fall molt (n = 16) migrations from 2004 to 2006 (Rosenberg et al. 2011). Most of the birds marked near Kodiak migrated to eastern arctic Russia prior to the nesting period and none were relocated on land or in nearshore waters north of the Yukon River Delta in Alaska (Rosenberg et al. 2011).

4.1.4.4 Winter Distribution

After molting, many of the Pacific-wintering Steller's eiders congregate in select near-shore waters throughout the Alaska Peninsula and the Aleutian Islands, around Nunivak Island, the Kodiak Archipelago, and in lower Cook Inlet, although thousands may remain in lagoons used for molting (Bent 1987, Larned 2000a, Martin 2001, Larned and Zwiefelhofer 2002). Winter ice formation often temporarily forces birds out of shallow protected areas such as Izembek and Nelson Lagoons. Wintering Steller's eiders usually occur in shallow waters (less than 33 feet (10 m) deep), which are generally within 1,312 feet (400 m) of shore or at offshore shallows (Service 2002b). However, Martin et al. (2015) reported substantial use of habitats greater than 33 feet (10 m) deep during mid-winter. Use of these habitats by wintering Steller's eiders may be associated with night-time resting periods or with shifts in the availability of local food resources (Martin et al. 2015).

In Cook Inlet, Steller's eider regularly winter along both the eastern coast, where the population between Clam Gulch and Kachemak Bay has been estimated at 1,499, and at other times greater than 2,000 between Anchor River and Kenai (Larned 2006); and the western coastline from Tuxedni Bay to Cape Douglas with as many as 4,284 surveyed (Figure 5) (Larned 2006), with a total estimate of 5,783 in lower Cook Inlet for a single season survey (BOEM 2016b). Steller's eiders are present in Cook Inlet from late July through the winter to as late as April, with numbers reportedly peaking in January and February (Larned 2006, Martin et al. 2015, Rosenberg et al. 2014).

4.1.4.5 Spring Migration

In the spring, Steller's eiders form large flocks along the north side of the Alaska Peninsula and move east and north (Larned et al. 1993, Larned 1998, Larned 2000b). Larned (1998) concluded that Steller's eiders show strong site fidelity to "favored" habitats during migration, where they congregate in large numbers to feed before continuing their northward migration. Spring migration usually includes movement along the coast, although birds may take shortcuts across water bodies such as Bristol Bay (Service, unpublished data). Several areas receive consistent use during spring migration, including Bechevin Bay, Morzhovoi Bay, Izembek Lagoon, Nelson Lagoon/Port Moller Complex, Cape Seniavin, Seal Islands, Port Heiden, Cinder River State Critical Habitat Area, Ugashik Bay, Egegik Bay, Kulukak Bay, Togiak Bay, Nanwak Bay, Kuskokwim Bay, Goodnews Bay, and the south side of Nunivak Island (Larned et al. 1993, Larned 1998, Larned 2000b). Like other eiders, Steller's eiders probably use spring leads for feeding and resting as they move northward, but there is little information on habitat use after departing spring staging areas. Despite many daytime aerial surveys, migratory flights of Steller's eiders have never been observed (Service, unpublished data).

A small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay, while a few may spend the summer at Izembek Lagoon (Service, unpublished data).

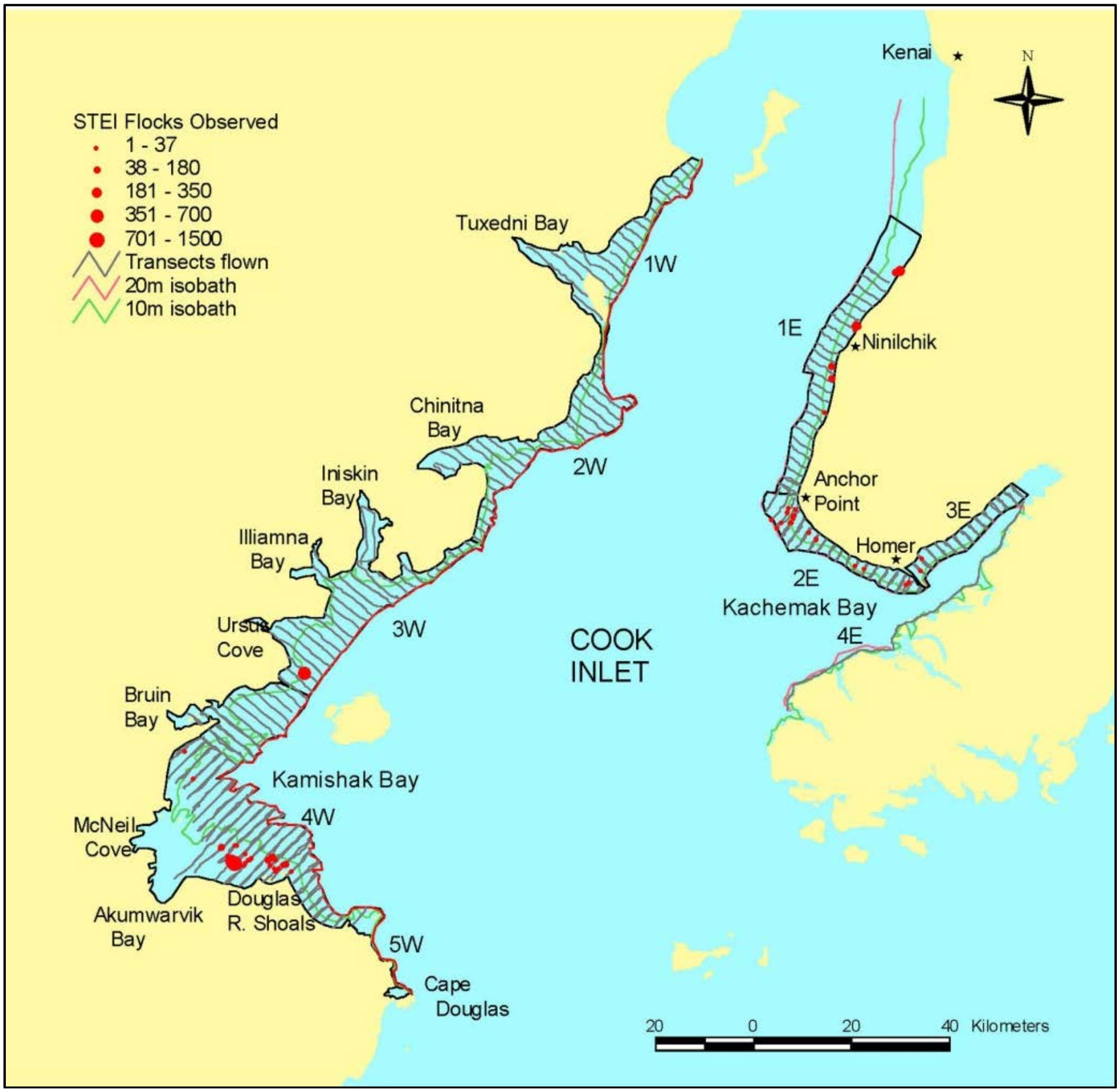

Figure 5. Distribution of Steller's eider sightings during aerial surveys in February 2004 (Larned 2006). Flock symbol sizes are proportional to numbers of Steller's eider sightings as indicated in the legend.

4.1.4.6 Summer Distribution in Southern Alaska

4.1.5 Site Fidelity

In many species of waterfowl, female philopatry to breeding grounds is high (Anderson et al. 1992). Banding data from the Barrow area suggests some level of site fidelity for Steller's eiders breeding there (Quakenbush et al. 1995). Evidence of nest site philopatry has also been reported on the Y-K Delta. In 2003, 2004, and 2005, a single female Steller's eider nest was found in the same area each year. Nests were located as little as 407 feet (124 m) apart between years (P. Flint, USGS, pers. comm.). Interestingly, natal philopatry has not been reported in Steller's eiders nesting in Russia (D. Solovieva, Zoological Institute, Russian Academy of Science, pers. comm.).

There is good evidence to suggest that individual eiders return to the same seasonal use areas each year, but individual fidelity to wintering areas is unknown. Eiders are known to overwinter in select near-shore waters year after year (Bent 1987, Larned and Zwiefelhofer 1995, Larned 2000a). Flocks of Steller's eiders also use the same molting areas each year (Larned 1998). About 95 percent of recaptured molting Steller's eiders were found at the same site at which they were banded (Flint et al. 2000). Telemetry data from Steller's eiders captured near Unalaska showed high within-season site fidelity on wintering areas (Reed and Flint 2007). Other species of waterfowl show high rates of individual fidelity to wintering areas as well (Robertson et al. 1999).

4.1.6 Life History

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

Steller's eiders initiate nesting in the first half of June and nests are commonly located on the rims of polygons and troughs (Quakenbush et al. 2000 2004). Mean clutch size at Barrow was 5.4 over 5 nesting years between 1992 and 1999 (Quakenbush et al. 2004). Breeding males depart following onset of incubation by the female. Nest survival is affected by predation levels, and averaged 0.23 from 1991 to 2004 before fox control was implemented near Barrow and 0.47

from 2005 to 2012 during years with fox control (Service, unpublished data). Steller's eider nest failure has been attributed to depredation by jaegers (*Stercorarius spp*.), common ravens (*Corvus corax*), arctic foxes (*Alopex lagopus*), glaucous gulls (*Larus hyperboreus*), and in at least one instance, polar bears (Quakenbush et al. 1995, Rojek 2008, Safine 2011, Safine 2012).

Hatching occurs from mid-July through early August, after which hens move their broods to adjacent ponds with emergent vegetation dominated by *Carex* spp. and *Arctophila fulva* (Quakenbush et al. 2000, Rojek 2006, 2007, and 2008). In these brood-rearing ponds, hens with ducklings feed on aquatic insect larvae and freshwater crustaceans. In general, broods remain within 0.43 mile (0.7 km) of their nests (Quakenbush et al. 2004); although, movements of up to 2.2 miles (3.5 km) from nests have been documented (Rojek 2006, 2007). Large distance movements from hatch sites may be a response to drying of wetlands that would normally have been used for brood-rearing (Rojek 2006). Fledging occurs 32 to 37 days post hatch (Obritschkewitsch et al. 2001, Quakenbush et al. 2004, Rojek 2006, 2007).

Information on breeding site fidelity of Steller's eiders is limited. However, ongoing research at Barrow has documented some cases of site fidelity in nesting Steller's eiders. Since the mid-1990s, eight banded birds that nested near Barrow were recaptured in subsequent years again nesting near Barrow. Time between capture events ranged from 1 to 12 years and distance between nests ranged from 328 ft to 3.9 mi (100 m to 6.3 km) (Service , unpublished data).

4.1.7 Threats to the Species

Factors identified as potential causes of decline in the final rule listing the population as threatened (62 FR 31748; June 11, 1997) included predation, disease, hunting, ingestion of spent lead shot in wetlands, and changes in the marine environment that could affect Steller's eider food or other resources. Since the 1997 listing, additional potential threats, such as collision with man-made structures, contact or ingestion of oil, and exposure to fish processing facility wastes have been identified and included in the Steller's Eider Recovery Plan (Service 2002) for evaluation.

4.1.7.1 Predation

In extreme cases, nest predation can seriously limit waterfowl production, and even cause population declines. Kertell (1991) hypothesized that changes in predation pressure may have contributed to the near-disappearance of Steller's eiders from the Y-K Delta. Predators include snowy owls, short-eared owls (*Asio flammeus*), peregrine falcons (*Falco peregrinus*), gyrfalcon (*Falco rusticolus*), pomarine jaegers (*Stercorarius pomarinus*), rough-legged hawks (*Buteo lagopus*), common ravens (*Corvus corax*), glaucous gulls (*Larus hyperboreus*), Arctic fox, red fox (*V. vulpes*), and bald eagles (*Haliaeetus leucocephalus*) (Quakenbush et al. 1995, Rojek 2008, Safine 2011). The Steller's Eider Recovery Plan suggests that human actions may have disrupted normal predator-prey relationships in Alaska by providing nesting sites for common ravens (*Corvus corax*), which can allow them to breed in otherwise unsuitable areas, and by providing food sources for avian and mammalian predators, such as ravens, gulls, and foxes, which can affect their distribution and abundance by increasing fecundity and survival (Service 2002). Nest depredation by a family group of polar bears was documented in 2011 (Safine 2011).

4.1.7.2 Disease

The Steller's Eider Recovery Plan suggests that Steller's eiders and other sea ducks in Alaska may have significant exposure rates to a virus in the family Adenoviridae (Hollmen and Franson 2002). The Recovery Plan does not include any tasks to address diseases, but states that for Steller's eiders to be considered recovered, continued sampling must demonstrate that viruses or other diseases are not thought to threaten or endanger the population.

4.1.7.3 Hunting

Although not cited as a cause in the decline of Steller's eiders, the take of this species by subsistence hunters near Barrow was cited as a factor in the decision to list the population of Steller's eiders (62 FR 31748; June 11, 1997). Hunting for Steller's eiders was closed in 1991. In 2003, spring/summer subsistence harvest of migratory birds in Alaska was opened by Alaska State regulations and Service policy, but harvest of Steller's eiders remained prohibited. Estimates of Steller's eider subsistence harvest predicted that approximately 97 Steller's eiders were shot each year before this regulation took effect (Service 2006). After 2003, it was predicted that approximately 59 Steller's eiders were killed each year (Service 2007). Shooting mortality during 2004-2008 was estimated to be 23 birds (Service unpublished data, 2010 in Service 2015a).

Historically, Alaska Natives at several villages hunted Steller's eiders and their eggs for food but many communities along the population's migration route had not been surveyed at the time of the 1997 ESA listing decision and so the total annual subsistence harvest at that time was unknown (62 FR 31748; June 11, 1997). However, Steller's eiders were not a preferred subsistence species (Quakenbush and Cochrane 1993, in 62 FR 31748; June 11, 1997) and harvest data from 1993 through 2012 show that the Cook Inlet and Gulf of Alaska region harvests few if any eider species (Rothe et al. 2015). Among all the regions for which data were available, Steller's and spectacled eiders (another federally listed species) were the two sea duck species harvested the least, with takes an order of magnitude less than that of other species (Rothe et al. 2015).

4.1.7.4 Lead Poisoning

The primary source of lead contaminant to Steller's eiders is from ingestion of spent lead shot deposited in nearshore wetlands or nearshore marine waters used for foraging (Service 2002). The effect of exposure varies, but lethal and sublethal responses can occur (Hoffman 1990). Blood samples from hens breeding near Barrow in 1999 showed that all (seven individuals) had been exposed to lead (indicated by greater than 0.2 ppm lead in blood) and one had experienced lead poisoning (greater than 0.6 ppm). Lead isotope analysis confirmed the lead in these samples originated from lead shot rather than other potential environmental sources (Trust et al. 1997, Matz et al. 2004). Use of lead shot for hunting waterfowl is prohibited nationwide, and its use for hunting all birds is specifically prohibited in Alaska where these birds are harvested on the North Slope. The Service has collaborated with other government and tribal organizations to minimize the sale and use of lead shot. Reduced availability of lead shot in stores and the paucity of spent shell casings from shells with lead shot at popular hunting sites suggest that the use of this type of ammunition has been greatly reduced and continues to decline in Alaska. Because this species continues to feed near the nesting site before and during incubation, it may be subjected to an increased risk of exposure to lead shot compared to other tundra waterfowl species that largely forego feeding at this time.

4.1.7.5 Collisions with Man-made Structures

Steller's eiders are known to collide with anthropogenic structures including radio communication towers, guy wires, ship rigging, radar domes, and other on-land and marine structures. Most collisions are likely to involve one or two birds, but "bird storms" have been documented to occur when fishing vessels use bright lights during inclement nighttime weather. The actual number of birds injured and killed through collisions is likely higher than reported; many injured and killed birds are believed to go unreported, or become scavenged before humans detect them. For example, carcass removal rates from scavengers on the Alaska Peninsula could be as high as 50 percent per 24 hours (Flint et al. 2010). Therefore, unless obstructions are checked every day, few carcasses would ever be documented. Searcher efficiency can also affect bird mortality estimates, as has been documented following oil spills (Ford 2006).

4.1.7.6 Habitat Loss and Change

Destruction or modification of habitat is not thought to have played a major role in the decline of the Alaska-breeding population of Steller's eider. However, the Recovery Plan states that habitat changes near the village of Barrow could be a threat (Service 2002). The region surrounding the village of Barrow is the core of the Steller's eider's current breeding distribution in northern Alaska, and this area is expected to be disproportionately important to the survival and recovery of the Alaska-breeding population. Barrow also is an important human population center, and, as a result of the significant human presence and rapid village growth, Steller's eiders near Barrow are exposed to disturbance associated with human activity such as all-terrain vehicle (ATV) traffic through nesting areas and loss or alteration of habitat as a result of development. Additionally, numerous research efforts, including those directed at Steller's eiders as well as other topics, result in additional disturbance.

4.1.7.7 Oil Spills and Other Contaminants

A significant proportion of the world's population of Steller's eiders winter in shallow, nearshore waters from the eastern Aleutian Islands to southern Cook Inlet in Alaska, where they may be exposed to petroleum and other contaminants (Service 2002). Harbors and bays (e.g., Akutan, Sand Point, Unalaska Bay, King Cove, and Cold Bay), and areas with proposed harbors or harbor expansions, have substantial current or potential maritime traffic. Many of these areas are occupied by hundreds of wintering or staging Steller's eiders (Martin et al. 2015, Larned 2012b). Steller's eiders have been observed roosting and feeding in nearshore waters near industrial activity and amid ship traffic in these areas. Conservative estimates indicate that at least 18,000 gallons of petroleum products were spilled from activities associated with the commercial fishing/seafood processing industry from 1995 to 2000, and that at least 4,800 gallons of petroleum products are spilled annually in harbors in southwest Alaska (Day and Pritchard 2000). Other contaminants found in industrial marine wastes, such as organochlorine pesticides and polychlorinated biphenyls (PCBs), may occur in or near Steller's eider wintering areas. Thus, it is plausible that Steller's eiders associated with nearshore waters influenced by industrial marine activity are being exposed to petroleum and other organic contaminants (Service 2002, Reed and Flint 2007).

Discharge from seafood processors has recently become an increasing concern for its potential impacts to marine life, including seabirds. Fish-waste from seafood processing plants could potentially harm Steller's eiders indirectly by degrading foraging habitat, and directly by exposing individuals to contaminants, disease, and increased predation (Service 2015a).

4.1.7.8 Climate Change

Steller's eiders, like other arctic breeders, may be especially vulnerable to the effects of climate change (Prowse et al. 2006). The most prominent effects of climate change on Steller's eider habitat are likely to occur within the Arctic breeding grounds.

Climate change could modify both the physical environment and the biota within the Arctic breeding grounds of the Steller's eider population. Impacts that already have been observed in Alaska include earlier snowmelt, reduced sea ice, glacial retreat, warmer permafrost, drier landscapes, increased wildfires, and more extensive insect outbreaks (Chapin et al. 2014). The Arctic climate directly affects a range of physical, chemical and biological processes in aquatic systems and creates indirect ecological effects through the control of terrestrial hydrologic systems and processes, particularly those associated with cryospheric components such as permafrost, freshwater ice and snow accumulation and melting (Prowse et al. 2006). With the reduction in summer sea-ice, the frequency and magnitude of coastal storm surges has increased. These can cause breaching of lakes and inundation of low-lying coastal wetland areas, killing salt-intolerant plants and altering soil and water chemistry, and hence, the fauna and flora of the area (Jorgenson and Ely 2001). These changes may alter the nesting habitat of eiders on the Y-K Delta. Thawing permafrost and the inundation of the shoreline due to lack of sea-ice has significantly increased coastal erosion rates (Mars and Houseknech 2007), potentially reducing the quality or quantity of Steller's eider habitat throughout the population's range.

Existing studies suggest that Steller's eider survival rates may be influenced by climate variability. Modeling results by Frost et al. (2013) indicate that the lowest estimates of annual survival of Steller's eiders in the Pacific population during 1993-2003 coincided with a brief warming event in the Pacific Decadal Oscillation while the return to cooler temperatures in the Bering Sea that followed coincided with the highest estimated annual survival rates and an increasing trend in annual survival. The authors note, however, that confident conclusions cannot be drawn from apparent correlation with a single climatic event. Similarly, some evidence indicates that short-term changes in populations of common eiders may have been influenced by non-breeding habitat issues such as food shortages, and although data does not support direct correlation between these non-breeding factors and climate change at this time (Coulson 2010), it seems likely that a complex relationship exists between climate change, resource availability, and eider population effects (Dunham 2016).

4.1.8 Steller's Eider Recovery Criteria

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

Criteria used to determine when species are recovered are often based on historical abundance and distribution, or on the population size required to ensure that extinction risk, based on population modeling, is tolerably low. For Steller's eiders, information on historical abundance is lacking, and demographic parameters needed for accurate population modeling are poorly understood. Therefore, the Recovery Plan for Steller's Eiders (Service 2002) establishes interim recovery criteria based on extinction risk, with the assumption that numeric population goals will be developed as demographic parameters become better understood. Under the Recovery Plan, the Alaska-breeding population would be considered for delisting from threatened status if it has less than or equal to 1 percent probability of extinction in the next 100 years, and each of the northern and western subpopulations are stable or increasing and have less than or equal to 10 percent probability of extinction in 100 years.

At present independent analysis suggests that if there is no permanent immigration or emigration between Russian breeding and Alaska-breeding Steller's eiders, if declining trends continue, and if the available estimates of vital rates are accurate and precise, the listed Steller's eiders have a high probability of extinction in the foreseeable future (Swem and Matz 2008).

4.2 Southwest Alaska DPS of Northern Sea Otter

The southwest Alaska DPS of the northern sea otter was designated as a threatened species in 2005 (70 FR 46366; August 9, 2005). At the time of the 2005 final listing rule, it was estimated that the southwest DPS had experienced a rapid decline in abundance of more than 50 percent since the late 1980s and consisted of approximately 42,000 sea otters. The cause of the overall decline is not known with certainty, but the weight of evidence points to increased predation, probably by the killer whale (*Orcinus orca*), as the most likely cause (Service 2013a). Critical habitat was designated in 2009 (74 *FR* 51988; October 8, 2009). Critical habitat for the southwest Alaska DPS of northern sea otter is discussed separately, below in *Northern Sea Otter Critical Habitat* of the *Status of Listed Species and Critical Habitat* section. Key documents for this species include the Recovery Plan (Service 2013a) and a 5-Year Review: Summary and Evaluation (Service 2013b).

The northern sea otter (*Enhydra lutris kenyoni*) is a marine mammal related to mink and river otters that lives in shallow water areas along the shores of the North Pacific, including the Action Area. Adult males average 4.3 feet (1.3 m) in length and 66 pounds (30 kg) in weight; adult females average 3.9 feet (1.2 m) in length and 44 pounds (20 kg) in weight (Kenyon 1969). Sea otters lack blubber and depend entirely upon their fur for insulation (Riedman and Estes 1990). They molt gradually throughout the year (Kenyon 1969).

There is variation in age of first reproduction, but generally, male sea otters appear to reach sexual maturity at 5 to 6 years of age and females reach sexual maturity at 3 to 4 years (Garshelis et al. 1984, von Biela et al. 2008). The interval between pups is typically 1 year. The presence of pups and fetuses at different stages of development throughout the year suggests that reproduction occurs at all times of the year. Most areas that have been studied show evidence of one or more seasonal peaks in pupping (Rotterman and Simon-Jackson 1988). Similar to other mustelids, sea otters can have delayed implantation of the blastocyst (developing embryo) (Sinha et al. 1966). As a result, pregnancy can have two phases: from fertilization to implantation, and from implantation to birth (Rotterman and Simon-Jackson 1988). The average time between copulation and birth is 6 to 7 months. Although young may be born in any season, in Alaska most pups are born in late spring. Like other marine mammals, they have only one pup during each breeding cycle. The female's maternal instinct is very strong and she seldom leaves her pup except when diving for food. When the female travels or sleeps, the pup usually rides on its mother's chest as she floats on her back. The pup may weigh 30 pounds (14 kg) or more when weaned and looks almost as big as its mother. Females can produce one pup a year, but in areas where food is limited, they may produce pups less frequently. Female sea otters typically will not mate while accompanied by a pup (Lensink 1962, Kenyon 1969, Garshelis et al. 1984).

Estimating the rate of recruitment of sea otters into a population is difficult primarily because of asynchronous pupping and an inability to reliably distinguish males from females and juveniles from adults externally. For long-lived species, we expect that survivorship of offspring is related to maternal age and experience, and that recruitment rate is more sensitive than survival rate to environmental fluctuations (Eberhardt 1977). The maximum life span of a wild sea otter is believed to be 23 years (Nowak 1999).

Across its range, three subspecies of northern sea otter are recognized: 1) the Asian northern sea otter (*E. l. lutris*), which occurs west of the Aleutian Islands; 2) the southern sea otter (*E. l. nereis*), which occurs off the coast of California and Oregon; and 3) the Alaskan northern sea otter (*E. l. kenyoni*), which occurs from the west end of the Aleutian Islands to the coast of the State of Washington (Wilson et al. 1991). Among Alaskan northern sea otters, three stocks or distinct population segments (DPS) are recognized: southwest, southcentral, and southeast (Figure 6). The range of the southwest Alaska DPS includes the west side of Cook Inlet, the Alaska Peninsula and Bristol Bay coasts, and the Aleutian, Barren, Kodiak, and Pribilof Islands (see Figure 4 above; Service 2013a).

4.2.1 Status and Distribution

Large sea otter populations in Alaska were discovered by the Russian Bering expedition in 1741, resulting in a commercial fur harvest that lasted 170 years and extirpated sea otters from much of their historic range (Service 2013a). When the species was finally given protection under the International Fur Seal Treaty of 1911, the worldwide population may have consisted of fewer than 1,000 individuals in 13 remnant colonies. Throughout much of the 20th century, these remnant colonies grew and expanded their range, eventually recolonizing much of the species' historically occupied habitat. During the 1990s, sea otter surveys in the Aleutian Archipelago indicated that the population trend had shifted from growth and expansion to decline (Doroff et al. 2003). Additional surveys (i.e., Burn and Doroff 2005) throughout southwest Alaska helped define the scope and magnitude of the population decline, which led eventually to listing this DPS as threatened (70 FR 46366; August 9, 2005).

As stated previously, the southwest Alaska stock ranges from Attu Island at the western end of the Near Islands in the Aleutians, east to Kamishak Bay on the western side of lower Cook Inlet, and includes waters adjacent to the Aleutian Islands, the Alaska Peninsula, the Kodiak

Archipelago, and the Barren Islands (Service 2005a). Within the range of northern sea otters there may be physical barriers to movement across the upper and the lower portions of Cook Inlet, and there are morphological and some genetic differences between sea otters that correspond to the southwest and southcentral Alaska stocks (Service 2005a). Genetic analyses show some similarities between sea otters in the Commander Islands, Russia, and Alaska (Cronin et al. 1996), which indicates that movements between these areas has occurred, at least over evolutionary time scales. All existing sea otter populations have experienced at least one genetic bottleneck caused by the commercial fur harvests from 1741 to 1911. As part of efforts to re-establish sea otters in portions of their historical range, otters from Amchitka Island (part of the Aleutian Islands) and Prince William Sound were translocated to other areas outside the range of what we now recognize as the southwest Alaska distinct population segment, but within the range of *E. l. kenyoni* (Jameson 2002).

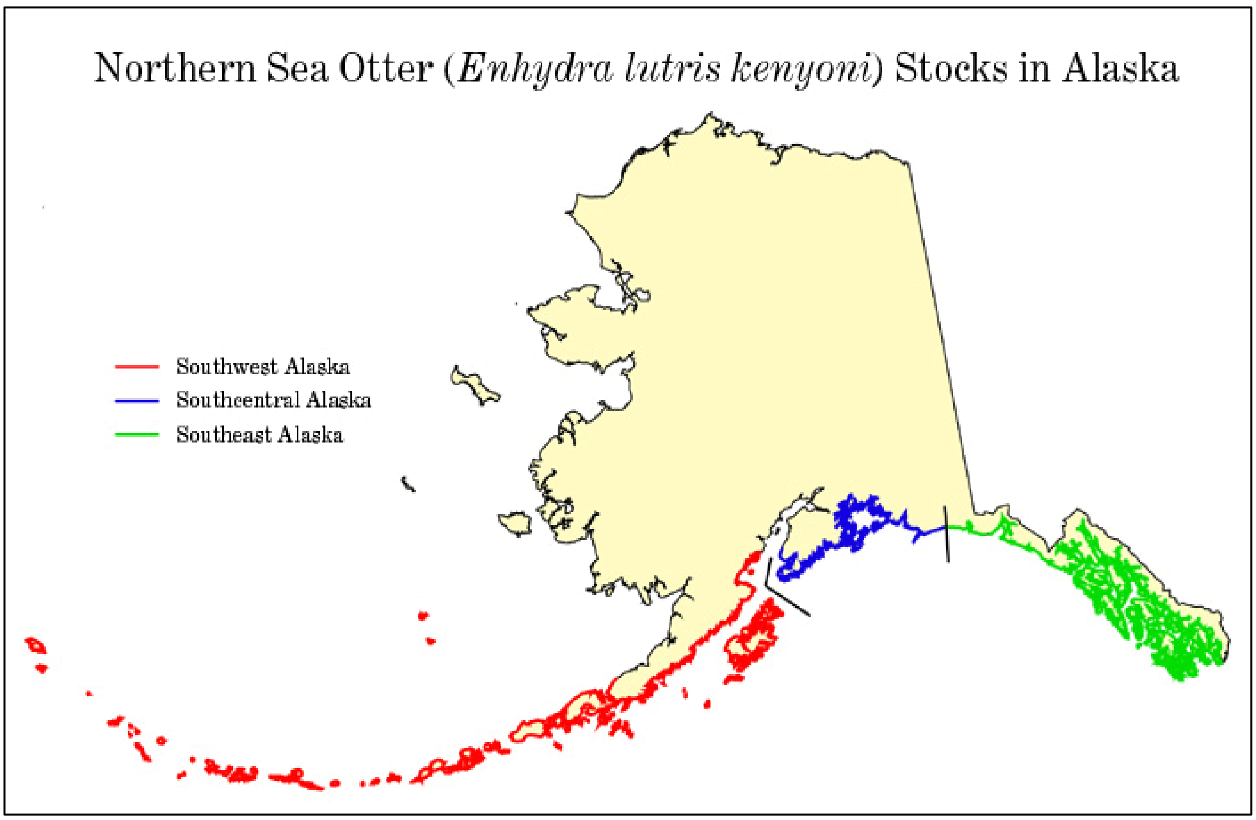

Figure 6. Northern sea otter stocks in Alaska.

Sea otters in Alaska are non-migratory and generally do not disperse over long distances (Service 2008a). They usually remain within a few kilometers of their established feeding grounds (Kenyon 1981); however they are capable of long distance travel. Translocated populations are known to shift and expand their distribution in favorable habitats, sometimes traversing distances up to 217 miles (350 km) over a relatively short period (Ralls et al. 1992; Jameson 2002). Juvenile males (1 to 2 years of age) are known to disperse up to 75 miles (120 km) from their natal (birth) area; young females traveled up to 23.6 miles (38 km) (Garshelis and Garshelis 1984, Monnett and Rotterman 1988, Riedman and Estes 1990). Routine movements between feeding and resting areas as large as 35 to 60 miles (57 to 97 km) have also been observed by VanBlaricom et al. (2001).

Once a population has become established and has reached equilibrium density within the habitat, the home ranges of sea otters are relatively small. Home range and movement patterns vary depending on the gender and breeding status. The home range of individual sea otters can vary from only a few square miles (mi^2) to over 24 mi^2 (few km^2 to over 40 km^2) (Schneider and Ballachey 2008). In the Aleutian Islands, breeding males remain for all or part of the year within the bounds of their breeding territory, which constitutes a length of coastline anywhere from328 ft (100 m) to approximately 0.62 miles (1 km). Sexually mature females have home ranges of approximately 5 to 10 miles (8 to 16 km), which may include one or more male territories. Male sea otters that do not hold territories may move greater distances between resting and foraging areas than territorial males (Lensink 1962, Kenyon 1969, Riedman and Estes 1990, Estes and Tinker 1996). Typical daily movement distances may exceed 1.8 miles (3 km) at rates of speed up to 3.4 miles per hour (5.5 km per hour) (Garshelis and Garshelis 1984).

Sea otter movements are also influenced by local climatic conditions such as storm events, prevailing winds, and in some areas, tidal states. Sea otters tend to move to protected or sheltered waters (bays, inlets, or lees) during storm events or high winds. In calm weather conditions, sea otters may be encountered further from shore (Lensink 1962, Kenyon 1969). In the Commander Islands, Russia, weather, season, time of day, and human disturbance have been cited as factors that induce sea otter movement (Barabash-Nikiforov et al. 1947, Barabash-Nikiforov et al. 1968).

The approximate range of sea otters within Cook Inlet, including the Action Area, extends along both shorelines of Cook Inlet as far north as approximately Ninilchik on the eastern side of Cook Inlet, and south of Kalgin Island on the western side (see Figure 6 above; BOEM 2016b). Although sea otters often occur individually or as mother and pup, they may also spend time in high density rafts or groups of typically up to 20, and rarely up to 300-500, animals in the Cook Inlet area (Doroff and Badajos, 2010; V. Gill, 2016, pers. comm.). Sea otters are year-round residents in the Action Area and generally occur in shallow water areas near the shoreline. They are most commonly observed within the 131 feet (40 m) depth contour (Service 2008a), although they can be found in waters up to 328 feet (100 m) deep. Most foraging dives take place in waters less than 98 feet (30 m) deep (Bodkin et al. 2004). As water depth is generally correlated with distance to shore, sea otters typically inhabit waters within 0.62 to 1.24 miles (1 to 2 km) of shore (Riedman and Estes 1990). Much of the marine habitat of the sea otter in southwest Alaska is characterized by a rocky substrate. In these areas, sea otters typically are concentrated between the shoreline and the outer limit of the kelp canopy (Riedman and Estes 1990), but they also occur further seaward. Sea otters also inhabit marine environments that have soft sediment substrates, such as areas in Bristol Bay and the Kodiak Archipelago. As communities of benthic invertebrates differ between rocky and soft sediment substrate areas, so do sea otter diets.

The most recent stock assessment for the southwest Alaska DPS of sea otters (Service 2014b) estimates a minimum population estimate of approximately 55,000 individuals (Table 7). The Management Unit (MU) in the Action Area is the Kodiak, Kamishak, Alaska Peninsula MU (KKAPMU) which may have almost half of the population of the southwest Alaska DPS residing within it (Service 2014a). The latest survey information available specifically for the west side of Cook Inlet between approximately Illiamna Point to Douglass Reef (i.e., Greater Kashimak Bay) estimated 6,918 otters (Bodkin et al. 2003). Although sea otters often occur individually or as mother and pup, they may also spend time in high density rafts or groups of typically up to 20, and rarely up to 300-500, animals in the Action Area (Doroff and Badajos, 2010; V. Gill, 2016, pers. comm.).

4.2.2 Population Trends

Historically, sea otters occurred throughout the coastal waters of the North Pacific Ocean from the northern Japanese Archipelago around the North Pacific Rim to central Baja California. Between 1741 and 1911, sea otters were hunted to the brink of extinction by Russian and American fur hunters. Prior to commercial exploitation, the worldwide population of sea otters was estimated at 150,000 to 300,000 animals (Kenyon 1969, Johnson 1982).

Sea otters were protected from further commercial harvests under the International Fur Seal Treaty of 1911. At that time, only 13 small remnant populations were believed to have persisted. The total worldwide population may have been only 1,000 to 2,000 animals. Two of these remnant populations (Queen Charlotte Island and San Benito Islands) declined to extinction (Kenyon 1969, Estes 1980). The remaining 11 populations began to grow in number, and expanded to recolonize much of the former range. Six of these remnant populations (Rat Islands, Delarof Islands, False Pass, Sandman Reefs, Shumagin Islands, and Kodiak Island) were located within the bounds of the southwest Alaska DPS. Because of the remote, pristine nature of southwest Alaska, these remnant populations grew rapidly during the first 50 years following protection from further commercial hunting. The population in southwest Alaska had grown in numbers and re-colonized much of the former range by the mid- to late-1980s. At that time, numbers were believed to be around 92,800 to 126,900 in southwest Alaska.

4.2.2.1 Aleutian Islands

From the mid-1960s to the mid-1980s, otters expanded their range, and presumably their numbers as well, until they had recolonized all the major island groups in the Aleutians. Although the maximum size reached by the sea otter population is unknown, a habitat-based computer model estimates that the population in the late 1980s may have numbered approximately 74,000 individuals in the Aleutians (Burn et al. 2003). But in a 1992 aerial survey of the entire Aleutian Archipelago, only 8,048 otters were counted (Evans et al. 1997); approximately 19 percent fewer than the total reported for a 1965 survey Kenyon (1969). In April 2000, 2,442 sea otters were counted; a 70 percent decline from the count 8 years previous (Doroff et al. 2003). Along the more than 3,107 miles (5,000 km) of shoreline surveyed, sea otter density was at a uniformly low level, which clearly indicated that sea otter abundance had declined throughout the Archipelago. Doroff et al. (2003) calculated that the decline occurred at an average rate of 17.5 percent per year throughout the Aleutians.

4.2.2.2 Alaska Peninsula

Remnant colonies along the Alaska Peninsula expanded through the 1950s and early 1960s, (Kenyon 1969). Schneider (1976) estimated 17,000 sea otters on the north side of the Alaska Peninsula in 1976 (Burn and Doroff 2005), which he believed to have been within the carrying capacity for that area. In 1986, an estimated 6,474–9,215 sea otters occupied this area (Burn and Doroff 2005). By May 2000, estimates had dropped 27 to 49 percent from 1986 (Burn and Doroff 2005). Declines were also occurring along the south side of the Alaska Peninsula between the mid-1960s and early 2000s (Kenyon 1969, Brueggeman et al. 1988, DeGange et al. 1995). Rates of decline as high as 93 percent were documented in some areas (Burn and Doroff 2005).

Table 7. Population estimates for the Southwest Alaska stock of northern sea otters compared to the previous stock assessment report (SAR) total from 2008.

Survey Area	**Year**	**Unadjusted Estimate**	**Adjusted Estimate**	**CV**	**N_{min}**	**Reference**
Aleutian Islands	2000	2,442	8,742	0.22	7,309	Doroff *et al*. (2003)
North Alaska Peninsula	2000	4,728	11,253	0.34	8,535	Burn and Doroff (2005)
South Alaska Peninsula - Offshore	2001	1,005	2,392	0.82	1,311	Burn and Doroff (2005)
South Alaska Peninsula - Shoreline	2001	2,651	6,309	0.09	5,865	Burn and Doroff (2005)
South Alaska Peninsula - Islands	2001	402	957	0.09	889	Burn and Doroff (2005)
Unimak Island	2001	42	100	0.09	93	USFWS unpublished data
Kodiak Archipelago	2004		11,005	0.19	9,361	USFWS unpublished data
Katmai	2008		7,095	0.13	6,362	Coletti *et al*. (2009)
Kamishak Bay	2002		6,918	0.32	5,340	Bodkin *et al*. (2003)
Current Total			**54,771**		**45,064**	
Previous SAR Total			47,676		38,703	

Source: Service 2014a

Overall, the combined counts for the entire Alaska Peninsula have declined by 65 to 72 percent since the mid-1980s. The estimated number of sea otters along the Alaska Peninsula was 9,658 as of 2014.

4.2.2.3 Kamishak Bay, the Kodiak Archipelago and Cook Inlet

The eastern extent of the population decline of the1960s to 1990s appears to occur at about Castle Cape. Populations around Kodiak, Katmai, Kamishak, and lower Cook Inlet are stable or increasing (Coletti et al. 2009, Estes et al. 2010). In 2002, Bodkin et al. (2003) found sea otters to be relatively abundant within Kamishak Bay (6,918 otters). In 1994, there were an estimated 9,817 otters in the Kodiak Archipelago (Service unpublished data). An aerial survey of the Kodiak Archipelago conducted in 2004 resulted in an estimate of 11,005 sea otters (CV = 0.19; Service unpublished data).

Population trends in southwest Alaska changed during the period 2003 to 2011. Declines leveled off and average growth rates approached zero. Some variation was evident but the overall trends were consistent among islands. These results suggest that population declines may have recently stabilized in the western Aleutian Islands, although there is still no evidence of recovery (USGS unpublished data, Service unpublished data).

4.2.3 Foraging Ecology

Sea otters are carnivores that forage on the seafloor in nearshore marine and intertidal habitats in areas with rocky substrates and soft bottom sediments (Riedman and Estes 1990). They typically forage close to shore in waters less than 82 to 131 ft (25 to 40 m) in depth (Estes 1980, Van Blaricom and Estes 1988). Due to their benthic foraging, sea otter distribution is largely limited by their ability to dive to the sea floor (Bodkin et al. 2004). Sea otters eat a wide variety of benthic (living in or on the sea floor) invertebrates, including sea urchins, clams, mussels, crabs, and octopus. Clams were the most frequently identified sea otter prey item (57 to 67 percent of the diet) in the northern Kodiak Archipelago. Mussels, crabs, and green sea urchins contributed less than or equal to 25 percent of the total prey (Doroff and DeGange 1994). Sea otters mainly forage in depths less than 6.6 feet (20 m) (Bodkin et al. 2004). However, diving depth of sea otters is highly variable and ranges from 5 to 250 feet (2 to 75 m) depending on the prey species (Schneider and Ballachey 2008). In some parts of Alaska, sea otters also eat epibenthic (living upon the sea floor) fishes (Estes et al. 1982, Estes 1990). Sea otters dive and return with several items of food, roll on their backs, place the food on their chests and eat it piece by piece using their forepaws, sometimes using a rock to crack shells. In the wild, sea otters never eat on land. Feeding dives generally last about 1 to 1.5 minutes, although some otters are capable of staying underwater for 5 minutes or more (Riedman and Estes 1990). They have a high metabolic rate compared to land mammals of similar size (Costa 1978, Costa and Kooyman 1984). To maintain the level of heat production required to sustain them, sea otters eat large amounts of food; estimated at 23 to 33 percent of their body weight per day (Riedman and Estes 1990).

Esslinger et al. (2014) showed that otters spend less time foraging during summer (females 8.8 hours/day, males 7.9 hours/day) than other seasons (females 10.1 to 10.5 hours/day, males 9.2 to 9.5 hours/day). Both sexes showed strong preferences for diurnal foraging and adjusted their foraging effort in response to available daylight. One exception to this diurnal foraging mode occurred after females gave birth. For approximately 3 weeks post-partum, females switched to nocturnal foraging, possibly in an effort to reduce the risk of predation by eagles on newborn pups (Esslinger et al. 2014).

4.2.4 Threats to the Species

Threats and stressors affecting the southwest Alaska DPS of northern sea otter are identified in the Recovery Plan (Service 2013a), and summarized in Table 8. The Five-Year Review and Evaluation supported the conclusions of the Recovery Plan and found no new information to alter its conclusions (Service 2013b).

4.2.4.1 Predation

Available information suggests that predation by killer whales (*Orcinus orca*) may be the most likely cause of the sea otter decline in the Aleutian Islands (Estes et al. 1998). Data that support this hypothesis includes:

- A significant increase in the number of killer whale attacks on sea otters during the 1990s (Hatfield et al. 1998);
- The number of observed attacks fits expectations from computer models of killer whale energetics;
- The scarcity of beach cast otter carcasses that would be expected if disease or starvation were occurring;
- Markedly lower mortality rates for sea otters in a sheltered lagoon (where killer whales cannot go) than for those in an adjacent exposed bay; and
- Documentation of elevated mortality rate as the cause of decline, rather than reduced fertility or redistribution (Laidre et al. 2006).

Table 8. Potential Threats to the Southwest Alaska DPS of Northern Sea Otter

Importance Level	Threat
Moderate to High Importance	Predation (especially by killer whales)
Low to Moderate Importance	Oil spills and oiling Illegal takes Subsistence harvest Infectious diseases
Low Importance	Biotoxins (from harmful algal blooms) Contaminants (persistent organic pollutants, heavy metals) Disturbance Fishery bycatch and entanglement in debris Food limitation (prey base) Habitat loss and alteration

Note: Threats were identified in the Recovery Plan. Source Service 2013a

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- Documentation of elevated mortality rate as the cause of decline, rather than reduced fertility or redistribution (Laidre et al. 2006).

The hypothesis that killer whales may be the principal cause of the sea otter decline suggests that there may have been significant changes in predator-prey relationships in the Bering Sea ecosystem (Estes et al. 1998, Springer et al. 2003). For the past several decades, harbor seals (*Phoca vitulina*) and Steller sea lions (*Eumetopias jubatus*), the preferred prey species of transient, marine mammal eating killer whales, have been in decline throughout the western North Pacific. In 1990, Steller sea lions were listed as threatened under the ESA (55 FR 49204). Estes et al. (1998) hypothesized that killer whales may have responded to declines in their preferred prey species, harbor seals and Steller sea lions, by broadening their prey base to include sea otters. Springer et al. (2003) suggest that modern industrial whaling led to declines in great whale populations in the North Pacific, which in turn resulted in killer whales “fishing down” the marine food web; first harbor seals, then fur seals (*Callorhinus ursinus*), sea lions, and finally sea otters in succession as preferred prey were depleted.

4.2.4.3 Subsistence Harvest

Subsistence harvest has reportedly removed fewer than 1,400 sea otters from the southwest Alaska DPS between 1989 and 2011 (average from 2006 to 2010 was 76 per year; with a range of 30 to 122 per year; Service unpublished data, Service 2014b). The majority of the subsistence harvest in southwest Alaska occurs in the Kodiak Archipelago. Given the estimated population growth rate of 10 percent per year estimated for the Kodiak Archipelago by Bodkin et al. (1999), we would expect that these harvest levels by themselves would not cause a population decline. Some of the largest observed sea otter declines have occurred in areas where subsistence harvest is either nonexistent or extremely low. The best available scientific information does not indicate that subsistence harvest by Alaska Natives has had a major impact on the southwest Alaska DPS of the northern sea otter.

4.2.4.4 Interaction with Commercial Fisheries

Sea otters are sometimes taken incidentally in commercial set net, trawl, and finfish pot fisheries fishing operations (76 FR 73912). Entanglements of single animals have been reported from the Bering Sea, Bristol Bay, and Prince William Sound. In 1992, eight sea otters were observed caught in the Pacific cod pot fishery in the Aleutian Islands (Perez 2006, 2007). In 2002, four incidents of entanglement with no mortality or serious injury were recorded in the Kodiak salmon set net fishery (Manly et al. 2003). Based on Kodiak fisheries data, coupled with self-reporting records from the Bering Sea and Aleutian Island ground fish trawl fishery, it is estimated that fewer than 10 sea otters per year might be killed or seriously injured as a result of entanglement with fishing gear (Service 2008b).

4.2.4.5 Development

Habitat destruction or modification is not known to be a major factor in the decline of the southwest Alaska DPS of the northern sea otter. Development of harbors and channels by dredging may affect sea otter habitat on a local scale by disturbing the sea floor and affecting benthic invertebrates that sea otters eat. As harbor and dredging projects typically impact an area of 123.5 acres (50 hectares) or less, the overall impact of these projects on sea otter habitat is considered to be negligible (Service 2008c). However, the cumulative effect of incremental, small losses of critical habitat may affect the population by removing or reducing the availability of PCEs. Between 2002 and 2014, section 7 consultation documented an estimated 50 acres (20.2 hectares) of habitat impact (including both temporary and permanent impacts) and take by disturbance of 36 otters.

4.2.4.6 Research

Scientific research on sea otters occurs primarily as annual aerial and skiff surveys. When they occur, they last for very short durations of time. Other research includes capture and handling of individuals. During the 1990s, 198 otters were captured and released as part of health monitoring and radio telemetry studies at Adak and Amchitka. In the 2000s, 98 sea otters from the southwest Alaska DPS were live-captured and released as part of a multi-agency health monitoring study (Service 2005a, 2008b). Accidental capture-related deaths have been rare, with research activities carefully monitored by the Division of Management Authority.

4.2.4.7 Disease

Parasitic infection was an identified cause of increased mortality of sea otters at Amchitka Island in 1951 (Rausch 1953). These highly pathogenic infestations were apparently the result of sea otters foraging on fish, combined with a weakened body condition brought about by nutritional stress. More recently, sea otters have been impacted by parasitic infections resulting from the consumption of fish waste. Necropsies of carcasses recovered in Orca Inlet, Prince William Sound, revealed that some otters in these areas had developed parasitic infections and fish bone impactions that contributed to their deaths (Ballachey et al. 2002). Valvular endocarditis and septicemia have been isolated as a major, proximate cause of sea otter deaths in Alaska (Goldstein et al. 2009). The majority of these deaths are directly related to exposure to and infection from *Streptococcus* bacteria.

4.2.4.8 Oil Spills

A review of the oil threat potential to sea otter recovery completed in the Recovery Plan judged oil spills of low to moderate importance (Service 2013a). The Recovery Plan concludes that due to the large spatial extent of the DPS, even a large spill from a crude oil tanker would be unlikely to affect a substantial proportion of the overall sea otter population (Service 2013a). Table 9 summarizes that analysis for the KKAPMU.

The effects of oil on sea otters include short-term acute oiling of fur, resulting in death from hypothermia, smothering, drowning, or ingestion of toxics during preening. While these acute effects are not disputed, a growing body of evidence suggests that oil also affects sea otters over the long term, with interactions between natural environmental stressors and the compromised health of animals exposed to oil lingering well beyond the acute mortality phase (Peterson et al. 2003). The myriad studies that have been undertaken since the Exxon Valdez Oil Spill provide the most comprehensive data by which to evaluate the effects to wild populations of sea otters to long-term, low-level exposure to hydrocarbons (Bodkin et al. 2002, Stephensen et al. 2001). An estimated 3,905 (1,904 to 11,257) sea otters died during the Exxon Valdez Oil Spill (DeGange et al. 1995), and the Prince William Sound population has only recently shown signs of full recovery (Harwell and Gentile 2014).However, documenting chronic effects of the Exxon Valdez Oil Spill on sea otters has been difficult due to lack of appropriate controls combined with the natural variability among affected resources. Without experimental controls, correlation analysis is the best available inferential tool in assessing the impacts of unpredictable environmental perturbations.

Sublethal exposure compromises health, reproduction, and survival across generations (Bodkin et al. 2002). Sea otters consuming prey in habitats contaminated by residual oil have a high likelihood of encountering subsurface oil while excavating prey from sediments (Bodkin et al. 2002). Unlike vertebrates, invertebrates do not metabolize hydrocarbons; thus they accumulate hydrocarbon burdens in their tissues (Short and Harris 1996). Sea otters are therefore, potentially exposed to residual oil through two pathways: physical contact with oil while digging for prey, and ingestion of contaminated prey.

Research has confirmed the persistent exposure of sea otters to residual oil in western Prince William Sound. Several studies reported higher levels of a biomarker (P450 1A), which indicates exposure to aromatic hydrocarbons in sea otters sampled from oiled areas of Prince William Sound compared to animals sampled from un-oiled areas (Ballachey et al. 2000a, Ballachey et al. 2000b, Bodkin et al. 2002). Chronic, persistent exposure to oil appears to cause reduced productivity and reduced survival of young (Mazet et al. 2001, Ballachey et al. 2003). A comparison of body lengths of sea otters that attained adulthood prior to the spill, relative to post-spill measurements, suggests that food resources were approximately equivalent before and after. These results imply that factors other than body condition are affecting pup survival in western Prince William Sound (Ballachey et al. 2003).

Spills generally involve waste products, hazardous materials, or petroleum products. Waste products are substances that can be accidently introduced into the environment by industry activities. Examples include ethyl glycol, drilling muds, or treated water. Hazardous materials include any substance that can pose a health or environmental risk, including products such as ammonia and urea. Releases of oil or other petroleum products are generally referred to here as oil spills. Examples include oil, gas, or hydraulic fluid spills from mechanized equipment or spills from pipelines or facilities. Oil spills as considered either small (less than 1,000 barrels (bbls)) or large (greater than or equal to 1,000 bbls). A volume of oil of 1,000 bbls equals 42,000 U.S. gallons (gal), or 158,987 liters. Large spills are associated with oil platforms, such as drill rigs or pads and pipelines.

Table 9. Summary of importance of threats to recovery of the southwest Alaska DPS of the northern sea otter by management unit (from Service 2013a).

Management Unit		**Western Aleutians**	**Eastern Aleutian**	**Bristol Bay**	**South Alaska Peninsula**	**Kodiak, Kamishak, Alaska Peninsula**
Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range from Oil spills	Potential Impact	High	High	High	High	High
	Geographic Scope	Local to Widespread	Local to Widespread	Local to Widespread	Local to Widespread	Local to Widespread
	Likelihood	Very to Not Likely	Very to Somewhat Likely	Very to Not Likely	Very to Not Likely	Very to Somewhat Likely
	Level of Confidence	High	High	High	High	High
	Importance to Recovery	Low	Moderate	Low	Low	Moderate
	Management potential	High	Moderate	Moderate	Moderate	Moderate

Spill data for events occurring both in marine waters and on land was compiled from 1995 to 2005 (ADEC 2007). These data show that most spills were caused by structural or mechanical failures or inadequacies or human factors. Accidents caused 3 percent of spills, but resulted in 13 percent of total volume spilled. Major sources of spills from regulated industries included oil exploration and production (60 percent of spills and 38 percent of total volume), non-crude terminals (11 percent of spills), pipelines (9 percent of spills and 32 percent of volume), and rail transport (3 percent of spills, but 15 percent of volume). Lesser sources within regulated industry included crude terminals and refineries. Major sources in unregulated industries included mining, vessel transport, and storage.

Within the Action Area, spill risk to sea otters is primarily associated with shipping and local industry. The shipping industry transports various types of petroleum products both as fuel and cargo within southwest Alaska. Vessel traffic in Cook Inlet is primarily associated with crude oil and product transport, commodity shipment, and passenger and vehicle carriage (Nuka 2012). In 2010 approximately 480 ships (excluding tugs and off-shore supply vessels) in excess of 300 gross tons entered Cook Inlet (Nuka 2012). Of the 480 ships, 218 were to the Port of Anchorage, 86 were to the Nikiski oil or gas terminals, and 123 were through Kachemak Bay. Most of these deep draft vessels transit along the east side of Cook Inlet while tank ships occasionally transit between Nikiski and the Drift River terminal on the western side of the middle Cook Inlet zone. Tugs and tank barges, cargo barges, and resident tugs (all less than 300 gross tons) carry a large proportion of the non-persistent oil transported within and through Cook Inlet (Nuka 2012). Approximately 8.75 million barrels of non-persistent fuel oil (367.4 million gallons) are moved into and through the Cook Inlet on these tug/barge voyages (Nuka 2012). These include automotive diesel, No. 2 heating oil, avgas, and gasoline and account for 66 percent of the non-persistent oil movement within Cook Inlet. However, the majority (58 percent) of persistent oil carried in Cook Inlet in 2010 was by crude oil tankers/carriers bringing unrefined oil to Nikiski. Vessel traffic forecasts for the 10-year period from 2011 to 2020 suggest moderate increases (1.5 to 2.5 percent annually). However, dramatic increases in the volume and variety of vessel traffic in Cook Inlet may occur, depending on the development of and global demand for Alaska’s coal, oil, gas, and minerals (Nuka 2012).

Trans-generational effects may arise from direct exposure to a mutagen such as petroleum hydrocarbons, and therefore may be realized long after the contaminant exposure has ceased (Bickham and Smolen 1994). Sea otters are long-lived, with relatively low annual reproductive rates and high annual adult survival; factors that result in reduced reproduction, increased mortality, or increased emigration will eventually lead to depressed population growth rates (Riedman and Estes 1990). Finally, exposure to pollutants such as crude oil may affect sea otters at a variety of levels of organization, beginning with somatic or germinal cell mutations and leading to a cascade of alterations that go beyond the individual or community to threaten the long-term survival of the population (Bickham et al. 2000, Clements 2000).

4.2.4.9 Climate Change

It is difficult to predict how climate change will affect sea otter recovery (Service 2013a). The most important effects are likely to be indirect (e.g., expansion in the range of species that predate sea otters, adverse effects to prey from ocean acidification). Predation by killer whales is identified in the Recovery Plan as the most likely cause for the decline of the southwest Alaska

DPS (Service 2013a). Climate change is also identified as a factor affecting the recovery of killer whale populations (NMFS 2008).

4.2.5 Sea Otter Recovery Criteria

The southwest Alaska DPS ranges from west to east across more than 1,500 miles of shoreline, and the otters occur in a number of distinct habitat types. The magnitude of the population decline has varied over the range. In some areas, numbers have declined by more than an order of magnitude, while in other areas no decline has been detected. To address such differences, the recovery plan identifies five management units (MUs) within the DPS: 1) Western Aleutian Islands; 2) Eastern Aleutian Islands; 3) South Alaska Peninsula; 4) Bristol Bay; and 5) Kodiak, Kamishak, Alaska Peninsula (Service 2013a). The relative importance of threats are assessed for each of the five MUs, with predation judged to be most important (moderate to high importance) followed by oil spills (low to moderate importance). Threats from subsistence harvest, illegal take, and infectious disease are assessed to be of moderate importance in the KKAPMU, but of low importance elsewhere.

Specific actions to achieve recovery and delisting of the southwest Alaska DPS that are specified in the Recovery Plan are:

- Demographic criterion. The probability of the sea otter becoming endangered within 25 years would be less than 5 percent. Because of this criterion, population monitoring and population modeling are considered high priorities.
- Ecosystem-based criterion. Greater than 50 percent of the islands need to be in the kelp-dominated state. This criterion applies to the Western Aleutians and Eastern Aleutians MUs only. Monitoring the status of the kelp forest ecosystem in these MUs is considered a high priority, as results from such monitoring will be needed to evaluate the ecosystem-based delisting criteria.
- Threats-based criterion. Predation is considered to be the most important threat to recovery, so additional research on that threat is also a high priority. Other high-priority actions include identifying characteristics of sea otter habitat, and ensuring that adequate oil spill response capability exists in southwest Alaska.

4.3 Northern Sea Otter Critical Habitat

4.3.1 Critical Habitat Status

On October 8, 2009, the Service finalized designation of 5,855 mi^2 (15,164 km^2) of critical habitat for the threatened northern sea otter in southwest Alaska (74 FR 51988; October 8, 2009). The Primary Constituent Elements (PCEs) are the physical and biological features essential to conservation of the species and may require special management considerations.

The PCEs for the designated critical habitat of the sea otter are:

- PCE 1: Shallow, rocky areas where marine predators are less likely to forage, which are waters less than 6.6 ft (2 m) in depth;
- PCE 2: Nearshore waters that may provide protection or escape from marine predators, which are those within 328 ft (100 m) of the mean high tide line;

- PCE 3: Kelp forests that provide protection from marine predators; forests occur in waters less than 66 ft (20 m) in depth; and
- PCE 4: Prey resources within the areas identified by PCEs 1, 2, and 3 that are present in sufficient quantity and quality to support the energetic requirements of the species.

The critical habitat for northern sea otters is subdivided into five MUs: 1) Western Aleutian Islands; 2) Eastern Aleutian Islands; 3) South Alaska Peninsula; 4) Bristol Bay; and 5) Kodiak, Kamishak, Alaska Peninsula (Figure 7**)**. All five MUs in the critical habitat designation contain some or all of the PCEs and support multiple life processes. With the exception of some relatively small areas on Kodiak Island, sea otters currently occupy all of their former range (74 FR 51988; October 8, 2009).

4.3.2 Threats to Critical Habitat

No trends in the condition of sea otter critical habitat are identified in the critical habitat designation, Recovery Plan, or 5-Year Review. However, the Recovery Plan rates habitat loss as a low threat to recovery of the population (Service 2013a). The physical habitat for sea otters is largely unspoiled throughout the vast majority of the range of the southwest Alaska DPS. The human population in this area is small, and development has been limited to the few, widely scattered towns, villages, and military installations. Developments that physically modify sea otter habitat are limited to nearshore waters immediately adjacent to towns, villages, and military bases, and are usually in the form of docks, piers, and boat harbors. Sea otters continue to use these sites. The shoreline and nearshore waters throughout most of the range of the southwest Alaska DPS are expected to remain relatively free of such development, as much of these areas are within Federal and State refuges, parks, preserves, and sanctuaries.

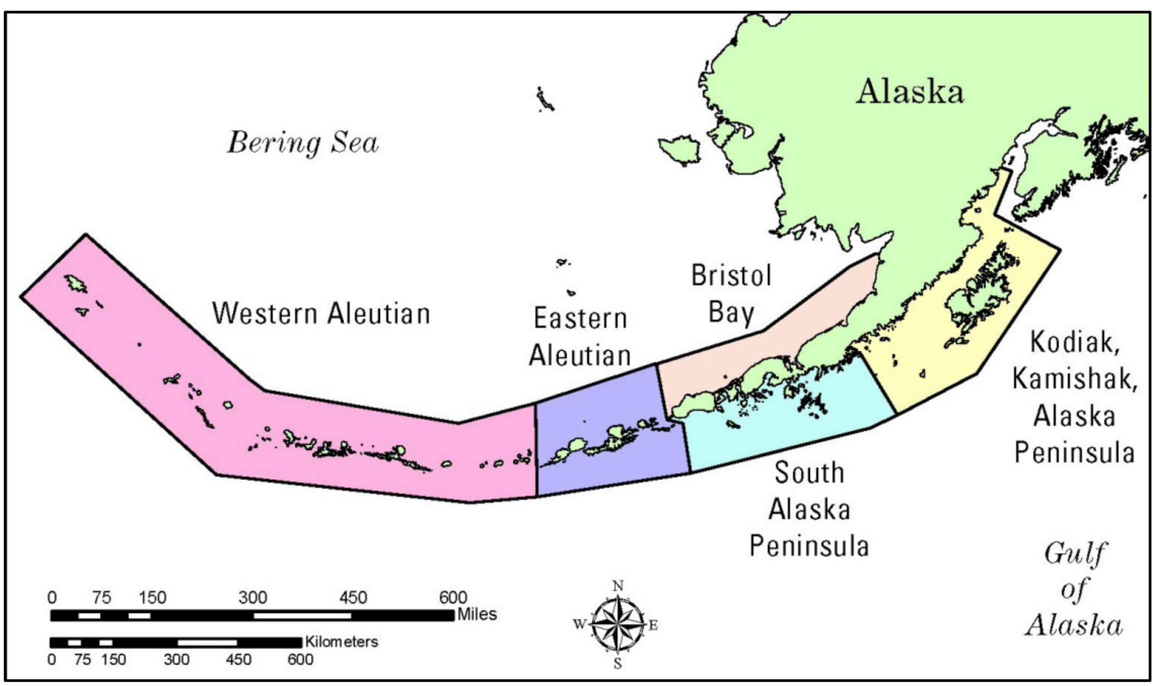

Figure 7. Management units (MUs) for the Southwest Alaska DPS of Northern Sea Otter (Service 2013a). The Action Area is within MU #5, Kodiak, Kamishak, Alaska Peninsula.

Climate change is expected to modify both the physical environment and the biota within the critical habitat (Service 2013a). It is difficult to predict how climate change will affect sea otter critical habitat. Potential changes that could affect PCEs 3 and 4 are:

- PCE 3 **–** Kelp forests are a key component of sea otter critical habitat. Climate change is projected to result in broad shift in the distribution of seaweeds in polar and cold-temperate waters (Muller et al. 2009).
- PCE 4 **–** Prey resources in sufficient quantity and quality to support the energetic requirements of the species. Ocean acidification, a consequence of rising atmospheric CO_2 levels, may affect the ability of sea otter prey species such as bivalves, snails, and crabs to form exoskeletons (Green et al. 2004).

5 ENVIRONMENTAL BASELINE

Regulations implementing the ESA (50 CFR §402.02) define the environmental baseline to include the past and present impacts of all Federal, State, or private actions and other human activities in the Action Area. Also included in the environmental baseline are anticipated impacts of all proposed Federal projects in the Action Area that have undergone section 7 consultation, and the impacts of State and private actions contemporaneous with the consultation in progress. The Action Area for this biological opinion is shown in Figure 1 and includes waters and shorelines of lower Cook Inlet and the Shelikof Strait. In this section, the baseline for each species and their critical habitat in the Action area are discussed first, followed by past oil and gas activities, and other activities occurring in the Action Area.

The environmental baseline also includes the effects of climate change on listed species and designated critical habitat. This biological opinion considers ongoing and projected changes in climate using terms as defined by the Intergovernmental Panel on Climate Change (IPCC). “Climate” refers to the means and variability of different types of weather conditions over time, with 30 years being a typical period for such measurements, although shorter or longer periods may also be used (IPCC 2007). The term “climate change” thus refers to a change in the mean or variability of one or more measures of climate (e.g., temperature or precipitation) that persists for an extended period, typically decades or longer, whether the change is due to natural variability, human activity, or both (IPCC 2007). Results of scientific analyses presented by the IPCC show that most of the observed increase in global average temperature since the mid-20th century cannot be explained by natural variability in climate, and is “very likely” (defined by IPCC as 90 percent or higher probability) due to the observed increase in greenhouse gas (GHG) concentrations in the atmosphere as a result of human activities, particularly carbon dioxide (CO^2) emissions from use of fossil fuels (IPCC 2007, Solomon et al. 2007). Various types of changes in climate can have direct or indirect effects on most species. These effects may be positive, neutral, or negative, and they may change over time, depending on the species and other relevant considerations, such as the effects of interactions of climate with other variables (e.g., habitat fragmentation) (IPCC 2007). This biological opinion uses expert judgment to weigh relevant information, including uncertainty, in consideration of climate change.

5.1 Alaska-Breeding Steller's Eider in the Action Area

The Action Area includes the easternmost extent of the molting and wintering range for Steller's eiders. Individuals arrive in Cook Inlet habitats in late fall, with numbers peaking in January and February, then declining as birds depart in March through mid-April on spring migration to nesting grounds (Larned 2006, Martin et al. 2015). However, birds may be present in lower Cook Inlet as early as late July or as late as late April (as they are in Kodiak), with numbers reportedly peaking in January and February (Larned 2006, Martin et al. 2015, Rosenberg et al. 2014). The chronology described likely varies somewhat among and within years depending on weather and sea ice dynamics, and perhaps also as a function of the physiological condition of the birds. Winter aerial surveys of lower Cook Inlet in 2004 and 2005 identified concentrations of these birds in Kachemak Bay, along the shoreline of the lower Kenai Peninsula near Ninilchik, and along the southcentral shore of Kamishak Bay (Larned 2006, Rosenberg et al. 2014). Figure 5 shows the distribution of sightings in February 2004. The largest monthly Steller's eider estimates in the 2004 to 2005 study were 1,499 in February, 2004, for eastern Cook Inlet survey areas, and 4,200 in January, 2005, for western survey areas (Larned 2006).

The ABR, Inc. (2011) collected marine wildlife observations in a lower western Cook Inlet study area as part of baseline studies for the proposed Pebble copper mine. Surveys were conducted via boat and helicopter between June 2004 and December 2009, and more than 100 eiders were observed in each monthly survey conducted between January and April of 2006, 2007, and 2008. Overall, eiders were observed from the second half of November through the first half of April, "primarily as large flocks resting and foraging within the centers of Iliamna and Iniskin Bays, with one small flock seen near the Iniskin Islands and none seen in Chinitna Bay." They found that mean group size in late winter and spring in these western Cook Inlet areas surveyed averaged 156 birds, with no significant difference between seasons.

As discussed in *Status of the Species*, spring surveys from 1992 to 2011 in the core of the species' spring staging habitat in southwestern Alaska (but not including Cook Inlet) have provided annual population estimates for Pacific-breeding Steller's eider ranging from 54,888 (year 2010) to 137,904 (year 1992), and averaged 81,453 individuals. The report estimated a declining trend of 2.4 percent annually between 1992 and 2012. The report indicated that the low number of 59,638 observed in 2012 may have been in part affected by delayed migration due to late sea ice dispersal (Larned 2012b). A small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay (Service, unpublished data).

5.1.1 Threats and Potential Stressors in the Action Area

Threats to the species' recovery have been summarized in *Status of the Species*. These factors include predation, disease, hunting, ingestion of spent lead shot, changes in the marine environment that could affect Steller's eider food or other resources, collisions with man-made structures, contact or ingestion of oil, and exposure to fish processing facility wastes. Threats in the Action Area typically mirror those previously described for range-wide threats to the species. Activities that have, are, or are expected to occur in the Action Area and their potential impact to Steller's eiders are described below in *Other Activities in the Action Area*. These activities include marine transport, mining, fisheries, wastewater discharge and runoff, and climate change

5.1.2 Recovery

The Steller's eider Recovery Plan (Service 2002) establishes criteria for reclassifying the species from threatened to endangered when either (a) the population has reached 20 percent or less probability of extinction in the next 100 years for 3 consecutive years; or (b) the population has reached 20 percent or less probability of extinction in the next 100 years and is decreasing in abundance. The Alaska-breeding population would be considered for delisting from threatened status if it has less than or equal to a 1 percent probability of extinction in the next 100 years, and each of the northern and western subpopulations are stable or increasing and have less than or equal to a 10 percent probability of extinction in 100 years. A revision of the population viability analyses for both the Alaska-breeding population and the Pacific population of Steller's eiders (Runge 2004) concluded that without reintroduction of breeding birds to the wild population, the listed population is at high risk of extinction (Swem and Matz 2008). Although the population viability analyses model incorporates the best available information, estimates are thought to be imprecise and likely biased in various ways. Regardless, recovery goals are not likely to be met at this time.

5.2 Sea Otters in the Action Area

The most recent estimate of the size of the southwest Alaska DPS of the northern sea otter based on surveys in 2000 to 2011 is 54,771 animals (Table 7; Service 2014) The Action Area falls within the KKAPMU which has approximately half of the population of the southwest Alaska DPS residing within it. (Service 2014).

Populations are stable or increasing in the Kodiak, Katmai, Kamishak, and Cook Inlet Areas and stable or decreasing in the Aleutians and the Alaska Peninsula (Service 2014). The population size in southwest Alaska has declined by more than 50 percent since the mid-1980s. While the overall population trend for the Southwest Alaska stock is believed to have stabilized, current numbers are well below historical levels, and there is no evidence of recovery.

5.2.1 Threats and Potential Stressors in the Action Area

Threats to the species' recovery have been summarized in *Status of the Species*. These factors include predation, subsistence harvest, interactions with commercial fisheries, development, research, disease, and oil spills. Threats in the Action Area typically mirror those previously described as range-wide threats. Activities that have, are, or are expected to occur in the Action Area and their potential impact to sea otter are described below in *Other Activities in the Action Area*. These activities include marine transport, mining, fisheries, wastewater discharge and runoff, and climate change.

5.2.2 Recovery

The sea otter recovery plan was completed in 2013 (Service 2013a). The goal of the recovery program is to establish a framework within which recovery actions are undertaken to ensure the long-term survival of the southwest Alaska DPS of the northern sea otter and to control or reduce threats to the species to the extent that it no longer requires the protections afforded by the ESA, and therefore warrants delisting. Although subject to change, full recovery of the southwest Alaska DPS is currently envisioned as a cessation of further population declines with viable numbers of sea otters present throughout the current range of the DPS. Threats to the species will be adequately identified, and will have sufficiently abated to ensure the high probability of the survival of the southwest Alaska DPS for at least 100 years. The current status of the population does not meet these criteria.

5.3 Sea Otter Critical Habitat

On October 8, 2009, the Service finalized designation of 5,855 mi^2 (15,164 km^2) of critical habitat for the threatened northern sea otter in southwest Alaska. The Primary Constituent Elements (PCEs) are the physical and biological features essential to conservation of the species and may require special management considerations. The PCEs for the designated critical habitat of the sea otter are:

- PCE 1: Shallow, rocky areas where marine predators are less likely to forage, which are waters less than 6.6 ft (2 m) in depth;
- PCE 2: Nearshore waters that may provide protection or escape from marine predators, which are those within 328 ft (100 m) of the mean high tide line;
- PCE 3: Kelp forests that provide protection from marine predators; forests occur in waters less than 66 ft (20 m) in depth; and
- PCE 4: Prey resources within the areas identified by PCEs 1, 2, and 3 that are present in sufficient quantity and quality to support the energetic requirements of the species.

This final critical habitat designation encompasses those areas containing PCEs necessary to support one or more of the species' life history functions and laid out in the appropriate quantity and spatial arrangement essential to the conservation of the DPS.

No trends in the condition of sea otter critical habitat are identified in the critical habitat designation, Recovery Plan, or 5-Year Review. However, the Recovery Plan rates habitat loss as a low threat to recovery of the population (Service 2013a). The physical habitat for sea otters is largely unspoiled and intact throughout the vast majority of the range of the southwest Alaska DPS. The human population in the Action Area is relatively small, and development has been limited to the few, widely scattered towns, villages, and military installations. Developments that physically modify sea otter habitat are limited to nearshore waters immediately adjacent to towns, villages, and military bases, and are usually in the form of docks, piers, and boat harbors. Sea otters continue to use these sites. The shoreline and nearshore waters throughout most of the range of the southwest Alaska DPS are expected to remain relatively free of such development, as much of these areas are within Federal and State refuges, parks, preserves, and sanctuaries.

5.4 Past Oil and Gas Activities in the Cook Inlet Planning Area

5.4.1 Federal Waters

The Action Area contains 244 oil and gas OCS lease blocks in the northern portion of the Cook Inlet Planning Area. Limited oil and gas activities have occurred since the proposed leases of the Proposed Action. Five OCS lease sales have been held in the Cook Inlet Planning Area in the past 39 years, resulting in the issuance of 103 leases total. A sixth sale (Cook Inlet Lease Sale 211) was planned but cancelled due to lack of industry interest. Lease Sale 244 is the only OCS lease sale in Cook Inlet included in the Five-Year Oil & Gas Leasing Program for 2012-2017

(BOEM 2012), which is currently in development (BOEM 2015) and will not be implemented until 2017.

These leasing activities precipitated only a limited degree of oil and gas activities. Between 1978 and 1985, a total of 13 exploratory wells were drilled in the Cook Inlet Planning Area, all of which have been permanently plugged and abandoned. From 1966 to 2005, operators collected approximately 192,000 line miles of pre-lease, deep-penetration seismic data which were used by BOEM and companies to evaluate the geologic potential for oil and gas resources and possible hydrocarbon prospects. All OCS leases have since expired or been relinquished. Survey companies continue to conduct off-lease 3D seismic operations in State and Federal waters in both upper and lower Cook Inlet (Apache Alaska Corporation 2012, Apache Alaska Corporation 2013, Apache Alaska Corporation 2014, BlueCrest Energy 2014, SAExploration Inc. 2015). These survey activities are likely to continue for the foreseeable future.

5.4.2 State Waters and Onshore Activities

Over the past 40 years, extensive oil and gas exploration and development has occurred in Alaskan State waters of Cook Inlet under the management of the Alaska Department of Natural Resources (ADNR) (ADNR 2015). Oil and gas discoveries in upper Cook Inlet cover an estimated 4,400 mi^2 (11,400 km^2), and extend from Kachemak Bay north to the Susitna River. The area includes oil fields offshore in Cook Inlet, and along the west shoreline of the inlet. The most recent annual area-wide sale to have occurred in State waters was held in May 2015. Existing infrastructure in Upper Cook Inlet includes 17 offshore platforms (13 currently active), associated oil and gas pipelines, and onshore processing facilities (ADNR 2016)

Most of the past and present oil and gas activities and facilities are in Upper Cook Inlet north of Kalgin Island, or along the eastern shoreline north of Anchor Point. Based on the range of sea otters in the Action Area (Figure 8), oil and gas activities in Alaska State lands or waters have not overlapped substantially with areas used by northern sea otters. However, in 2014, the State of Alaska issued an exploration license in southwest Cook Inlet covering an area of approximately 68,400 ha (169,000 ac) (ADNR 2014). The exploration license issued to Cook Inlet Energy LLC carries a primary license term of 4 years and includes nearshore waters north of Augustine Island that overlap with sea otter critical habitat. However, to date, no planned activities have been reported in nearshore waters in this area.

5.5 Other Activities in the Action Area

This environmental baseline also includes impacts of ongoing Federal projects.

5.5.1 Marine Transportation

Cook Inlet is a regional hub of marine transportation and is used by various vessels, including containerships, bulk cargo freighters, tankers, commercial and sport-fishing vessels, and recreational vessels. Cook Inlet supports six deep-draft ports, including four within the Action Area (Nikiski Industrial Facilities, Port of Homer, City of Seldovia, and Drift River Oil Terminal), and several light-draft ports in the Action Area (e.g., Port Graham, Tyonek, Williamsport). The Port of Anchorage, the third largest port in Alaska, is designated a U.S. Department of Defense National Strategic Port, and provides services to approximately 75 percent of the total population of Alaska. According to a 2012 study of vessel traffic in Cook Inlet, most vessel traffic moves along north-south transit lines, with deep-draft vessels generally using the east side of the inlet (Figure 9).

A baseline spill study conducted by The Glosten Associates and ERC (2012) as part of the Cook Inlet Risk Assessment estimated a historical vessel spill rate of 3.4 spills (regardless of size) per year, with 3.9 spills per year forecasted for the years 2015 through 2020 across all vessel categories. Historical rates ranged from 0.7 spills per year for tank ships to 1.3 spills per year for non-tank/non-workboat vessels (The Glosten Associates and ERC 2012). Eight large spills (greater than or equal to 1000 bbl) from vessels (tankers and, in one case, a tug) were documented in Cook Inlet between 1966 and 2015 (BOEM 2016a, Appendix A).

5.5.2 Mining

Several mining projects have been proposed for the Action Area however only the Diamond Point Granite Rock Quarry has undergone Section 7 consultation. In 2012, Diamond Point LLC proposed to develop a granite quarry at Diamond Point, located on the west side of Cook Inlet at the convergence of Cottonwood and Iliamna Bays. The plan includes extensive modification of the shoreline to construct a staging area and dock facility (Service 2012). The project is not currently in active construction. U.S. Army Corps of Engineers (USACE) initiated ESA Section 7 consultation with the Service for Steller's eiders, the southwest Alaska DPS of northern sea otter, and northern sea otter critical habitat (Service 2012).

5.5.3 Fisheries

Federal and State-directed commercial fisheries as well as recreational and subsistence fisheries for shellfish, groundfish, herring, and salmon have occurred and will continue to occur in the Action Area. Although some commercial fisheries operate year-round (e.g., clamming), others such as gillnet fisheries targeting various salmon species, are highly seasonal and occur mainly during June, July, and August. A variety of harvest techniques based on target species are used within the commercial fishery. These including pot fishing (shellfish), dredging (scallops, clams), gillnets and purse seines (herring, salmon), trawls (groundfish), and longlines (groundfish). Vessels used during the harvest range from small inland vessels to large ocean-going vessels, depending on the location of the fishery and weather conditions.

5.5.4 Scientific Research

The lands and waters of the Action Area have a history of research activities, from early ecological exploration to quantitative evaluations of aquatic biodiversity. Recent research activities include: aerial and boat-based wildlife surveys conducted by wildlife and land management agencies and by private entities (e.g., ABR, Inc. 2011); onshore and offshore seismic and offshore hydrographic data collection by management agencies (e.g., NOAA 2013; Service 2003), and environmental and socioeconomic data collection funded by BOEM.

5.5.5 Wastewater Discharges and Run-Off

Wastewater discharges are regulated through the Alaska Pollutant Discharge Elimination System (APDES) program administered by the ADEC. The APDES is Alaska's implementation of the U.S. EPA's NPDES program (ADEC 2012). Wastewater discharges are regulated in the Federal waters of Cook Inlet OCS under a NPDES General Permit that is issued by EPA.

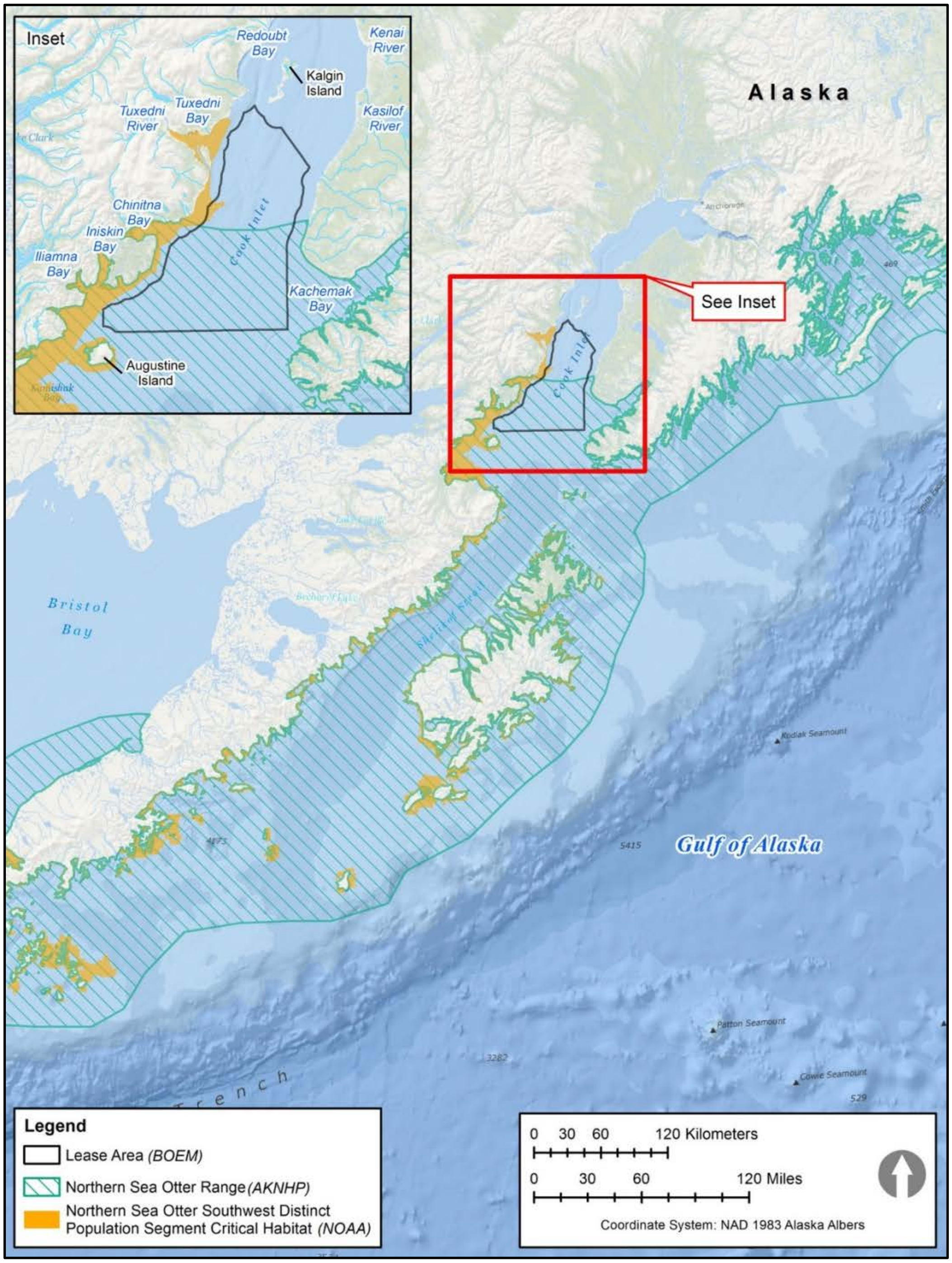

Figure 8. Range of Northern Sea Otter and Critical Habitat of Southwest DPS of Northern Sea Otter, in Cook Inlet area (BOEM 2016b).

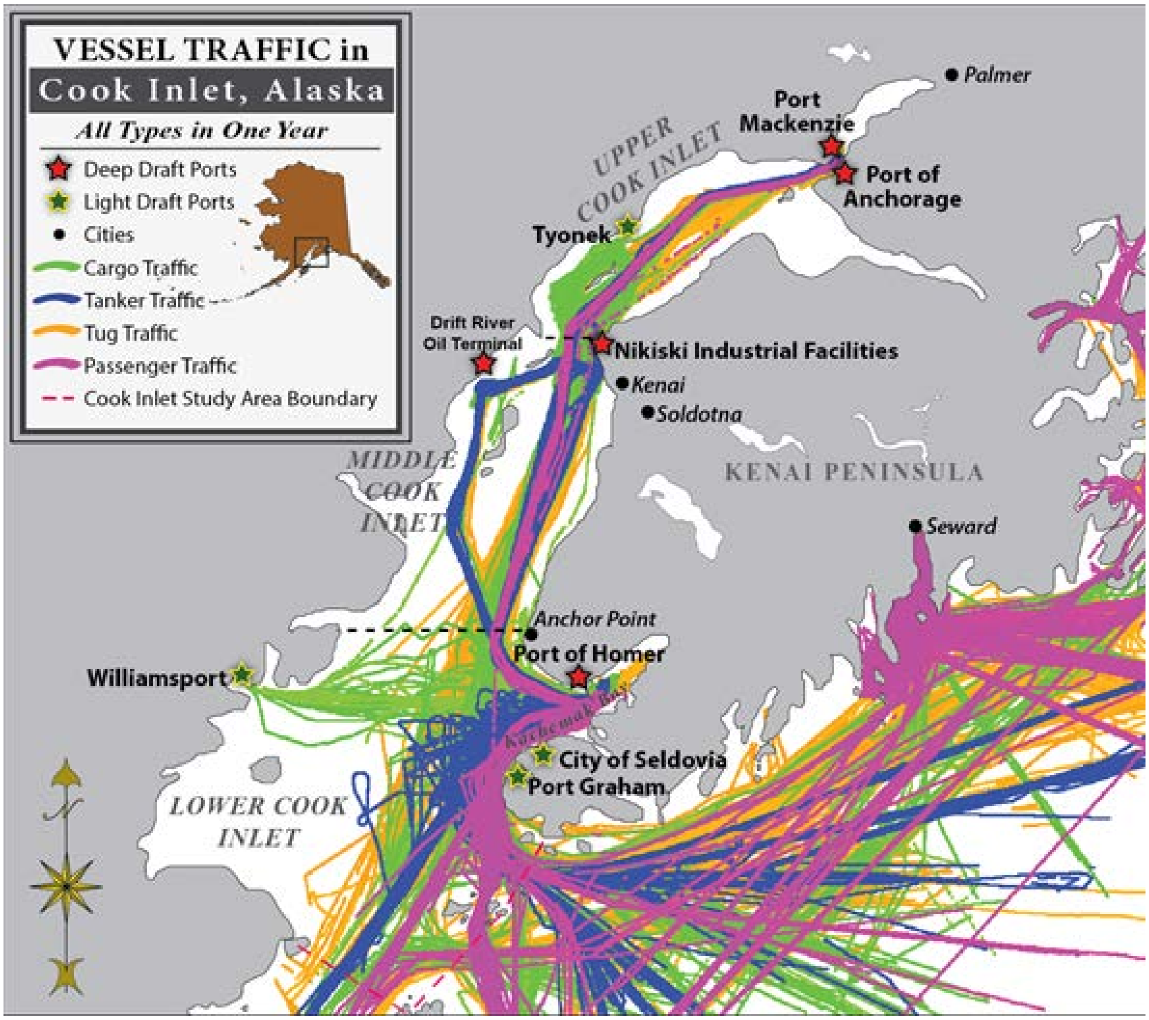

Figure 9. Cook Inlet Vessel Traffic by Vessel Type. From: Cape International, Inc. (2012).

Currently, the treated municipal wastes of 10 communities are being discharged into Cook Inlet waters. Levels of treatment of these waste waters range from primary (only materials easily collected from the wastewater [i.e., oils, fats, greases, sand, gravel, rocks, and human waste] are removed) to secondary (further treated to substantially degrade the biological content of the discharge) to tertiary (employing additional technologies to increase quality of discharge). Wastewaters entering these plants may contain a variety of organic and inorganic pollutants, metals, nutrients, sediments, bacteria, viruses, and other emerging pollutants of concern (e.g., endocrine disruptors [substances that interfere with the functions of hormones], pharmaceuticals, personal care products, and prions [proteins that may cause an infection]). Non-point sources of pollution include stormwater and snowmelt that runs over land or through the ground, entraining pollutants and depositing them into the inlet.

The Cook Inlet watershed is home to two-thirds of Alaska's population; therefore, the quality of runoff in the watershed is heavily influenced by human activity. The most common forms of pollution in Alaska's urban runoff include fecal coliform, sedimentation, and petroleum. Snow disposal into the marine environmental also introduces oil, grease, antifreeze, chemicals, trash, animal waste, salt, and sediments (e.g., sand, gravel, suspended and dissolved solids). Non-point source management programs under Section 319 of the Clean Water Act (CWA) regulate these pollutant sources. The EPA and National Oceanic and Atmospheric Administration (NOAA) co-administer the state Coastal Non-Point Pollution Control Programs under Section 6217 of the Coastal Zone Act Reauthorization Amendments of 1990 (NOAA 1993).

5.5.6 Climate Change

Although changes in climate are a global phenomenon, high latitude regions, including Alaska and the surrounding oceans, are thought to be especially sensitive to its effects (Schindler and Smol 2006, Smol et al. 2005). Data collected during the past 60 years indicate the State of Alaska has warmed more than twice as fast as the rest of the U.S., with average annual air temperature increasing by 3°F (1.7°C) (Stewart et al. 2013). The IPCC (2015) Workgroup projected that the globally averaged surface temperature will increase by 0.54°F to 1.26°F (0.3°C to 0.7°C) between 2016 and 2035, with land areas, particularly those in higher latitudes, warming more rapidly.

Rising atmospheric CO_2 results in increased oceanic CO_2 uptake; this uptake of CO_2 by the oceans is the predominant factor driving ocean acidification (Doney et al. 2012, Dore et al. 2009). Sea-surface pH has dropped by an estimated 0.1 pH units since the preindustrial era, a 26 percent increase in acidity over the past 150 years, mostly in the past several decades. Sea-surface pH is projected to decline by an additional 0.2 to 0.3 pH unit over this century (Doney et al. 2012). Ocean acidification can cause several chemical changes including elevated aqueous CO_2 and reduced carbonate and calcium carbonate saturation (Doney et al. 2009). By lowering carbonate levels, ocean acidification is thought to increase the energetic cost of calcification (Fabry et al. 2008). Observations of mostly negative effects of higher CO_2 on calcification rates for several marine invertebrate species support this hypothesis (Kroeker et al. 2009 *in* Doney et al. 2012, Hartman et al. 2014). Ocean acidification could impact the prey species (shellfish and other marine organisms) that create their shells and other hard parts from calcium carbonate. Sea otters and Steller's eiders rely on these types of organisms for food. It is not clear whether climate change or ocean acidification will affect sea otters or Steller's eiders recovery.

6 EFFECTS OF THE ACTION

This section of the biological opinion analyzes the direct and indirect effects of the proposed Action on listed Alaska breeding Steller's eider, the southwest Alaska DPS of northern sea otter, and critical habitat for the southwest Alaska DPS of northern sea otter. We describe anticipated effects of the First Incremental Step and future incremental steps for each species and critical habitat for the southwest Alaska DPS of northern sea otter.

First Incremental Step

This section assesses the impact of exploration and delineation of oil and gas resources in the proposed Lease Sale Area including marine seismic surveys, geohazard and geotechnical surveys, drilling exploration and delineation wells, government-initiated oil spill response exercises, and associated aircraft, vessel, and vehicle operations. Exploration and delineation of the Lease Sale Area would take place offshore, while associated vessel operation and support would take place in or through nearshore environments. Some activities proposed during the First Incremental Step include mitigation measures that could minimize effects on federally endangered species and designated critical habitat.

6.1 Steller's Eider – First Incremental Step

We expect BOEM's and BSEE's proposed activities during the First Incremental Step to affect Steller's eiders through temporary and permanent habitat loss, disturbance of normal foraging behavior, and potential injury or death.

6.1.1 Habitat Loss

Permanent structures in high-quality habitats may affect Steller's eider by rendering those habitats permanently unsuitable and relegating birds to lower quality habitats. However, permanent structures in the marine environment during the First Incremental Step would be limited to capped and abandoned exploratory wells on the sea floor. While listed Steller's eider forage on the sea floor, these capped wells would have an extremely small footprint compared to the expansive extent of available marine habitat.

Wintering Steller's eiders usually inhabit nearshore shallow waters within the 66 ft (20 m) depth contour (Larned 2006), although individual birds have been recorded up to 12.1 mi (19.5 km) from shore (Martin et al. 2015). Most of the First Incremental Step activities will occur within the proposed Lease Sale Area, at least 3 mi (4.8 km) from the nearest shoreline. This is generally outside the typical range of the wintering eiders, except in the eastern-most lease blocks between Ninilchik and Anchor Point where eiders regularly occur between the shore and just beyond the 66 ft (20 m) depth contour at approximately 6.2 mi (10 km) from shore (Figure 5) (Larned 2006).

Therefore the Service expects that effects of permanent foraging habitat loss on listed Steller's eiders in the marine environment from the First Incremental Step would be minor.

6.1.2 Disturbance

The severity of disturbance depends on the duration, frequency, and timing of the action causing the disturbance. Disturbance that results in changes to behavior (e.g., flushing or diving) may increase energetic costs, especially for birds that may be already energetically stressed from cold, lack of food, or a physiologically demanding life cycle stage such as molt. Birds may also be displaced from preferred habitats to areas where resources are less abundant or of lower quality. During the First Incremental Step, disturbance and displacement of Steller's eiders could occur from aircraft operations, vessel traffic, or acoustic sources associated with deep-penetration and high resolution seismic surveys and exploratory drilling.

6.1.2.1 Aircraft operations

Aircraft may disturb listed Steller's eiders in the action area as they migrate, forage, or molt. Aircraft support bases are located along shorelines where Steller's eiders are known to overwinter, generally from December to late April, but peaking in January and February (Larned, 2006). Exploration and delineation drilling and oil response drills could occur year-round, so aircraft operations potentially could overlap with the winter season for Steller's eiders. Larned (2006) reported estimates of 1,499 Steller's eiders wintering along the shoreline between Clam Gulch and Kachemak Bay to greater than 2,000 Steller's eiders between Anchor River and Kenai. The Steller's eider period of flightless wingmolt is approximately August to October; however, the east side of Cook Inlet has not been identified as a molting location for Steller's eiders. A small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay, while a few may spend the summer at Izembek Lagoon (Chris Dau, Service, unpublished data *in* Service 2015a).

While specific information regarding listed Steller's eider response to aircraft disturbance in the marine environment is lacking, we expect that they would exhibit a response similar to king eiders (*Somateria spectabilis*); therefore, we consider the response of king eiders to be a reliable surrogate for evaluating effects of disturbance on listed eiders in the marine environment. King eiders in western Greenland dove when survey aircraft approached (Mosbech and Boertmann 1999). Bird response varied with time of day, and increased with decreasing aircraft altitude. After a preliminary dive by nearly all birds, over 50 percent remained submerged until the aircraft passed.

The BOEM and BSEE anticipate low numbers of aircraft operations would support actions associated with the First Incremental Step. For example, during exploration and delineation drilling, BOEM and BSEE anticipate approximately 1 to 3 flights per day (per drilling rig while on location), with 7 to 21 trips total per week (Table 2). These helicopter flights may be used for basic resupply and crew rotation operations and will likely travel from Nikiski or Homer land bases. Evidence suggests that some eider species may habituate to certain sources of disturbance or avoid impacts associated with certain areas (Service 2005b). For example, some spectacled eiders nest and rear broods near the Deadhorse airport, indicating that some individuals tolerate occasional aircraft noise. Individual tolerance is expected to vary, and the intensity of disturbance, in most cases, would be less than that experienced by spectacled eiders at the Deadhorse airport.

Support aircraft are typically required to operate within specific height parameters to minimize effects on marine mammals and birds in nearshore waters or the coastline. Collisions with helicopters are unlikely; Steller's eiders typically fly low 26 to 92 ft (8 to 28 m) above ground/sea level and fast 50 mph (80 km/h) over water and along the shoreline (Alerstam and Gudmundsson 1999, Petersen and Savard 2015). Although some birds may be temporarily displaced, it is unlikely that the relatively small number of helicopter trips included in the First Incremental Step would disturb substantial numbers of the listed population of overwintering Steller's eiders in the Action Area.

6.1.2.2 Vessel Traffic

There are a variety of vessel-based operations in the First Incremental Step (Table 2). The required vessels vary depending upon the geophysical or geotechnical surveys taking place. For example, two vessels would be used for 3D marine seismic surveys, one for towed streamer plus a support vessel. When OBNs are used, BOEM estimates up to seven vessels may be used: two node layout vessels, one to two sound-source vessels, and up three smaller utility boats. The required vessels are the same as OBN (up to seven), with the addition of one vessel for recording. During geohazard and geotechnical surveys, two vessels (including a marine protected species monitoring vessel) and one vessel or a drilling barge, would be used respectively. There would also be one to two MODUs with each their own smaller vessel for support, and there would be one to two vessel supply trips/week. Other vessel traffic would include activities associated with up to three oil spill response drills per year (Table 2).

Vessels may disturb listed Steller's eiders in the action area as they migrate, forage, or molt. Vessel support bases are located along shorelines where Steller's eiders are known to overwinter, generally from December to late April, but peaking in January and February (Larned 2006). Exploration and delineation drilling and oil response drills could occur year-round, so vessel operations potentially could overlap with the winter season for Steller's eiders. Larned (2006) reported estimates of 1,499 Steller's eiders wintering along the shoreline between Clam Gulch and Kachemak Bay up to greater than 2,000 Steller's eiders between Anchor River and Kenai. The Steller's eider period of flightless wingmolt is approximately August to October; however, the east side of Cook Inlet has not been identified as a molting location for Steller's eiders. A small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay, while a few may spend the summer at Izembek Lagoon (Chris Dau, Service, unpublished data *in* Service 2015a).

Vessel traffic impacts on listed Steller's eiders include periodic disruption of behavior. While Steller's eiders wintering in the Action Area would have the ability to depart an area by swimming away from a disturbance, this movement would come at an energetic cost, and birds may be displaced to areas of lower desirability. Frequent or prolonged disturbance from vessels could result in energy expenditures that prolong the molt or decrease energy reserves available for winter survival. As most of these eiders are believed to be successfully breeding females and hatch-year juveniles, even a seemingly trivial impact to individual fitness (caused by repeated or prolonged vessel disturbance) imposed on a large number of birds could result in reduced overwinter survival and decreased population size, productivity, and/or recruitment. However, 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, Madsen 1994). Steller's eiders show variable degrees of tolerance to vessel traffic as documented by ABR Inc. (2013) in the Chukchi Sea area on Alaska's North Slope. Ward et al. (1994) investigated response of wintering waterfowl to boat traffic and found that Steller's eiders flushed when boats came within 985 ft (300 m). Despite this, it is known that Steller's eiders commonly overwinter in areas of high vessel traffic near Homer.

Vessels transiting through the near shore marine environment may cause short-term disturbance, but the effects would likely be limited due to the brief duration of a vessel transit and the relatively low numbers of vessels that may enter the area (BOEM and BSEE estimate two trips per week to each of two drilling rigs, plus the activity associated with up to three oil spill response drills per year. Other vessel traffic would include seismic survey vessels). Given the relatively low number of vessels, it is unlikely that vessels would encounter these species. Individual birds that do encounter vessels during the First Incremental Step would likely only experience minor, temporary changes in behavior such as moving away to a perceived safe distance.

6.1.2.3 Deep-penetration and high-resolution seismic activity sources

Seismic work, exploratory/delineation drilling, and related support activities would typically be conducted from vessels during ice-free, open-water periods. The First Incremental Step includes two marine seismic survey/exploration/delineation surveys conducted during the first two years of the EDS. Seismic vessels operate day and night, and a single survey effort may continue for days, weeks, or months, depending on the size of the survey. In addition, four to five geohazard surveys could be conducted during the first three years of the Action that would allow leaseholders to investigate the potential for oil or gas production.

Seismic surveys generate intense energy pulses in the water column. Seismic survey vessels typically move slowly through an area, and "ramp up" the airgun array (gradually increase the decibel level) before starting a survey or after a power down. Airgun use during seismic surveys results in both vertical and horizontal sound propagation. Vertical propagation would be less likely than horizontal propagation to impact listed eiders, because it is less likely that birds would be directly beneath 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 31 to 46 miles (50-75 km) in water 82 to 164 feet (25-50m) deep (Richardson et al. 1995).

Little is known about avian behavioral response to seismic acoustics; however, in a study of long-tailed ducks (*Clangula hyemalis*) in the Beaufort Sea, Lacroix et al. (2003) found no significant difference in numbers of ducks in an area before and after seismic survey work. In some survey areas, long-tailed ducks were observed to dive more frequently than in undisturbed areas, but the cause (vessel versus seismic acoustic source) was unclear. Nevertheless, listed eiders foraging in the water column or on the seafloor could be exposed to underwater seismic noise. It is conceivable that birds could be near enough to marine seismic or geohazard survey sound sources to be injured by a pulse, although the threshold for physiological damage, especially to the auditory system, for marine birds is unknown. However, because seismic vessels move slowly through a survey area and airgun arrays are required to ramp up as seismic activities begin; Steller's eiders in the vicinity of the survey would likely depart the area before injury occurs. Furthermore, seismic surveys typically require a single pass over a given line and repeated seismic disturbance in a particular location would not be expected. Therefore, the effects of disturbance on listed eiders from open-water seismic survey operations would likely be similar to those of disturbance from vessel traffic.

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

6.1.2.4 Exploratory Drilling

In addition to vessels transiting to and from exploratory drill sites (discussed above in *Vessel Traffic*), exploratory drilling may disturb or displace Steller's eiders from the immediate area of the exploration site. However, due to low densities of Alaska-breeding Steller's eiders in the majority of the leased area, listed eiders are unlikely to be present and encounter exploratory drilling activities and be disturbed. Furthermore, exploratory drilling activities are limited to a relatively small spatial area and are stationary, allowing birds that are adjacent to exploratory drilling to depart the area or habituate to the disturbance. Therefore, effects of disturbance from exploratory drilling during the First Incremental Step on listed eiders are expected to be minor and temporary.

6.1.2.5 Collisions and Disorientation

Migratory birds suffer considerable mortality from collisions with man-made structures (Manville 2004). Birds involved in collisions with man-made structures may also experience severe injuries, including concussions, internal hemorrhaging, and broken bones. Birds are particularly at risk of collision when visibility is impaired by darkness or inclement weather (Weir 1976). In a study of avian interactions with offshore oil platforms in the Gulf of Mexico, collision events were more common, and more severe (i.e., the number of collision incidents increased) during poor weather (Russell 2005). There is also evidence that lights on structures, particularly red steady-state lights, result in disorientation which increases collision risk (Reed et al. 1985, Russell 2005, Manville 2000). Strike rate may also be related to flight behavior, in particular, altitude (Anderson and Murphy 1988). Johnson and Richardson (1982) in their study of migratory behavior along the Beaufort Sea coast reported that 88 percent of eiders flew below an estimated altitude of 32 ft (10 m) and well over half flew below 16 ft (5 m). Day et al. (2004 and 2005) also noted eider species may be particularly susceptible to collisions with offshore structures as they fly low (mean flight altitude 39 ft (12.1 m)) and at relatively high speeds (approximately 45 mph) over water.

Based on extrapolations from data collected in the Chukchi Sea, we expect few eiders to be killed or injured by collisions with vessels (See *Appendix A. Calculations of Steller's Eider Collision Rates*).

6.1.2.6 Discharges

6.1.2.6.1 Authorized discharges

Discharges of drilling muds (lubrication for drill bits) and cuttings (material removed from drill holes) during exploratory or delineation drilling could increase the turbidity of waters surrounding benthic habitat. These conditions could influence the ability of listed eiders to forage effectively, especially for benthic prey. Discharges of drilling mud and cuttings could also conceivably impact listed eiders through contamination of individual birds or important benthic feeding habitats. For example, BOEM and BSEE noted changes in species composition, abundance, or biomass of the benthic biota resulting from the release of synthetic-based mud cuttings were generally detected at distances of 164 to 1,640 ft (50 m to 500 m) from well sites. These biological effects can be attributed to chemical toxicity of discharges, organic enrichment, and deposition of fine particles in drilling wastes (MMS 2008 citing Hurley and Ellis 2004). While the recovery of benthic communities was documented, generally within 1 year of completion of the well, a decrease in benthic invertebrate species richness and abundance could occur at a distance of 164 ft (50 m) for up to 2 years after exploratory drilling ceased (Hurley and Ellis 2004 in MMS 2008). However, the EPA regulates discharge of drilling muds, cuttings, and other materials to the marine environment, and the Cook Inlet exploration NPDES General Permit (AKG-28-5100) for oil and gas exploration facilities on the OCS is currently in effect (issued in July 2015 with an effective date of September 1, 2016) and would mandate specific discharge limits (USEPA 2015).

In addition to drilling mud and cuttings, discharges of grey or ballast water from vessel or platform operations could take place during the First Incremental Step. However, these discharges would also be authorized under the Cook Inlet exploration NPDES General Permit (AKG-28-5100), and EPA regulations (40 CFR 125.122) would require a determination that permitted discharge would not cause unreasonable degradation to the marine environment. Furthermore, because authorized discharges during the First Incremental Step would occur over relatively short periods of time (weeks or months at specific locations), impacts to water quality from authorized discharges would be expected to be localized and short term.

The Service anticipates only minor impacts to listed eiders from discharges of drilling mud, cuttings, ballast and grey water during the First Incremental Step based on: 1) the relatively small impact area associated with exploratory drilling in relation to the size of the lease area; 2) the low number of wells expected in the area (BOEM and BSEE estimate up to 7 to 10 exploratory or delineation wells could be drilled during the First Incremental Step); and 3) limits on discharges enforced through the NPDES permit process.

6.1.2.6.2 Small spills

Exposure to oil may impact listed eiders in several ways, depending on the volume, location, and timing of a spill and the severity of exposure. For example, waterfowl that directly contact even small amounts of oil may lose the hydrophobic, insulative properties of their feathers and suffer impaired thermoregulation. These birds may become wet, hypothermic, or potentially drown (Jenssen 1994), particularly if the oil exposure occurs in cold environments (Piatt et al. 1990). Birds exposed to oil may also suffer reduced reproductive success. Mortality of embryos and nestlings has been documented by exposure to small amounts of hydrocarbons (light fuel oil, crude oil, or weathered oil) transferred to offspring by adults with lightly oiled plumage (Szaro et al. 1980, Parnell et al. 1984, Hoffman 1990, and Stubblefield et al. 1995). Furthermore, birds that ingest oil in the course of normal foraging or preening behaviors may experience toxicological effects including gastrointestinal irritation, pneumonia, dehydration, red blood cell damage, impaired osmoregulation, immune system suppression, hormonal imbalance, inhibited reproduction, retarded growth, and abnormal parental behavior (Hartung and Hunt 1966, Epply 1992, Fowler et al. 1995, Briggs et al. 1997, and Albers 2003). Birds also bioaccumulate hydrocarbons and are vulnerable to both acute and sub lethal effects from contaminated food supplies (Albers 2003).

Based on information provided by BOEM and BSEE (BOEM 2016b), up to 10 small refined oil spills (less than 1,000 bbl) would be reasonably foreseeable during the First Incremental Step. Although low-volume spills could occur during exploration surveys, drilling operations, or refueling, due to safety measures in place (operation-specific spill prevention and oil spill response plans), these unauthorized discharges are expected to be uncommon. In addition, due to relatively low densities of Steller's eiders in the action area, we expect the likelihood of Steller's eiders encountering oil from a small spill in the marine environment would be very low. Small offshore spills would be expected to be contained or weather quickly (within a few hours to a few days). Although disturbance of Steller's eiders could occur during cleanup efforts for small spills, this level of disturbance is expected to be minor and temporary as birds would be expected to move away to a perceived safe distance (Service 2015a). Furthermore, disturbance from cleanup activities is likely to be extremely infrequent and limited to a small geographic area, and would therefore impact very few individual eiders.

The Service expects few, if any, listed eiders are likely to encounter oil from a small spill during the First Incremental Step, because: 1) small spills are expected to occur infrequently and be of low volume; 2) Steller's eider density in Cook Inlet and the Action Area is relatively low; 3) small spills are expected to be contained or weather quickly; and 4) Steller's eiders would likely avoid disturbance associated with areas of active cleanup. Therefore, although the effects of small-volume spills on listed eiders would depend on the location and timing of the spill and the speed and success of cleanup efforts, small spills resulting from the First Incremental Step are expected to affect few, if any, individuals.

6.1.2.7 Large and very large spills

Based on information provided by BOEM and BSEE (BOEM 2016b), spills greater than 1,000 bbl are not reasonably likely to occur during the First Incremental Step. Rather, based on BOEM and BSEE's oil spill risk analysis, the only type of larger spill that would potentially occur during this step would be a VLOS (greater than 150,000 bbl) from loss of well control resulting in a long duration flow. However, such an event would be unlikely to occur during the First Incremental Step, based on the historical frequency of such an event. Therefore, while the effects of a VLOS would likely result in injury or death of an unknown, but potentially large number of listed eiders, a VLOS is not considered to be an effect of the First Incremental Step within the meaning of the ESA, because it is not reasonably likely to occur.

6.1.3 Spill response

Cleanup activities would likely take place if a large spill occurred. Activities could include vessel and aircraft operations, mechanical recovery (skimming and booming), use of dispersants, and in-situ burning (BOEM 2016a). It is difficult to say how effective cleanup efforts would be at removing oil from the environment. Based on clean-up activities with the Exxon Valdez Oil Spill where only about 14 percent was recovered or disposed (Wolf et al. 1994), spill response may be largely unsuccessful in remote open water conditions, and spill response drills have had various levels of success in the cleanup of oil in broken-ice conditions (Dickens 2011). The duration of cleanup activities for a large spill would depend on the timing and amount of oil spilled, but would likely last months or years.

6.1.3.1 Cleanup Activities – Steller's Eiders

Disturbance associated with cleanup activities, including capturing oiled birds, could further stress birds already compromised from contact with oil. Hazing birds away from oiled areas, however, may reduce the number of individuals contacting spilled oil. We expect that the potential effects from cleanup activities on listed eiders would increase with increasing spill volume and oil persistence. While a few individuals could experience disturbance, we would not expect population-level effects to occur from oil spill response efforts.

6.2 Northern sea otter – First Incremental Step

We expect BOEM's and BSEE's proposed activities during the First Incremental Step to affect listed northern sea otters through disturbance of normal foraging and loafing behavior and potential injury or death.

6.2.1 Disturbance

6.2.1.1 Effects of disturbance from vessels and helicopters

Disturbance to sea otters from support vessel and helicopter traffic from EDS activities and government initiated oil spill response activities may occur during the First Incremental Step.

Disturbance that results in changes to behavior may increase energetic costs however; disturbance of sea otters by boat traffic is identified in the Recovery Plan as a threat of low importance to the species' recovery (Service 2013a). Sea otters generally show a high degree of tolerance and habituation to shoreline activities and vessel traffic (Service 2012). Sea otters have been shown to avoid areas with high vessel traffic, but return when seasonal traffic subsides (Garshelis et. al. 1984). In response to approaching survey vessels, sea otters in the water were prone to swim away, hauled out sea otters entered the water and dispersed, and feeding sea otters began to periscope or dive (Udevitz et al. 1995).

Disturbance from vessel traffic associated with First Incremental Step activities is likely, particularly if EDS drill sites are located in OCS blocks overlapping with critical habitat within Cook Inlet (Figure 9). The potential for disturbance would be greatest during summer when sea otters are in open waters; during winter, protected bays and inshore waters are preferred and sea otters are less likely to be found in OCS waters. Because the likely shore bases are located on the eastern side of Cook Inlet, however, routine vessel traffic (e.g., resupply trips) would be unlikely to transit through the critical habitat that overlaps OCS blocks. Therefore, the potential for disturbance to the listed DPS of sea otters occurring in the eastern portion of sea otter habitat occupied by otters would likely affect few individuals.

Helicopter traffic may also disturb listed sea otters, particularly if EDS drill sites are located in OCS blocks overlapping with otter critical habitat along the western side of Cook Inlet. Disturbance would then likely be localized to jack-up drilling rigs. Disturbance from helicopters may be reduced through mitigation measures proposed by BOEM for maintaining operation at an altitude of 2,000 ft (610 m) or higher and to avoid extended flights over the coastline to minimize effects on marine mammals in nearshore waters or the coastline (BOEM 2016b). The potential for disturbance to sea otters from helicopter support vessels is unlikely, although a few individuals may be affected.

Collisions between sea otters and vessels (both slow and fast-moving vessels) do occur but are considered infrequent (Service 2012). Collisions between listed otters and vessels associated with the First Incremental Step are also considered unlikely because of the limited vessel traffic resulting from the Proposed Action in the range of the listed DPS on the western side of Cook Inlet. In addition, otters are primarily in the nearshore areas of the Action Area where vessels from this activity are less likely to transit.

We expect a low level of disturbance and a small number of collisions, at most, caused by vessel and helicopter traffic associated with the First Incremental Step, based on the low number of helicopter and vessel trips expected in the few OCS blocks overlapping with otter critical habitat and habitats occupied by sea otters.

6.2.1.2 Effects of disturbance from seismic survey noise

The BOEM assumes seismic surveys will occur during Years 1 through 3 of the First Incremental Step. These include one or more 3D marine seismic surveys and four to five geohazard surveys (Table 2). Individual surveys vary greatly in duration, lasting from days to weeks, and are most likely to be conducted between March and December.

Seismic surveys generate intense energy pulses in the water column. Seismic survey vessels typically move slowly through an area, and "ramp up" the airgun array (gradually increase the decibel level) before starting a survey or after a power down. The sound-source level (zero-to-peak) for airguns typically used in marine seismic surveys ranges between 233 and 255 dB re 1 μPa @ 1 m, with most of the energy emitted between 10 and 120 Hz. In a typical marine 3D seismic survey, the source vessel tows one to three source arrays of six to nine. Airgun use during seismic surveys results in both vertical and horizontal sound propagation. 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 31.1 to 46.36 mi (50 to 75 km) in water 82 to 164 ft (25 to 50 m) deep (Richardson et al. 1995).

The frequencies produced by airguns and other acoustic sources are within the hearing range of sea otters. Ciminello et al. (2012) estimated the sea otter hearing range is approximately 20 Hz to 60 kHz. Southern sea otters displayed behavioral responses to underwater sounds between 10 to 40 kHz (Wendell et al. 1995). Potential auditory effects of underwater noise include temporary hearing loss (i.e., temporary threshold shift, (TTS)) and permanent hearing loss (i.e., permanent threshold shift, PTS). The level of loss is dependent on sound frequency, intensity, and duration. Hearing loss may lessen a marine mammal's ability to forage efficiently, maintain social cohesion, and avoid predators (Weilgart 2017).

In evaluating acoustic impacts, the Service categorizes harassment from sound as Level A or Level B. Level A harassment is conservatively based on TTS with a threshold of 190 dB for pinnipeds and 180 dB for cetaceans (All decibels re 1µPa are based off SPL_{mms}). Level B harassment is defined for impulsive and non-impulsive noises with noise thresholds occurring at 160 and 120 dBs respectively. The 120 dB threshold may be slightly adjusted if background noise levels are at or above this level. These thresholds pertain to received levels (by the marine mammal), not source levels (NOAA 2014). Under the Marine Mammal Protection Act, a Level A harassment has the potential to injure a marine mammal or marine mammal stock in the wild, and a Level B harassment has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including migration, breathing, nursing, breeding, feeding, or sheltering (16 U.S.C. § 1362(13)). The ESA defines harassment as, "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, and sheltering" (50 CFR 17.3).

Little is known about TTS impacts to sea otters. The time sea otters spend beneath the water exposed to underwater sounds is brief. Studies by Wolt et al. (2012) showed an average sea otters average dive time of 149 seconds with 8.6 dives during a single feeding bout. Based on these values, BOEM estimates the total underwater dive time (about 21 minutes) equivalent to 12 or 18 percent of the time a typical 2 to 3 hour slack tide seismic survey shoot may occur. Since seismic surveys are mobile, and airgun arrays usually fire only 8 to 15 seconds, the number of pulses a single sea otter may be exposed to before the vessels and airgun array have moved out of the area are limited.

The BOEM and BSEE include mitigation for seismic surveys as described in *Mitigation Measures* within *The Proposed Action* section of this biological opinion. Typical mitigation measures include timing and location limitations, minimized energy levels, safety and disturbance zones, ramp up, shutdown and power down requirements, and detailed monitoring requirements for on-board Protected Species Officers (PSOs).

Mitigation requirements are expected to be effective in preventing injury (Level A harassment) of sea otters by underwater noise from airguns and other active acoustic sources used in marine seismic surveys and geohazard surveys. Sea otters are likely to be detected by PSOs during seismic surveys because these animals often congregate in large groups of up to 20 individuals and spend a considerable amount of time floating at the water's surface. However, mitigation may not prevent all behavioral disturbance (Level B harassment) of sea otters. Sound produced by seismic source arrays may persist at noise levels greater than 160 dB (the noise level threshold above which Level B disturbance is assumed to occur) for up to several miles from the source – e.g., 4.2 miles (6.83 km) for a 1,760 cubic inch airgun array used in a recent seismic survey IHA in Cook Inlet (SAExploration, Inc. 2015). PSOs would monitor this area, but it is too large to ensure all animals be detected, and shutdowns would only be required if a sea otter were detected within the much smaller safety range based on the 190 dB criteria (assuming pinniped criteria are used for sea otters).

The potential for take by harassment would vary depending on the survey location and timing. The potential for behavioral disturbance would be greatest for surveys in OCS blocks containing sea otter critical habitat, and in other relatively shallow areas less than 131 ft depth (40 m) where sea otters may forage. However, given sea otters' underwater hearing ability and limited time spent below the water's surface, seismic survey noise are expected to result in only localized and temporary disturbance effects to a few individual sea otters.

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

6.2.1.3 Effects of exploration and drilling

In addition to vessels transiting to and from exploratory drill sites (discussed above), exploratory drilling may disturb or displace listed sea otters from the immediate area of the exploration site. BOEMs EDS estimates 7 to 10 exploration and delineation wells will be drilled in the proposed Lease Sale Area during a 4-year period (Table 2). For BOEMs analysis, it is assumed that exploration or delineation wells will be drilled in areas inhabited by sea otters. However, over 97 percent of the OCS of the proposed Lease Sale Area is outside of designated critical habitat so we expect the majority of wells to be drilled outside of critical sea otter habitat. Furthermore, exploratory drilling activities are limited to a relatively small spatial area and are stationary, allowing sea otters that are adjacent to exploratory drilling to depart the area or habituate to the disturbance. Additionally, in areas where sea otter critical habitat (therefore sea otters) may be present, BOEM and BSEE may impose mitigation measures on exploratory drilling operations.

The BOEM estimates drilling of an exploration or delineation well may take 30-60 days. Given the sea otter's tolerance for noise and ability to habituate, disturbances due to noise are expected to be only minor, localized, and short-term. If an exploration or delineation well site is located in sea otter habitat, the resulting noise and seafloor disturbance may result in localized and temporary affects to a few individual sea otters or rafts of otters (typically 10 to 20, but fewer than 100) when a drilling rig is present (30-60 days). Therefore, exploration and delineation drilling may result in disturbance of a few individual or groups of tens of sea otters.

6.2.2 Authorized Discharges

Discharges of drilling muds (lubrication for drill bits) and cuttings (material removed from drill holes) during exploratory or delineation drilling would be small in scale and would likely dissipate quickly. Deposition of cuttings on the seafloor could alter benthic zone characteristics such as grain size, mineralogy, and micro-topography. It could also alter sea otter prey availability as discussed in *Effects to PCEs* within the *Northern Sea Otter Critical Habitat: Kodiak, Kamishak, Alaska Peninsula Management Unit* section below. In Cook Inlet, it is expected that drilling mud and cuttings discharges would be quickly transported away by strong currents.

Furthermore the EPA regulates discharge of drilling muds, cuttings, and other materials to the marine environment, and the 2015-2020 NDPES General Permit for Oil and Gas Exploration Facilities on the OCS in Cook Inlet (AKG 28-5100) (USEPA 2015) is in effect and would mandate specific discharge limits.

In addition to drilling mud and cuttings, discharges of grey or ballast water from vessel or platform operations could take place during the First Incremental Step. However, these discharges would also be authorized under 2015-2020 NDPES General Permit for Oil and Gas Exploration Facilities on the OCS in Cook Inlet (AKG 28-5100), and EPA regulations (40 CFR 125.122) would require a determination that the permitted discharge would not cause unreasonable degradation to the marine environment. Furthermore, because authorized discharges during the First Incremental Step would occur over relatively short periods of time (weeks or months at specific locations), impacts to water quality from authorized discharges would be expected to be localized and short term.

Given: 1) the relatively small impact area associated with exploratory drilling in relation to the size of the lease area; 2) the low number of wells expected in the area (BOEM and BSEE estimate 7 to 10 exploration and delineation wells could be drilled during the First Incremental Step); 3) BOEMs FEIS Preferred Alternative 4B, which prohibits drilling operations for 14 of the 224 OCS blocks located within 3,280 ft (1,000 m) of northern sea otter critical habitat; and 4) limits on discharges imposed by the NPDES permit process, the Service anticipates only minor impacts to sea otters from discharges of drilling mud, cuttings, ballast and grey water during the First Incremental Step.

6.2.3 Small Spills

Based on information provided by BOEM and BSEE (BOEM 2016b), up to 10 small refined oil spills (less than 1,000 bbl) would be reasonably foreseeable during the First Incremental Step. Although low-volume spills could occur during exploration surveys, drilling operations, or refueling, due to safety measures in place (i.e., operation-specific spill prevention and oil spill response plans), these unauthorized discharges are expected to be uncommon. In the unlikely event a small spill reaches sea otter habitat, one or more sea otters may be impacted. Impacts to otters from contact with oil may include fouling of fur, ingestion, skin irritation, corneal ulcers, respiratory effects, reproductive effects, and others (Geraci and Williams 1990; Ralls and Siniff 1990). BOEM assumes that impacts to sea otters from contact with oil would be lethal for the individual (BOEM 2016b). We expect the likelihood of sea otters encountering oil from a small spill in the marine environment would be very low. Small offshore spills would be expected to be contained or weather quickly (within a few hours to a few days). Although disturbance of sea otters could occur during cleanup efforts for small spills, this level of disturbance is expected to be minor and temporary. Furthermore, disturbance from cleanup activities is likely to be extremely infrequent and limited to a small geographic area, and would therefore impact very few individual sea otters.

Because: 1) small spills are expected to occur infrequently and be of low volume; 2) small spills are expected to be contained or weather quickly; and 3) sea otters would likely avoid disturbance associated with areas of active cleanup, sea otters are extremely unlikely to encounter oil from a small spill during the First Incremental Step. Therefore, although the effects of small-volume spills on sea otters would depend on: 1) the location and timing of the spill; and 2) the speed and success of cleanup efforts, small spills resulting from the First Incremental Step would therefore impact very few individual sea otters.

6.2.4 Large and Very Large Spills

Based on information provided by BOEM and BSEE (BOEM 2016b), spills greater than 1,000 bbl are not reasonably likely to occur during the First Incremental Step. Rather, based on BOEM and BSEE's oil spill risk analysis, the only type of larger spill that would potentially occur during this step would be a VLOS (greater than 150,000 bbl) from loss of well control resulting in a long duration flow. However, such an event would be unlikely to occur because a loss of well control incident is extremely rare and is therefore not reasonably certain as a result of the First Incremental Step. Therefore, while the effects of a VLOS would likely result in injury or death of an unknown, but potentially large number of sea otters, a VLOS is not considered to be an effect of the First Incremental Step within the meaning of the ESA, because it is not reasonably likely to occur. However, the effects of a large and VLOS to northern sea otter are discussed below in the section *Effects of Large Oil Spills – First and Future Incremental Steps.*

6.2.5 Spill response

Cleanup activities would likely take place if a large spill occurred. Activities could include vessel and aircraft operations, mechanical recovery (skimming and booming), use of dispersants, and in-situ burning (BOEM 2016a). It is difficult to say how effective cleanup efforts would be at removing oil from the environment. Based on clean-up activities with the Exxon Valdez Oil Spill where only about 14 percent was recovered or disposed (Wolf et al. 1994), spill response may be largely unsuccessful in remote open water conditions, and spill response drills have had various levels of success in the cleanup of oil in broken-ice conditions (Dickens 2011). The duration of cleanup activities for a large spill would depend on the timing and amount of oil spilled, but would likely last months or years.

6.2.5.1 Cleanup Activities – Sea otters

Oil spill cleanup operations may also displace or otherwise disturb sea otters present in or near habitats that have been affected by oil. The response of sea otters to clean up operations will depend on intensity, scale, duration, location, and type of activity. The likelihood of large spill response actions, which may have impacts to large numbers of otters, is extremely low. However, oil spill cleanup operations may result in adverse effects to individual sea otters as a result of direct exposure to dispersed oil, physical manipulations of habitat associated with mechanical spill response actions, and/or chemical changes in habitat following use of dispersants or in situ burning, and vessel and aircraft traffic associated with these activities. The risk of effects from spill response activities is low (Service 2015a) but may affect hundreds, but less likely, thousands of listed sea otters.

6.3 Northern Sea Otter Critical Habitat: Kodiak, Kamishak, Alaska Peninsula Management Unit

The Kodiak, Kamishak, Alaska Peninsula Management Unit (KKAPMU) is an important area for northern sea otters, and the Primary Constituent Elements (PCEs) identified in Critical Habitat designation (74 FR 51988; October 8, 2009) are the physical and biological features essential to conservation of the northern sea otter and may require special management considerations.

The PCEs for the designated critical habitat of the sea otter are:

- PCE 1 – Shallow, rocky areas where marine predators are less likely to forage, which are waters less than 6.6 ft (2 m) in depth;
- PCE 2 – Nearshore waters that may provide protection or escape from marine predators, which are those within 328 ft (100 m) of the mean high tide line;
- PCE 3 – Kelp forests that provide protection from marine predators; forests occur in waters less than 66 ft (20 m) in depth; and
- PCE 4 – Prey resources within the areas identified by PCEs 1, 2, and 3 that are present in sufficient quantity and quality to support the energetic requirements of the species.

The proposed Lease Sale Area does not support the first two PCEs. Kelp forests (PCE 3) and associated prey resources (PCE 4) occur within the seven OCS blocks that overlap with the proposed Lease Sale Area (Figure 10), as well as in other areas along the shorelines of Cook Inlet.

6.3.1 Effects to PCEs

Effects of disturbance on PCEs

Support vessels could occasionally transit through KKAPMU during the First Incremental Step. Given the size of KKAPMU and the relatively small number of vessels that could operate within it at any one time, we do not anticipate vessel traffic during the First Incremental Step would appreciably affect the conservation value of the KKAPMU for northern sea otter. However, temporary effects to kelp forests (PCE 3) via propeller cuts to blades and stipes. This may occur as vessels travel through kelp beds or during the process of 'backing down' when engines are run in reverse to dislodge propellers fouled by kelp fronds and stipes.

The BOEM's EDS estimates 7 to 10 exploration and development wells will be drilled within the proposed Lease Sale Area during a four-year period beginning the second year (Table 2). BOEM (2016b) assumes that one of these exploration or delineation wells will be drilled in the sea otter critical habitat; seven blocks overlap with designated critical habitat representing 2.69 percent of the proposed Lease Sale Area. Seafloor area disturbance from jack-up rig legs varies by rig design and the number of wells drilled. However, each set up of a jack-up rig disturbs approximately 1 ha (2.5 ac) (BOEM 2012). The total area of designated critical habitat for the southwest Alaska DPS of the northern sea otter is 15,164 km^2 (74 *FR* 51988, October 8, 2009). The disturbance area of 1 to 2 ha represents less than 0.0001 percent of the total critical habitat (BOEM 2016b). In the unlikely event drilling did occur within the sea otter critical habitat, the seafloor disturbed by anchoring or placement of jack-up rig legs would eventually recover over a period of months to years as sediments were redistributed by currents (NRC 1983). Activities associated with exploration and delineation drilling may therefore affect critical habitat for sea otters; however, these activities will have only localized and temporary, and therefore no more than minimal effects on critical habitat. In the unlikely event drilling activities would occur in sea otter critical habitat during the First Incremental Step, they would not diminish the value or biological features essential to the conservation of the listed stock of sea otters.

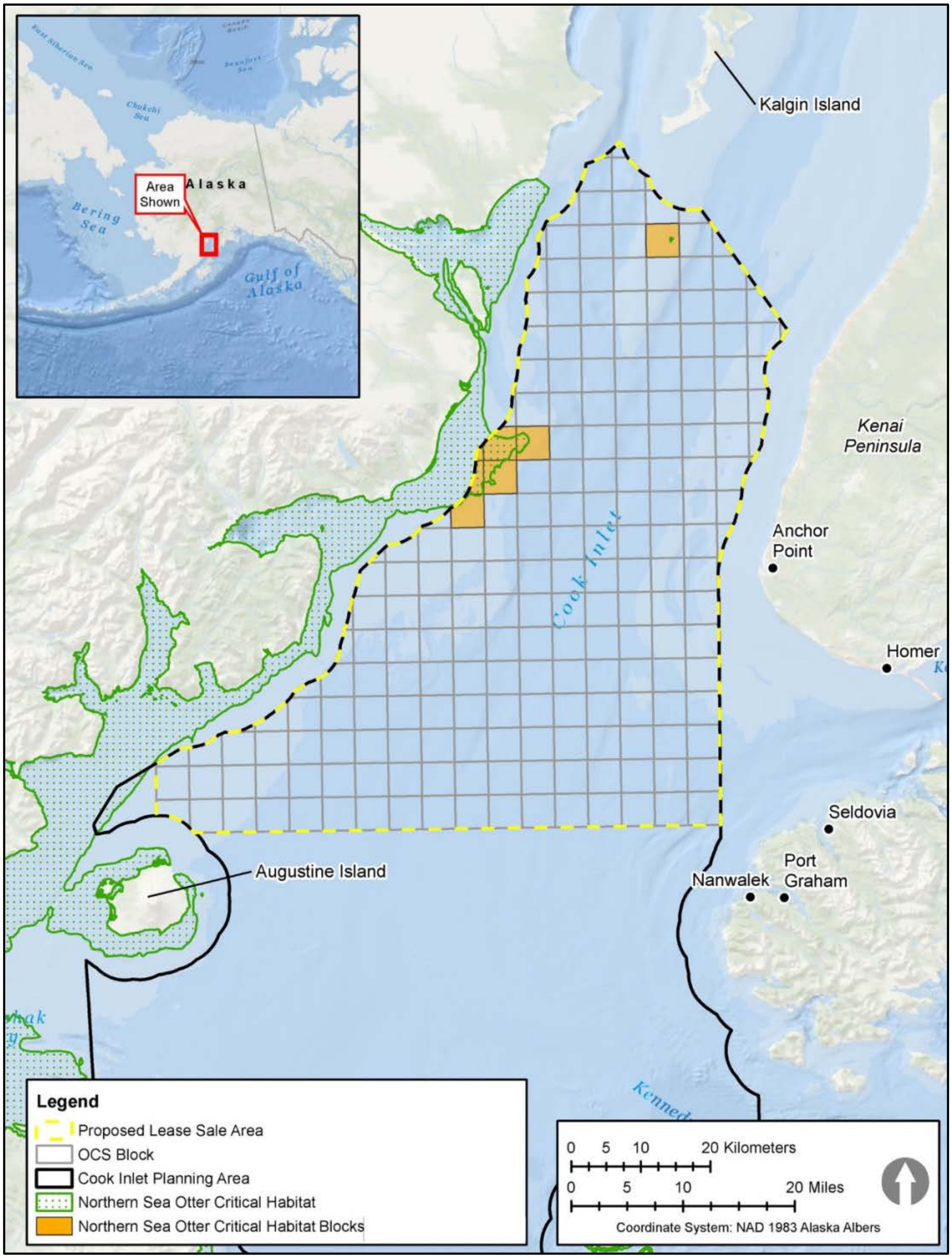

Figure 10. Northern Sea Otter Critical Habitat in the Proposed Lease Sale Area. OCS blocks that overlap with the critical habitat are shaded. From BOEM (2016b).

6.3.1.1 Effects of authorized discharges on PCEs

Authorized discharges during the First Incremental Step may include drilling mud and cuttings, deck drainage, sanitary and domestic waste, desalination unit brine, cooling water, bilge and ballast water, and other miscellaneous discharges. BOEM's EDS estimates 7 to 10 exploration and development wells will be drilled within the proposed Lease Sale Area during a 4-year period beginning the second year (Table 2). Six OCS blocks within the western portion of the proposed Lease Sale Area overlap with northern sea otter critical habitat. One additional OCS block in the north-central portion of the proposed Lease Sale Area also contains sea otter critical habitat (Figure 9). The areal extent of the sea otter critical habitat within the proposed Lease Sale Area is 11,893 ha (29,388 ac). This represents 2.69 percent of the proposed Lease Sale Area and approximately 0.23 percent of the total area of northern sea otter critical habitat.

The BOEM's EDS assumes the average exploration or delineation well would produce approximately 435 tons of drilling mud and 747 tons of drill cuttings, which would be discharged to the ocean at each well site (BOEM 2016b). Deposition of cuttings on the seafloor could alter seafloor characteristics such as grain size, mineralogy, and microtopography. It could also alter prey availability (PCE 4) in the immediate vicinity of the discharges through burial of benthic organisms or altering substrate habitat characteristics, but such effects might be of limited size and duration. Benthic impacts including burial and smothering are most likely to occur within a radius of approximately 1,640 ft (500 m) around each well site, affecting an area of 0.48 mi^2 (0.78 km^2) per well site. This represents approximately 0.005 percent of the total designated critical habitat (BOEM 2016b).

6.3.1.2 Effects of small spills on PCEs

In order for small spills to affect PCEs in the KKAPMU, they would need to occur within or adjacent to this critical habitat area. BOEM and BSEE estimate greater than 99.5 percent chance of a small spill to occur during the First Incremental Step (BOEM 2016b). Depending on the spill location, a small refined spill is likely to evaporate and disperse in offshore waters without ever reaching sea otter critical habitat. In the event a small refined oil spill occurs and reaches sea otter critical habitat, it is likely that any habitat impacts would be short-term and there would be no persistent contamination. In that event, it is also unlikely that a small refined spill would diminish the value of the physical or biological features essential to the conservation of the listed stock of sea otters. That is, small spills may affect critical habitat for sea otters but the PCEs (shallow depth, protection from predators, kelp, and prey resources) are present in sufficient quantity and quality to support the energetic requirements of the species, and this availability will not be affected by small spills associated with the First Incremental Step.

Given the low number of activities expected within the KKAPMU during the First Incremental Step we expect major effects to critical habitat would be unlikely. We do not expect small spills to have long-term effects that would diminish the function or conservation value of the KKAPMU for northern sea otters occurring in the Lease Area, because: 1) although spills during the First Incremental Step would be highly probable, a spill is expected to be of relatively low volume (approximately 432 spills less than 1 bbl, 16 spills between 1 and 50 bbls, and 2 spills between 500 bbls and 1,000 bbl; Table 10); 2) the area affected by these spills would be small; 3) most of the oil would be quickly recovered, evaporate, or disperse; and 4) the likelihood of spills occurring within or adjacent to the KKAPMU is low.

Table 10. Oil spill estimates: Phase, activity and source of spill, type of oil, number and size of spill, and volume BOEM assumes for analyses in Cook Inlet Lease Sale 244 Action Area (BOEM 2016a)

Phase	**Type of Oil**	**Activity**	**Source of Spill**	**Number of Spill(s)**		**Size of Spill(s) (in bbl)**	**Estimated Total Spill Volume**
Exploration	Diesel or Refined	Small Spills					
		Geological and Geophysical Activities[2]	Offshore	0-6		<1 or one up to 13 bbl	<18 bbl
		Exploration Plan Activities	Offshore and/or Onshore Operational Spills from all Sources	0-4		5 bbl or one up to 50 bbl	65 bbl
Development, Production and Decommissioning	Crude, Condensate, Diesel or Refined Oil or Gas Release	Development Plan Activities	Offshore and/or Onshore Operational Spills from all Sources	~450[1] Total			~300 Total
				<1 bbl	432[1]	3 gallons	10 bbl
				1-<50 bbl	16	3 bbl	48 bbl
				50-<500 bbl	2	126 bbl	252 bbl
				500-<1,000 bbl	0	0 bbl	0 bbl
		Large Spills or Gas Releases					
		Development Plan Activities	Onshore Pipeline, or Offshore Pipeline, or Offshore Platform/Storage Tank/Well	Up to 1 from either		2,500 bbl, or 1,700 bbl, or 5,100 bbl	2,500 bbl, or 1,700 bbl, or 5,100 bbl
			Offshore Platform/Well	1 gas release		8 million ft^3	8 million ft^3

6.3.1.3 Effects of large spills

Based on information provided by BOEM and BSEE (BOEM 2016a), spills greater than 1,000 bbl are not reasonably likely to occur during the First Incremental Step. Rather, based on BOEM and BSEE's BO, the only type of larger spill that would potentially occur during this step would be a VLOS (greater than 150,000 bbl) from loss of well control resulting in a long duration flow. However, such an event would be extremely unlikely to occur because a loss of well control incident is extremely rare and is therefore not reasonably certain as a result of the First Incremental Step. Therefore, while the effects of a VLOS would likely result in adverse effects to PCEs 3 and 4, a VLOS is not considered to be an effect of the First Incremental Step within the meaning of the ESA, because it is not reasonably certain to occur. However, the effects of a large and VLOS to sea otter critical habitat are discussed below in the section *Effects of Large Oil Spills – First and Future Incremental Steps.*

6.3.2 Spill response

Cleanup activities would likely take place if a large spill occurred. Activities could include vessel and aircraft operations, mechanical recovery (skimming and booming), use of dispersants, and in-situ burning (BOEM 2016a). It is difficult to say how effective cleanup efforts would be at removing oil from the environment. Based on clean-up activities with the Exxon Valdez Oil Spill where only about 14 percent was recovered or disposed (Wolf et al. 1994), spill response may be largely unsuccessful in remote open water conditions, and spill response drills have had various levels of success in the cleanup of oil in broken-ice conditions (Dickens 2011). The duration of cleanup activities for a large spill would depend on the timing and amount of oil spilled, but would likely last months or years.

6.3.2.1 Cleanup Activities - KKAPMU

Cleanup activities could reduce use of the KKAPMU by causing disturbance and displacement of sea otters from spill response vessels and aircraft. We would expect that the extent and severity of potential effects to the KKAPMU from cleanup activities would increase with increasing spill volume, depending on location and timing of the spill. The effects of such disturbance and displacement would end once vessels and aircraft left the area. Thus, although oil spill response efforts could conceivably last one or more years, these efforts would likely be temporary and therefore would not significantly impact the PCEs and their ability to serve their conservation role.

6.4 Effects on Recovery

6.4.1 Recovery of Steller's Eider

The potential impacts of BOEM's proposed actions on the recovery of Alaska-breeding Steller's eiders will be negligible given that relatively few Steller's eiders use Cook Inlet as wintering habitat. As described in the *Status of the Species* section, the Russian Pacific population (believed to contain 50,000 to 100,000 individuals) mixes with the listed population on the molting and wintering grounds in southwest Alaska (Figure 4). Reports by Larned (2006) suggest Steller's eiders overwintering in Cook Inlet vary by month with numbers upwards of 12,000 individuals peaking in January and February. The Service considers the potential impacts of the proposed action on recovery of the species to be negligible given that: 1) less than 1 percent of all Steller's eiders occurring on the molting and wintering grounds in Alaska may be of the listed Alaska-breeding population; and 2) Steller's eiders are disproportionately distributed throughout Cook Inlet surrounding the Action Area (Figure 5); 3) a small percent of the listed entity may be located within Cook Inlet; and 4) the listed population of Steller's eiders do not significantly overlap with the lease sale area.

6.4.2 Recovery of the Southwest Alaska DPS of the Northern Sea Otter

A review of the threats to sea otter recovery was completed in 2013(Service 2013a). Most threats were assessed to be of low importance to recovery of the sea otter; threats judged to be most important are predation (moderate to high importance) and oil spills (low to moderate importance). Due to the large spatial extent of the DPS, even a large volume oil spill in lower Cook Inlet would be unlikely to affect a substantial proportion of the overall sea otter population given their wide distribution (Service 2013a). Table 10 summarizes that analysis. Southwest Alaska DPS of northern sea otter recovery criteria is discussed in detail in the *Sea Otter Recovery Criteria* of the *Status of the Species*.

The potential impacts of this development on recovery of the southwest Alaska DPS should be negligible because sea otters occur primarily in the near shore zone and the lease sale area is at least 3 miles off shore. Therefore, sea otters do not significantly overlap with the lease sale area. However, large-volume oil spills, once they have occurred, are nearly impossible to contain or manage with current technology. When large numbers of otters become contaminated with spilled oil, it is not possible to capture and treat the great majority of the animals. Those that become extensively contaminated or ingest large quantities of oil are difficult, if not impossible, to rehabilitate with currently available technology (Estes 1991). Even with those constraints, however, it should be possible to protect small areas that provide important habitat in specific parts of the southwest Alaska DPS from becoming oiled.

6.4.3 Critical Habitat

Threats and impacts of past and present impacts of Federal, State, or private actions and activities are described in *Status of the Species and Critical Habitat*. No trends in the condition of sea otter critical habitat are identified in the critical habitat designation, Recovery Plan, or 5-Year Review. However, the Recovery Plan rates habitat loss as a low threat to recovery of the population (Service 2013a). The physical habitat for sea otters is largely unspoiled throughout the vast majority of the range of the southwest Alaska DPS.

Impacts to critical habitat within the KKAPMU from activities authorized in the First Incremental Step of the proposed Action are anticipated to have at most minor, short-term impacts to the PCEs, and therefore are not likely to diminish the function and conservation value to northern sea otters for which it was designated.

6.5 Summary of Effects for the First Incremental Step

6.5.1 Listed Steller's eiders

In evaluating impacts of the proposed project to Steller's eider, the Service identified potential adverse effects from collisions and disturbances. Using methods explained in *Effects of the Action*, the Service estimates loss of approximately eight (8**)** Steller's eider from collision with

MODUs and vessels with one (1) or fewer of these belonging to the Alaska-breeding population of Steller's eider (see Appendix A for calculations).

In addition to adverse effects from collisions, listed eiders could be impacted by disturbance from aircraft, vessel traffic, seismic surveys, and exploratory drilling, as well as authorized discharges and small oil spills. However, due to: 1) the low density of Alaska-breeding Steller's eiders in the action area; 2) the low number of activities compared to the size of the action area; 3) the implementation of mitigation measures such as flight altitudes, downward shielded lights, and timing restrictions for activities in the action area; 4) the limits on authorized discharges enforced through the NPEDES permit process; 5) the anticipated low frequency and low volumes of small oil spills; and 6) the high likelihood that spills would be recovered or dissipated quickly (due to spill prevention and response measures), we anticipate impacts from these factors would be limited to one (1) or fewer individual Alaska-breeding Steller's eiders resulting in only minor, temporary changes in behavior, and would be unlikely to result in injury or death (see Appendix A for calculations).

6.5.2 Southwest Alaska DPS of Northern Sea Otter

We have identified potential impacts to sea otters from activities proposed during the First Incremental Step. As described in the *Effects of the Action*, activities that may result from the action could affect sea otters through disturbance and oil spills.

Sea otters could be impacted by disturbance from aircraft, vessel traffic, seismic surveys, and exploratory drilling, as well as authorized discharges and small oil spills. However, due to: 1) the low number of activities compared to the size of the action area; 2) the implementation of ship-based mitigation measures, including protected species monitoring, establishing and monitoring safety and disturbance zones, speed and course alterations, ramp-up (or soft start), power-down and shutdown procedures, and provisions for poor visibility conditions; 3) the limits on authorized discharges enforced through the NPEDES permit process; 4) the anticipated low frequency and low volumes of small oil spills; 5) the likelihood that spills would be recovered or dissipated quickly (due to spill prevention and response measures), we anticipate impacts from these factors would be limited to typical sea otter raft congregations, which typically range from 10 to 500 in Cook Inlet (and most commonly around 20 individuals), resulting in only minor, temporary changes in behavior, and would unlikely to result in injury or death.

6.5.3 Critical Habitat for the Southwest Alaska DPS of Northern Sea Otter

Impacts to Critical Habitat for the southwest Alaska DPS of northern sea otter within the KKAPMU from activities authorized during the First Incremental Step of the proposed Action are anticipated to have at most only minor, short-term impacts to the primary constituent elements and habitat qualities, and are therefore not likely to diminish the function and conservation value of critical habitat.

Although small spills would be reasonably foreseeable during the First Incremental Step, they would be by definition so limited in size that oil or other spilled substances would likely evaporate, weather, or be mostly recovered. By virtue of their size, they would also likely cover a limited areal extent, and would be unlikely to persist long enough to reach critical habitat if spilled elsewhere. Moreover, given the limited volumes of small spills, effects on the biological and physical features of critical habitat would likely be short term and localized, and therefore would not diminish the function and conservation value of critical habitat within the KKAPMU for Alaska DPS of northern sea otter.

Spills of greater volume would not be likely to occur during the first increment. According to analysis by BOEM and BSEE, large and very large oil spills would be so unlikely during the First Incremental Step as to be considered not reasonably foreseeable. Therefore, they would not be considered a direct or indirect effect of the first increment within the meaning of the ESA.

In summary, although we identified potential impacts to critical habitat within the KKAPMU from disturbance and small spills, due to: 1) the implementation of minimization measures designed to reduce or avoid industry impacts within the Action Area; 2) the low likelihood and volume of spills during the First Incremental Step; and 3) the implementation of spill prevention and response measures, these effects would be expected to have at most only minor, short-term impacts to the primary constituent elements and habitat qualities, and are therefore not likely to diminish the function and conservation value of critical habitat for the southwest Alaska DPS of northern sea otter within the KKAPMU.

6.6 Future Incremental Steps

This section assesses the impact of future exploration and development activities, both onshore and offshore; oil and gas pipeline installation; platform installations; drill production and service wells; oil and gas production; and Government-initiated oil spill response exercises. Development, production, and decommissioning would take place on- and offshore, and could include construction of permanent infrastructure (e.g., subsea pipelines), use of aircraft and vessels, operation of facilities, and decommissioning of infrastructure. The Proposed Action includes mitigation measures that could minimize effects on listed species and critical habitat within the KKAPMU. Mitigation measures associated with First and Future Incremental Steps are detailed in the *Mitigation Measures* section within the *Proposed Action* section of this biological opinion.

6.6.1 Steller's Eiders – Future Incremental Steps

6.6.1.1 Habitat Loss

Offshore infrastructure would include three platforms installed over approximately 3 years (Table 4) with associated pipelines. This infrastructure would impact a small area of the sea floor, with some structures above the water surface. Platforms and wells will not be located within areas used by large numbers of listed eiders. Oil and gas pipelines, however, could be routed through these areas buried in the substrate. Given the relatively small size of the offshore footprint described by BOEM, adverse effects would likely occur infrequently and be limited in extent. Additionally, most impacts to foraging habitat offshore would be temporary because platforms and seafloor infrastructure would be removed, and benthic areas disturbed by pipeline burial would recover following the disturbance.

6.6.1.2 Disturbance and Displacement

Effects of disturbance and displacement will likely be greater during future incremental steps than the First Incremental Step, and impacts would depend upon the duration, frequency, and timing of a given activity, as well as tolerance of disturbance by individuals.

As during the First Incremental Step, disturbance and displacement could occur from aircraft operations, vessel traffic, and acoustic sources associated with open-water seismic surveys and exploratory drilling. Vessels (barges and other support vessels) and aircraft (fixed-wing and helicopters) could transport materials and personnel to offshore facilities, and the number and frequency of vessel and aircraft operations would likely be significantly higher during development and decommissioning than production (Table 4).

Disturbance associated with seismic surveys and exploratory drilling may occur and disturbance could result from platform operations. As described in the *Effects of the Action* of the First Incremental Step, disturbance from vessel, aircraft, open-water seismic, and drilling operations on Steller's eiders may include flushing and displacement at some energetic cost to individual birds. Because Steller's eiders generally occur at low densities in the Leased Area, and of these, only 0.8 percent are of the Alaska-breeding population (i.e., the listed entity), we expect few listed Steller's eiders to be present and encounter open-water seismic, exploratory drilling operations and production platform operations.

6.6.1.3 Collisions and Disorientation

As during the First Incremental Step, Steller's eiders may be disoriented and drawn to artificial lighting of MODUs and vessels, particularly during migration, thus increasing collision risk; platforms would pose a collision risk not present during the First Incremental Step, and the overall number of structures and vessels would be greater. Location and timing of vessel and drilling structure operations would also influence collision risk. We expect that when Steller's eiders collide with infrastructure, they suffer severe injuries or death.

While encounters could occur throughout the anticipated project life, the highest offshore collision risk would likely occur when the highest number of MODUs, platforms, and vessels are operating, which is expected to be during the Development and Production phase (BOEM 2016b). However, the exact level of activity associated with the Decommissioning phase is unknown; the number of vessels would vary dependent upon decommissioning activities (Table 4). At this time there are many uncertainties regarding the Future Incremental Steps to enable us to estimate collisions of Steller's eider. For example, Steller's eider collision rates with vessels could be higher during nearshore pipeline installation than during drilling in the Leased Area because Steller's eiders generally migrate closer to shore than in the Leased Area. Additionally, Steller's eiders may also collide with onshore structures. The frequency of collisions would depend on the distance of infrastructure from the coast. Furthermore, bird disorientation could also occur during gas production operations during a loss of control (flaring) or during normal operations when a small amount of natural gas is released. Some migrating birds may become disoriented by light produced during these conditions, especially during darkness or inclement weather, and collide with the platform structure. Data collected during exploratory drilling may improve our ability to estimate collision rates during future incremental steps. However, we expect collisions of Steller's eiders on an order similar to that of the First Incremental Step.

Mitigation measures – As discussed during the effects analysis of the First Incremental Step, mitigation measures may also lower collision injury and mortality, although the effectiveness of these measures is unclear. Mitigation measures were implemented during Shell's 2012 drilling, and while no listed eider collisions between vessels or MODUs occurred, collisions between other sea ducks (BOEM 2016a) and vessels and MODUs indicate such encounters with listed eiders are possible.

Because the most recent population estimate for North Slope-breeding Steller's eiders is 576 (292-859, 90 percent CI), we would not anticipate population-level effects from an annual collision loss during future incremental steps.

6.6.1.4 Authorized Discharges

Toxic contamination from disposal of drilling muds and cuttings could potentially occur. However, given that only a small fraction of listed eider prey base would likely be affected by a relatively small project footprint, the Service anticipates only minor impacts would occur. At this time BOEM is uncertain if drilling muds would be disposed of at sea (in service wells) or barged to shore, but disposal on land could further minimize toxin exposure in the marine environment because we would not expect listed eiders to contact drilling wastes at onshore facilities.

6.6.1.5 Small Spills

Although small spills are likely in Future Incremental steps, we do not expect Steller's eiders would be significantly affected. Small spills are expected to be of very low volumes, and the oil is likely to evaporate, weather, or be almost entirely recovered prior to listed eiders contacting it (BOEM 2016b). Therefore, even if a small spill reaches the marine environment, there is a low likelihood these species would be affected. Accordingly, based on BOEM's oil spill risk analysis, the low volume and small area expected to be impacted by small spills, and the sparse distribution of listed eiders over much of the Action Area, we anticipate that adverse impacts to listed eiders from small oil spills are not likely to occur during future incremental steps.

6.6.2 Southwest Alaska DPS of Northern Sea Otter

6.6.2.1 Disturbance

6.6.2.1.1 Effects of disturbance from vessels and helicopters

Future Incremental Steps include support vessel and helicopter traffic from development, production and decommissioning activities, and government initiated oil spill response exercises. Disturbance to sea otters may occur along the western side of Cook Inlet, particularly if a production platform is located within a lease block overlapping with critical habitat. Sea otter collisions with vessels associated with Future Incremental Steps are unlikely, although collisions between sea otters and vessels do occur but are infrequent (Service 2012).

Helicopter traffic to and from production platforms may disturb sea otters; however, the disturbance would likely be localized to the vicinity of the platform. The BOEM anticipates helicopters will maintain a minimum altitude of 2,000 ft (610 m) which is usually sufficient to avoid disturbing marine mammals (BOEM 2016b). Although sea otters occurring in the action area may be susceptible to disturbance from helicopter and vessel traffic, we expect this effect to be localized and temporary. Because sea otters in Cook Inlet are known to spend time in high density rafts, small localized temporary disturbances have potential to affect a larger number of individuals than may normally occur to individual foraging or nursing sea otters. However, rafting otters occurring in the vicinity of platforms are likely habituated to the presence of the platform and platform activities.

6.6.2.1.2 Effects of disturbance from drill production

BOEM and BSEE's EDS estimates three production platforms will be installed in the proposed Lease Sale Area during Years 7 to 10 (Table 2). The BOEM anticipates that one platform will be in an area inhabited by sea otters. Platform construction activities would disturb the seafloor and create noise. BOEM calculates the total area of sediment disturbed by a steel-caisson platform is approximately 3.7 ac (1.5 ha) of seafloor (BOEM 2012).

The EDS also assumes two offshore pipelines (one oil, one gas) installed from the initial platform to shore, with landfall likely occurring on the east side of Cook Inlet on the Kenai Peninsula between Homer and Nikiski. Additional pipelines installed will connect the second and third platforms to the initial platform. Pipelines are unlikely to pass through sea otter critical habitat unless a platform is located there. However, BOEM has proposed mitigation which could prevent seafloor disturbance within OCS blocks overlapping with sea otter critical habitat.

Pipeline route construction and installation may generate noise and turbidity along the route primarily occurring from two vessels conducting pipe-laying and trenching. Trenching of the new oil pipelines 60 to 85 mi (97 to 137 km) in length and the new gas pipelines 60 to 115 mi (97 to 185 km) in length is estimated to disturb 398 to 796 ac (161 to 322 ha) of seafloor (BOEM 2016b). As each pipeline is buried, turbidity could extend hundreds to thousands of feet from the trenching location along the pipeline corridor. The BOEM estimates within a particular OCS block, this disturbance would likely last for a few days.

Impacts of sedimentation on sessile benthic organisms are transmitted up through the food chain, affecting wildlife species that eat them, including sea otters. Otters are most likely to respond to changes in food availability by dispersing to unaffected areas. However, sea otter population declines are not likely attributed to food limitations (Service 2013a, 2013b). If a production platform or an offshore pipeline is located in sea otter habitat, the resulting seafloor disturbance and noise may cause sea otters to avoid the area. For the duration of the Action, sea otters may either become habituated to the platform's presence or permanently avoid the area. Therefore, if development and production activities are located in habitat of listed sea otters in the nearshore waters on the western side of Cook Inlet, the resulting noise and seafloor disturbance may result in short-term disturbance to or long-term habitat avoidance for hundreds of sea otters.

6.6.2.2 Authorized Discharges

Discharges are regulated through the NPDES permit (USEPA 2015) which will ensure adherence to the Clean Water Act (CWA) standard of no unreasonable degradation of the marine environment (CWA Section 403 and implementing regulations at 40 CFR Part 125.122). In addition, any discharges from production platforms are expected to be diluted rapidly in receiving waters. Therefore, the Service expects any discharges during Future Incremental steps to likely have no significant impacts to sea otters.

6.6.2.3 Small Spills

The BOEM and BSEE estimate that approximately 450 small spills may occur during the Future Incremental Steps. The BOEM and BSEE estimate that the majority of these spills would be 3 gallons or less on average (BOEM 2016b). Of the total, 432 spills are estimated to be less than 1 bbl, 16 spills are estimated to be between 1 and 50 bbl, and 2 spills are estimated to be between 50 and 500 bbl. Although small spills are expected to occur infrequently, are of low volume, and expected to be contained or weather quickly, it is not discountable that a small spill may reach relatively shallow areas where sea otters typically forage (waters less than 131 ft [40 m]). In the event of a small spill reaching sea otter habitat, it is likely one or two otters may be impacted as sea otter densities are relatively small and can vary from only 0.6 mi^2 to over 25 mi^2 (1 km^2 to over 40 km^2) (Schneider and Ballachey 2008). In addition, because sea otters may raft together in groups, it is not entirely unlikely that up to twenty listed otters, but rarely 300 to 500 individuals may be impacted if a small spill should reach their habitat when a raft is present.

6.6.3 Critical Habitat for the Southwest Alaska DPS of Northern Sea Otter - KKAPMU

6.6.3.1 Disturbance within the KKAPMU

Construction activities for a production platform or offshore pipeline would cause short-term habitat impacts. However, once installed, a production platform would be in place for decades (Years 7-34 for oil platform; Years 7-39 for a gas platform). This would represent a very localized, but long-term habitat change due to the presence of the platform and the associated noise and lights. Once a pipeline is in place (and especially if it is buried), there would likely be little or no residual effect on the critical habitat.

Although platform and offshore pipeline installation may cause seafloor disturbance in the unlikely event they would occur in sea otters critical habitat, they would not diminish the value of the primary constituent elements (i.e., shallow depth, protection from predators, kelp, and prey resources that are present in sufficient quantity and quality to support the energetic requirements of the species) essential to the conservation of the listed stock of sea otters. Therefore, activities associated with development and production may affect critical habitat for sea otters; however, activities are not likely to destroy or adversely modify critical habitat.

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The BOEM and BSEE estimate that approximately 450 small spills may occur during the Future Incremental Steps. The BOEM and BSEE estimate that the majority of these spills would be 3 gallons or less on average (BOEM 2016b). Of the total, 432 spills are estimated to be less than 1 bbl, 16 spills are estimated to be between 1 and 50 bbl, and 2 spills are estimated to be between 50 and 500 bbl. Although small spills are expected to occur infrequently, be low volume, and be contained or weather quickly, it is not discountable that a small spill may reach sea otter critical habitat.

Small spills could temporarily contaminate a very small area within the KKAPMU containing flora and fauna in the water column; although some oil from small spills could also contaminate the underlying benthic community, this is less likely than contamination within the water column. For these effects to occur, spills would have to occur directly adjacent to or within the KKAPMU, and few activities are likely to occur in this area. Additionally, effects of such contamination would be minimized through oil evaporation, weathering, and recovery efforts. If small spills do occur, the area affected would be small, and most of the spilled oil would evaporate, weather, or would be recovered; therefore, we do not expect small spills would have long-term effects that would diminish the function and conservation value of the KKAPMU for sea otters.

6.6.4 Summary: Future Incremental Steps

Actions occurring during future incremental steps affect Steller's eiders and the southwest Alaska DPS of northern sea otters; but, given the current status and environmental baseline of these species and the relatively few individuals affected compared to the size of the listed Alaska-breeding Steller's eider and sea otter populations, we do not anticipate these adverse effects would cause population-level declines.

Uncertainty from a variety of factors complicated this effects analysis. The range of possible effects on listed species is large because of uncertainty regarding what may actually occur during future incremental steps. Additionally, the status of species will likely change (e.g., from effects of other development projects and climate change habitat alterations) before all future incremental steps occur; if population sizes change or species alter when or how they use the Action Area, the potential effects of development and production could differ from the analysis above.

6.7 Large Oil Spills

The BOEM and BSEE define large spills as those at least 1,000 barrels in volume and larger. The large oil spill scenario (BOEM 2016b) has many components aimed at assessing the likelihood and number of spills that could occur based on their sources and sizes (Table 5), and the likelihood that oil reaches important resources. Using this information, we assessed the likelihood of adverse and population-level effects to listed species and designated critical habitat. We begin by describing components of the spill scenario and the Oil-Spill Risk Analysis (OSRA; BOEM 2016b) considered relevant to analyzing potential effects to listed species:

1. Sources of spills;
2. Types of oils;
3. Likelihood of spills by size category;
4. Median OCS spill sizes for platform and pipelines;
5. Conditional probabilities (i.e., the chance a large oil spill would reach resources important to listed species assuming a spill occurs); and
6. Combined probabilities (i.e., the chance one or more large spills occurring and contacting a particular resource over the life of the Exploration and Development Scenario).

Estimating large oil-spill occurrence or contact with resources important to listed species while they are present in the Action Area is an exercise in mathematical probability. Uncertainty exists regarding whether exploration or development will occur at all, and if it does, the location, number, and size of potential large oil spill(s) and the wind, ice, and current conditions at the time of a spill(s). Although some uncertainty reflects incomplete or imperfect data, a considerable amount of uncertainty exists simply because it is difficult to predict events 15 to 40 years into the future.

While the ORSA model provided useful information to aid in the assessment of possible effects to listed species and critical habitats, like all models, the ORSA model has limitations such as the following:

1. BOEM (2016a) presented large spill mean rates and median volumes from platforms and pipelines in the Gulf of Mexico and the Pacific Ocean. Large spill rates and volumes in Cook Inlet may be influenced by environmental factors not present in these other areas.
2. Platform and pipeline design, operation, and maintenance may influence the actual spill rate and volumes for the Proposed Action.
3. Due to climatic changes, ice conditions, and environmental factors specific oil spill trajectories could differ from those calculated in the ORSA.
4. Environmental resource areas (ERA) important to Sea otters and Steller's eiders were based on current use of the Action Area. The chance that oil may reach an area important to listed species may differ from the OSRA ERAs because use patterns by these listed species may change with the changing climate.

6.7.1 The Chance of a Large Spill from Exploration and Delineation Drilling Activities – First and Future Incremental Steps.

Although diesel fuel spills are possible, large spills would most likely be in the form of crude or condensate oil whose sources are wells, storage tanks on platforms, and pipelines (Table 10). Because industry does not store large volumes of crude or condensate oil or construct pipelines during the First Incremental Step, large crude or condensate oil spills from storage tanks on drilling platforms and pipelines are only possible during future incremental steps (BOEM 2016a). No large crude or diesel oil spills are anticipated from exploration and delineation drilling wells, based on BOEM's and BSEE's review of potential discharges, historical oil spill and modeling data, and the likelihood of oil spill occurrence during the proposed action. The BOEM and BSEE reached this conclusion based on the following information:

1. During OCS exploratory drilling there has historically been a low rate of well-control incidents spilling crude oil;
2. Since 1971, 15,000 exploratory wells have been drilled, with only a single OCS crude oil spill (large/very large) during temporary abandonment (converting an exploration well to a development well);
3. For this proposed action, only 10 exploratory wells are projected to be drilled;
4. No crude oil would be produced from the exploratory wells, and the wells would be permanently plugged and abandoned after exploration;
5. Historically, the exploration spills that have occurred on the Alaska OCS, have all been small;
6. During drilling of 85 exploration wells to depth in the Alaska OCS between 1975 and 2015, no large spills occurred; and
7. Pollution prevention and oil spill response regulations and methods implemented by BOEM, BSEE, and operators and since the Deepwater Horizon spill have reduced the risk of spills and diminished their potential severity (BOEM 2011, Visser 2011).

A small possibility exists, however, that a loss of well control (LOWC; as defined by 30 CFR 250.188(3)) followed by a long-duration flow could occur during exploration. Therefore, it is possible, although unlikely, for this type of event to result in a large oil spill during the first and future incremental steps. BOEM and BSEE analyzed the potential impacts of a very large oil spill (VLOS; a spill of greater than 150,000 barrels) for the purposes of evaluating a low-probability, high-impact event in the Leased Area (BOEM 2016b). According to BOEM and BSEE, a large OCS oil spill from a LOWC followed by an uncontrolled flow event is extremely rare (probability of 0.0001 to 0.00001 per well), and such spills rarely reach large spill volumes. Thus, BOEM and BSEE estimate that a large spill, including one from a LOWC, is unlikely to occur from exploration and delineation wells during first or future incremental steps because the spill frequency from LOWCs is extremely low (Bercha 2014).

6.7.2 Fate of a Very Large Oil Spill from a Loss of Well Control

The BOEM (2016b) estimated the fate of oil spilled from a long duration LOWC that caused a spill to cumulatively reach the VLOS volume. In the LOWC scenario, BOEM (2016b) used a discharge model that estimated the highest possible uncontrolled flow rate that could occur within known prospects in Lease Sale 244 area. Under these conditions, oil would flow from a well for 80 days, the estimated time required for when the near-wellbore reservoir pressure has fallen to 2,892 psia or 80 percent of the initial reservoir pressure (3,120 psia). The initial oil discharge is projected to be more than 2,100 barrels/day during Day 1 and is projected to flatten somewhat after Day 12, declining gradually to 1,382 stock tank barrels (STB) per day by Day 80. The total oil discharge by the end of the flow period on Day 80 would be 121,467 STB. Approximately 120,000 barrels of oil would be spilled in the VLOS scenario (BOEM 2016a)

In the unlikely event that a VLOS were to occur, BOEM cites various recovery and chemically or naturally dispersion rates; about 10 to 40 percent of oil would be recovered or reduced (burned, chemically dispersed, and skimmed), 25 to 40 percent would be naturally dispersed, evaporated, or dissolved, and about 20 to 65 percent would remain offshore until biodegraded or until it reached shore (Wolfe et al. 1994; Lubchenco et al. 2010 cited in BOEM 2016a). For planning purposes, USCG estimates that 5 to 30 percent of oil would reach shore in the event of an offshore spill (33 CFR Part 154, Appendix C, Table 2 cited in BOEM 2016a).

The probability that a LOWC would occur is extremely low. We therefore do not consider a LOWC or a resulting VLOS as an indirect effect of the proposed Action. If, however, such an event were to occur, impacts to listed species and critical habitat could be significant, with the severity of impacts depending on the location, timing, and volume of oil spilled.

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The probability that a LOWC would occur is extremely low. We therefore do not consider a LOWC or a resulting VLOS as an indirect effect of the proposed Action. If, however, such an event were to occur, impacts to listed species and critical habitat could be significant, with the severity of impacts depending on the location, timing, and volume of oil spilled.

6.7.4 The Chance of One or More Large Oil Spills Occurring from Platforms and Pipelines – Future Incremental Steps Only

Large spill rates are based on the large OCS oil-spill rates from Anderson et al. (2012) and the BOEM estimated mean number of large spills per billion barrels of hydrocarbon produced; 0.25 spills per billion barrels (Bbbl) for platforms/wells and 0.88 spills per Bbbl produced for a total 1.13 spills per Bbbl produced (BOEM 2016a). BOEM (2016a) assumes 0.215 billion barrels of crude oil and 571 billion cubic feet of natural gas will be produced and transported by pipelines and therefore, BOEM estimates 0.19 pipeline spills and 0.05 platform (and well) spills would occur, for a total of 0.24 spills over the life of the Leased Area. Additionally, based on the mean spill number BOEM estimates the percentage of one or more large platform/well and pipeline spills as 5 percent and 17 percent, respectively, and estimates the chance of one or more large spills occurring from these combined sources as 22 percent over the estimated 39 years of exploration, development, and production (BOEM 2016b).

6.7.5 BOEM's Estimated Marine Crude Oil Spill Volumes, Future Incremental Steps

The large spill-size assumptions BOEM and BSEE used are based on reported spills in the Gulf of Mexico and Pacific OCS because no large spills have occurred in the Alaska OCS from oil and gas activities (BOEM 2016a). The median size of a large crude oil spill from a pipeline on the OCS over the last 15 years is 1,720 barrels, and the average is 2,771 barrels (Anderson et al. 2012 cited in BOEM 2016a). The median large crude oil spill size from a platform on the OCS over the entire record from 1964-2010 is 5,066 barrels, and the average is 395,500 barrels (Anderson et al. 2012 cited in BOEM 2016a). Median volumes, rounded to the nearest hundred, were used by BOEM and BSEE to determine the size of large spills analyzed in oil spill weathering (fate) models. The potential types of oil spilled from platforms are assumed to be crude oil, natural gas liquid condensate, or diesel oil.

6.7.5.1 Fate of a Large Platform Crude Spill

If a 5,100-barrel crude oil platform spill were to occur in summer for a given set of environmental conditions, 24 percent would remain after 30 days (after weathering [dispersion and evaporation]) in the environment (BOEM 2016a). The spill would cover approximately 720 mi^2 (1,159 km^2) of discontinuous area, oiling an estimated 24.8 mi (40 km) of coastline (BOEM 2016a). Thirty days after melt-out, the remaining 3 percent (after weathering) of a 5,100-barrel winter crude oil spill from a platform would cover 716 mi^2 (1,153 km^2)of discontinuous area, oiling an estimated 18.6 mi (30 km) of coastline (BOEM 2016a).

6.7.5.2 Fate of a Large Pipeline Crude Spill

If a 1,700-barrel pipeline spill were to occur in summer, 24 percent would remain after 30 days (after weathering) in the environment (BOEM 2016a). The spill would cover approximately 411 mi^2 (662 km^2) of discontinuous area, oiling an estimated 15 mi (24 km) of coastline (BOEM 2016a). Thirty days after melt-out, the remaining (after weathering) 3 percent of a 1,700-barrel winter crude oil spill from a pipeline would cover 408.8 mi^2 (658 km^2) of discontinuous area, oiling an estimated 10.5 (17 km) of coastline (BOEM 2016a).

6.7.6 Conditional Probabilities

The chance that a large oil spill will contact a specific environmental resource area (ERA), land segment (LS), or Grouped land segment (GLS) within a given time of travel from a launch area (LA) or pipeline segment (PL) is termed a conditional probability, where the condition is that a large spill occurs (Figure 11). Conditional probabilities, expressed as a percent chance, are reported for three seasons (annual, summer, and winter) and five time periods (1, 3, 10, 30, and 110 days). The annual period is from January 1 to December 31. The summer period is from April 1 through October 31 and generally represents open water or subarctic summer. The winter period is from November 1 through March 31 and represents subarctic winter. The choice of this seasonal division was based on meteorological, climatological, and biological cycles and consultation with BOEM, Alaska OCS Region analysts (BOEM 2016a). This portion of the OSRA assumes no clean up response and no containment.

Environmental resource areas of greatest interest to this consultation are those representing resources areas important to Steller's eiders and northern sea otters and their critical habitat (Tables 11 and 12). These areas have potential to be affected given the assumption that a large spill occurred within the proposed Lease Sale Area. Environmental resource areas identified in close proximity to the proposed Lease Sale, those that directly overlap the Sale Area or are located on the west side of Cook Inlet and upper Shelikof Straight, have the highest likelihood of contact. Winter conditional probabilities are provided for Steller's eider as Alaska-breeding Steller's eiders are most likely to occur in areas within or adjacent to the Lease Sale area (or areas potentially affected by a large oil spill), during this time.

6.7.7 Combined Probabilities

Combined probabilities are the chance of one or more large spills occurring and contacting a particular environmental resource area over the life of the EDS. They are estimated using matrix multiplication of the variables: large oil-spill rates, conditional probabilities, and resource estimates (e.g., estimated billions of barrels of oil produced), and transportation scenarios (e.g., hypothetical pipeline lengths). Combined probabilities are expressed as a percent chance of one or more large spills occurring and contacting a resource and the estimated mean number of spills occurring over the assumed life of the EDS. The ERAs of interest for the combined analysis are presented in Table 15.

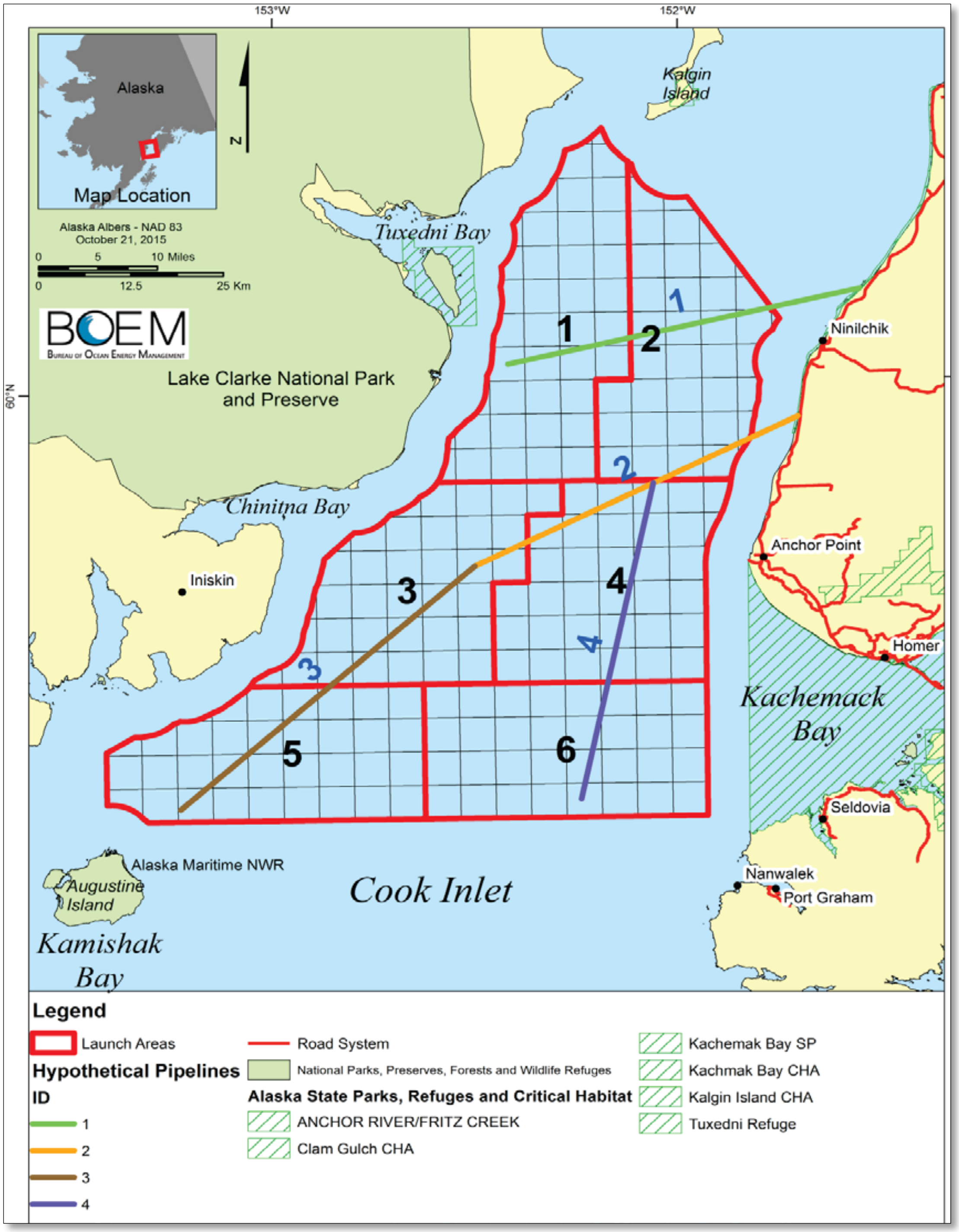

Figure 11. Hypothetical Launch Areas (LAs) and pipeline segments (PLs) used in the oil spill trajectory analyses From BOEM (2016a).

6.7.8 Effects of Large Oil Spills – First and Future Incremental Steps

Based on the OSRA (BOEM 2016a), a large spill is unlikely to occur during the First Incremental Step because the only source of a large spill would be a LOWC from an exploration or delineation well followed by an uncontrolled flow event. The probability that a LOWC would occur is extremely low. Thus, we conclude that effects to listed species and designated critical habitat from a large spill, including a VLOS, are not reasonably likely to occur during the First Incremental Step and are thus discountable.

If a large spill were to occur from an exploration or delineation well, however, it could adversely affect listed species, and could potentially cause population-level effects. Critical habitat in the Action Area could also be adversely affected. The severity of these impacts would likely increase with spill volume. We previously described the general potential effects of oil on individuals in the *Small Spills* section of the First Incremental Step. Thus, our effects analysis below focuses on the potential for large spills, including a VLOS, to cause population-level impacts and incorporates conditional and combined probabilities from the OSRA regarding the chance that oil would reach areas important to listed species and designated critical habitat. We also describe effects of disturbance from cleanup activities on listed species and designated critical habitat.

6.7.8.1 Steller's Eiders

A large oil spill has the potential to contact individuals of Steller's eiders and impact their habitat. Certain areas are of particular concern because of their importance to relatively large numbers of the species. Marine waters along the Cook Inlet coast support Steller's eiders from late July to as late as April, with numbers reportedly peaking in January and February (Larned, 2006; Martin et. al., 2015; Rosenberg et. al., 2014). The ERAs representing areas important to Alaska-breeding Steller's eiders are 114 (Chiniak Bay), 115 (Ugak Bay), 118 (Stikinak Straight), 125 (Chignik Bay vicinity), 128 (Wide Bay), 137 (Kamishak Bay), and 144 (Clam Gulch).

Although BOEM (2016a) presented information for other seasons, we focused our analysis on winter conditional probabilities because the timing represented by this analysis overlapped more with the timing of peak use of the Action Area by Steller's eiders. Depending on the origination of the spill and the number of days after a spill, winter conditional probabilities ranged from less than 0.5 percent to 29 percent (Table 11). The highest percent chance that oil reached a given ERA originated from a launch area (LA). For ERA 137 (Kamishak Bay), this was LA 5 (29 percent). Of the remaining ERAs of concern, the only other winter conditional probability exceeding 0.5 percent was from PL 2. Oil spilled from PL 2 resulted in a 23 percent chance that oil reached ERA 143 (Clam Gulch). These values are a mean of thousands of trajectories from several points along the hypothetical pipeline segment; values likely ranged from less than 0.5 to greater than 99.5 percent, depending on whether the launch point was within, adjacent to, or far from an ERA. The likelihood that oil reached a given ERA increased little after about 30 days post spill.

We provided a description of how oil could affect listed eiders in the *Effects of the Action* of the First Incremental Step. The number of birds oiled, and thus the potential for population-level effects, would depend on many factors, including season of the spill, its distance from congregations of birds, oil type, and oil spill volume. For example, observations of Steller's eiders during aerial surveys were not evenly distributed throughout the KKAPMU but instead tended to form clusters (e.g., Figure 5; Larned 2006). Thus, impacts of a large spill could range from 0 to 3,000 (Figure 5; Larned 2006) Steller's eiders affected. Steller's eiders may be vulnerable because large congregations occur disproportionately within areas adjacent to the Action Area. We expect few listed Alaska-breeding eiders to be affected based on their small proportional representation of all Steller's eiders occurring in Cook Inlet. However, because of its low abundance; population-level impacts could result from the loss of as few as 20 to 100 of Alaska-breeding females (Service 2002).

Steller eider estimates (Larned 2006) averaged over all months in which surveys were completed (March, April, and December, 2004 and January through April 2005), were 1,713 individuals occurring within Kamishak Bay. Given the scenario we are analyzing here, if 1,713 Steller's eiders in the Kamishak Bay area die from the effects of an oil spill, we may expect loss of approximately 14 Alaska-breeding Steller's eiders (assuming 0.08% of the 1,713 birds occurring within Kamishak Bay are of the Alaska-breeding population). Reported sex ratios of Steller's eiders from among 52,985 molting adult Steller's eiders banded on the Alaska Peninsula from 1961 to 1968, were approximately 46 percent female (Dau et al 2000). Documented sex ratios of Steller's eider populations in other locations include Finland, 39 percent males and 61 percent brown colored females for spring migrants (Hario 1997), and in Varangerfjord, Norway, close to 50 percent males and females (Henriksen and Lund 1994). If we assume the sex ratio of Alaska-breeding Steller's eiders occurring in the Action Area is 50:50, then we may expect lethal or injurious impacts to up to 14 listed Steller's eiders (including 7 females) could occur during Future Incremental Steps.

Table 11. Range of winter conditional probabilities (expressed as percent chance) that a large oil spill, starting at any Launch Areas or Pipeline Segments (Figure13), would contact environmental resource areas (ERAs; number in parenthesis) representing important areas for Steller's eiders within the stated number of days after a spill. From BOEM (2016a).

Environmental Resource Area	1 day	3 days	10 days	30 days	110 days
Chiniak Bay IBA (114)	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Ugak Bay (115)	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Stikinak Straight- STEI Habitat (118)	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Chignik Bay vicinity (125)	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Wide Bay (128)	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Kamishak Bay- STEI Habitat (137)	<0.5-6%	1-22%	8-29%	9-29%	9-29%
Clam Gulch- STEI Habitat (144)	<0.5-19%	<0.5-22%	0.5-23%	<0.5-23%	<0.5-23%

IBA = Important Bird Area
STEI = Steller's eider

The spill scenario presented by BOEM estimated a large spill, which could occur from a platform or pipeline. The OSRA suggests that a large spill some distance away from ERAs important to Steller's eiders (i.e., from some LAs representing portions of the Lease Area where platform spills could originate) is unlikely to reach these areas. Additionally, the chance of oil reaching these ERAs does not increase after about 30 days after the spill. Although we base this analysis upon conditional probabilities, BOEM's OSRA combined probability results, the chance of one or more spills occurring and contacting a given area, suggests an even lower chance of oil reaching important areas for Steller's eiders (Table 12). Therefore, based on the median spill size for pipelines (1,700 barrels) and conditional (Table 11) presented by BOEM (2016a), adverse effects from oil spills are possible; but, we do not anticipate population-level declines to occur for listed eiders.

6.7.8.2 Sea Otters

A large oil spill has the potential to affect individual northern sea otters and impact their habitat. Certain areas are of particular concern because of their importance to relatively large numbers of the species occurring within the KKAPMU. Marine waters along the Cook Inlet coast support northern sea otters throughout most of the year. The ERAs representing areas important to northern sea otters are 16 (Inner Kachemak Bay), 45 (Clam Gulch), 46 (outer Kachemak Bay), 47 (SW Cook Inlet), 48 (Kamishak Bay), 49 (Katmai NP), 50 (Becharof NWR), 57 (Trinity Islands), 59 (Kodiak NWR-south), 60 (Kodiak NWR-west), 64 (Afognak-west), 65 (Afognak-north), 66 (Afognak-east), 67 (Shuyak), 68 (Kenai Fjords-west), and 145 (Outer Kachemak Bay IBA).

Table 12. Combined probabilities (expressed as a percent chance), over the assumed life of the Leased Area of one or more spills ≥1,000 barrels, and the estimated number of spills (mean), occurring and contacting a given environmental resource area (ERA; number in parenthesis) representing important areas for Steller's eiders within the stated number of days after a spill. From BOEM (2016a).

Environmental Resource Area	1 day	3 days	10 days	30 days
Chiniak Bay IBA (114)	<0.5%	<0.5%	<0.5%	<0.5%
Ugak Bay (115)	<0.5%	<0.5%	<0.5%	<0.5%
Stikinak Straight- STEI Habitat (118)	<0.5%	<0.5%	<0.5%	<0.5%
Chignik Bay vicinity (125)	<0.5%	<0.5%	<0.5%	<0.5%
Wide Bay (128)	<0.5%	<0.5%	<0.5%	<0.5%
Kamishak Bay- STEI Habitat (137)	<0.5%	<0.5%	2%	2%
Clam Gulch- STEI Habitat (144)	<0.5%	1%	1%	1%

IBA = Important Bird Area
STEI = Steller's eider

Although BOEM (2016a) presented information for other seasons, we focused our analysis on summer and winter conditional probabilities because of the fates and behavior of oil in open water (summer) and ice (winter). Depending on the origination of the spill and the number of days after a spill, summer and winter conditional probabilities ranged from less than 0.5 percent to 97 percent (Tables 13 and 14). The highest percent chance that oil reached a given ERA originated from a pipeline segment (PL). For ERA 145 (Outer Kachemak Bay IBA), this was PL 4 with a conditional probability (summer and winter) of 97 percent.

Of the remaining ERAs of concern, three have a 50 percent chance or greater of contact during both seasons (summer and winter) within 30 days from one or more LAs or PLs (Tables 13 and 14). These are 47 (SW Cook Inlet): 13 to 62 percent chance in summer and 13 to 70 percent chance in winter, and 48 (Kamishak Bay): 16 to 97 percent chance in summer and 2 to 64 percent chance in winter. Outer Kachemak Bay (46) has a 10 to 59 percent chance of contact during summer and 2 to 45 percent chance in winter. With exception to Clam Gulch (45), all other ERAs of concern have summer and winter conditional probabilities less than 13 percent. Conditional probabilities for Clam Gulch are 1 to 48 percent in summer and 1 to 45 percent chance in winter.

For all ERAs of concern , the combined probabilities of one or more spills greater than 1,000 barrels occurring and contacting an ERA range from 2 percent to 11 percent within 30 days (Table 15). For all other ERAs, LSs or GLSs in Table 15, the combined probabilities range from 1 to 3 percent after 30 days. These values are a mean of thousands of trajectories from several points along the hypothetical pipeline segment; values likely ranged from less than 0.5 to greater than 99.5 percent, depending on whether the launch point was within, adjacent to, or far from an ERA. The likelihood that oil would reach a given ERA increased little after about 30 days post spill.

We provided a description of how oil could affect sea otters in the *Effects of the Action* of the First Incremental Step. The number of sea otters oiled, and thus the potential for population-level effects, would depend on many factors, including season of the spill, its distance from rafts of sea otters, oil type, and oil spill volume. For example, in 2002, Bodkin et al. (2003) found sea otters to be relatively abundant within Kamishak Bay (6,918 otters). Thus, impacts of a large spill could range from zero to large numbers of sea otters affected. Sea otters may be vulnerable because large congregations occur disproportionately within areas adjacent to the Action Area. For example there were an estimated 7,095 otters in Katmai, and aerial surveys of the Kodiak Archipelago conducted in 2008 resulted in an estimate of 11,005 sea otters (Service 2014a).

Adjusted sea otter population estimates for Kamishak Bay (6,918 individuals) and Katmai (7,095 individuals) survey areas each represents approximately 28 percent of the population within the KKAPMU, and 13 percent of the total population of southwest Alaska DPS of northern sea otter (Service 2014a). Although population estimates from the Kodiak Archipelago represent a greater proportion of the sea otter population than Kamishak Bay or Katmai, BOEM and BSEE's OSRA analyses does not provide a singular combined or conditional probability for an ERA representative of the Kodiak Archipelago as it does for Kamishak Bay and Katmai National Park (NP). In the OSRA evaluated by BOEM, both Kamishak Bay and Katmai NP represents a singular ERA (i.e. ERA 48 and 49, respectively) which can be directly compared to locations for which adjusted population estimates exist.

The BOEM and BSEE present conditional and combined probabilities for their OSRA, where a conditional probability is that of a large spill contacting assuming a large spill occurs and a combined probability which factors in the chances of one or more large spills occurring and then contacting. For Kamishak Bay (ERA 48), BOEM’s conditional probability is 20 to 64 percent (110 day winter) and the combined probability is 6 percent (30 day) (BOEM 2016a). For Katmai NP (ERA 49), BOEM’s conditional probability is 4 to 10 percent (110 day winter) and the combined probability is 2 percent (30 day). In their BA, BOEM (2016b) assumes that impacts to sea otters from contact with oil would be lethal. Therefore, in the scenario we are analyzing, given the winter 110 day conditional probability that a large spill contacts either Kamishak Bay or Katmai, assuming a large spill occurs, then we may expect lethal or injurious impacts to up to 7,100 northern sea otters could occur during Future Incremental Steps.

The spill scenario modeling presented by BOEM (2016a) estimated a large spill, which could occur from a platform or pipeline. The OSRA suggests that a large spill some distance away from ERAs important to sea otters (i.e., from some LAs representing portions of the Lease Area where platform spills could originate) is reasonably likely to reach these areas given winter 110 day conditional probabilities (Table 14). However, based on the median spill size for pipelines (1,700 barrels) and combined probabilities (Table 15) presented by BOEM (2016a), spills are unlikely to reach these ERAs given 30 day combined probabilities. Therefore, although 13 percent of the total population of southwest Alaska DPS of northern sea otter may experience adverse effects from oil spills given the scenario we analyze, we do not anticipate population-level declines to occur for the southwest Alaska DPS of the northern sea otter.

6.7.8.3 Sea Otter Critical Habitat: KKAPMU

Based on the conditional probabilities (Tables 13 and 14), two ERAs, 47 (SW Cook Inlet) and 48 (Kamishak Bay), along the southwest shoreline of Cook Inlet are the critical habitat areas most likely to be affected if a large spill occurred in the proposed Lease Sale Area. The conditional probabilities (expressed as percent chance) for ERA 47 range from 13 to 61 percent in summer and 13 to 70 percent in winter from among all LAs or PLs. The conditional probabilities (expressed as percent chance) for ERA 48 range from 19 to 55 percent in summer and 2 to 64 percent in winter (expressed as percent chance). Although the combined probability of one or more large spills occurring and contacting these areas is 11 percent for ERA 47 and 6 percent for ERA 48, a large spill during Future Incremental Steps may cause physical effects which could likely alter the quality of the essential features of sea otter critical habitat (shallow depth, protection from predators, kelp, and prey resources that are present in sufficient quantity and quality to support the energetic requirements of the species), or render it temporarily unsuitable. For example, the likely effects of a large oil spill would include lethal and sublethal effects to millions of eggs and the juvenile stages of shellfish. A large spill could measurably depress and affect local populations of shellfish for about a year, and small amounts of oil could persist in shoreline sediments for a decade or more, possibly affecting sea otter critical habitat for decades. Although these effects could last one year to tens of years, the affected PCEs would eventually recover and be capable of supporting sea otters.

Table 13. Range of summer conditional probabilities (expressed as percent chance) that a large oil spill, starting at any Launch Areas or Pipeline Segments (Figure 13), would contact environmental resource areas (ERAs; number in parenthesis), land segments (LS; number in parenthesis), or grouped land segments (GLS; number in parenthesis) representing important areas for sea otters and sea otter critical habitat.

Environmental Resource	Summer				
Area	1 day	3 days	10 days	30 days	110 days
ERA					
Inner Kachemak Bay (16)	<0.5%	3-5%	1-9%	1-9%	1-9%
Clam Gulch (45)	<0.5-40%	<0.5-45%	1-48%	1-48%	1-48%
Outer Kachemak Bay (46)	<0.5-38%	4-52%	10-58%	10-59%	10-59%
SW Cook Inlet (47)	<0.5-43%	7-55%	11-60%	13-61%	13-61%
Kamishak Bay (48)	<0.5-19%	3-39%	16-53%	19-55%	19-56%
Katmai NP (49)	<0.5%	<0.5-1%	3-9%	6-13%	6-13%
Becharof NWR (50)	<0.5%	<0.5%	<0.5-1%	1%	1%
Trinity Islands (57)	<0.5%	<0.5%	<0.05%	<0.05%	<0.05
Kodiak NWR-south (59)	<0.5%	<0.5%	<0.05%	1%	1-2%
Kodiak NWR-west (60)	<0.5%	<0.5%	<0.5-2%	1-3%	1-3%
Afognak-west (64)	<0.5%	<0.5%	1-4%	2-6%	3-6%
Afognak-north (65)	<0.5%	<0.5%	<0.5%	<0.5-1%	<0.5-1%
Afognak-east (66)	<0.5%	<0.5%	<0.05%	<0.5-1%	<0.5-1%
Shuyak (67)	<0.5%	<0.5%	1-5%	3-7%	3-7%
Kenai Fjords-west (68)	<0.5-1%	<0.5-5%	2-8%	4-10%	4-10%
Outer Kachemak Bay/IBA (145)	<0.5-97%	11-97%	16-97%	16-97%	16-97%
LS					
Tuxedni Bay (35)	<0.5-5%	<0.5-10%	<0.5-11%	<0.5-11%	<0.5-11%
GLS					
Seldovia side Kachemak Bay (141)	<0.5-2%	<0.5-9%	3-16%	3-17%	3-17%
Barren Islands (152)	<0.5%	<0.5-1%	1-3%	2-4%	2-4%

IBA = Important Bird Area

Table 14. Range of winter conditional probabilities (expressed as percent chance) that a large oil spill, starting at any Launch Areas or Pipeline Segments (Figure 13), would contact environmental resource areas (ERAs; number in parenthesis), land segments (LS; number in parenthesis), or grouped land segments (GLS; number in parenthesis) representing important areas for sea otters and sea otter critical habitat.

Environmental Resource Area	Winter				
	1 day	3 days	10 days	30 days	110 days
ERA					
Inner Kachemak Bay (16)	<0.5-1%	<0.5-3%	<0.5-4%	<0.5-4%	<0.5-4%
Clam Gulch (45)	<0.5-31%	<0.5-33%	<0.5-34%	<0.5-34%	<0.5-34%
Outer Kachemak Bay (46)	<0.5-36%	1-42%	2-45%	2-45%	2-45%
SW Cook Inlet (47)	<0.5-54%	11-67%	13-70%	13-70%	13-70%
Kamishak Bay (48)	<0.5-27%	3-52%	18-64%	20-64%	20-64%
Katmai NP (49)	<0.5%	<0.5-1%	3-8%	4-10%	4-10%
Becharof NWR (50)	<0.5%	<0.5%	<0.5%	<0.5-1%	<0.5-1%
Trinity Islands (57)	<0.5%	<0.5%	<0.5%	<0.5-1%	<0.5-1%
Kodiak NWR-south (59)	<0.5%	<0.5%	<0.5-1%	1-2%	1-2%
Kodiak NWR-west (60)	<0.5%	<0.5%	1-3%	2-5%	2-5%
Afognak-west (64)	<0.5%	<0.5%	2-7%	3-8%	3-8%
Afognak-north (65)	<0.5%	<0.5%	<0.5%	<0.5-1%	<0.5-1%
Afognak-east (66)	<0.5%	<0.5%	<0.5%	<0.5%	<0.5%
Shuyak (67)	<0.5%	<0.5%	2-5%	2-6%	2-6%
Kenai Fjords-west (68)	<0.5-1%	<0.5-6%	1-9%	2-9%	2-9%
Outer Kachemak Bay/IBA (145)	1-97%	4-97%	5-97%	5-97%	5-97%
LS					
Tuxedni Bay (35)	<0.5-12%	<0.5-19%	<0.5-20%	<0.5-20%	<0.5-20%
GLS					
Seldovia side Kachemak Bay (141)	<0.5-2%	<0.5-8%	1-11%	1-11%	1-11%
Barren Islands (152)	<0.5%	<0.5-1%	1-4%	1-4%	1-4%

IBA = Important Bird Area

Table 15. Combined probabilities (expressed as a percent chance), over the assumed life of the Leased Area of one or more spills ≥1,000 barrels, and the estimated number of spills (mean), occurring and contacting a given environmental resource areas (ERAs; number in parenthesis), land segments (LS; number in parenthesis), or grouped land segments (GLS; number in parenthesis) representing important areas for sea otters and sea otter critical habitat. From BOEM (2016a).

Environmental Resource Area	1 day	3 days	10 days	30 days
ERA				
Inner Kachemak Bay (16)	<0.5%	<0.5%	<0.5%	1%
Clam Gulch (45)	1%	2%	3%	3%
Outer Kachemak Bay (46)	3%	4%	5%	6%
SW Cook Inlet (47)	4%	8%	11%	11%
Kamishak Bay (48)	<0.5%	2%	6%	6%
Katmai (49)	<0.5%	<0.5%	1%	2%
Becharof NWR (50)	<0.5%	<0.5%	<0.5%	<0.5%
Trinity Islands (57)	<0.5%	<0.5%	<0.5%	<0.5%
Kodiak NWR-south (59)	<0.5%	<0.5%	<0.5%	<0.5%
Kodiak NWR-west (60)	<0.5%	<0.5%	<0.5%	1%
Afognak-west (64)	<0.5%	<0.5%	1%	1%
Afognak-north (65)	<0.5%	<0.5%	<0.5%	<0.5%
Afognak-east (66)	<0.5%	<0.5%	<0.5%	<0.5%
Shuyak (67)	<0.5%	<0.5%	1%	1%
Kenai Fjords-west (68)	<0.5%	<0.5%	1%	1%
Outer Kachemak Bay/IBA (145)	7%	9%	10%	10%
LS				
Tuxedni Bay (35)	1%	2%	2%	2%
GLS				
Seldovia side Kachemak Bay (141)	<0.5%	<0.5%	1%	1%
Barren Islands (152)	<0.5%	<0.5%	<0.5%	1%

IBA = Important Bird Area

6.7.9 Summary – Large Oil Spills

We analyzed a scenario which estimated two large spills, which could occur from a platform or a pipeline, as modeled by BOEM (2016a). The analysis of two large spills allowed an estimate of effects because the chance of a spill occurring is 22 percent, which is less than that for no spills (78 percent) occurring (Table A.1-20; BOEM 2016a). Large spills from launch areas (LAs) (i.e., from platforms) generally are more likely to reach environmental resource areas (ERAs) and land segments (LSs) representing areas important to listed sea otters than from pipeline segments (PLs). The land segments with the highest chance of contact from all LAs are generally along the western shores of lower Cook Inlet in Kamishak Bay and upper Shelikof Strait (BOEM 2016a). Pipelines will almost certainly pass through eastern nearshore Cook Inlet environments, however; the potential impacts of oil spills on sea otters will mostly depend on pipeline location relative to sea otter congregations. The general conclusion for sea otters, therefore, is that large oil spills could cause adverse effects for hundreds to thousands of otters, but severe population-level impacts are not reasonably likely to occur. The general conclusion for Steller's eiders is that 20 to 100 of Steller's eiders could be adversely affected by large oil spills, but population-level effects to Alaska-breeding Steller's eiders are not anticipated.

7 CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. We do not consider future Federal actions that are unrelated to the proposed action in this section because they require separate consultation pursuant to section 7 of the Act. Within the Action Area, oil and gas development, scientific research, and community growth will likely occur. However, these activities would require Federal permits (e.g., from the BLM and USACE) and separate consultation and therefore are not considered cumulative impacts under the ESA. Therefore, in this section we analyze other non-Federal activities reasonably likely to occur in the Action Area during the same period as the Proposed Action.

7.1 Vessel Traffic

Most of the Action Area is navigable and will continue to be used by various classes of vessels, including containerships, bulk cargo freighters, tankers, commercial and sport-fishing vessels, and recreational vessels. The Port of Anchorage is the third largest port in Alaska, is designated as a U.S. Department of Defense (DOD) National Strategic Port, and provides services to approximately 75 percent of the total population of Alaska (BOEM, 2016a). Vessel traffic is likely to either remain at current levels or increase moderately in the future, as dictated by economic demands (Cape International Inc. 2012, Service 2012). Increases in vessel traffic may increase the level of disturbance and potential for collisions with Steller's eiders, although most of the vessel traffic occurs from May to September, when few Steller's eiders are present (Service 2012). Boat traffic is expected to continue as a source of disturbance to sea otter populations (Service 2013a). Sea otter habitat along the eastern side of Cook Inlet is adjacent to high levels of vessel traffic; in contrast, areas along the western shorelines and Kamishak Bay (including sea otter critical habitat) are generally exposed to lower levels of boat traffic. In addition to disturbance, vessel traffic is a source of spills that could affect sea otters and their critical habitat (Nuka Research and Planning Group, LLC, 2013).

7.2 Wastewater Discharge

Wastewater discharges and run-off in the Action Area from state regulated sources are expected to increase in the future as coastal development, marine transportation, and the human population in the Action Area increases. These increases are expected to be incremental and gradual. Because of improved feeding opportunities associated with invertebrate abundance, Steller's eiders may be preferentially attracted to eutrophied, nearshore marine waters that can also serve as reservoirs for legally or illegally discharged pollutants (Reed and Flint, 2007), containing polycyclic aromatic hydrocarbons, heavy metals, and bacteria. Steller's eiders' risk of exposure to harmful contaminants may be elevated in the presence of mixing zones within water bodies that are impaired, or have multiple, overlapping or adjacent mixing zones. A secondary impact from wastewater discharge may be incurred if an abundant concentration of sea ducks and other potential prey attracts an unnaturally high population of bald eagles, a common coastal sea duck predator. Sea otters may be impacted by wastewater discharges and terrestrial run-off. Because Sea otters feed on shellfish and other invertebrates, they can concentrate and integrate contaminants found in their prey items. Sea otters appear to be susceptible to a number of diseases and parasites that and shellfish may serve as an intermediary for some of these infections. It has been documented that coastal freshwater is a risk factor for *Toxoplasma gondii* infection in southern sea otters *Enhydra lutris nereis* (Miller et al., 2002) and that land-based surface runoff is a source of infection for marine mammals, specifically sea otters. However, it is likely that risks, and infection rates, to northern sea otters and their critical habitat in Alaska are much lower from wastewater discharges and terrestrial run-off.

7.3 Subsistence Use

Subsistence hunters in the Cook Inlet and Gulf of Alaska regions take much smaller numbers of sea ducks than do other regions and few, if any, Steller's eiders have been reported as harvested in the last approximately 20 years (Rothe et al., 2015). As such, no harvest (accidental or intentional) of individuals of the listed population of Steller's eiders is expected to occur in the Action Area in the foreseeable future. The Marine Mammal Protection Act permits Alaska Natives to harvest sea otters for subsistence purposes or for the purposes of creating authentic Native articles of handicrafts and clothing, provided this is accomplished in a non-wasteful manner. The best available scientific information does not indicate that the subsistence harvest by Alaska Natives has had a major impact on the southwest Alaska DPS of the northern sea otter (Service 2013a, 2013b). Subsistence harvest has reportedly removed fewer than 1,400 sea otters from the southwest Alaska DPS since 1989 (average = 85 per year; range = 24 to 180 per year; Service 2012).

7.4 Summary

We anticipate ongoing cumulative effects on the listed population of Steller's eiders and northern sea otters in the Action Area. Typically these cumulative effects would represent short-term disturbances of a few individuals, removal or modification of small amounts of potential habitat, increases in anthropogenic noise, potential disturbance or mortality caused by attraction to structures or vessels, and limited pollutant exposure from authorized and accidental discharges. The success of future management efforts will rely in part on continued investments in research investigating population status and trends and habitat use patterns. The effectiveness of various mitigation measures and management actions will need to be continually evaluated through monitoring programs and adaptive management. Based on the expected impacts of these cumulative effects, we do not anticipate a significant additive level of impacts to listed Steller's eiders or northern sea otters.

8 CONCLUSION

Section 7(a)(2) of the ESA requires that each "Federal agency will, in consultation with...the Secretary, insure that any action authorized, funded, or carried out by such agency...is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification" of designated critical habitat. This biological opinion evaluates the potential impacts of the proposed Action on listed species and designated critical habitat, and was conducted as an incremental step consultation. As an incremental step consultation, this biological opinion must address whether:

1. Activities within the First Incremental Step violate section 7(a)(2) of the ESA; and
2. There is a reasonable likelihood the entire Action will violate section 7(a)(2) of the ESA.

To reach conclusions, impacts of the incremental steps of the proposed Action are not considered in isolation, but are placed in the context of the current status of the species and critical habitat, the environmental baseline, and cumulative effects (as defined by the ESA).

8.1 Conclusion for the First Incremental Step

This portion of the biological opinion considers impacts to Alaska-breeding Steller's eiders, southwest Alaska DPS of northern sea otter, and designated critical habitat that may result from the First Incremental Step of the proposed Action. In evaluating the impacts of exploration and development on listed species, the Service identified a number of adverse effects that may occur. These are discussed more fully in the *Effects of the Action* and are summarized below.

8.1.1 Conclusion for Steller's Eider

Collisions - Activities taking place during the First Incremental Step may result in collisions between MODUs and vessels and Alaska-breeding Steller's eiders. Collisions between birds and human-built structures are episodic, and it is difficult to estimate collision risk for listed eiders from MODUs and vessels using the short-term datasets currently available. Based on exploratory activities in Cook Inlet, however, we estimate that up to eight Steller's eiders could be killed from collisions with MODUs and vessels associated with seismic surveys and exploratory activities in the first increment; we expect this total of eight eiders to include no more than one Alaska-breeding Steller's eider (see Appendix A for calculations). The BOEM's requirements regarding lighting protocols for vessels operating in Cook Inlet will likely reduce collision risk.

Oil Spills - Although small spills would be reasonably foreseeable in the First Incremental Step, it is unlikely that listed eiders will be significantly affected because small spills are by definition of such low volume that oil or other spilled substances would likely evaporate, weather, or be mostly recovered. Moreover, the density of listed eiders in most of the Leased Area where most small spills would occur is very low, so few, if any, are likely to encounter small spills, and disturbance from spill response activities would likely displace individuals away from spill sites before they come into contact with oil or other spilled substances. Spills of greater volume would not be likely to occur during the first increment. According to analysis by BOEM/BSEE, large and very large oil spills would be so unlikely during the First Incremental Step as to be considered not reasonably foreseeable. Thus, they are not considered to be direct or indirect effects of the first increment in our analysis and conclusions.

Conclusion – In evaluating impacts of the First Incremental Step to Steller's eiders, the Service identified potential adverse effects from collisions and from exposure to oil spills. The Service anticipates few if any listed Alaska-breeding Steller's eiders will be taken during 5 years of exploration and delineation activities. We have reached this conclusion based on the following: 1) 0.8% of all Steller's eiders occurring on the wintering grounds in Alaska are from the listed Alaska breeding population; 2) extrapolations from data collected in the Chukchi Sea suggests few eiders to be killed or injured by collisions with vessels and MODUs (see Appendix A for detailed calculations); 3) implementation of minimized lighting protocols such as the use of down-shielded lights or the avoidance of spotlights; 4) the risk of impacts of oil spills during the first increment is very low because Steller's eiders are unlikely to encounter small spills; and 5) large spills are not reasonably likely to occur during the first increment.

After reviewing the current status of the Alaska-breeding Steller's eider, the environmental baseline for the Action Area, the effects of the proposed oil and gas activities associated with Lease Sale 244 and cumulative effects, it is the Service's biological opinion that oil and gas activities associated with Lease Sale 244, as proposed, is not likely to jeopardize the continued existence of Alaska-breeding Steller's eider by reducing appreciably their likelihood of survival and recovery in the wild by reducing their reproduction, numbers, and distribution.

8.1.2 Conclusion for Southwest Alaska DPS of the Northern Sea Otter

Disturbance – Disturbance from vessel or helicopter traffic associated with First Incremental Step activities is likely, particularly if EDS drill sites are located in close proximity with critical habitat. The potential for disturbance is greatest during summer when sea otters are in open water. Helicopter traffic may also disturb listed sea otters, likely localized to jack-up rigs that may occur in close proximity to critical habitat. Disturbance from helicopters may be reduced through mitigation measures proposed by BOEM for maintaining operation at an altitude of 2,000 ft (610 m) or higher and to avoid extended flights over the coastline (BOEM 2016b). The potential for disturbance by vessel or helicopter support vessels to sea otters is unlikely, but could rarely impact a few individuals. We anticipate that most disturbances would result in only minor, temporary changes in behavior that would not rise to the level of adverse effects to the individual sea otters involved. Collisions between sea otters and vessels (both slow and fast-moving vessels) do occur but are considered infrequent Service 2012). Collisions between listed otters and vessels associated with the First Incremental Step are considered unlikely because of limited vessel traffic in the range of the listed DPS on the western side of Cook Inlet and mitigation measures proposed by BOEM.

Oil Spills – Although small spills would be reasonably likely in the First Incremental Step, it is unlikely that sea otters will be significantly affected because small spills are by definition of such low volume that oil or other spilled substances would likely evaporate, weather, or be mostly recovered. We expect the likelihood of sea otters encountering oil from a small spill in the marine environment would be very low. Small offshore spills would be expected to be contained or weather quickly (within a few hours to a few days). Although disturbance of sea otters could occur during cleanup efforts for small spills, this level of disturbance is expected to be minor and temporary. Furthermore, disturbance from cleanup activities is likely to be infrequent and limited to a small geographic area, and would therefore impact very few individual sea otters.

Conclusion - Activities that may result from the First Incremental Step that could affect sea otters include disturbance (i.e., vessel, helicopter support, and collisions) and exposure to oil spills. We expect effects caused by the First Incremental Step to be generally limited to the individual level and not the population level. We have reached this conclusion based on the following: 1) disturbance from vessels and helicopters would be unlikely to result in the death of a sea otter; 2) collisions would be unlikely because of limited vessel activity in areas of critical sea otter habitat overlap; 3) implementation of ship-based mitigation measures, including protected species monitoring, establishing and monitoring safety and disturbance zones, speed and course alterations, ramp-up (or soft start), power-down and shutdown procedures, and provisions for poor visibility conditions, would avoid or minimize vessel-caused impacts; 4) small spills would be expected to affect few, if any, individuals due to small volumes, weathering, and spill prevention and response measures,; and 5) large or very large oil spills would be unlikely to occur. After reviewing the current status of the southwest Alaska DPS of northern sea otter, the environmental baseline for the Action Area, the effects of the proposed oil and gas activities associated with Lease Sale 244 and cumulative effects, it is the Service’s biological opinion that the oil and gas activities associated with Lease Sale 244, as proposed, is not likely to jeopardize the continued existence of the southwest Alaska DPS of the northern sea otter by reducing appreciably their likelihood of survival and recovery in the wild by reducing their reproduction, numbers, and distribution.

8.1.3 Conclusion for northern sea otter critical habitat

Disturbance - Impacts to the KKAPMU from activities authorized in the First Incremental Step of the proposed Action are anticipated to have at most only minor, short-term impacts to the PCEs, and therefore are not likely to diminish the function and conservation value of the critical habitat unit for northern sea otters. In addition, due to minimization measure designed to avoid disturbance within the critical habitat (e.g., prohibiting lessees from conducting seafloor disturbance within 3,280 ft (1,000 m) of areas designated as critical habitat), human presence and disturbance is not expected to prevent northern sea otters from accessing or utilizing critical habitat or associated PCEs.

Oil spills - Although small spills would be reasonably likely in the First Incremental Step, they are by definition so limited in size that oil or other spilled substances would likely evaporate, weather, or be mostly recovered. By virtue of their size, they are also likely to cover a limited areal extent, and are unlikely to persist long enough to reach the KKAPMU if spilled elsewhere. Moreover, given the limited volumes of small spills, effects on the biological and physical features of the critical habitat would be short term and localized, and therefore would not diminish the function and conservation value of the KKAPMU for northern sea otters.

Spills of greater volume would not be likely to occur during the first increment. According to analysis by BOEM/BSEE, large and very large oil spills would be so unlikely during the First Incremental Step as to be considered not reasonably foreseeable. Thus, they are not considered to be direct or indirect effects of the first increment within the meaning of the ESA.

Activities that may result from the First Incremental Step that could affect critical habitat of southwest Alaska DPS northern sea otter include disturbance and exposure to oil spills. These effects would be expected to have at most only minor, short-term impacts to the PCEs and disturbance is not expected to prevent northern sea otters from accessing or utilizing the KKAPMU or associated PCEs. We have reached this conclusion based on the following: 1) BOEM modeling predicts low numbers and low volumes of small oil spills; 2) BOEM will prohibit lessees from discharging drilling fluids and cuttings and conducting seafloor disturbance including anchoring and placement of bottom founded structures, within 3,280 ft (1,000 m) of areas designated as critical habitat; 3) BOEM will require lessees to implement spill prevention and response measures, which will ensure spill out would be expected to be completely recovered or dissipated quickly; and 4) BOEM modeling predicts a large oil spill is unlikely to occur during the First Incremental Step.

After reviewing the current status of the critical habitat of southwest Alaska DPS northern sea otter, the environmental baseline of critical habitat for the action area, the effects of the proposed oil and gas activities associated with Lease Sale 244 on critical habitat, and the cumulative effects, it is the Service's biological opinion that oil and gas activities associated with Lease Sale 244, as proposed, is not likely to result in the destruction or adverse modification of critical habitat of the northern sea otter habitat such that it fails to retain the intended function and conservation role for which it was designated.

8.2 Conclusion for the Entire Proposed Action

In addition to considering the effects of activities proposed in the First Incremental Step, we analyzed effects of the entire proposed Action, including the actions that would occur during the Future Incremental Steps (such as platform and on- and offshore oil and gas pipelines installation, production and service well drilling, oil and gas production, and decommissioning) to determine if there is a reasonable likelihood that the entire proposed Action would violate section 7(a)(2) of the ESA. We first discuss some of the relevant uncertainties, followed by a discussion of the legal framework within which our conclusion must be made, and then provide our conclusions.

8.2.1 Key Uncertainties

Evaluating the potential effects of the proposed Action, which entails oil and gas activities projected to take place over 40 years, is complicated by uncertainty in several respects. First, there is uncertainty inherent in the proposed action provided by BOEM/BSEE that formed the basis for impact evaluation. For example, the EDS provided is an updated and detailed hypothetical scenario based upon the best available information. It projects reasonably foreseeable activities and locations, and thereby provides a reasonable and suitable basis for impact evaluation. Nonetheless, actual development proposals and the ensuing projects are likely to differ, possibly substantially, from this EDS, and potential impacts would thereby vary correspondingly. Second, probably the most important factor in determining ultimate impacts to listed species and designated critical habitat will be the number, volume, timing, and location of possible oil spills. The DEIS (BOEM 2016a) and BA (BOEM 2016b) estimate the number and volume of spills that may take place, based on mean spill rates and sophisticated spill trajectory models that evaluate the chances that spilled oil will contact important resource areas. Nonetheless, actual events would be unlikely to exactly match estimates and projections provided. Elaboration on some of these important uncertainties follows.

The scale of future development – BOEM and BSEE have provided a EDS for the leased area that projects one large prospect containing potential oil and condensate resources of 215 million barrels, developed from one oil field entailing 3 24-slot offshore platforms and 66 total production and service wells, with subsea pipelines transporting product to a shorebase at an unknown location (likely between Nikiski and Homer). The actual scale of development could vary from this projection, likely considerably, based on future resource estimates, market forces, changes in societal environmental risk tolerance, advances in technology, and other factors.

The number of large marine oil spills – The greatest identified population-level risk to listed species and designated critical habitat from development and production is from a large marine oil spill. BOEM (2016a) stated that large (greater than 1,000 bbl) spills could originate from three sources: wells, production platforms, and production pipelines. Based on information on spill occurrence in the OCS to date, BOEM (2016a) estimates 0.19 pipeline spills and 0.05 platform (and well) spills would occur over the life of the Leased Area, for an estimated total of 0.24 large spills. Using the median volume of spills occurring on the OCS to date, BOEM (2016a) estimated spill sizes of 1,700 bbl and 5,100 bbl for pipeline and platform spills, respectively. While providing a reasonable basis for environmental impact assessment, it must be appreciated that actual events resulting from Lease Sale 244 are extremely unlikely to perfectly match these estimates that were necessarily calculated well in advance of any development that may occur.

Effectiveness of oil spill response and cleanup efforts – In the event that an oil spill occurs, a response effort would be implemented and cleanup efforts would begin. Because there have been no large marine oil spills in Cook Inlet, the effectiveness of response efforts there is unknown. However, efficacy would likely be affected by timing (i.e., presence of ice, broken ice, or open water), location (i.e., proximity to infrastructure, spill response equipment, and ease of logistics), weather and current conditions, and volume of oil spilled. Given these variables, it is impossible to reliably predict the benefit to listed species or critical habitat that spill response efforts would provide.

Whether a spill would encounter listed species or designated critical habitat – In the event that oil is spilled in the marine environment, a number of factors would influence the extent to which listed species or designated critical habitat would be affected. First, effects would depend in part on the amount of oil spilled, which would be influenced by the technology used to transport oil, the length of pipelines, and numerous other factors. Further, the location of a spill would have great bearing on the likelihood that listed species would be exposed. For example, the probability of spills reaching important habitats for the southwest Alaska DPS northern sea otters such as Kamishak Bay varies considerably depending on spill location and source. Finally, the seasonal timing of spills would influence the occurrence and location of listed species in the region, affecting the chances of contact, and the likelihood that oil would cause lasting impacts to the primary constituent elements of critical habitat

8.3 Conclusion – Entire Action

8.3.1 Steller's Eider

Collisions and small spills – We conclude that collisions with structures (in marine and terrestrial environments) and small oil spills may adversely affect Steller's eiders at the individual level. In all cases, however, we also conclude that these potential effects would be unlikely to cause population-level impacts based on the best information available at this time.

Habitat loss and disturbance or displacement – The impact of potential habitat loss and disturbance/displacement to Steller's eiders will be proportional to the spatial overlap between significant oil and gas infrastructure and eider concentration areas. Alaska-breeding Steller's eiders occur at low or very low density throughout the majority of the action area. To have population-level impacts, there would need to be substantial development or repeated disturbance in areas where Alaska-breeding Steller's eiders concentrate, which given the probability of occurrence, (we assume that 0.8 percent of all Steller's eiders occurring on the molting and wintering grounds in Alaska are from the listed Alaska-breeding population), is unlikely.

We expect that repetitive disturbance of birds is unlikely in the Action Area because disturbance can be avoided by routing vessels and aircraft around identified concentrations of Steller's eiders. Vessels transit may cause short-term minor disturbance but the effects are likely to be limited to the brief duration of the vessel's transit and by the small number of vessels expected to transit the area (Tables 2 and 4). Pipelines connecting offshore platforms with the shoreline are likely, but considering the proportion of the benthos area subject to habitat alteration or construction-related disturbance would likely be limited. Further, the benthic community and its use by Steller's eiders is expected to recover quickly to such disturbance.

Oil spills – For the purposes of analysis under the EDS, BOEM and BSEE estimate that approximately 460 small spills (less than 1,000 bbl) would occur over the life of the scenario (10 during the First Incremental Step and 450 during future incremental steps). We expect small spills would be contained or evaporate and dissipate quickly, and travel limited distances, reducing the likelihood of contacting Steller's eiders. We conclude that small spills would be reasonably likely events, but based on their limited size and other ameliorating factors, would have minimal effects to listed eiders.

In addition to small spills, development activities carry the additional risk of large (greater than 1,000 bbl) spills and very large (greater than 150,000 bbl) spills. We refer to the reader to the DEIS (BOEM 2016a), BA (BOEM 2016b), and *Effects of the Action* for more detail, however particularly salient points derived from our understanding of species distribution and the analyses of oil spill risk provided by BOEM and BSEE include:

1. Alaska-breeding Steller's eiders generally occur at low or very low densities in the marine environment within the Action Area, with the exception of the west coast of Cook Inlet between Tuxedni Bay and Kamishak Bay, and the east coast of Cook Inlet between Clam Gulch and Kachemak Bay. Therefore, for large numbers of individuals to come in contact with oil, a large volume of oil would need to be spilled such that it affected a significant proportion of the Action Area.

2. During the winter, Steller's eiders are present in large numbers in select near-shore waters in Cook Inlet. Oil reaching these areas during high use periods has the potential to contact and kill a significant number of Steller's eiders. We anticipate the potential for population-level impacts from spill-caused mortality for Alaska-breeding Steller's eiders. However, we expect this to be unlikely because Alaska-breeding Steller's eiders are less abundant, and the level of mortality is likely to be limited to tens of individuals.

3. BOEM estimates 0.19 pipeline spills and 0.05 platform (and well) spills would occur over the life of the Leased Area, for an estimated total of 0.24 large spills, based on information on spill occurrence in the OCS to date and the EDS for this lease sale. Using these mean spill numbers, the chance of one or more large pipeline spills occurring is 17 percent. The chance of one or more large platform (wells and platform) spills is 5 percent. Using the total mean spill number, the chance of one or more large spills is 22 percent for future incremental steps (BOEM 2016a).

Based on these conclusions, population-level impacts from oil spills, although possible, are not reasonably likely to occur. For population-level impacts to occur, all of the following would have to take place: 1) one or more large oil spills would have to occur (the estimated likelihood of one or more large spills is 22 percent); 2) spilled oil would have to reach an area used by large congregations of Steller's eiders (e.g., Kamishak Bay; Figure 5), although these areas comprise only a small subset of the Action Area; 3) the spill would have to reach these areas when concentrations of spectacled or Steller's eiders are present, or persist until they return; and 4) the oil would have to actually contact a significant proportion of the Alaska-breeding population. While one or more of these events could occur, we conclude that it is not reasonably likely that all of these events would occur, based on the best information currently available. Furthermore, BOEM and BSEE will require avoidance and minimization measures, including a spill response plan, to further reduce the likelihood of a large spill contacting sensitive resources.

Therefore, the Service concludes the effects of all incremental steps, in light of the uncertainty regarding the scale of potential development and oil spills, and in the context of the status of the species, environmental baseline, and cumulative effects, are not reasonably likely to jeopardize the continued existence of Alaska-breeding Steller's eiders by reducing appreciably the likelihood of survival and recovery of these species in the wild by reducing their reproduction, numbers, and distribution.

8.3.2 Southwest Alaska DPS of the Northern Sea Otter

Collisions and small spills – We conclude that vessel collisions and small oil spills may adversely affect sea otters at the individual level. In all cases, however, we also conclude that these potential effects would be very unlikely to cause population-level impacts based on the best information available at this time.

Disturbance or displacement – The impact of potential disturbance/displacement to sea otters will be proportional to the spatial overlap between significant oil and gas infrastructure and sea otter concentration and critical habitat areas. To have population-level impacts, there would need to be substantial development or repeated disturbance in areas where sea otters concentrate.

We expect that repetitive disturbance of sea otters is unlikely in the Action Area because disturbance can be avoided by routing vessels and aircraft around identified concentrations of sea otters. Vessels transit may cause short-term minor disturbance but the effects are likely to be limited to the brief duration of the vessel's transit and by the small number of vessels expected to transit the area (Tables 2 and 4). Pipelines connecting offshore platforms with the shoreline are likely, but considering pipeline landfall is expected to occur along the eastern Cook Inlet shoreline (likely between Nikiski and Homer) where no sea otter critical habitat occurs, the proportion of the benthos area subject to habitat alteration or construction-related disturbance would likely be limited. The occurrence of sea otters along the eastern shoreline in areas where pipeline landfalls are anticipated (likely between Nikiski and Homer) are not areas typically associated with high sea otter densities. Further, the benthic community and its use by sea otters would be expected to recover quickly.

Oil spills – For the purposes of analysis under the EDS, BOEM and BSEE estimate that approximately 460 small spills (less than 1,000 bbl) would occur over the life of the scenario (10 during the First Incremental Step and 450 during future incremental steps). We expect small spills would be contained or evaporate and dissipate quickly, and travel limited distances, reducing the likelihood of contacting northern sea otters. We conclude that small spills would be reasonably likely events, but based on their limited size and other ameliorating factors, would have minimal effects to listed sea otters.

In addition to small spills, development activities carry the additional risk of large (greater than 1,000 bbl) spills and very large (greater than 150,000 bbl) spills. We refer to the reader to the DEIS (BOEM 2016a), BA (BOEM 2016b), and *Effects of the Action* section above for more detail, however particularly salient points derived from our understanding of species distribution and the analyses of oil spill risk provided by BOEM and BSEE include:

1. The KKAPMU is one of five southwest Alaska DPS of northern sea otter management units that supports Northern sea otters year-round. Additionally, the KKAPMU contains the entirety of the Action Area. The most recent available information suggests the KKAPMU may support almost half the population of southwest Alaska DPS sea otter (Service 2014a), with population levels being stable or increasing (Coletti et al. 2009, Estes et al. 2010). Furthermore, the KKAPMU includes high population density regions including the Kodiak Archipelago (Service, unpublished data), Katmai NP, and Kashimak Bay (Bodkin et al. 2003). Adjusted sea otter population estimates for Kamishak Bay (6,918 individuals) and Katmai (7,095 individuals) survey areas each represents approximately 28 percent of the population within the KKAPMU, and 13

percent of the total population of southwest Alaska DPS of northern sea otter (Service 2014a).

2. The BOEM estimates 0.19 pipeline spills and 0.05 platform (and well) spills would occur over the life of the Leased Area, for an estimated total of 0.24 large spills, based on information on spill occurrence in the OCS to date and the EDS for this lease sale. Using these mean spill numbers, the chance of one or more large pipeline spills occurring is 17 percent. The chance of one or more large platform (wells and platform) spills is 5 percent. Using the total mean spill number, the chance of one or more large spills is 22 percent for future incremental steps (BOEM 2016a).
3. The BOEM modeled spills originating from hypothetical launch points distributed throughout the Leased Area and along hypothetical pipeline routes to shore to evaluate the likelihood of spilled oil reaching specific areas of interest, assuming that a large spill occurs. According to the OSRA model from BOEM, depending upon the geographic origin of the spill, the conditional probability of a large oil spill contacting areas within the Kodiak Archipelago (including ERAs 59, 60, 64, 65, 66, and 67) within 110 days range from less than 0.5 percent to 8 percent (for both winter and summer); Kamishak Bay (ERA 48) within 110 days ranges from 19 percent to 56 percent for summer or 20 to 64 percent for winter. For Katmai NP (ERA 49), the conditional probability of contact within 110 days ranges from 6 percent to13 percent in summer and 4 percent to 10 percent in winter.

The Recovery Plan for the Alaska DPS of northern sea otter concludes that due to the large spatial extent of the DPS, even a large spill from a crude oil tanker would be unlikely to affect a substantial proportion of the overall sea otter population (Service 2013a). Using this same rationale, we expect that impacts from oil spills caused by the Proposed Action are unlikely to result in population-level effects.

Therefore, the Service concludes the effects of all incremental steps, considered in the context of the status of the species, environmental baseline, and cumulative effects, are not reasonably likely to jeopardize the continued existence of Alaska DPS of northern sea otter by reducing appreciably the likelihood of survival and recovery of these species in the wild by reducing their reproduction, numbers, and distribution.

8.3.3 Sea Otter Critical Habitat

The direct loss of habitat caused by placing infrastructure in areas of sea otter critical habitat would be limited to a very small portion of the designated critical habitat. Burying one or more pipelines through critical habitat would disturb the benthos and the PCE of the marine benthic community, but would affect only a very small proportion of critical habitat, and would likely pose a short-term effect, as the benthos would likely recolonize the area. Drilling muds and cuttings from exploration or production facilities on leases outside of critical habitat would leave footprints around well sites and would impact the surrounding benthos. These discharges could result in drifting sediments that affect the flora and fauna in the water column and underlying benthic community through toxicity or organic enrichment. While development, production, and other activities may adversely affect critical habitat, effects on the PCEs would be localized and would not diminish the function and conservation value of the critical habitat for the Alaska DPS of northern sea otter.

Oil spills –Small spills are by definition of low volume and would be largely recoverable; such spills would therefore have a limited dispersal distance. Small spills would also have to occur directly adjacent to or within critical habitat for effects to occur, and expect few activities would be likely to occur there. Additionally, effects of such contamination would be minimized through oil evaporation, weathering, and recovery efforts. While it is possible that small spills may occur in areas adjacent to designated sea otter critical habitat, their effects on the PCEs would be short-term and localized and would not diminish the function and conservation value of the critical habitat for sea otters.

Large oil spills during future incremental steps could originate from platforms (and wells) and pipelines or from a loss of control incident followed by a long-duration flow. According to the OSRA model used by BOEM and BSEE, depending upon the geographic origin of the spill, the chance of a large oil spill contacting sea otter critical habitat within 110 days, ranges from less than 0.5 percent to 70 percent. Thus, assuming that a spill occurs, there would be an appreciable chance that oil would reach sea otter critical habitat. Combining the probability of one or more large spills occurring over the assumed life of the Leased Area, with that of oil from a large spill reaching sea otter critical habitat within 30 days, BOEM and BSEE estimate a range of less than 0.5 percent to 11 percent chance that one or more large spills will occur and contact sea otter critical habitat. BOEM AND BSEE conclude that a large spill could cause physical effects, which could likely alter the quality of the essential features of sea otter critical habitat PCEs, or render the function of the critical habitat temporarily unsuitable.

Although the effects of a large spill could reduce the conservation value of the critical habitat unit for an unknown length of time, we expect the likelihood of this occurring to be low. For this level of impact to occur, all of the following would have to take place: 1) one or more large oil spill occurs; 2) the oil would have to contact and compromise a large portion of sea otter critical habitat and/or associated prey species, and; 3) no clean-up efforts would occur (the OSRA trajectory model is based on the movement of unweathered oil with no mitigation from oil spill response activities. Further, should these events occur, the actual effects to sea otter critical habitat and its ability to support sea otters would depend on a variety of factors, including the amount of oil to reach sea otter critical habitat and efficacy of clean-up efforts. Based on this low likelihood of these factors all occurring, we do not expect the Proposed Action to result in a significant reduction in function of critical habitat for the norther sea otter.

The Service concludes the effects of all incremental steps, considered together with uncertainty regarding the scale of potential development and oil spills, and in the context of the status of the critical habitat, environmental baseline, and cumulative effects, are not reasonably likely to destroy or adversely modify sea otter critical habitat, and the critical habitat would retain the intended function and conservation role for which it was designated.

8.4 Future Consultation

Consultation prior to future incremental steps in this phased oil and gas process is required to fully evaluate actions beyond exploration and delineation of the oil field. As stated previously, considerable uncertainty regarding specific future activities exists. Therefore, when future incremental steps are proposed with specific information about the nature and extent of proposed activities, including the scale and location of activities and description of specific technology to be employed to reduce oil spill risk, more precise estimation of the actual risk of impacts to listed species and critical habitat will be possible. As a result, formal section 7 consultation to evaluate specific proposals in future incremental steps will be crucial.

8.5 Avoiding Jeopardy and Destruction/Adverse Modification in Future Incremental Steps

Under the incremental step consultation approach, BOEM and BSEE have continuing obligations to:

1. Avoid irreversible or irretrievable commitment of resources that would prevent implementation of reasonable and prudent alternatives to the Action at a later date; and
2. Obtain sufficient data upon which to base the final BO(s) for future incremental steps.

It is incumbent upon BOEM and BSEE and lessees proposing to develop oil and gas resources associated with Lease Sale 244 to design future proposed production projects that are not likely to result in jeopardy or destruction or adverse modification of critical habitat. Therefore, BOEM/BSEE and the oil and gas industry must remain fully aware of the need to consult on other future increments, and the requirement for additional jeopardy or destruction/adverse modification analysis by the Service for all future incremental steps. Further, BOEM/BSEE and the oil and gas industry should recognize their obligations to incorporate effective avoidance, minimization, and mitigation measures into their future proposed actions to reduce take and avoid jeopardy or destruction or adverse modification of critical habitat from development/production and the impacts of potential oil spills.

9 Incidental Take Statement

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

In June 2015, the Service finalized new regulations implementing the incidental take provisions of section 7(a)(2) of the Act. The new regulations also clarify the standard regarding when the Service formulates an Incidental Take Statement [50 CFR 402.14(g)(7)], from "…if such take may occur" to "…if such take is reasonably certain to occur." This is not a new standard, but merely a clarification and codification of the applicable standard that the Service has been using and is consistent with case law. The standard does not require a guarantee that take will result; only that the Service establishes a rational basis for a finding of take. The Service continues to rely on the best available scientific and commercial data, as well as professional judgment, in reaching these determinations and resolving uncertainties or information gaps.

This Incidental Take Statement is limited to take caused by the First Incremental Step. Take caused by Future Incremental Steps will be analyzed and included in an Incidental Take Statement in a future formal consultation. This Incidental Take Statement is further limited to otherwise lawful activities; therefore, take caused by a large oil spill, which is not a lawful activity, is not included here, and is not exempted from section 9 of the ESA.

9.1 Steller's Eiders

We anticipate that some Alaska-breeding Steller's eider could be taken as a result of the proposed action. We expect the incidental take to be in the form of disturbance, injury, or mortality**.** This Incidental Take Statement provides exemption for incidental take only for offshore activities in the First Incremental Step of the Action. The BOEM and BSEE must continue consultation for future incremental steps, and should reinitiate consultation in the event that thresholds for reinitiation (as described in *Reinitiation Notice* below) are exceeded. Incidental take exemptions for future incremental steps and for actions for which consultation is reinitiated may be provided when the proposed projects are evaluated. As described in the *Effects of the Action*, activities during the First Incremental Step may adversely affect Alaska-breeding Steller's eiders through collisions with structures.

9.1.1 Collisions

During exploratory operations, equipment and vessels would be present in the marine environment posing a collision risk for listed eiders. Collision risk is a function of proximity of structures to habitats used by these species, including migratory routes. Estimating the number of collisions is complicated by: 1) a lack of information on listed eider migration routes, behavior, and vulnerability to collisions with these types of structures; 2) uncertainty over locations of activities in the Action Area; and 3) the extent to which lease stipulations/permit requirements governing lighting and operations will reduce collision risk.

Because Alaska-breeding Steller's eiders are believed to winter in Cook Inlet, to the south of their North Slope nesting range, in the absence of information about vessel location, the Service assumes the entire North Slope population of Alaska-breeding Steller's eider over-wintering within Cook Inlet could conceivably pass by exploratory drill sites in Cook Inlet during spring migration and therefore would potentially be at risk of colliding with structures.

Using methods explained in detail in Appendix A, we estimate and provide lethal incidental take exemption for up to, but not more than eight (8), Steller's eider from collisions with MODUs and support vessels during exploration and delineation of the oil field in the First Incremental Step.

9.2 Alaska DPS Northern Sea Otter

Sea otters move over time and their site selection can vary considerably over the course of a year; for example, during summer sea otters are more likely to be found in open waters whereas during winter, sea otters prefer protected bays and inshore waters. Concentrations of sea otters within these areas may make a greater number susceptible to effects of the Action. While in open water, sea otters may occur as individuals, as mother and a pup, or are also known to spend time in high density rafts or groups of typically up to 20, and rarely up to 300-500, animals in the Cook Inlet area (BOEM 2016a). The protective measures proposed by BOEM/BSEE are likely to prevent mortality or injury of most individuals.

However, exploratory operations, equipment and vessels would be present in the marine environment posing a disturbance risk for sea otters. Disturbance risk is a function of proximity of vessels and structures to habitats used by these species, including proximity to critical habitat or habitats occupied by sea otters. Estimating the number of collisions or disturbances is complicated by: 1) behavior, and vulnerability to collisions with EDS vessels; 2) uncertainty over locations of activities in the Action Area; and 3) the extent to which lease stipulations/permit requirements and operations will reduce collision risk.

Consequently, we are unable to reasonably anticipate the actual number of southwest Alaska DPS northern sea otter that would be taken by the proposed project; however, we must provide a level at which formal consultation would have to be reinitiated. The Environmental Baseline and Effects Analysis sections of this biological opinion indicate that adverse effects to southwest Alaska DPS northern sea otter would likely be low given the nature of the proposed activities, and we, therefore, anticipate that take of southwest Alaska DPS northern sea otter would also be low. We also recognize that for every southwest Alaska DPS northern sea otter found dead or injured, other individuals may be killed or injured that are not detected, so when we determine an appropriate take level we are anticipating that the actual take would be higher and we set the number below that level.

Based on the expected annual effects, we anticipate that in most years up to one raft of sea otters may be affected by project activities. However, sea otter distribution can vary significantly from year to year, so in some years we may observe higher levels of impacts and in some years lower levels of impact. Thus, while we expect an average of one raft of otters to be affected annually during the First Incremental Step, we also expect variability such that in any given year the observed effects could range from zero to several rafts.

We anticipate that all individuals occurring in a raft would be subject to take in the form of disturbance or harassment. The typical sea otter raft size is 20 animals; therefore we expect that up to 20 animals would be non-lethally harassed (disturbed) annually. Of these 20 individuals, we expect that a small percentage might suffer injury or death. Although we cannot predict a precise proportion of individuals that might suffer injury or death, we expect this total to be limited to one or two individuals per year. Because sea otter distribution can vary significantly from year to year, sit is difficult to provide a precise projection for annual and total take of northern sea otters. Nonetheless, we must set a threshold for the level of take that is expected based on the proposed activities. Therefore, BOEM/BSEE must contact our office immediately to reinitiate formal consultation if more than five (5) adult, subadult, or juvenile southwest Alaska DPS northern sea otter are found dead or injured during any single year or if cumulatively more than ten (10) adult, subadult, or juvenile southwest Alaska DPS northern sea otter are found dead or injured during the entire period of the First Incremental Step. Project activities that are likely to cause additional take should cease during this review period because the exemption provided under section 7(o)(2) would lapse and any additional take would not be exempt from the section 9 prohibitions.

This biological opinion and associated Incidental Take Statement are only valid when paired with an accompanying Letter of Authorization to allow harassment of marine mammals pursuant to the Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 et seq).

10 REASONABLE AND PRUDENT MEASURES

The measures described below are non-discretionary, and must be undertaken by BOEM and BSEE or made binding conditions of any grant or permit issued to the (applicant), as appropriate, for the exemption in section 7(o)(2) to apply. BOEM and BSEE have a continuing duty to regulate the activity covered by this incidental take statement. If BOEM and BSEE: (1) fail to assume and implement the terms and conditions or (2) fail to require the lessee to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. To monitor the impact of incidental take, BOEM or BSEE must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

These Reasonable and Prudent Measures (RPMs) and their implementing Terms and Conditions (T&Cs) aim to minimize the incidental take anticipated for the First Incremental Step (marine deep-penetration surveys, high-resolution activities, and exploratory and delineation drilling) of the proposed Action. Additional RPMs will be developed and implemented during consultation on future incremental steps in this project.

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize the impacts of the incidental take of Alaska-breeding Steller's eiders and Alaska DPS of northern sea otter:

RPM 1 – BOEM and BSEE must ensure that the amount and form of incidental take of Steller's eiders is commensurate with the analysis contained within this biological opinion by coordinating with the Service to develop and implement strategies to avoid and minimize bird collisions.

RPM 2 – BOEM and BSEE must monitor and report oil spills to the Service to improve understanding of risk and impacts.

RPM 3 – BOEM and BSEE must ensure that the amount and form of incidental take of the southwest Alaska DPS of northern sea otters is commensurate with the analysis contained within this biological opinion by coordinating with the Service to develop and implement strategies to avoid and minimize harassment and disturbance to sea otters.

11 TERMS AND CONDITIONS

To be exempt from the prohibitions of section 9 of the ESA, BOEM and BSEE must comply with the following terms and conditions (T&C), which implement the reasonable and prudent measures described above and outline reporting and monitoring requirements. These terms and conditions are non-discretionary.

T&C 1 – The following T&Cs implement RPM 1:

1.1 BOEM and BSEE must require lessees and their contractors to implement lighting protocols on MODUs aimed at minimizing outward radiation of light. 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 structures while operating on a lease or if staged within nearshore Federal waters pending lease deployment. Lessees must provide BOEM with a written statement of measures that will be or have been taken to meet the lighting objective, and must submit this information with an exploration plan when it is submitted for regulatory review and approval pursuant to 30 CFR 550.203.

1.2 BOEM and BSEE must require their lessees, permittees, and agents of their lessees and permittees to minimize the use of high-intensity work lights on vessels, especially inside the 66 ft (20 m) bathymetric contour. Exterior lights will only be used as necessary to illuminate active, on-deck work areas during periods of darkness or inclement weather; otherwise they will be turned off. Interior and navigation lights should remain on as needed for safety.

1.3 BOEM and BSEE must require their lessees, permittees, and agents of their lessees and permittees, to report avian encounters with vessels or drilling structures within 3 days to BSEE who will then provide these avian encounter reports to the Ecological Services Branch Chief, Service, Anchorage Fish and Wildlife Conservation Office (AFWCO) within 7 days. Minimum information for encounter reporting will include species, date/time, location, weather, identification of the vessel or drilling structure involved and its operational status when the encounter occurred, and one or more photographs (or a statement explaining why obtaining a photograph of any particular bird was not possible). The AFWCO should be contacted regarding the recovery or transport of dead birds.

T&C 2 – The following T&Cs implement RPM 2:

2.1 BSEE must report oil spills greater than 1 bbl, as defined by 30 CFR 254.46, if the spill contacted water or ice, to the Ecological Services Branch Chief, Service, AFWCO, within 7 days. A follow-up report by BSEE is required within 30 days after the first report if the oil contacted any birds in the area, including information on number and species of birds contacted their behavioral response and fate, and other circumstances relevant to the impact of contact.

2.2 BOEM and BSEE must require their lessees to develop an oil and gas spill response plan and have it approved by BOEM, BSEE, and the Service. Spill response plans should be submitted to the Service for review and approval at least 30 days prior to the start of work.

T&C 3 – The following T&Cs implement RPM 3:

3.1 BOEM and BSEE must require their lessees, permittees, and agents of their lessees and permittees, to report sea otter collisions with vessels within 3 days to BSEE who will then provide these sea otter encounter reports to the Ecological Services Branch Chief, Service, AFWCO, within 7 days. Minimum information for sea otter encounter reporting will include species, date/time, location, weather, identification of the vessel or drilling structure involved and its operational status when the encounter occurred, and one or more photographs (or a statement explaining why obtaining a photograph of any particular sea otter was not possible). The AFWCO should be contacted regarding the recovery or transport of dead northern sea otters.

3.2 BOEM and BSEE must require their lessees, permittees, and agents of their lessees and permittees to apply the appropriate disturbance radii in order to establish those noise thresholds that prevent exposure to noise exceeding harassment and injury to prevent take (Service 2012, 81 FR 28891 May 13, 2016; see also Quintillion IHA in 81 FR 40902 June 23, 2016).

3.3 BOEM and BSEE must require that any biological observers used for protected species monitoring will submit their qualifications (resume, certificates of training, etc.), documenting his or her qualifications to the Service for approval prior to serving as observer. Such requests must be submitting in writing at least 30 days prior to the commencement of any activities requiring a monitor.

12 REPORTING REQUIREMENTS

Pursuant to 50 CFR 402.14(i)(3), BOEM and BSEE must report the progress of the action and its impact on the species to the Service as specified in this incidental take statement. BOEM and BSEE must ensure submittal of the following reports:

Notable Events Reporting. BOEM/BSEE must submit an informal written report within 24 hours, such as electronic mail, for any notable event including injury or mortality of a listed species, biologically important observations associated with a listed species, implementation of any of the Conservation Recommendations listed below, etc. Electronic mail reports can be submitted to Mr. Kevin Foley at kevin_foley@fws.gov and to the AFWCO general delivery mailbox at ak_fisheries@fws.gov. Please include the consultation number (2016-F-0226) in the subject line of the correspondence. Notable Events include such events including, but not limited to:

- Any injury or mortality to a listed species
- Observation of large rafts of Steller's eiders or northern sea otters in close proximity (as per T&C 3.2) to EDS activities.
- Occurrence of any spill of a size greater than 50 barrels

Annual Reporting. The BOEM, Alaska OCS Region, must submit an Annual Monitoring Report for each year, by March 1st of the following year, to the Ecological Services Branch Chief, the Service, AFWCO, and the Regional Supervisor – Environment, BSEE, Alaska OCS Region. The purpose of this report is to monitor the effectiveness of RPMs/T&Cs and effects of the First Incremental Step on listed species and critical habitat. The Annual Monitoring Report will include the following information on incidents observed:

- A summary of avian collisions reported during the previous calendar year;
- A summary of all reported discharges, leaks and spills greater than or equal to 1 barrel for the preceding calendar year;
- A summary of support vessels and aircraft entries into the Action Area;
- A summary of any incidences of non-compliance issued to the lessees and permittees of BOEM or BSEE and the agents of their lessees and permittees for activities conducted in the preceding year. If new incidents of non-compliance from previous years emerge, report these incidents in the next annual report; and
- A summary of efforts by BOEM and BSEE to implement Conservation Recommendations (see below).

The annual report should also include summaries of operational activities, as proposed and specified by BOEM and BSEE (BOEM 2016b):

- Summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through study period versus operational state, sea state, and other factors affecting visibility and detectability of marine mammals);
- Summaries of the occurrence of power-downs, shutdowns, ramp-ups, and ramp-up delays;
- Analyses of the effects of various factors, influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare);
- Species composition, occurrence, and distribution of marine mammals, including date, water depth, mammal numbers, age/size/gender categories (if determinable), group sizes, and ice cover;
- Sighting rates of marine mammals versus operational state (and other variables that could affect detectability), including:
    - Initial sighting distances versus operational state;
    - Closest point of approach versus operational state;
    - Observed behaviors and types of movements versus operational state;
    - Numbers of sightings/individuals seen versus operational state; and
    - Distribution around the acoustic source vessel versus operational state;
- Estimates of take by harassment.

13 DISPOSITION OF DEAD OR INJURED SPECIMENS

Pursuant to 50 CFR 402.14(i)(1)(v), upon locating a dead or injured Steller's eider or sea otter, initial notification within 3 working days of its finding must be made by telephone and in writing to the AFWCO (907-271-2888). The report must include the date, time, location of the carcass, a photograph, cause of death or injury, if known, and any other pertinent information.

The BOEM and BSEE, or the lessee must take care in handling injured animals to ensure effective treatment and care, and in handling dead specimens to preserve biological material in the best possible state. The BOEM and BSEE, or the lessee must transport injured animals to a qualified veterinarian. Should any treated Steller's eider or sea otter survive, BOEM and BSEE or the lessee must contact the Service regarding the final disposition of the animal(s).

14 CONSERVATION RECOMMENDATIONS

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

1. BOEM should work with the oil and gas industry to develop and improve technologies for reducing migratory bird collisions with offshore and onshore oil and gas development infrastructure, particularly for Steller's eiders;
2. BOEM should work with the oil and gas industry to improve technologies to reduce the risk of and effects from oil spills in Cook Inlet;
3. BOEM should work with the Service and the oil and gas industry to improve technologies and strategies to prevent spilled oil from contacting listed species in the event of a large marine spill in Cook Inlet;
4. BOEM should work with the Service to characterize the distribution and use of marine habitats and over-wintering areas of Steller's eiders in Cook Inlet;
5. BOEM should work with the Service to conduct monitoring of abundance, trends, habitat use, and productivity of listed species to assist with understanding potential effects of human activities on populations in Cook Inlet.

The Service requests notification of the implementation of any conservation recommendations so we may be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats.

15 REINITIATION NOTICE

This concludes formal consultation on the action(s) outlined in the BA of Oil and Gas Activities associated with Lease Sale 244 (BOEM 2016b). As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; (2) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or (3) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, the exemption issued pursuant to section 7(o)(2) may have lapsed and any further take could be a violation of section 4(d) or 9. Consequently, we recommend that any operations causing such take cease pending reinitiation.

If you have any questions about this biological opinion, please contact Mr. Kevin Foley of our staff at (907) 271-2788, or by e-mail at kevin_foley@fws.gov.

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APPENDIX A. Calculations of Steller's Eider Collision Rates.

Comparing collision data of eiders to population estimates provides a method to determine strike rates (the percentage of the population killed per year by collision). The collision rate can be used as a surrogate to assess potential impacts to Steller's eiders by converting it to a percentage and applying it to the estimated population size of listed eiders that may migrate past a structure. This same methodology was applied to estimating collision risk for listed eiders as part of the Service's Biological Opinion (BO) for oil and gas activities associated with lease sale 193 (Service 2015b). Although limited, the best available data for estimating collision risk to Steller's eiders for Lease Sale 244 is bird encounter data recorded during Shell's 2012 exploratory drilling season in the Chukchi Sea.

Eiders comprised 13 percent of avian encounters during Shell's 2012 drilling season (i.e., 17 of 131 total encounters, BOEM unpublished data 2015 *in* Service 2015b). Those 17 collisions included 13 king eiders and 4 common eiders, and occurred over approximately 60 percent of a normal duration drilling season. Unlike passerines, or other perching birds, seaducks would be extremely unlikely to alight deliberately on vessels or drilling structures to rest, therefore we believe these encounters represent collisions resulting in severe injury or death. Of the 17 eider collisions, 2 were recorded on Mobile Offshore Drilling Units (MODU), and 15 on support vessels. Because 2 MODUs and 10 other vessels operated during Shell's 2012 season, collisions per vessel would equate to:

2 collisions ÷ 2 MODUs = 1 collision per MODU per season; and

15 collisions ÷ 10 support vessels = 1.5 collisions per support vessel per season.

These rates are based on reported collisions for king eiders and common eiders during a single season in the Chukchi Sea. Listed eider species were not among the sea duck collisions recorded in 2012, however spectacled eiders and Steller's eiders moving through the Chukchi Sea during spring, summer, and fall would also be at risk of colliding with MODUs and vessels associated with the First Incremental Step.

Assuming that Steller's eiders are equally as vulnerable to collisions as king eiders and common eiders, and because there is no basis to assume otherwise, we would expect collisions to occur in proportion to species abundance. Based on a total of 673,486 eiders (499,423 king and 174,063 common eiders) recorded during migration counts near Barrow in late summer and fall of 2002 (Quakenbush et. al. 2009[1]), we very roughly estimate the risk of collision to be:

1 collision per MODU per season ÷ 673,486 eiders = 0.0000015 collisions per MODU per season; and

[1] This survey was based on observed counts from a fixed location. It employed a subset of time intervals and extrapolated the data to account for intervals during which no observations were made. Because the majority of king and common eiders nest in Northern Canada, we believe these counts reasonably estimate the number of king and common eiders passing through Arctic Alaska. Listed eiders were not detected during these migration counts, presumably due to the comparative scarcity and identification challenges for spectacled and Steller's eiders.

1.5 collision per support vessel per season ÷ 673,486 eiders = 0.0000022 collisions per support vessel per season

We can approximate the number of potential collisions for Steller's eiders by applying the rates calculated for king and common eiders (above), to estimates of Steller's eiders using observational survey data of Pacific-wintering Steller's eiders in Cook Inlet (Larned 2006, BOEM 2016b). Although peak estimates of Steller's eiders in Cook Inlet may vary considerably among years in both number and timing, we use the range of estimates (monthly totals) of Steller's eiders observed during aerial surveys in Cook Inlet for our approximation of potential collisions. The surveys maximum and minimum estimates of Steller's eider in Cook Inlet number approximately 5,783 and 739, respectively (Larned 2006, BOEM 2016b). Therefore, we estimate listed eider collision rates for MODUs would be:

5,783 Steller's eider (maximum value) × 0.0000015 collisions per MODU per season = 0.0087 Steller's eiders (maximum value) per MODU per season.

739 Steller's eiders (minimum value) × 0.0000015 collisions per MODU per season = 0.0011 Steller's eiders (minimum value) per MODU per season.

Similarly, collision rates for support vessels are estimated as:

5,783 Steller's eider (maximum value) × 0.0000022 collisions per support vessel per season = 0.013 Steller's eiders (maximum value) per support vessel per season.

739 Steller's eider (minimum value) × 0.0000022 collisions per support vessel per season = 0.0016 Steller's eiders (minimum value) per support vessel per season.

If these figures represent the maximum and minimum number of collisions expected per listed eider moving through Cook Inlet, we can then approximate the number of collisions expected for each vessel type by applying collision rates to the number of vessels anticipated during the First Incremental Step.

Two MODUs and up to 35 additional vessels (23 for seismic exploration, 6 for drilling support, and 6 for oil spill response; Table 2) would be in operation during the First Incremental Step. Therefore, estimated collisions for listed eiders would be calculated as follows:

For MODUs:

0.0087 Steller's eiders (maximum value) per MODU per season × 2 MODUs = 0.017 Steller's eiders (maximum value) per season

0.0011 Steller's eiders (minimum value) per MODU per season × 2 MODUs = 0.0022 Steller's eiders (minimum value) per season

For support vessels:

0.013 Steller's eiders (maximum value) per support vessel per season × 35 support vessels = 0.46 Steller's eiders (maximum value) per season

0.0016 Steller's eiders (minimum value) per support vessel per season × 35 support vessels = 0.056Steller's eiders (minimum value) per season

Because a typical open-water season would conceivably be any time without ice formation, generally March through December, we estimate a full exploration and delineation season would be approximately 300 days (we would not anticipate listed eider collisions during no activity periods because very few vessels would be expected to be present during ice presence (Table 2). We therefore adjust the estimates calculated above, which were based on a single season of approximately 108 days (Shell's 2012 exploratory drilling season), to estimate collisions over 5 seasons[2] of 300 days.

For MODUs:

0.017 Steller's eiders (maximum value) per MODU per season ÷ 108 days = 0.00016 collisions per day; therefore, 0.00016 collisions per day × 300 days × 5 years = **0.24 Steller's eiders (maximum value) collisions for MODUs**

0.0022 Steller's eiders (minimum value) per MODU per season ÷ 108 days = collisions per day; therefore, collisions per day × 300 days × 5 years = 0.000002 collisions per day; therefore, 0.000002 collisions per day × 300 days × 5 years =**0.003 Steller's eiders (minimum value) collisions for MODUs**

For support vessels:

0.46 Steller's eiders (maximum value) per vessel per season ÷ 108 days = 0.0043 collisions per day; therefore, 0.0043 collisions per day × 300 days × 5 years = **6.4 Steller's eiders (maximum value) collisions for support vessels**

0.056Steller's eiders (minimum value) per vessel per season ÷ 108 days = 0.000052 collisions per day; therefore, 0.000052 collisions per day × 300 days × 5 years = **0.078 Steller's eiders (maximum value) collisions for support vessels**

To determine the total number of individuals expected to be affected we use the calculations above and round up to the nearest whole number of individuals (because you cannot have a fraction of a bird). Therefore, we estimate approximately one (1) Steller's eider collision with MODUs and seven (7) Steller's eider collisions with support vessels for a total of eight (8) Steller's eider collisions during the First Incremental Step.

The reliability of these estimates may be limited due to a number of inherent biases. For example: 1) collisions are often episodic, and those resulting from light attraction in inclement weather may be particularly so, such that observations collected on a few vessels in a single year may not be representative of collisions in general; 2) monitoring for collisions is difficult and an unknown number of collisions may go undetected, even by trained bird observers; and 3) low visibility often coincides with increased collisions (Ronconi et al. 2015), which may increase the number of undetected collisions. The proportion of birds potentially vulnerable to collision, and the validity of this means of estimating potential impacts, is also affected by the proximity of

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[2] The duration of the First Incremental Step is estimated to be 5 years

facilities and support vessels to migration flight paths which are relatively unknown in Cook Inlet. However, these estimates are based on the best information available. Because the most recent maximum and minimum estimates for overwintering Steller's eiders within Cook Inlet is 5,783 and 739, respectively (Larned 2006, BOEM 2016b), we would not anticipate population level effects from the loss of eight or fewer Steller's eiders from collisions during the First Incremental Step. Furthermore, we assume that 0.8 percent of all Steller's eiders occurring on the molting and wintering grounds in Alaska are from the listed Alaska breeding population, which may put the number of Alaska-breeding Steller's eiders overwintering in the Action Area in the tens of individuals. If we apply the 0.8 percent occurrence of Alaska breeding population Steller's eider to our estimates of Steller's eider collisions for support vessels (the maximum number of Steller's eider collision estimates among all vessel types) we have:

> 8 Steller's eiders (maximum MODU and support vessel value round up) collisions for support vessels × 0.8 percent listed Alaska breeding population Steller's eider = 0.056 Alaska breeding population Steller's eiders collisions for support vessels.

Therefore, we estimate one or fewer listed Alaska-breeding Steller eider collisions with MODUs or support vessels during the First Incremental Step. This estimate is what we use for our jeopardy analysis and the conclusion of our biological opinion.

However, it will be impossible to determine if a dead or injured Steller's eider belongs to the listed breeding population, absent sophisticated genetic testing. Therefore, while we expect no more than one individual of the listed entity to be killed or injured, we use the total of eight Steller's eiders, regardless of origin (as calculated above), as the anticipated effect of the action for the purposes of the reinitiation threshold.