**Alaska Outer Continental Shelf**

**OCS EIS/EA**

**BOEMRE 2010-020**

# Chukchi Sea Planning Area

**Statoil USA E&P Inc.**
**Geological & Geophysical Permit**
**2010 3D/2D Seismic Acquisition**
**Chukchi Sea, Alaska**

# Environmental Assessment

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Prepared by:

Bureau of Ocean Energy Management, Regulation, and Enforcement
Alaska OCS Region
Office of Leasing and Environment

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## Contents

## List of Figures



## List of Tables

# 1.0 PURPOSE OF THE PROPOSED ACTION

On December 18, 2009, Statoil USA E&P Inc. (Statoil) submitted a Geological and Geophysical (G&G) permit application (Statoil, 2009a) and supporting documents (Statoil, 2009b) for a proposed 2010 open-water, exploration seismic survey program within the federal Outer Continental Shelf (OCS) of the Chukchi Sea Planning Area (Figures 1-1 and A-1). The purpose of the seismic survey is to collect geophysical data for use in evaluating hydrocarbon accumulations in the Chukchi Sea. In accordance with the OCS Lands Act, as amended (43 United States Code (USC) 1331 et seq.), the Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMRE) (formerly the Minerals Management Service or MMS)[1] issues permits for exploration seismic surveys. Exploration seismic surveys are regulated by 30 Code of Federal Regulations (CFR) 251. The permit application can be found at: http://www.mms.gov/alaska/re/recentgg/10-01_letter.pdf.

The BOEMRE conducts environmental assessments (EAs) to ensure proposed seismic surveys are conducted "in a safe and environmentally sound manner so as to prevent harm or damage...to any life (including fish and other aquatic life)...or the marine, coastal, or human environment" (30 CFR 251.2). In accordance with the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations at 40 CFR 1501.3(b) and 1508.9, Department of the Interior (USDOI) regulations implementing NEPA at 43 CFR Part 46, and BOEMRE policy, BOEMRE prepared this environmental assessment (EA) of the potential effects of Statoil's proposed 2010 seismic survey in the Chukchi Sea Planning Area of the Alaska OCS.

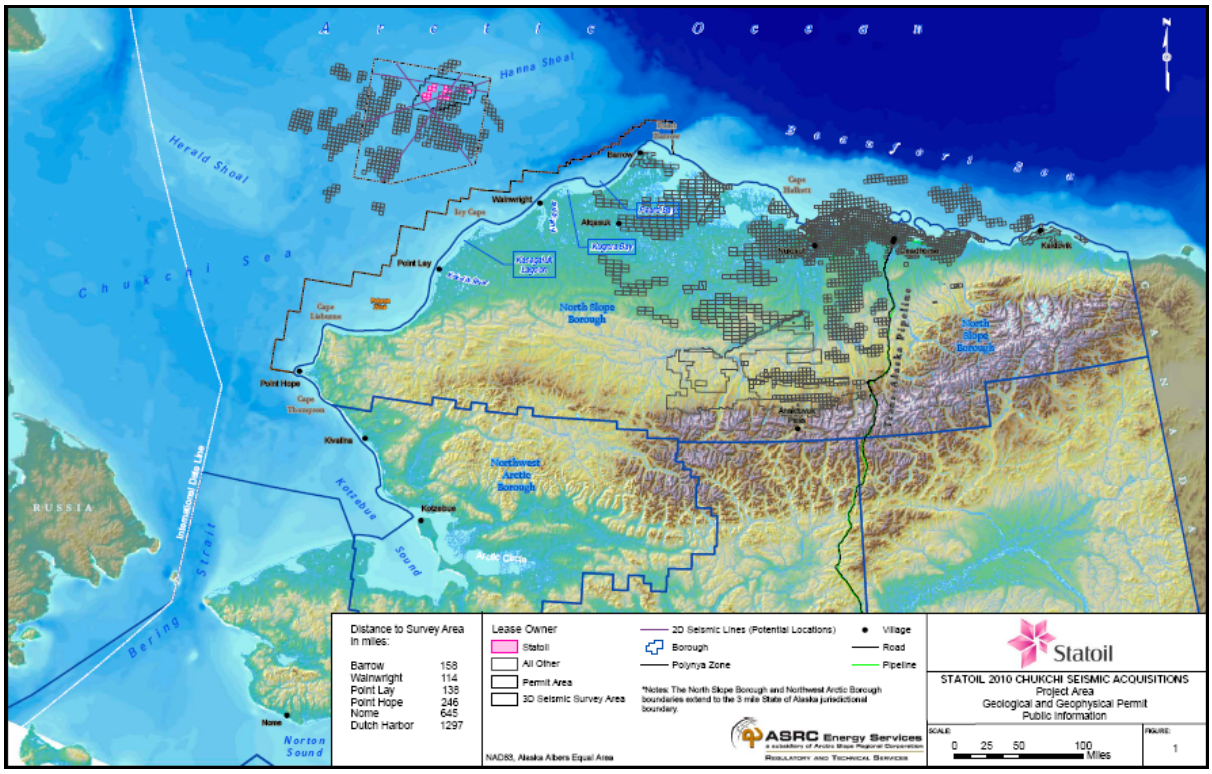


**Figure 1-1 Survey area in relation to the Chukchi Sea and Alaskan arctic (Statoil, 2009a).**

The BOEMRE has prepared this EA to determine whether Statoil's proposed seismic survey would result in significant effects to the environment, as defined at 40 CFR 1508.27, that could trigger the

[1] On June 18, 2010, the Secretary of the Interior changed the name from Minerals Management Service to the Bureau of Ocean Energy Management, Regulation, and Enforcement (Secretarial Order No. 3302).

need to prepare an environmental impact statement (EIS) and to assist with BOEMRE planning and decision-making (40 CFR 1501.3(b)).

# 2.0 PRIOR ENVIRONMENTAL ANALYSES

This EA tiers from the following documents:

- Final Programmatic Environmental Assessment (PEA), Arctic Ocean Outer Continental Shelf, Seismic Surveys – 2006 (OCS EIS/EA MMS 2006-038) June 2006. (USDOI, MMS, 2006b or PEA)
- Final Environmental Impact Statement, Chukchi Sea Planning Area, Oil and Gas Sale 193 EIS and Seismic Surveying Activities in the Chukchi Sea (OCS EIS/EA MMS 2007-026) May 2007. (USDOI, MMS, 2007b or Sale 193 EIS)

The tiering-process is defined in NEPA regulations (40 CFR 1502.20 and 1508.28) and is intended to eliminate repetitive discussions of similar issues and focus on issues related to the proposed activities. It also considers existing site-specific information and newer information, such as recently available environmental studies.

The BOEMRE previously addressed seismic activities throughout the Chukchi Sea (USDOI, MMS, 2006b; 2007b). Statoil's proposed activities are within the scope of seismic surveys previously evaluated (see Table 2-1).

**Table 2-1 Statoil's proposed 2010 survey parameters compared with those in the PEA (USDOI, MMS, 2006b).**

| Comparative Parameters | Statoil USA E&P Inc. Proposed Seismic Survey Activities (Statoil, 2009a) | 2006 Final Seismic PEA (USDOI, MMS, 2006b) |
|---|---|---|
| **Survey Type** | 3D streamer and possible 2D streamer | 2D/3D streamer; ocean-bottom-cable; high resolution |
| **Geographic Survey Area** | Chukchi Sea OCS (See Figure 1-1) | Chukchi Sea OCS/Beaufort Sea OCS |
| **Permit Authorization Period** | 7/15–11/30 (2010) | 7/1 - 12/31 |
| **Number of Seismic Source Vessels** | 1 | Up to 4 |
| **Energy Source Array** | 3,000 $in^3$ | 1,800 - 4,000 $in^3$ |
| **Streamer/Receiver Array** | 12 streamer/receiver cables each cable~4-km long | 4-12 streamer/receiver cables each cable 3-8 km long |
| **Streamer/Receiver Array Width** | 1,100 m (3,609 ft)[#] | 400-900 m (1,312-2,953 ft) |
| **Streamer Buoyancy** | Solid | Liquid paraffin or solid/gel |
| **Support Vessels** | 2 - (1 support/environmental monitoring/chase vessel and 1 support/environmental monitoring/crew transfer vessel) | Up to 3 per survey (including crew boats, supply boats, monitoring vessels, icebreakers) |
| **Aircraft** | None | Fixed-wing and/or helicopter |
| **Mitigation & Monitoring** | IHA application to NMFS (12/18/2009; revised 4/14/2010); LOA application to FWS (12/18/2009); POC; Marine Mammal Monitoring and Mitigation Plan (Statoil, 2010c), FWS BOs (2007; 2008; and 2009), NMFS BOs (2008a&b) | IHA from NMFS; ITA from FWS; POC; Marine Mammal Monitoring and Mitigation Plan |

Note: [#] A wider streamer/receiver array allows collection of more data per transect and has no additive effect over what was analyzed in the PEA.
Sources: BOEMRE (USDOI, MMS, 2006b) and Statoil (2009a).

The PEA analyzed the impact of up to four seismic surveys for each open-water season in the Chukchi Sea Planning Area and concluded in a Finding of No Significant Impact (FONSI) for the Selected Alternative 6, which specified mitigation measures under 30 CFR 251.

Statoil's proposed activities are within the scope of current BOEMRE consultations with National Marine Fisheries Service (NMFS) and Fish and Wildlife Service (FWS) under section 7 of the Endangered Species Act (ESA). The consultation documents listed below have been reviewed, summarized, and incorporated, as appropriate, in this EA.

- Biological Evaluation of the Potential Effects of Oil and Gas Leasing and Exploration in the Alaska OCS Beaufort Sea and Chukchi Sea Planning Areas on Endangered Bowhead Whales (*Balaena mysticetus*), Fin Whales (*Balaenoptera physalus*), and Humpback Whales (*Megaptera novaeangliae*) (USDOI, MMS, 2006a).
- Supplement to the 2006 Biological Evaluation of the Potential Effects of Oil and Gas Leasing and Exploration in the Alaska OCS Beaufort Sea and Chukchi Sea Planning Areas on Endangered Bowhead Whales (*Balaena mysticetus*), Fin Whales (*Balaenoptera physalus*), and Humpback Whales (*Megaptera novaeangliae*) (USDOI, MMS, 2008a).
- Biological Opinion (BO) for Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska and Authorization of Small Takes under the Marine Mammal Protection Act (USDOC, NMFS, 2008a).
- Biological Opinion for Beaufort and Chukchi Sea Program Area Lease Sales and Associated Seismic Surveys and Exploratory Drilling (USDOI, FWS, 2009).
- Supplemental Essential Fish Habitat Analysis: Arctic Cod, Saffron Cod and Opilio Crab, for July-December, 2010 (USDOI, BOEMRE, 2010)

Although the PEA and the Sale 193 EIS addressed seismic activities throughout the Chukchi Sea and Statoil's proposed project area, in developing this EA BOEMRE has focused on site-specific information associated with the proposed action, considering and analyzing new information, such as recent environmental studies, that update information in previous NEPA analyses.

The BOEMRE reviewed Statoil's Environmental Evaluation Document (EED) (Statoil, 2010b), supplementing the information provided in the EED where necessary (40 CFR 1506.5(a)).

> 40 CFR 1506.5 Agency responsibility.
>
> (a) Information. If an agency requires an applicant to submit environmental information for possible use by the agency in preparing an environmental impact statement, then the agency should assist the applicant by outlining the types of information required. The agency shall independently evaluate the information submitted and shall be responsible for its accuracy. If the agency chooses to use the information submitted by the applicant in the environmental impact statement, either directly or by reference, then the names of the persons responsible for the independent evaluation shall be included in the list of preparers (Sec. 1502.17). It is the intent of this paragraph that acceptable work not be redone, but that it be verified by the agency.

# 3.0 PROPOSED ACTION

Statoil proposes to conduct a seismic survey during the annual open-water (≥ 90% ice free) season from July 15 through November 30, 2010 (ice and weather permitting). This proposal includes three-dimensional (3D) and two-dimensional (2D) surveys. The primary objective of this proposal is the acquisition of 3D data. A secondary objective is the acquisition of 2D data if operationally feasible.

Airguns are used as the sound source for 2D and 3D seismic surveys. The 2D and 3D surveys use similar survey methods but different operational configurations. A 2D survey provides less-detailed geological information because the survey lines are spaced farther apart. These surveys are used to cover wider areas to map geologic structures on a regional scale. Three dimensional (3D) survey lines

are spaced closer together and are concentrated in a specific area of interest. These surveys provide the resolution needed for detailed geological evaluation.

The *M/V Geo Celtic* (*Geo Celtic*) would be the primary survey vessel. The *R/V Norseman* (*Norseman*) and the *M/V Tanux I* (*Tanux I*) would be used for support and environmental monitoring. All vessel personnel would be billeted aboard their respective ships.

Vessels would depart Dutch Harbor, Alaska, mid to late July, depending on environmental conditions, and travel to the survey area (Figure A-11). The anticipated transit time is five days. Upon arrival in the survey area, the *Geo Celtic* would deploy the airgun arrays and hydrophone streamers, taking three to five days. Sound source verification (SSV) data will be collected as soon as the systems are deployed and operational. Survey operations would be conducted 24 hours per day as sea conditions permit. Data acquisition is expected to continue for approximately 60 days. Operations would be conducted on a 24 hours per day schedule as sea conditions permit; however, array and streamer deployment, equipment maintenance, weather down time, the presence of ice and other delays contribute to time in the survey area. Typically, survey data would be collected 25% to 30% of the time (USDOI, MMS, 2006b). Upon completion of the survey, all vessels would depart the survey area and return to Dutch Harbor, Alaska.

Statoil's proposed action was obtained from the following G&G permit application and supporting information:

- Permit application forms MMS-327 Application for Permit to Conduct G&G Exploration for Mineral Resources or Scientific Research in the OCS and MMS-328 Permit for Geophysical Exploration for Mineral Resources or Scientific Research in the OCS (Statoil, 2009a) submitted on 18 December 2009.
- Statoil's Plan of Operations; 2010 3D Seismic Acquisition; Chukchi Sea, Alaska (Statoil, 2009a; Statoil, 2009b) submitted on 18 December 2009.
- Statoil's Request to FWS for Letter of Authorization for the Incidental Take of Polar Bears and Pacific Walrus and Intentional Take of Polar Bears by Harassment; Statoil USA E&P Inc.; 2010 3D Seismic Acquisition; Chukchi Sea, Alaska (Statoil, 2009b) submitted on 18 December 2009.
- Statoil's Polar Bear and Pacific Walrus Monitoring, Mitigation, and Reporting Plan, Statoil 2010 3D Seismic Acquisition Chukchi Sea, Alaska (Statoil, 2009b) submitted on 18 December 2009.
- Statoil's Polar Bear and Pacific Walrus Awareness and Interaction Plan, Statoil 2010 3D Seismic Acquisition Chukchi Sea, Alaska (Statoil, 2009b) submitted on 18 December 2009.
- Equipment and vessel specifications for the *M/V Geo Celtic*, *M/V Tanux I*, and *R/V Norseman* (http://www.bergengroup.no/publish_files/GeoCeltic_eng.pdf?PHPSESSID=7831f3a74533fff20b4cc789ca201ef6; http://norsemanmaritme.com/ourships.html; http://www.tananger-offshore.no/index.php?option=com_content&view=article&id= 10&Itemid=8).
- Statoil's Request to NMFS for an Incidental Harassment Authorization to Allow the Incidental Harassment of Marine Mammals During a 3D Marine Seismic Survey in the Chukchi Sea, Alaska, 2010 (Statoil, 2009a) submitted on 18 December 2009 and revised on 14 April 2010.
- Statoil's Plan of Cooperation (POC), 2010 Marine Seismic Survey, Chukchi Sea, Alaska (May 2010a) submitted on 28 May 2010.
- Statoil's Environmental Evaluation Document, Statoil 2010 Chukchi Marine Seismic Survey Chukchi Sea, Alaska (Statoil, 2010b) submitted on 19 April 2010.

- Statoil's Marine Mammal Monitoring and Mitigation Plan for Marine Seismic Surveys of Selected Lease Areas in the Alaskan Chukchi Sea in 2010 (Statoil, 2010c) submitted on 23 April 2010.
- Statoil's Chukchi 2010 Seismic Marine Survey Cumulative Effects Analysis, May 2010 (Statoil, 2010d) submitted on 27 May 2010.
- Ballast Water Management Plan, Wilhelmsen Ship Management, DS059

Statoil's proposed mitigation includes implementing a Polar Bear and Pacific Walrus Monitoring, Mitigation, and Reporting Plan; a Polar Bear and Pacific Walrus Awareness and Interaction Plan; a Marine Mammal Monitoring and Mitigation Plan; and a Plan of Cooperation (POC). Statoil has incorporated design features and operational procedures for mitigating potential impacts on cetaceans, pinnipeds, birds, and subsistence activities. These measures include:

- Remaining at least 60 miles (mi) offshore of the Ledyard Bay Critical Habitat Unit;
- Limiting the power output of the seismic energy source to that the minimum level required to meet the technical objectives of the survey;
- Configuring the airgun array to maximize downward and minimize horizontal energy propagation;
- Using a larger receiving hydrophone array to minimize the number of required survey lines; and
- Conducting preseason modeling and early season SSV to delineate NMFS-directed safety zones. The SSV will be performed upon arrival in the survey area.

Marine seismic surveys vary markedly depending on client specifications, subsurface geology, water depth, and geologic target. The *Geo Celtic* would tow two airgun arrays. Each array consists of 26 airguns with a total discharge volume of 3,000 $in^3$. Table 3-1 provides the modeled sound pressure level radii from the airgun arrays that Statoil intends to use. Details of the airgun array and the sound signature are described in Statoil's G&G Permit Application (Statoil, 2009a).

**Table 3-1 Modeled sound radii for mitigation gun and airgun array.**

| Received Levels (dB re 1 µPa rms) | Estimated Distance (m) 3,000 $in^3$ airgun array | Distance (m) 60 $in^3$ mitigation gun |
|---|---|---|
| **190** | 700 m (2,296 ft) | 75 m (246 ft) |
| **180** | 2,500 m (8,202 ft) | 220 m (721 ft) |
| **160** | 13,000 m (44,291 ft) | 1,800 m (5,905 ft) |
| **120** | 70,000 - 120,000 m (229,658 - 393,700 ft) | 50,000 m (164,041 ft) |

Source: Statoil (2009a; 2010b).

## 3.1. Proposed Operations

Operations would commence with the deployment of the airgun array and hydrophone streamers. The airgun arrays would be towed at a depth of 6 m (20 ft) and roughly 275 m (900 ft) astern. The *Geo Celtic* would proceed along pre-planned survey lines at a speed of 4 to 5 knots. The airgun arrays would discharge at 8 second intervals in an alternating mode. A single 60 $in^3$ mitigation airgun would be used as the *Geo Celtic* repositions to discourage marine mammals and fish from approaching.

The hydrophone array will consist of twelve streamers up to 4,050 m (2.5 mi) in length, with 20,000 to 25,000 hydrophones spaced 2 m (6.5 ft) apart. The 12-streamer receiver array was selected to maximize the amount of data collected on each survey line reducing the number of times the vessel would have to traverse the survey area. The hydrophones will receive the reflected signals from the airgun array and transfer the data to an on-board processing system. A multiple-pinger system will be used to position the streamer relative to the vessel (Statoil, 2009a). This positioning system permits tighter turns between lines and reduces total operating time.

Retrieval of the streamers and airgun arrays upon completion of the survey would take at least 24 hours.

The support vessels *Norsemen* and *Tanux I* will not use seismic survey equipment and will not introduce sounds into the water beyond those associated with normal vessel operations.

Marine mammal observers (MMOs) will be posted on each vessel to watch for marine mammals. Observations will be conducted during the transits to and from the survey area and during the seismic survey.

Crew changes and refueling of the support vessels *Norseman* and *Tanux I* will be necessary during the proposed survey. *Norseman* and *Tanux I* will refuel and conduct crew changes in Nome, Alaska. Statoil intends to complete the seismic survey by mid-October 2010. If this schedule is achieved, the *Geo Celtic* will not require refueling during the survey. If inclement weather and/or ice conditions extend the survey operations into November, at-sea refueling may become necessary for the *Geo Celtic*.

Helicopter operations are not planned as part of this survey, although in an emergency, helicopter transport of individuals and equipment may be used. A Barrow-based search and rescue helicopter would be available to address emergency situations (Statoil, 2009a).

The BOEMRE conducted a spill analysis for refueling operations for this project and estimated a worst-case spill volume of 13 bbl of diesel fuel. Weathering modeling indicates approximately 21% of a 13 bbl spill would evaporate and 79% would disperse within 48 hours. This analysis is consistent with the analysis of fuel-transfer operations conducted (Shell Gulf of Mexico, 2009) that analyzed for a 48 bbl spill. The analyses in the PEA and in Shell's 2010 exploration plan (Shell Gulf of Mexico, 2009) concluded any effects from a 48 bbl spill would be localized, and temporary (persisting up to 3 days). Likewise the effects of a smaller 13 bbl spill cannot reasonably be expected to exceed those of a 48 bbl spill as was analyzed in the PEA and in Shell's 2010 Exploration Plan. Therefore the effects of a 13 bbl spill would most likely be localized, persisting less than 3 days. Accordingly, refueling spills will not be further analyzed in this EA.

Emissions and discharges from the survey vessels must comply with regulations and apply to all vessels. Discharges from Statoil's proposed activities would be regulated under the Environmental Protection Agency's National Pollutant Discharge Elimination System Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels (USEPA, 2009). The USCG regulations related to pollution prevention and discharges for vessels carrying oil, noxious liquid substances, garbage, municipal or commercial waste, and ballast water are at 33 CFR 151. Previous PEA and Sale 193 EIS analyses of emissions and discharges related to seismic surveys concluded any effects would be localized, temporary, and negligible. Therefore, effects to air quality and water quality from emissions and discharges will not be further analyzed in this EA.

Ballast-water discharge, hull fouling, and equipment placed overboard (e.g., anchors, seismic airguns, hydrophone arrays) are potential vectors for introducing invasive species. Vessels brought into State of Alaska or Federal waters are subject to USCG regulations (33 CFR 151, Subpart D), which are intended to reduce the risk of introduction of invasive species. The regulations require vessels coming from overseas to: conduct mid-ocean ballast water exchange at least 200 nautical miles from shore,

preferably in water depths greater than 200 m prior to entering U.S. waters; retain the ballast water on board while in U.S. water; or use a Coast Guard approved alternative environmentally sound method to treat the ballast water. The regulations require ballast water management plans and vessel inspections. Statoil submitted a copy of the ballast water management plan for the *Geo Celtic* demonstrating compliance with these regulations.

Standard practice aboard the *Geo Celtic* is to remove species such as barnacles from hydrophone streamers and other equipment when recovering the gear at the completion of a project by scraping or a high-pressure, sea-water wash. These procedures, in combination with USCG regulations and inspections, are expected to minimize the probability of introduction of invasive species.

### 3.1.1. 3D Seismic Survey

The proposed 3D survey area includes Statoil's lease holdings obtained in Sale 193 EIS held in February 2008 (USDOI, MMS, 2008a). The 3D survey area is located approximately 160 km (114 mi) northwest of Wainwright and 240 km (158 mi) west of Barrow in the Chukchi Sea (Figures 1-1 and A-1). The 3D survey will be conducted within a 2,385 $km^2$ (915 $mi^2$) area and will consist of 5,000 km (3,100 mi) of data acquisition.

Offshore geophysical-exploration seismic surveys conducted in summer are sources of noise in the arctic marine environment. Airgun arrays are the most common, and loudest, source of seismic-survey noise. These surveys emit loud, pulsed sounds that can propagate long distances from their source. As airgun pulses are directed towards the ocean bottom, sound propagates horizontally for several kilometers (Greene and Richardson, 1988).

In waters 25 - 50 m (82 - 164 ft) deep, sound produced by airguns may be detectable 50 - 75 km (31 - 46 mi) away depending upon the noise output. Sound produced by airguns can be detected by some cetaceans that are 10 - 100 km (6 - 62 mi) from the source (Greene and Richardson, 1988; Bowles et al., 1994; Richardson et al., 1995a) or potentially farther under certain conditions.

### 3.1.2. 2D Seismic Survey

Obtaining 2D seismic data is a secondary objective for Statoil. The 2D seismic survey data would be collected if ice conditions restrict access to the 3D seismic survey area or if the 3D seismic survey is completed early. A maximum of four 2D lines with a total line length of 675 km (420 mi) would be surveyed at a minimum distance of 72 km (45 mi) from the coast. The 2D data acquisition would use the same vessels, airgun array, and streamer configuration as the 3D survey. Approximate 2D line layouts are illustrated in Figures 1-1 and A-1.

## 3.2. Environmental Conditions at the Proposed Survey Area

The environmental conditions in the survey area are expected to be the same as the general conditions described in the PEA and in the Sale 193 EIS. There are no indications from recent studies or site-specific information that the survey area differs from what was generally described in the PEA and Sale 193 EIS. Water depths in the 3D survey area vary from 30 m to 50 m (100 - 165 ft). The proposed 3D survey area overlies the relatively homogeneous ocean bottom found in the mid-shelf region of the Chukchi Sea. Seafloor surveys conducted in the area have not revealed any unusual or special benthic features or communities. Most of the proposed 2D survey lines overlie areas of the same water depth range and homogenous ocean-bottom.

Hanna Shoal is a shallow area in the Chukchi Sea located northeast of the survey area (Figures 1-1 and A-1). During the spring and early summer much of Hanna Shoal retains sea ice. The northeast portion of the 3D survey area is approximately 8 mi southwest of Hanna Shoal. One of the 2D survey lines extends onto the southwestern portion of Hanna Shoal.

Statoil's proposed survey areas are within the Arctic Climatic Zone, which is characterized by cold temperatures, nearly constant wind, and low precipitation. The open-water season is from the beginning of July to the end of November. Summers frequently have fog and southwesterly wind conditions; while winter snowstorms are accompanied by strong easterly, northeasterly, and northerly winds. In general, the region has 6-10 storm-days per month with storms typically lasting from 6 to 24 hours; however, individual storms may last up to 14 days.

Open-water seismic surveys require a largely ice-free environment (<10% ice cover) to allow effective operation and maneuvering of the airgun arrays and streamers. The start of project activities onsite would begin on or after July 15, which is after the retreat of the ice in most years (early June to late July). The duration of open-water conditions in the central Chukchi Sea averages 17 weeks; however, the duration of open water is variable from year-to-year and ice could be present at the proposed location. Concentrations (>10%) of ice in early July may delay start of operations.

Two forms of sea ice can be found in the survey area, including, (1) grounded ridge ice that is not associated with landfast ice; and (2) pack ice, that may accumulate under the influence of winds and currents. Statoil's seismic survey activities are planned for the open-water season when grounded ice is not expected in the survey area, with a possible exception of Hanna Shoal for part of the open water season. Winds and currents could move pack ice into the proposed survey area at any time during operations.

# 4.0 ENVIRONMENTAL EVALUATION

This section describes the marine species, subsistence activities and environment potentially affected by Statoil's proposed seismic survey activities, focusing on protected or sensitive species and areas. Section 4.4 herein provides a summary level of analysis of the expected effects of the proposed action, and is used as an aid in determining which issues and concerns to carry forward into Section 5.0 for detailed analysis.

## 4.1. Issues and Concerns

The following issues and concerns were identified by the technical analysts for consideration in the preliminary screening for potential effects and site-specific environmental review:

- potential effects of seismic survey sound on bowhead whale migrations;
- potential effects of seismic survey sound on marine fish, essential fish habitat, and lower trophic species;
- potential effects of seismic survey operations on marine wildlife, including marine mammals, marine birds, and threatened and endangered species; and
- potential effects of seismic survey operations on subsistence activities.

Previous BOEMRE seismic survey-related environmental evaluations in the PEA and Sale 193 EIS concluded that the following resources would be negligibly or not impacted by open water seismic survey operations in the Chukchi Sea:

| | | |
|---|---|---|
| air quality | coastal wetlands | freshwater fishes |
| sediments | terrestrial mammals | water quality |

Based on the analyses in the PEA and Sale 193 EIS, newer information such as recent environmental studies, and our review of the proposed action (see Section 3.1), those conclusions remain valid and thus these resources are not evaluated further in this EA.

## 4.2. Sensitive Areas

**Hanna Shoal (Appendix A, Figure A-1)**: Hanna Shoal rises from the ocean floor to within 20 m of the surface waters in some places. It is believed to be a feeding area for seals, Pacific walrus and gray whales and some sea birds (USDOI, MMS, 2009). The shoal often retains grounded sea ice well into early summer, providing resting and foraging platforms for seals and walrus. Hanna Shoal lies over 8 mi from the 3D survey area; one of the potential 2D survey line terminates over the southwest portion of the shoal.

**Ledyard Bay Critical Habitat Unit (LBCHU) (Figure A-2)**: LBCHU is a critical habitat area designated by the FWS for the protection of spectacled eiders. Spectacled eiders are listed as threatened under the ESA. The proposed 3D survey area is a more than 90 mi (144 km) from LBCHU (Figure A-2) and the closest 2D survey line terminates over 50 mi (80 km) from the LBCHU.

**Essential Fish Habitat (EFH) (Appendix A, Figure A-3 as delineated by the Exclusive Economic Zone (EEZ) and Figure A-4)**: The five species of Pacific salmon occurring in the Chukchi Sea Planning Area are managed under the Alaska Salmon Fishery Management Plan (1990, and amendments). The EFH for salmon encompasses the entire Chukchi Sea OCS Planning Area.

The Arctic Fishery Management Plan (2009) identified Arctic cod, saffron cod and snow crab (opilio crab) as target species in the region north of the Bering Strait. The EFH for these three species occurs in the Chukchi Sea, however only the Arctic cod EFH fully overlaps with the Chukchi Sea OCS Planning Area and proposed survey area. Saffron cod EFH and snow crab EFH are south of the proposed survey area.

**Polar Bear Proposed Critical Habitat (Figures A-5 and A-6):** The FWS has proposed land-fast sea ice (immobile sea ice frozen to the shoreline or to the seafloor), pack ice (annual and multi-year ice that is in constant motion due to winds and currents) and some shoreline and barrier islands as critical sea-ice habitats for polar bears [74 *FR* 56059 (2009)]. Open water is not proposed as critical habitat for polar bears (FWS, 2010). The proposed survey area is within the region proposed for critical habitat for polar bears, but the seismic survey operations would occur during the open-water season when polar bears are not expected to occupy the area. Polar bears may be encountered swimming between shore and pack ice during open-water conditions.

## 4.3. Levels of Effects Definitions for Biological Resources

**Significance:**

*Biological significance* is a term used in association with ESA consultations. It refers to effects from an activity or event impacting the health, wellbeing, behavior, or reproductive potential of individual animals or plants and how many of those get transferred to a population level of effects.

*Significance* as defined by the Council on Environmental Quality (CEQ) NEPA regulations (40 CFR 1500-1508) defines the term "significantly" in terms of both context and intensity (40 CFR 1508.27). "Context" considers the setting of the Proposed Action, what the affected resource might be, and whether the effect on this resource would be local or more regional in extent. Factors to be considered in evaluating "intensity" include: (1) the severity of the impact; (2) whether the impact is beneficial or adverse; (3) the degree to which the Proposed Action affects public health and safety; (4) the unique characteristics of the affected area; (5) the degree of controversy; (6) uncertainty; (7) establishing precedence; (8) the cumulative, direct, and indirect aspects of the impact; (9) the affects upon endangered or threatened species; and (10) whether Federal, State, or local laws may be violated.

These above terms are not interchangeable.

**Level of Effects Definitions:**

**Negligible:**

- No measurable physiological impacts and no population-level effects.
- May cause brief behavioral reactions such as temporary avoidances of or deflections around an area.
- Localized, short-term disturbance or habitat effects experienced during one season are not anticipated to accumulate across multiple seasons.
- No mortality or detectable impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are fully implemented or are not necessary.

**Minor:**

- Low but measurable physiological impacts with no population-level effects.
- A small number of mortalities are unlikely but possible.
- May cause behavioral reactions such as avoidances of or deflections around an area lasting from one hour to several days.
- Localized, disturbance or habitat effects experienced during one season may accumulate across subsequent seasons, but not over one year.
- No mortality or detectable impacts to reproductive success or recruitment are anticipated.
- Mitigation measures are fully implemented or are not necessary.

**Moderate:**

- Mortalities or disturbances could occur, but no detectable population-level effects.
- A small number of mortalities are likely, but not to an extent resulting in detectable population level effects.
- Adverse impacts to ESA-listed species could occur.
- Widespread annual or chronic disturbances or habitat effects could persist for more than one year and up to a decade.
- Widespread implementation of mitigation measures for similar activities may be effective in reducing the level of avoidable adverse effects.
- Unmitigated or unavoidable adverse effects may be short term and widespread, or are long term and localized.

**Major:**

- Mortalities or disturbances occur that have detectable population-level effects.
- For marine mammals, mortality might occur at or above the estimated Potential Biological Removal (PBR) as a result of the proposed action.
- For fish and benthic invertebrates, the anticipated mortality is estimated or measured in terms of tens of thousands of individuals or >20% of a local breeding population and/or >5% of a regional population, which may produce population-level effects.
- Widespread seasonal or chronic effects are cumulative and are likely to persist for more than one decade.
- Mitigation measures are implemented only for a small portion of similar impacting activities, but more widespread implementation for similar activities could be more effective in reducing the level of avoidable adverse effects.
- Unmitigatable or unavoidable adverse effects are widespread and long lasting.

## 4.4. Preliminary Screening of Potential Impacts and Affected Biological Resources.

Previous NEPA analyses and Statoil's Plan of Operation were reviewed to determine the expected level of effects from the proposed activities. Previous NEPA documents, Statoil's Plan of Operations (Statoil, 2009a), and recent biological surveys (Brueggeman, 2009a; Brueggeman, 2009b; Funk et al, 2007; Funk et al, 2008; Funk et al, 2010; Gall and Day, 2009; Ireland et al, 2008; Ireland et al, 2009a; Ireland et al, 2009b; Ireland et al, 2009c) were also reviewed to determine the presence or absence of biological resources during the July-November operational timeframe in the vicinity of the proposed survey area. Marine Mammal Protection Act (MMPA) and ESA protected species, and any resources affected to a minor or greater level of effects are carried into the effects analyses in Sections 5.2, 5.3, and 5.5.

Table 4-1 through Table 4-4 indicate the expected levels of impact based upon previous NEPA analyses implementing the same mitigations as the proposed action (USDOI, MMS, 2006a; 2007b). The impact levels presented in Sections 4.4.1 through 4.4.3 describe the expected impact levels of the proposed activities on the biota in the vicinity of the seismic surveys. The impact level determinations are based on the types and levels of effects outlined in previous NEPA documents (see Section 2.0; USDOI, MMS, 2006b, 2007b; USDOC, NMFS, 2008b), BOEMRE's EFH Arctic Consultation with NMFS (USDOI, BOEMRE, 2010), and Endangered Species Act (ESA) consultation documents (USDOI, MMS 2006a, 2008a; USDOI, FWS, 2009; USDOC, NMFS, 2008a). Effects level determinations are applied independent of the presence, absence, or numbers of a species that might occur at the site-specific level. Cumulative determinations are developed using the highest level of effect rating for a species, adding in other ratings greater than negligible.

### 4.4.1. Marine Mammals

Table 4-1 shows the expected level of effects of seismic activities on marine mammal species. BOEMRE considered whether additional studies of marine mammals would be necessary to determine the effects for an analysis of seismic surveys in the Chukchi Sea. Although information on marine mammal species in the Chukchi Sea is sometimes limited compared to other regions of Alaska, there is sufficient data to evaluate the effects on marine mammals from the proposed activities. These effects include noise, physical disturbance, and temporary displacement. The area of disturbance would be very limited in time and space. The largest effect determination was for the gray whale where a minor level of effect from seismic noise led to a minor cumulative level of effect.

**Table 4-1 Effects level determination results for marine mammal species expected to occur in the Chukchi Sea Planning Area.**

| Species | Vessel Traffic | Vessel Noise | Seismic Noise | Cumulative Effects |
|---|---|---|---|---|
| **Bearded Seal** | NG | NG | NG | NG |
| **Beluga Whale** | NG | NG | NG | NG |
| **Bowhead Whale** | NG | NG | NG | NG |
| **Fin Whale** | NG | NG | NG | NG |
| **Gray Whale** | MN | NG | MN | MN |
| **Harbor Porpoise** | NG | NG | NG | NG |
| **Humpback Whale** | NG | NG | NG | NG |
| **Killer Whale** | NG | NG | NG | NG |
| **Minke Whale** | NG | NG | NG | NG |

| Species | Vessel Traffic | Vessel Noise | Seismic Noise | Cumulative Effects |
|---|---|---|---|---|
| **Narwhal** | NG | NG | NG | NG |
| **Pacific Walrus** | MN | NG | NG | MN |
| **Polar Bear** | NG | NG | NG | NG |
| **Ribbon Seal** | NG | NG | NG | NG |
| **Ringed Seal** | NG | NG | NG | NG |
| **Spotted Seal** | NG | NG | NG | NG |

Note: NG = negligible, MN = minor, MO = moderate, MJ = major,
Determinations are based on existing analyses in USDOI, MMS, 2006b and USDOI, MMS, 2007b, and incorporate more recent information from other sources, as appropriate.

Statoil has stated they will only use aircraft during emergencies. Vessel traffic related to the proposed activities would be limited to routes from Nome directly to the seismic survey area and would not occur in sensitive near shore waters such as Ledyard Bay, Peard Bay, or Kasegaluk Lagoon. Vessels would have marine mammal observers on board at all times and would slow down and/or change course to avoid close approaches to marine mammals as necessary.

### 4.4.2. Birds

Tables 4-2 and 4-3 summarize the level of effects for similar seismic activities analyzed in previous NEPA documents (USDOI, MMS, 2006b; 2007b). Birds are typically present in the proposed survey area in low densities, and would easily move away from vessel traffic and noise, seismic noise and other disturbances associated with survey activity (Statoil, 2010b). The distance between the survey area and aggregations such as colonies or nesting/brood-rearing areas for of waterfowl, seabirds, loons, and shorebirds makes their occurrence in the vicinity of the survey area sporadic with comparatively low population densities. Minor levels of cumulative effect were generally determined for bird species in the Chukchi Sea in the PEA and in the Sale 193 EIS.

**Table 4-2 Effects level determination results for seabird and shorebird species that occur in the Chukchi Sea Planning Area.**

| Species | Vessel Traffic | Vessel Noise | Seismic Noise | Bird/Ship Collisions | Cumulative Effects |
|---|---|---|---|---|---|
| **Common Murre** | NG | NG | NG | NG | NG |
| **Thick-Billed Murre** | NG | NG | NG | NG | NG |
| **Tufted Puffin** | NG | NG | NG | NG | NG |
| **Horned Puffin** | NG | NG | NG | NG | NG |
| **Black Guillemot** | NG | NG | NG | NG | NG |
| **Parakeet Auklet** | NG | NG | NG | NG | NG |
| **Least Auklet** | NG | NG | NG | NG | NG |
| **Crested Auklet** | NG | NG | NG | NG | NG |
| **Kittlitz's Murrelet** | NG | NG | NG | NG | NG |
| **Black-legged Kittiwake** | NG | NG | NG | NG | NG |
| **Short-Tailed Shearwater** | NG | NG | NG | NG | NG |
| **Northern Fulmar** | NG | NG | NG | NG | NG |
| **Pelagic Cormorant** | NG | NG | NG | NG | NG |
| **Glaucous Gull** | NG | NG | NG | NG | NG |
| **Ivory Gull** | NG | NG | NG | NG | NG |
| **Ross's Gull** | NG | NG | NG | NG | NG |
| **Sabine's Gull** | NG | NG | NG | NG | NG |

| Species | Vessel Traffic | Vessel Noise | Seismic Noise | Bird/Ship Collisions | Cumulative Effects |
|---|---|---|---|---|---|
| **Arctic Tern** | NG | NG | NG | NG | NG |
| **Pomarine Jaeger** | NG | NG | NG | NG | NG |
| **Parasitic Jaeger** | NG | NG | NG | NG | NG |
| **Long-Tailed Jaeger** | NG | NG | NG | NG | NG |
| **Red-Necked Phalarope** | NG | NG | NG | NG | NG |
| **Red Phalarope** | NG | NG | NG | NG | NG |

Note: NG = negligible, MN = minor, MO = moderate, MJ = major
Determinations are based on existing analyses in USDOI, MMS, 2006b and USDOI, MMS, 2007b, and incorporate more recent information from other sources, as appropriate.

**Table 4-3 Effects level determination results for waterfowl species that occur in the Chukchi Sea Planning Area.**

| Species | Vessel Traffic | Vessel Noise | Seismic Noise | Bird/Ship Collisions | Cumulative Effects |
|---|---|---|---|---|---|
| **Common Eider** | NG | NG | NG | MN | MN |
| **Spectacled Eider** | NG | NG | NG | MN | MN |
| **Steller's Eider** | NG | NG | NG | MN | MN |
| **King Eider** | NG | NG | NG | MN | MN |
| **Northern Pintail** | NG | NG | NG | NG | NG |
| **Red-Breasted Merganser** | NG | NG | NG | NG | NG |
| **Long-tailed Duck** | NG | NG | NG | MN | MN |
| **Black Scoter** | NG | NG | NG | NG | NG |
| **White-Winged Scoter** | NG | NG | NG | NG | NG |
| **Greater Scaup** | NG | NG | NG | NG | NG |
| **Lesser Snow Goose** | NG | NG | NG | NG | NG |
| **Greater White-Fronted Goose** | NG | NG | NG | NG | NG |
| **Canada Goose** | NG | NG | NG | NG | NG |
| **Pacific Black Brant** | NG | NG | NG | NG | NG |
| **Tundra Swan** | NG | NG | NG | NG | NG |
| **Pacific Loon** | NG | NG | NG | NG | NG |
| **Red-Throated Loon** | NG | NG | NG | NG | NG |
| **Yellow-Billed Loon** | NG | NG | NG | NG | NG |

Note: NG = negligible, MN = minor, MO = moderate, MJ = major
Determinations are based on existing analyses in USDOI, MMS, 2006b and USDOI, MMS, 2007b, and incorporate more recent information from other sources, as appropriate.

Recent BO's (FWS, 2009) limits the use of high intensity shipboard lights to critical operations for safety, lessening the chance of attracting or disorienting birds. Most bird species are likely to avoid ongoing seismic surveys (Statoil, 2010b); accordingly, the BOEMRE (USDOI, MMS, 2006a; 2007b) concluded many bird species would not occur near the survey.

### 4.4.3. Fish, Essential Fish Habitat, and Lower Trophic Species

More than 66 species of fish have been documented in the northeastern Chukchi Sea (Barber et al., 1997; Statoil, 2010b). These include marine fish (largely restricted to marine habitats) and diadromous (migratory) fish that utilize both marine and freshwater habitats. Most of the literature that is available on Arctic fish is related to adult fish in the nearshore environment during the open-

water season and addresses general distribution and abundance. Information regarding discrete populations, migration, offshore occurrence and life history of most fish species in the U.S. Arctic is limited. The distribution of marine fish species in the Chukchi Sea is driven by salinity, water depth, and percentage of gravel in the sediments (Barber et al., 1997) and often shifts as seasonal changes occur. There is sufficient information to describe the types of marine fish that would be expected to occur in the survey area. Barber et al. (1994) identified Arctic cod as the most abundant fish species in the survey area. Arctic cod depend on a variety of habitats throughout their life history including nearshore, offshore and sea ice (Craig, 1984; Craig, et al, 1982).

Two Fishery Management Plans apply to the survey area: the Arctic Fishery Management Plan (2009); and the Salmon Fishery Management Plan for Coastal Alaska (1990). EFH for Arctic Cod (adult and late juvenile) and the five species of Pacific salmon (adult and late juvenile) extend over the survey area. EFH for Pacific salmon eggs and larvae and the Saffron cod and Opilio crab do not occur in the survey area. The analysis for EFH consultation with NMFS concluded that the proposed seismic survey activities are expected to have negligible effects on EFH.

Benthic and epibenthic organisms are diverse and abundant in the survey area. The northeastern quadrant of the Chukchi Sea generally supports a higher biomass of benthic organisms than other areas of the Chukchi Sea (Grebmeier and Dunton, 2000).

Hard-bottom communities are aggregations of macrophytic algae (large kelps), benthic microalgae, and benthic invertebrates associated with rocks and other hard substrate. No kelp beds, hard-bottom communities, or other special benthic habitats are known to occur in the survey area or have been identified in nearby areas.

Table 4-4 shows the more common fish and invertebrate species expected to occur within the survey area and the expected level of effects of seismic surveys on these species.

**Table 4-4 Effects level determination results for fish and invertebrate species that regularly occur in the Chukchi Sea Planning Area.**

| Species | Vessel Traffic | Vessel Noise | Seismic Noise | Cumulative Effects |
|---|---|---|---|---|
| **Arctic Cod** | NG | NG | NG | NG |
| **Saffron Cod** | NG | NG | NG | NG |
| **Sculpin** | NG | NG | NG | NG |
| **Staghorn Sculpin** | NG | NG | NG | NG |
| **Bering Flounder** | NG | NG | NG | NG |
| **Warty Sculpin** | NG | NG | NG | NG |
| **Hamecon** | NG | NG | NG | NG |
| **Walleye Pollock** | NG | NG | NG | NG |
| **Ribbed Sculpin** | NG | NG | NG | NG |
| **Capelin** | NG | NG | NG | NG |
| **Wattled Eelpout** | NG | NG | NG | NG |
| **Pacific Herring** | NG | NG | NG | NG |
| **Slender Eelblenny** | NG | NG | NG | NG |
| **Canadian Eelpout** | NG | NG | NG | NG |
| **Eelpout** | NG | NG | NG | NG |
| **Sturgeon Poacher** | NG | NG | NG | NG |
| **Pacific Cod** | NG | NG | NG | NG |
| **Variegated Snailfish** | NG | NG | NG | NG |
| **Butterfly Sculpin** | NG | NG | NG | NG |
| **Hookear Sculpin** | NG | NG | NG | NG |
| **Sandlance** | NG | NG | NG | NG |

| Species | Vessel Traffic | Vessel Noise | Seismic Noise | Cumulative Effects |
|---|---|---|---|---|
| **polychaetes** | NG | NG | NG | NG |
| **echinoderms** | NG | NG | NG | NG |
| **sipunculids** | NG | NG | NG | NG |
| **bivalves** | NG | NG | NG | NG |
| **amphipods** | NG | NG | NG | NG |
| **Opilio crab** | NG | NG | NG | NG |
| **copepods** | NG | NG | NG | NG |
| **euphausids** | NG | NG | NG | NG |

Note: NG = negligible, MN = minor, MO = moderate, MJ = major
Determinations are based on existing analyses in USDOI, MMS, 2006b and USDOI, MMS, 2007b, and incorporate more recent information from other sources, as appropriate.

Pelagic schooling species, such as Arctic cod and salmon are highly mobile and would likely avoid areas where seismic survey sound sources are active. Sedentary and epibenthic-obligated fish would likely experience a higher level of effects from seismic activities because of their limited mobility.

Studies conducted during the past ten years have indicated there may be adverse effects from seismic survey sound on certain developmental stages of lower trophic species such as snow crabs. Available information does not indicate that these effects would occur at a population level, and so would most likely be negligible.

Marine seismic streamers do not physically disrupt the benthic habitat and therefore are not expected to cause direct or long-lasting alteration of benthic habitat or to invertebrate populations in the survey area of the Chukchi Sea.

Seismic streamers may entrain pelagic biota, however, the degree of entrainment and the risk of transporting marine invasive species is relatively low when compared to other types of vessels and vessel activities (Kinloch et al., 2003). Typical organisms entrained are jellyfish, which are removed from the streamer by hand before it is rewound on the drum (Higgenbotham, *pers. comm*., 2010). A marine invasive species can affect can affect a marine ecosystem in various ways and at various trophic levels (Ruis and Hewitt, 2009). The standard practice aboard the *Geo Celtic* is to remove species such as barnacles from hydrophone streamers and other equipment when recovering the gear at the completion of a project (Morillo, *pers. comm.,* 2010), in combination with USCG regulations and inspections,) reduces the transfer of marine species and is expected to minimize the likelihood of introduction of invasive species into the survey area.

## 4.5. Presence and Habitat Use

Population estimates, habitat preferences, and anticipated exposure of species to sound are discussed in this section.

### 4.5.1. Marine Mammals

Results from surveys conducted in nearby areas (Funk et al, 2007; Funk et al, 2008; Funk et al, 2010; Bruggeman, 2009; Nelson et al., 1993; Ljungblad et al., 1988; Ireland et al, 2008; Ireland et al, 2009a; Ireland et al, 2009b; Ireland et al, 2009c) acknowledged the presence of polar bear, five pinnipeds (four ice seal species and the Pacific walrus), and nine cetaceans (four odontocetes - toothed whales, and five mysticetes - baleen whales species) (Funk et al., 2009). Pacific walrus were most often encountered along with ringed seals, bearded seals, and gray whales. Less common were spotted seals, ribbon seals, bowhead whales, and beluga whales, harbor porpoises, killer whales, minke whales, and polar bears (Brueggeman, 2009a; 2009b). Fin and humpback whales are considered rare in the survey area (USDOI, MMS, 2006b and 2008b; NMFS, 2008a and 2008b).

Allen and Angliss (2010) characterize the population estimates for ice seals (ringed, ribbon, bearded, and spotted seals) as unreliable or tentative, noting populations are known to be in the tens to hundreds of thousands across the Arctic. Ice seals are associated with sea ice for all or part of the year. Some species tend to remain near the ice edge during the summer months, but regularly occur in open water. Seals are likely to be widely dispersed as they move through the area as they forage.

**Table 4-5 Population information and habitat use for marine mammal species occurring in the Chukchi Sea Planning Area.**

| Species | Population Size | Area Habitat Preferences During Open Water Season |
|---|---|---|
| **Bearded Seal** | No reliable population estimate in Bering/Chukchi/ Beaufort Seas (Allen and Angliss, 2010). | Over continental shelf with 70 - 90% ice cover and between 20 and 100 nautical miles offshore. May remain near ice, or in open waters. Hanna Shoal is an important feeding ground for bearded seals. |
| **Beluga Whale** | 32,453 Bering/Chukchi/Beaufort Seas stock, 3,710 eastern Chukchi Sea stock, and 18,142 eastern Bering Sea stock (Allen and Angliss, 2010). | Usually follow lead systems and nearshore areas in spring migration. Summer habitat use is segregated with older males using the continental shelf break and heavy ice, while females with young prefer shallower water over the shelf. Belugas migrate westward along the shelf edge during their fall migration. Common in nearshore waters and lagoons where they most likely molt. |
| **Bearded Seal** | There is no reliable estimate for the Alaska stock of bearded seals. Early estimates of the Bering-Chukchi population ranged from 250,000 to 300,000 seals. (Allen and Angliss, 2010) | Circumpolar distribution south into the Northern Pacific Ocean. Shallow waters less than 200 m deep that are at least seasonally ice covered. Areas of broken sea ice and sometimes fast ice areas with access to open waters. |
| **Bowhead Whale** | 1,836 Western Arctic Stock (Allen and Angliss, 2010). | Migrate through the Chukchi Sea in spring and fall, feeding over deep water and in shallow waters in U.S. Beaufort Sea, and to a lesser extent, Chukchi Sea, in summer. An unknown portion of the population migrates westward or southward through or past the proposed survey area in the fall. |
| **Fin Whale** | 5,700 northeast Pacific stock (Allen and Angliss, 2010). | Deep offshore waters. |
| **Gray Whale** | Minimum estimate of 17,752 Eastern Pacific/Stock (Allen and Angliss, 2010). | Waters over continental shelf, nearshore waters, and shallow offshore areas. Hanna Shoal is an important feeding ground for Eastern Pacific gray whales. |
| **Harbor Porpoise** | Unreliable estimate of 48,215 Bering Sea stock (Allen and Angliss, 2010). | Uncommon in open waters of the Chukchi Sea. Usually found over the continental shelf. |
| **Humpback Whale** | Minimum estimate of 732 western North Pacific stock (Allen and Angliss, 2010). | Considered rare and extralimital, Sightings are becoming more common recently. |
| **Killer Whale** | >314 Bering Sea transient stock (Allen and Angliss, 2010). | Open water and ice front, some coastal areas. Uncommon in the eastern Chukchi Sea. More common in waters off Chukotka. |
| **Minke Whale** | No estimates available, no min. abundance estimate available (Allen and Angliss, 2010). | Common but not abundant in the Bering/Chukchi Seas., may penetrate loose ice in summer, migratory. |
| **Narwhal** | Estimate of 60,000-80,000 world wide (Richard et al., 2010). | A few records exist for the Chukchi Sea, Rare and most likely extralimital. Feed in deep waters near continental shelf edge. |
| **Pacific Walrus** | 129,000 in the Bering/Chukchi Seas (Allen and Angliss, 2010) | Seasonally abundant in area. Usually forage over continental shelf. Hanna Shoal is an important feeding ground. |
| **Polar Bear** | 2,000 Chukchi-Bering Stock(Allen and Angliss, 2010 , 1,526 Southern Beaufort Sea Stock (Allen and Angliss, 2010) | Areas of sufficient sea ice cover north of the project location from July-October. Some in open water transiting between sea ice and the coast. Females with young, and sub adults may occur onshore. |
| **Ribbon Seal** | 49,000 in eastern and central Bering Sea (Allen and Angliss, 2010). | Pelagic waters in the Bering and Chukchi Seas. |
| **Ringed Seal** | Unreliable estimate of 249,000 in Bering/Chukchi Seas (Allen and Angliss, 2010). | Shallow waters over continental shelf. |

| Species | Population Size | Area Habitat Preferences During Open Water Season |
|---|---|---|
| **Spotted Seal** | Unreliable estimate of 59,214 Bering/Chukchi Seas (Allen and Angliss, 2010). | Seasonal visitor to Beaufort Sea. Shallow waters over continental shelf. Occupy terrestrial haul outs in summer, including Kasegaluk Lagoon. |

Source: Information sources are USDOC, NMFS (2008a; 2008b; and 2009b) and USDOI, FWS (2007; 2008; and 2009), unless otherwise noted.

Also dependent upon available sea ice are walrus and polar bears. Partial counts indicated a minimum of 129,000 walrus in the Bering and Chukchi Seas (Allen and Angliss, 2010), but a more accurate population-wide estimate is not available. Pacific walrus remain along the ice edge for much of the year, with most males migrating to terrestrial haulout sites along the coast in summer. Females and calves remain along the ice edge until sea ice retreats north of the continental shelf. Then females and calves move to terrestrial haul out sites along the coast of the Chukchi Sea. Polar bears prefer to remain with the sea ice using it as a resting or hunting platform during summer months, but may be found transiting the open water after sea ice disappears from the region.

From July to October bowhead whale feeding concentrations occur in the Canadian Arctic and near Point Barrow or Wrangel Island (Figure A-8). Unknown numbers pass through the proposed survey area as they migrate from the Beaufort Sea to Wrangel Island or to the Chukotka coastal waters. Although data are preliminary, results from recent tagging projects (Quakenbush, 2010) indicate varied movements of migrating bowhead whales in the Chukchi Sea.

Gray whales are found in shallow nearshore waters or shallow offshore areas, such as Hanna Shoal where they feed on benthic organisms (Figure A-9).

In recent years, the sea ice edge has retreated north of the proposed survey area by mid to late July (Statoil, 2009a; Polar Research Group, 2010).

Hanna and Herald Shoals have the highest gravel concentration of surface sediments near the survey area. These shoals are important feeding grounds for bottom-feeding animals, such as bearded seals, walrus, and gray whales because of their high benthic biomass and shallow depth (Statoil, 2010a; Blanchard, Nichols, and Parris, 2010; Brueggeman, 2009b). Existing information is adequate for describing ice seal, gray whale, and walrus habitat use, and site specific information available in existing NEPA documents (USDOI, MMS, 2006b; 2007b) and Statoil (2010b).

The 3D survey area is located more than 8 mi from Hanna Shoal; however it is in known gray whale, walrus, and seal feeding habitat. Animals moving to, from, or between Hanna and/or Herald Shoals may use the survey area.

The presence and abundance of each species of marine mammal within the survey area depends upon factors such as water depth, time of year, and the sea ice presence. Depth preference varies between species. The presence of ice in the prospect areas has varied greatly in past years (Polar Research Group, 2010), and the prevalence of ice in the vicinity of Statoil's 3D/2D seismic surveys would have a direct bearing on the number of ice-associated marine mammals, particularly polar bears, ice seals, and Pacific walrus that may be present during surveys.

Marine mammals are federally protected under the Marine Mammal Protection Act (MMPA). There are no state-listed marine mammal species of special concern within the northeastern Chukchi Sea area. Polar bears, bowhead whale, humpback whale, and fin whale are listed under the ESA. Pacific walrus, ringed seals, and bearded seals have been proposed for protected status under the ESA.

### 4.5.2. Birds

Bird habitat use in the northeastern Chukchi Sea was studied by Divoky (1987) from mid-July through mid-October in the 1970's and 1980's. His studies found three species of jaegers (pomarine,

parasitic, and long-tailed) were common in the Chukchi Sea until late September and dispersed throughout his study areas. Encounters with gulls varied by species and time throughout the July-October time frame.

Glaucous gulls were found to be present in all areas and ivory gulls were common to abundant in areas where ice was present, including the area of the Burger prospect from late September until the end of the observations on October 12 (Divoky, 1987). The lack of ice during his surveys likely had an effect on the number of ivory gull sightings. Ross's gulls became common in late September at the ice edge, though small numbers were seen well south of the ice, but they were found over most of his survey area and would be expected in the area of Statoil's survey.

Black-legged kittiwakes were common throughout most of the Divoky (1987) survey area in the 1970's - 1980's, including the area of the Burger prospect, from mid-July until late September. Densities increased from 1 to more than 2 birds/sq mi from late August to early September and decreased after as they left the Chukchi Sea (Divoky, 1987).

Sabine's gulls and arctic terns were rarely found in the pelagic Chukchi Sea; most observations were within 29 mi (46 km) from shore (Divoky, 1987). The lack of offshore sightings indicates migration likely occurs landward of the 66 ft (20 m) isobath. Divoky (1987) reported alcids (murres, auklets, murrelets, and puffins) were commonly encountered during the July-October period, but densities varied by species and time.

Murres were most abundant in the southern and south central areas of the Chukchi Sea, and less abundant in the northeastern Chukchi Sea (Divoky, 1987). Murre sightings decreased after August 20 as they migrated south. Black guillemots were regularly found in low densities in the central and northern Chukchi Sea when ice was present and were common in offshore areas during July and August. Parakeet auklets were uncommon until late August when they temporarily became common in the southern Chukchi Sea, becoming uncommon again in late September (Divoky, 1987).

Crested auklets move from the Bering Sea into the central Chukchi Sea in late August and early September; they were regularly encountered from August 27 into the first half of October. However, crested auklets were encountered in patches, likely reflecting the availability of zooplankton (Divoky, 1987). He found small numbers of least auklets in the central Chukchi Sea after late September and few after October 1. Tufted puffins occurred in the central and southern Chukchi Sea but only regularly found in the southern Chukchi Sea (Divoky, 1987). Few horned puffins occurred in the central Chukchi Sea in August and numbers increased in September after the breeding season (Divoky, 1987). Most horned puffins in the central Chukchi Sea were observed near the Cape Lisburne. Puffins were not observed during recent studies in the vicinity of Shell's Burger prospect (Figure A-8) near the proposed survey area (Gall and Day, 2009).

Recent surveys conducted at Shell's nearby prospects (Figure A-7) during July-October 2008 (Gall and Day, 2009), identified Pacific loon, northern fulmar, short-tailed shearwater, black-legged kittiwake, glaucous gull, thick-billed murre, least auklet, and crested auklet as the bird species most commonly encountered. Generally birds were more numerous in early fall, and less numerous in late summer or late fall. Short-tailed shearwaters were the most numerous species at both sites with an average density of 40 birds/km$^2$ in the area of Shell's Klondike prospect in early fall, and 32 birds/km$^2$ in the area of Shell's Burger prospect in early fall (Gall and Day, 2009). During surveys conducted as part of the BOEMRE-funded COMIDA (Chukchi Offshore Monitoring in Drilling Area) studies from mid-July through mid-August in 2009 no listed species were observed and the highest bird densities occurred in the nearshore waters and at Hanna Shoal (Grebmeier, 2009).

Northern fulmars were (Divoky, 1987; Gall and Day, 2009) present in the central Chukchi Sea before late August, and became more common from late August to mid-September and absent after late September. Shearwaters were common to abundant in the Chukchi Sea during the late August to late

September ice retreat and their distribution appears to follow zooplankton abundance and distribution (Divoky, 1987; Gall and Day, 2009).

**Table 4-6 Population information, density, and habitat use for bird species occurring in the Chukchi Sea Planning Area.**

| Species | Population Size | Range of Estimated Densities[A] | Area Habitat Preferences During Open Water Season |
|---|---|---|---|
| **Black-Legged Kittiwake** | Estimate of 1,322,000 in Alaska, (FWS, 2006). | 0.2-17.7 birds/km$^2$ | Nest southeast Alaska north to Point Hope; winters at sea Bering Sea, Gulf of Alaska |
| **Crested Auklet** | 2.9 million in North America, (FWS, 2006). | 0.0-0.3 birds/km$^2$ | Nest Aleutian / Bering Sea islands. Non-breeding in Chukchi. Winters offshore. |
| **Glaucous Gull** | Population numbers are poorly known, but estimate 100,000 in Alaska (FWS, 2006). | 0.1-4.2 birds/km$^2$ | Colonial nester along most of coastline, most common gull |
| **Kittlitz's Murrelet** | 20,000 in Alaska (90% of the world's population) (FWS, 2009) | uncommon, no observations (Grebmeier, 2009) | Occur at sea in substantial numbers along the ice edge in late summer and fall, particularly in the central Chukchi Sea. |
| **Least Auklet** | Difficult to census, estimates of 5.5-9 million in North America, (FWS, 2006). | 0.0-0.1 birds/km$^2$ | Nest AK Peninsula/Aleutians - Bering Sea islands. Non-breeding in Chukchi. Winters offshore. |
| **Long-tailed Ducks** | Estimate of 116,400 on Arctic Coastal Plain (Sea Duck Joint Venture, 2003a). | Maximum density of 2.2/km2 in northern Chukchi Sea (Sept.-Oct.) (Divoky, 1987). | Nearshore areas in 20 meter isobath. Most feeding is in water <9 m (30 ft) deep, but dives >60 m (200 ft) do occur. Nest inland and on Arctic coast near water. Molting occurs in coastal areas. (Sea Duck Joint Venture, 2003b) |
| **Northern Fulmar** | 2.1 million breeding birds in North America, (FWS, 2006). | 0.1-1.1 birds/km$^2$ | Nests on Alaska Peninsula and Bering Sea islands. Winters at sea – Bering Sea, Gulf of Alaska |
| **Pacific Loon** | 39,945 for the Arctic coastal plain survey area (FWS, 2006) | 0-4.9 birds/km$^2$ | Breeds on freshwater tundra lakes. Rests on open ocean during migration. Winters on ocean waters near coast, and sometimes on bays or estuaries |
| **Short-Tailed Shearwater** | Estimate 23 million breeding birds world-wide, (FWS, 2006). | 0.0-31.6 birds/km$^2$ | Most at sea in south Bering Sea, Gulf of Alaska, fewer in Chukchi & Beaufort Sea |
| **Spectacled Eider** | 5,047-7,368 nest on Alaska's North Slope (Larned et al, 2009) | rare | Currently breeding distribution includes the central coast of the Yukon-Kuskokwim (Y-K) Delta, the Arctic Coastal Plain of Alaska, and the Arctic Coastal Plain of Russia (USDOI, FWS 2005). After nesting, spectacled eiders move to coastal waters where they migrate to molting areas. |
| **Steller's Eider** | 100-866 on Alaska's North Slope (USDOI, FWS, 2009) | rare | Coastal and offshore areas provide habitat for Steller's eiders. The Alaska-breeding population is primarily confined to the Arctic Coastal Plain of Alaska's North Slope, with a distinguished concentration around Pt. Barrow (FWS, 2002c) |
| **Thick-Billed Murre** | Estimates of 2.2 million birds in Alaska (USDOI, FWS, 2006). | 0.0-0.1 birds/km$^2$ | Nest SE Alaska to Cape Lisburne. Winter in open water Bering Sea, Gulf of Alaska |
| **Yellow-Billed Loon** | 3,000-4,000 in Alaska (USDOI, FWS, 2009). | rare | Breeds on coastal and inland low-lying tundra in association with fish-bearing lakes, winters in coastal waters. |

Note: [A]Late summer, early fall, late fall (from nearby Burger area, 2008 surveys).
Source: USDOI, MMS, 2006b; 2007b and USDOI, FWS, 2007; 2008; 2009, unless otherwise noted.

Based on the available literature, northern fulmars; short-tailed shearwaters; red and red-necked phalaropes, glaucous, ivory, and Ross's gulls; kittiwakes; pomarine, parasitic, and long-tailed jaegers;

common and thick-billed murres; black guillemots; and least and crested auklets can be expected to occur in the vicinity of Statoil's survey area during the July-November time frame. These species often forage in the pelagic Chukchi Sea. Loons and sea ducks are typically found in nearshore waters where depths are shallower, but occasionally they can be found in pelagic habitat. Overall, bird densities in offshore waters are lower than in nearshore waters Divoky (1987), as well as Gall and Day (2009).

Surveys along 35 x 35 mi (56 x 56 km) transects including Shell's Burger and Klondike prospects (Figure A-8) area were performed by ABR, Inc. from July 23 to October 12, 2008 (Gall and Day, 2009). Comparisons between the ABR data and data collected by Divoky are difficult. The ABR data was collected during a single year, the studies have poor spatial overlap, and survey designs differed as did sample sizes (Gall and Day, 2009). Both studies found shearwaters, crested auklets, black-legged kittiwakes, northern fulmars, and thick-billed murres to be the most abundant species, accounting for 65% of the observations (Gall and Day, 2009).

Of the 31 bird species recorded during surveys eight were detected commonly enough to generate reliable estimates of density (Gall and Day, 2009). Densities for the eight most-abundant species differed substantially between seasons; however, seasonal patterns of abundance differed by species. Thick-billed murres were most numerous in late summer and early fall, while short-tailed shearwaters, northern fulmars, black-legged kittiwakes, and Pacific loons were most numerous in early fall; glaucous-gulls and least auklets were most numerous in both early and late fall; and crested auklets were most numerous only in late fall (Gall and Day, 2009).

### 4.5.3. Fishes and Invertebrates

Most of the proposed survey area overlies the relatively homogeneous ocean-bottom found in the mid-shelf region of the Chukchi Sea. Seafloor surveys conducted in the area have not revealed any unusual or special benthic features or communities. Similar surveys conducted at Shell's Popcorn prospect found benthos densities to be similar but lower than at Shell's Burger and Crackerjack prospects (Finney, 1989).

There are no ESA-listed marine fish or invertebrate species known to be present in the proposed survey area. As summarized in Section 4.4.3 and Table 4-4, the PEA and Sale 193 EIS (USDOI, MMS, 2006b; 2007b) concluded negligible effects from seismic surveys to marine fish and invertebrate species in the Arctic OCS. The 2010 supplemental EFH consultation NMFS concluded negligible to minor effects to EFH from Statoil's proposed seismic activities. Consequently, fish, EFH, and invertebrates will not be assessed further in this EA.

## 4.6. Species Carried into Effects Analysis

Tables 4-1 through 4-4 provides information regarding effecter-specific and cumulative levels of effects that can be expected for marine mammal, bird, and fish species in the northeastern Chukchi Sea. This information was reviewed to determine which species are most likely to be encountered based (based on habitat use, and presence), a species' ESA status, the expected cumulative level of effects that would apply to each of these species, and the effecters needing to be analyzed in Section 5 (summarized in Table 4-7). The information presented in Table 4-7 was then reviewed to identify all species that; a) had an ESA status, b) MMPA status, or c) would experience a minor level of effects or greater. The results from the Table 4-7 review were then summarized in Table 4-8. Those species featured in Table 4-8 that were not excluded from further analysis were carried forward to Section 5.2 for a more detailed analysis.

The literature indicates bowhead whales predominately feed near Point Barrow or Wrangel Island in the Chukchi Sea between July and October; and unknown numbers pass through the survey area as they depart the Beaufort Sea (Quakenbush, 2010) peaking in late September and early October.

Gray whales feed in shallow nearshore and offshore areas of the Chukchi Sea. Ice seals are widely dispersed offshore as are the remaining cetaceans. Walrus and polar bear are likely to remain on the sea ice north of the survey area, with Pacific walrus occurring onshore later in the summer-fall period. Tagging studies indicate that walrus forage in shallow waters throughout the area during this time period. Hanna Shoal can be a foraging area for gray whales and for Pacific walruses at certain times in the year (USGS, 2007; 2008).

**Table 4-7 Northeastern Chukchi Sea species listed under the ESA and MMPA, and those that may occur in the proposed survey area during the open water season.**

| Marine Mammal Species (All marine mammals have MMPA status) | ESA Status | Cumulative Level of Effects | Effecters |
|---|---|---|---|
| **Bearded Seal** | C | NG | None |
| **Beluga Whale** | NS | NG | None |
| **Bowhead Whale** | E | NG | Vessels, Airguns |
| **Fin Whale** | E | NG | Vessels, Airguns |
| **Gray Whale** | NS | MN | Vessels, Airguns |
| **Harbor Porpoise** | NS | NG | Vessels |
| **Humpback Whale** | E | NG | Vessels, Airguns |
| **Killer Whale** | NS | NG | Vessels |
| **Minke Whale** | NS | NG | Vessels, Airguns |
| **Pacific Walrus** | P | MN | Vessels, Airguns |
| **Polar Bear** | T | NG | Vessels |
| **Ribbon Seal** | NS | NG | Vessels |
| **Ringed Seal** | C | NG | Vessels, Airguns |
| **Spotted Seal** | NS | NG | Vessels, Airguns |
| **Bird Species** | **ESA Status** | **Level of Effects** | **Effecters** |
| **Black-legged Kittiwake** | NS | NG | Vessels |
| **Crested Auklets** | NS | NG | Vessels |
| **Glaucous Gulls** | NS | NG | Vessels |
| **Kittlitz's Murrelet** | C | NG | Vessels |
| **Least Auklet** | NS | NG | Vessels |
| **Long-tailed Duck** | NS | MN | Vessels |
| **Northern Fulmar** | NS | NG | Vessels |
| **Pacific Loon** | NS | NG | Vessels |
| **Short-tailed Shearwater** | NS | NG | Vessels |
| **Spectacled Eider** | E | NG | Vessels |
| **Steller's Eider** | E | NG | Vessels |
| **Thick-billed Murre** | NS | NG | Vessels |
| **Yellow-billed Loon** | C | NG | Vessels |

Note: NS = No ESA Status, E = Endangered ESA Status, T = Threatened ESA Status, C = Candidate ESA Status, P = Proposed ESA Status, NG = negligible, MN = minor, MO = moderate, MJ = major
Source: BOEMRE (USDOI, MMS, 2006b; 2007b); FWS (USDOI, FWS, 2007; 2008; 2009); Divoky (1987); Gall and Day (2009).

The species most likely encountered in the proposed survey area would be Pacific walrus, ringed and bearded seals, gray whales, bowhead whales, beluga whales, and a very small number of humpback whales, fin whales, killer whales, minke whales and ribbon or spotted seals. Only species protected by the MMPA (all marine mammals), ESA-listed species, ESA-candidate species, and species proposed for ESA listing are analyzed further. Steller's and spectacled eiders were included in the 2009 BO (FWS, 2009) addressing the effects of exploratory activities in the Beaufort and Chukchi Seas on ESA-listed birds. Both species will be included in the bird-strikes analysis below as will yellow-billed loons and Kittlitz's murrelet. Long-tailed ducks will also be analyzed due to their numbers in the Chukchi Sea and their presence in the survey area during certain times of the year.

**Table 4-8 Species included and excluded from subsequent effects analysis.**

| Species | Excluded from further analysis? Yes or No (Y/N) | Reason for Exclusion |
|---|---|---|
| **Marine Mammals** | | |
| **Bearded Seal** | N | -- |
| **Beluga Whale** | N | -- |
| **Bowhead Whale** | N | -- |
| **Fin Whale** | N | -- |
| **Gray Whale** | N | -- |
| **Harbor Porpoise** | N | -- |
| **Humpback Whale** | N | -- |
| **Killer Whale** | N | -- |
| **Minke Whale** | N | -- |
| **Narwhal** | Y | EO |
| **Pacific Walrus** | N | -- |
| **Polar Bear** | N | -- |
| **Ribbon Seal** | N | -- |
| **Ringed Seal** | N | -- |
| **Spotted Seal** | N | -- |
| **Birds** | | |
| **Black-legged Kittiwake** | Y | LE |
| **Crested Auklets** | Y | LE |
| **Glaucous Gulls** | Y | LE |
| **Kittlitz's Murrelet** | N | LE |
| **Least Auklet** | Y | LE |
| **Long-tailed Duck** | N | -- |
| **Northern Fulmar** | Y | LE |

| Species | Excluded from further analysis? Yes or No (Y/N) | Reason for Exclusion |
|---|---|---|
| **Pacific Loon** | Y | -- |
| **Short-tailed Shearwater** | Y | LE |
| **Spectacled Eider** | N | -- |
| **Steller's Eider** | N | -- |
| **Thick-billed Murre** | Y | LE |
| **Yellow-billed Loon** | N | -- |

Note: Y = Yes, N = No, LE = Level of Effects, EO = Extralimital Occurrence, - = not excluded (i.e., included for further analysis).
Source: BOEMRE (USDOI, MMS, 2006b; 2007b), FWS (USDOI, FWS, 2007; 2008; 2009), Gall and Day (2009), Divoky (1987), Ireland et al (2008; 2009a; 2009b), Funk et al, (2007; 2008; 2010), Brueggeman (2009b).

The offshore waters of the proposed survey area are too deep to provide effective habitat for most bird species including Steller's eiders and yellow-billed loons. Humpback and fin whales are believed to be rare visitors to the northern Chukchi Sea, however they may occur in the area and their ESA-protected status necessitates an analysis. Any polar bears encountered are expected to be swimming in the open water towards the coast or searching for ice floes to use as a resting or hunting platform. Groups of Kittlitz's murrelets have been noted in the ocean west of Point Barrow.

## 4.7. Preliminary Screening of Potential Effects to Economics, Public Health, and Subsistence Resources and Activities

In evaluating the potential adverse effects from OCS activities, BOEMRE examines both the magnitude and duration of disruption. For the screening analysis of subsistence activities and sociocultural issues the BOEMRE used the following four categories of impact levels ranging from negligible to high to characterize effects as documented in previous analyses:

**Negligible:**

- Periodic, brief effects that have no consequent effects to subsistence resources or harvests.
- Periodic, brief effects with no measurable effects on normal or routine community functions.
- Periodic, brief effects with no measurable effects on individual or community health.

**Minor:**

- One or more subsistence resources would be affected for up to one year (a harvest season), but none of these resources would become unavailable, undesirable for use, or experience population reductions.
- Sociocultural systems being affected for a period up to one year, but effects would not disrupt normal or routine community functions and could be avoided with proper mitigation.
- Individual or public health is affected for up to one year but not to a level of severity that interferes with the function of individuals or a community.

**Moderate:**

- Although one of more subsistence resources would be unavailable, undesirable for use, or experience population reductions for a period up to 1 year (1 harvest season), with subsistence harvests being affected for that period, the affected subsistence resources and

harvests would be expected to recover completely if proper mitigation is applied or proper remedial action is taken once mitigation is implemented.
- Effects on sociocultural systems would be unavoidable for a period longer than 1 year. Affected normal or routine community functions would have to adjust somewhat to account for impact disruptions, but they would be expected to recover completely if proper mitigation is applied during the life of the proposed action or proper remedial action is taken once the impacting agent is eliminated.
- Individual or public health is affected for greater than one year, but in a manner insufficient to create long-term health issues for individuals or communities.

**High:**

- The affected subsistence resources and harvests would not be expected to fully recover within 1 year, even if proper mitigation is applied during the life of the proposed action, or even if proper remedial action is taken once the impacting agent is eliminated.
- High levels of effects would be considered to be significant impacts.
- One or more important subsistence resources would become unavailable, undesirable for use, or available only in greatly reduced numbers for a period of 1 - 2 years.
- Chronic disruption of sociocultural systems occurs for a period of 2 - 5 years, with a tendency toward the displacement of existing social patterns.
- Effects on sociocultural systems would be unavoidable and normal or routine community functions would experience disruptions to a degree beyond what is normally acceptable. Once the impacting agent is eliminated, affected community functions may retain measurable effects, even if proper remedial action is taken. This would constitute a major impact on sociocultural systems.
- Individual or public health is affected for greater than one year, and long-term health issues for individuals or communities have ensued.

The number of local residents employed for the proposed activities is expected to be small (12 individuals hired as MMOs) (Statoil USA E&P Inc., 2010b) and the effect is expected to be negligible at the community level. The proposed activities would be supported from existing infrastructure located in Nome, and goods and services would be obtained from Dutch Harbor and Nome. These business interactions are expected to have a minor positive effect on the economies of Dutch Harbor and Nome and are not expected to adversely affect community health within these communities, while the economic impacts to North Slope Borough (NSB) communities are expected to be negligible. In terms of Environmental Justice, because the proposed activities are expected to have negligible impacts on subsistence resources, subsistence practices, and sociocultural systems, the proposed activities are expected to have no disproportionate adverse impacts on low-income or minority populations. The proposed activities are not expected to have adverse impacts on the health of the residents of the NSB, Nome, or Dutch Harbor. Therefore, no further analysis of the potential economic or public health effects is necessary.

The NSB Municipal Code (19.20.020 (67)) defines subsistence as:

> "an activity performed in support of the basic beliefs and nutritional needs of the residents of the borough and includes hunting, whaling, fishing, trapping, camping, food gathering, and other traditional and cultural activities."

The sharing, trading, and bartering of subsistence foods structures relationships among communities, while at the same time the giving of these foods helps maintain ties with family members elsewhere in Alaska. The marine and coastal food resources traditionally harvested are whales, seals, walruses, waterfowl, and fish. The subsistence pursuit of bowhead whales has major importance to the communities of Barrow and Wainwright. Some Point Lay men whale with crews from Wainwright, and some Atqasuk men whale with Barrow crews in their traditional subsistence use areas (USDOI,

MMS, 2007b). Point Lay men traditionally hunt only beluga whales but they have recently pursued obtaining a bowhead whale quota for the community. Point Lay took one bowhead whale in the spring 2009 hunt; any future whaling by the community would likely be concluded by early June (USDOI, MMS, 2008a). Most Chukchi Sea communities rely heavily on the harvest of walrus and seals. The beluga whale harvest is the mainstay of the community Point Lay. Barrow is the only community known to traditionally harvest bowhead whales in both the spring and fall.

The subsistence communities closest to the proposed survey area are Barrow 158 mi east, Wainwright 114 mi to the southeast, and Point Lay which is 125 mi south of the proposed 3D survey area. The subsistence areas for these communities are discussed in BOEMRE (USDOI, MMS, 2007b) and several studies (Braund, 2000; Braund and Burnham, 1984; Stephen R. Braund & Associates, 1989a; Stephen R. Braund & Associates, 1989b; and Stephen R. Braund & Associates, 2010). The proposed survey area is far beyond the subsistence use areas for these communities (Braund, 2000; Braund and Burnham, 1984; Stephen R. Braund & Associates, 1989a; Stephen R. Braund & Associates, 1989b; Stephen R. Braund & Associates, 2010; Huntington, 1999; Huntington, H.P. and N.I. Mymrin, 1996; Huntington and Quakenbush, 2009; Huntington and The Communities of Buckland, Elim, Koyuk, Point Lay, and Shaktoolik, 1999: Kassam, K-A.S. and Wainwright Traditional Council, 2001; North Slope Borough, Planning Dept., 1993; USDOI, MMS, 2007a; 2007b) making any measurable impacts to subsistence extremely unlikely. We conclude there will be negligible effects to subsistence activities. Therefore, no further analysis of the potential effects to subsistence activities is necessary.

# 5.0 EFFECTS ANALYSIS

This section provides an assessment of the direct, indirect, and cumulative impacts of those issues and concerns carried forward from Section 4.6 (Table 4-8) for detailed analysis.

## 5.1. Issues or Concerns

The energy emitted from airguns, i.e., the acoustic source for 3D/2D seismic surveys, has the greatest potential to have adverse effects on environmental resources, particularly marine mammals. Vessel traffic, noise, and lights associated with seismic survey source and support vessels might potentially have adverse impacts, particularly on marine mammals and birds. Issues and concerns associated with seismic survey operations have been extensively documented by the scientific community, in government publications, and at scientific symposia.

See Section 4.1 for a description of the issues and concerns identified by technical analysts for consideration in this EA.

## 5.2. Analysis of Effects to Biological Resources from the Proposed Action

The following analyses address the significance of the Proposed Action's potential impacts on appropriate biological resources, considering such factors as the nature of the impact (e.g., habitat disturbance or mortality); the spatial extent (local and regional); temporal and recovery times (years, generations); and the effects of mitigation and any associated mitigation monitoring plan. Impacts to some environmental resources may be measurable, but are not considered significant, because their potential effects and contribution to cumulative effects (additive, synergistic and countervailing) would be minimal and/or brief.

The BOEMRE has determined no unique resources or seafloor habitats occur in the vicinity of the proposed seismic survey area except for Hanna Shoal. The anticipated effects of the proposed action are consistent with those in previous BOEMRE NEPA documents (USDOI, MMS, 2006b; 2007b) and authorizations pursuant to MMPA and ESA.

### 5.2.1. Vessel Traffic and Vessel Noise

The effects of vessel traffic and vessel noises on marine mammals have been fully analyzed in the PEA, Sale 193 EIS, and NMFS IHA (NMFS, 2009b). Those effects are summarized below or hereby incorporated by reference.

#### 5.2.1.1. Pinnipeds

**Seals.** Richardson (1995) found that vessel noise does not seem to strongly affect phocid seals (ice seals) already in the water. Richardson explained seals on haulouts often respond more strongly to the presence of vessels. Since the brief disturbance would occur during the open water season, and seals have a high tolerance to vessels and vessel noise while in the water, the BOEMRE anticipates the proposed action would result in a negligible level of effects to seals.

**Pacific Walrus.** Vessel traffic could disturb walruses at sea and may interrupt the movements or foraging of walrus by temporarily displacing some animals as vessels pass through an area. Such traffic is expected to have a short-term (a few hours to a few days) effect on walrus movements or distributions. Adult walruses and sub-adults have the ability to cover large distances in a relatively small amount of time. Walrus calves with their mothers usually concentrate near haulout sites at areas of residual sea ice or along the Chukchi coasts. However, repeated disturbances from vessel traffic could have energetic costs and has the potential to separate walrus calves from cows although repeated disturbances are unlikely given the survey design. Because of the expected lack of sea ice in most of the survey area during the open water season, and the distance between the survey area and coastal haulout sites, the BOEMRE does not expect many walrus cow/calf pairs to be affected. Because of the brief disturbance and the mitigations incorporated in the proposed activities, including interaction plans (Statoil, 2009b) and use of MMOs, the BOEMRE anticipate a minor level of effects on Pacific walrus from the proposed action.

#### 5.2.1.2. Polar Bears

Seismic operations are proposed for the open water season when there is less than 10% ice cover in the survey area. Any polar bears encountered during the course of the proposed action would most likely be swimming towards shore, pack ice, or between ice floes, and not actively hunting in open water. The disturbance created by the presence and noise of seismic survey ships presents a brief disturbance, without lasting effects. The negligible level of effects from vessel traffic and noise would be further mitigated by implementing Statoil's polar bear interaction plan (Statoil, 2009b), and the use of MMOs on each ship in resulting in a negligible level of effects on polar bears.

#### 5.2.1.3. Cetaceans

The best available information indicates Bowhead, fin, gray, humpback, and minke whales respond to vessel traffic and vessel noise by avoidance. Vessels could strike or entangle (with streamers, gear) whales, causing injury or death. Potential effects of vessel traffic and noise depend on the size, propulsion systems, use, speed, and temporal/spatial relationships to whales, their habitat, and other human activities. The proposed action would occur at a time after the spring whale migrations and ending before or during the fall whale migrations.

In the fall migrating bowhead whales disperse across the Chukchi Sea after passing Point Barrow while gray whales tend to use coastal waters in their migrations, and belugas typically associate with coastal areas or the ice front (Figure A-9). Consequently the proposed action would not interfere with the fall cetacean migrations out of the Chukchi Sea since the survey area lies away from the migration routes used by cetacean species.

The ability of cetaceans to communicate, navigate, and echolocate can be compromised by underwater noises such as those produced by vessel engines and propulsion systems that can mask or interfere with sound reception in whales. Masking is the obscuring of the perception stimulus,

resulting from the presence of a stronger interfering stimulus in the same range (Richardson et al., 1995a; Richardson et al, 1995b). Decibels (dB) are used to describe the strength or "volume" of a sound. The proposed pressure criterion for non-pulsed energy leading to injury is 230 dB re: 1µPa (peak), and the sound exposure level criterion for nonpulse injury was calculated at 215 dB re: 1µPa$^2$-s (Southall et al., 2007). These can result in temporary threshold shifts (TTS), with recovery after minutes or hours, or to permanent threshold shifts (PTS) with no recovery (Gordon et al., 2004; 1998). The sound produced by vessels typically falls within the 128 to 186 dB range (Greene and Moore, 1995).

Frequency sensitivity is also a consideration for marine mammals. Frequencies and frequency sensitivities are described in units of hertz (Hz), kilo-hertz (kHz), etc. (the range of sounds detectable by an animal).

**Odontocetes (belugas, killer whales, harbor porpoises, etc.).** Belugas and other toothed whales seem to be most sensitive to frequencies near or above 10 kHz; sensitivity to frequencies below 10 kHz declines rapidly as frequencies decrease (Cosens and Dueck, 1993). For belugas, detection of vessel noise below 5 kHz appears to be limited by their auditory threshold. Belugas tend to react to sounds when they are just detectable, so their reaction zone is equivalent to their detection zones. Belugas apparently are unable to detect low frequencies beyond a few hundred meters from the source. However, reaction distances for belugas will be larger when industry noise contains high frequency components (Cosens and Dueck, 1993). Vessels typically produce sounds in the lower frequency bandwidths from 156 - 186 Hz with decibel levels ranging from 128 - 186 dB re: 1µPa$^2$-m (Greene and Moore, 1995).

Some belugas have an aversion to anthropogenic noise particularly outboard-powered boat traffic (Huntington, 1999; Huntington and Mymrin, 1996). Belugas may be capable of habituation to considerable noise when it is not associated with hunting (Huntington, 1999). The PEA and Sale 193 EIS concluded belugas could react to the approach of vessels at great distances. However, Statoil (2009a) proposes to conduct their seismic surveys during the open water season when sea ice has retreated far north of the proposal area. Consequently most belugas will be molting and feeding in coastal waters such as Kasegaluk Lagoon, or near the ice front, north of the survey area. Due to the low likelihood of encountering belugas, slow survey speeds, ice avoidance, and the mitigation plans (Statoil, 2010c) in place, BOEMRE anticipates a negligible level of effects to belugas from vessel traffic.

The rarity of killer whales in the survey area leads us to conclude that there is a very low likelihood of encountering an individual, let alone any groups, during the survey. Toothed whales such as killer whales and porpoises are sensitive to high frequency noise, not the mostly low-frequency noise produced by vessel traffic. Therefore, killer whales and porpoises are expected to experience negligible levels of effects from vessel traffic.

**Mysticetes (bowhead whale, fin whale, gray whale, humpback whale, minke whale, etc.).** From a behavioral perspective, increased noises, including vessel noise could mask whale vocalizations interfering with whale communications, or alter natural behaviors (i.e., displacement from migration routes or feeding areas; disruption of feeding, resting, or nursing). Behavioral impacts may vary by gender, reproductive status, age, accumulated hearing damage, type of activity engaged in at the time, group size, and/or whether the animal has heard the sound previously (e.g., Olesiuk et al., 1995; Richardson et al., 1995a; Kraus et al., 1997; NRC, 2003, 2005). For example, mysticete females with calves show a heightened behavioral response to seismic noise (Henley and Ryback, 1995; McCauley et al., 2000). In other studies on feeding bowhead responses to seismic activity some animals ceased feeding and others continuing feeding (Fraker, Richardson, and Würsig, 1995; Richardson, Wells, and Würsig, 1985).

Gray whales are low-frequency hearing specialists, with an auditory range starting at 10 Hz and possibly extending to 30 kHz (Ketten, 1998). Erbe (2002) inferring from gray whale vocalizations, suggested they would be sensitive to frequencies between 20 Hz and 4.5 kHz, with their greatest sensitivity occurring in the 20 Hz - 1.2 kHz range. Clicks were reported up to 10 kHz, with main frequencies between 1.4 and 4 kHz. The lowest response threshold reported was 82 - 95 dB at 800 Hz (Erbe, 2002). Other studies suggest gray whales habituate to whale-watching vessels and may even approach them. Gray whales showed no evident avoidance to underwater playback of outboard engine noise, but call rates and call structure changed with exposure to actual boats, perhaps to compensate for outboard noise masking their calls (Richardson et al., 1995b).

In comparison, minke whales appear most sensitive to sound between 100 and 200 Hz, with good sensitivity extending from 60 Hz - 2 kHz. High-frequency clicks were analyzed in two studies, indicating some sensitivity between 4 and 7.5 kHz, up to 20 kHz (Erbe, 2002). BOEMRE anticipates the effects to be generally similar to those noted for other mysticete whales because of shared morphological characteristics, and similar biological needs. A more accurate level of effects determination cannot be made since little is known regarding minke whale-habitat use, distribution, movements, or productivity in the Chukchi Sea.

Bowhead whales react to the approach of vessels at greater distances than they react to most other industrial activities. According to Richardson and Malme (1993), most bowheads begin to quickly swim away when vessels approach rapidly and directly. This avoidance may be related to the fact that bowheads have been commercially hunted within the lifetimes of some individuals within the population, and they continue to be hunted for subsistence throughout portions of their range. Avoidance usually begins when a rapidly approaching vessel is 1 - 4 km (0.62 - 2.5 mi) away. A few whales may react at distances from 5 - 7 km (3.1 - 4.3 mi), and a few whales may not react until the vessel is <1 km (<0.62 mi) away. Received noise levels as low as 84 dB re 1 µPa or 6 dB above ambient may elicit strong avoidance of an approaching vessel at a distance of 4 km (2.5 mi) (Richardson and Malme, 1993).

In the Canadian Beaufort Sea, bowheads observed in vessel-disturbance experiments began to orient away from an oncoming vessel at a range of 2 - 4 km (1.2 - 2.5 mi) and to move away at increased speeds when approached closer than 2 km (1.2 mi) (Richardson and Malme, 1993). Vessel disturbance during these experimental conditions temporarily disrupted activities and sometimes social groups, scattering as vessels approached. Reactions to slow-moving vessels, especially those that do not approach directly, are much less dramatic. Bowheads are often more tolerant of vessels moving slowly or in directions other than toward them. Fleeing from a vessel generally stopped within minutes after the vessel passed, but scattering may persist for hours. After some disturbance incidents, at least some bowheads returned to their original locations (Richardson and Malme, 1993). Some whales may exhibit subtle changes in their surfacing and blow cycles, while others appear to be unaffected. Bowheads actively engaged in social interactions or mating may be less responsive to vessels.

Vessel activities associated with exploration are not expected to disrupt the bowhead fall migration, and small deflections in individual bowhead-swimming paths and a reduction in use of possible bowhead-feeding areas near surveys would not result in major adverse effects on the species (NMFS, 2008a; 2008b; 2009b). Greene (2003) concluded that a broadband source level of 171 dB re 1µP at 1 m is a reasonable and potentially a conservative (higher than the likely actual source level) estimate to use as a source level for the smaller vessels used by ConocoPhillips in its demobilization activities." After evaluating alternative models for estimating transmission loss, and considering likely ambient noise levels (based on data collected in 1996 offshore of Northstar), Greene (2003) applied the estimated source level to what he viewed as the most reasonable sound-propagation-loss model to estimate the received level of sound at four distances (0.1 - 63 km [0.6 - 39.1 mi]) from the tug and barge. He estimated the following received sound levels at specific distances: 131 dB re 1 µPA at

0.1 km (0.6 mi); 111 dB re 1 µPA at 1.0 km (0.62); 102 dB re 1 µPA at 2.8 km (1.7 mi); and 75 dB re 1 µPA at 63 km (39 mi). Given the assumptions that were required about hearing and the approximations regarding sound transmission loss, Greene (2003) stated it would be best to consider the estimates of received sound levels as "guidelines." In addition to acting as a source of noise and disturbance, marine vessels potentially could strike bowhead, fin, gray, and humpback whales, causing injury or death. Available information indicates that current rates of vessel strikes of bowheads are low and there have been no known fin or humpback whale strikes in the Alaskan Arctic (USDOI, MMS, 2006b; 2007b).

Similar data regarding humpback and fin whale-specific responses to vessel traffic and vessel noise in the Arctic is unavailable; however, BOEMRE assumes that their responses to be similar to bowhead responses due to morphological and environmental similarities, but differences might exist. Few fin or humpback whales are expected to occur in the eastern Chukchi Sea, and even fewer are anticipated to occur in the proposed survey area.

The presence of MMO's onboard the vessels and a general slow speed of the survey vessel (4 - 5 kts) during operations is expected to prevent ship-whale collisions. While conducting seismic surveys, the propagation of noise from seismic activity would temporarily edge most if not all cetaceans out of the immediate area of effects for vessel activity. Moreover, the noises produced by discharging airguns would surpass and/or partially mask noises produced by vessels engaged in the survey.

The small chance of encountering bowhead, humpback, fin, or minke whales greatly lowers the potential impact of the proposed action on those species. In the unlikely event of an encounter with one of these species, the approaching and repetitive noise of discharging airguns would likely deflect any individuals from the area of effects until the seismic survey vessel has passed. Consequently, BOEMRE anticipates a negligible level of effects from vessel traffic and vessel noise to all cetacean species except gray whales, based on gray whale presence and feeding in the vicinity of Hanna Shoal. For gray whales a minor level of effects is anticipated because of a marked gray whale presence near Hanna Shoal.

### 5.2.2. Bird-Strikes (Collisions)

The effects of bird-ship collisions have been fully analyzed in the PEA, Sale 193 EIS, and NMFS IHA (NMFS, 2009b). Those effects are summarized below or incorporated by reference.

Population information, density, and habitat use for bird species likely to occur in the survey area are shown in Table 4-6. The birds likely to occur in the survey area are components of larger populations with ranges that extend beyond the boundaries of the proposed survey area. The greatest potential for collision occurs where structures are in nearshore or coastal areas where birds, particularly eiders and long-tailed ducks, are known to migrate.

No bird strikes between vessels and spectacled or Steller's eider are expected for the proposed activities (Statoil, 2010b). The FWS (2009) concluded with an annual overestimate of 0.235 (rounded up to 1) Steller's eider and 5.27 (rounded up to 6) spectacled eider takes via collision for all activities within Lease Sale Area 193 in the Chukchi Sea. The FWS estimates were for the maximum amount of permissible exploratory activity and greatly overestimate the probability of ESA-listed birds colliding with individual seismic survey vessels. Because the proposed survey is planned for an area far away from the known preferred habitat of ESA-listed eiders, yellow-billed loons, and Kittlitz's murrelets, the collision probabilities would be less than what was analyzed by the FWS (2009).

The 3D survey area lies more than 114 mi north of Wainwright and 158 mi northwest of Barrow, and unlike the Northstar and Endicott projects, far away from any migration or concentration areas for Steller's eiders (Figure A-11), yellow-billed loons (Figure A-12), or long-tailed ducks. During the survey period spectacled eiders concentrate in Ledyard Bay (Figure A-2) and coastal waters from 12 - 30 mi (19 - 48 km) offshore (Petersen, Larned, and Douglas, 1999). Long-tailed ducks and yellow-

billed loons are usually found at their inland breeding areas during this timeframe or in the case of non-breeding individuals, coastal waters. Very few if any threatened eiders are expected to use the proposed survey area because of the water depths and the proposed survey area's distance offshore. No threatened eiders were observed in the vicinity of the nearby Burger Prospect during intensive bird surveys carried out in the 2008 open water season (Gall and Day, 2009).

Bird ship collisions could result in injury or death. While an individual collision could be mortal to the individual, such events are unlikely to approach population-level significance effects. Statoil's 3D/2D seismic survey in the Chukchi Sea is not expected to result in ESA-listed eider strikes because operations are planned in areas where spectacled and Steller's eider presence is extremely unlikely and when there are prolonged periods of daylight. Bird strikes would not occur during the spring migration of spectacled and Steller's eiders since those migrations occur well before the seismic and support vessels would enter the Chukchi Sea.

Long-tailed ducks are prone to collisions with structures and vessels, and they frequently venture OCS areas. The diving ability of long-tailed ducks permits them to forage on the seafloor in the proposed survey area, however during much of August the long-tailed duck remains in coastal areas where they molt and the likelihood of any long-tailed duck strikes on ships during most of August is remote.

Because of the small numbers of birds expected to occur in the seismic survey area due to its remote location, the scarcity of ESA-listed bird species, and our expectation that birds will move away from slow-moving vessels, BOEMRE has concluded it is unlikely ESA-listed birds will strike any of the vessels. Furthermore the low likelihood of strikes by waterfowl and seabirds, including ESA-listed eiders, would be further reduced by mitigation measures (e.g., lighting protocols) incorporated in Statoil's proposed activities and required by the FWS (2009). Consequently a negligible level of effects is expected for all species except long-tailed ducks which could experience a minor level of effects from birds striking vessels.

### 5.2.3. Sound from Discharging Airguns

The effects of seismic surveys were assessed in MMS (2006b; 2007b), NMFS (2007b; 2008b; 2009b), and biological surveys that have occurred in the vicinity of the proposed survey area (Brueggeman et al., 2009b; Funk et al., 2010; and others). Statoil (2009a) reported their anticipated marine mammal Level B Harassment takes in their IHA request to NMFS, as summarized in Tables 5-1 and 5-2.

**Table 5-1 Number of Anticipated Marine Mammal Exposures to Sound Levels > 160 dB re 1µPA, for Statoil's 3D Seismic Survey.**

| | Summer | | | | | | Fall | | | | | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Open Water | | Ice Margin | | Total | | Open Water | | Ice Margin | | Total | | | |
| | Avg | Max | Avg | Max | Avg | Max | Avg | Max | Avg | Max | Avg | Max | Avg | Max[1] |
| **Odontocetes** | | | | | | | | | | | | | | |
| **Belugas** | 8 | 17 | 5 | 9 | 13 | 26 | 68 | 137 | 15 | 30 | 84 | 167 | 97 | 193 |
| **Narwhal** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 5 |
| **Killer Whale** | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 5 |
| **Harbor Porpoise** | 3 | 4 | 0 | 0 | 3 | 4 | 4 | 5 | 0 | 1 | 5 | 6 | 8 | 11 |
| **Mysticetes** | | | | | | | | | | | | | | |
| **Bowhead Whale** | 5 | 9 | 1 | 1 | 5 | 10 | 74 | 147 | 16 | 33 | 90 | 180 | 95 | 190 |

| | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Fin Whale** | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 5 |
| **Gray Whale** | 20 | 41 | 2 | 5 | 23 | 45 | 26 | 52 | 3 | 6 | 29 | 58 | 52 | 104 |
| **Humpback Whale** | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 5 |
| **Minke Whale** | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 1 | 5 |
| **Pinnipeds** | | | | | | | | | | | | | | |
| **Bearded Seal** | 27 | 51 | 4 | 8 | 31 | 59 | 45 | 86 | 7 | 13 | 52 | 98 | 82 | 157 |
| **Ribbon Seal** | 1 | 3 | 0 | 0 | 1 | 3 | 1 | 5 | 0 | 1 | 1 | 6 | 2 | 9 |
| **Ringed Seal** | 924 | 1,530 | 137 | 227 | 1,061 | 1,757 | 1,039 | 1,720 | 154 | 255 | 1,192 | 1,975 | 2,253 | 3,732 |
| **Spotted Seal** | 18 | 31 | 3 | 5 | 21 | 35 | 21 | 34 | 3 | 5 | 24 | 38 | 45 | 74 |

Note: Where population data does not support the conclusion that more than 5 individuals would be affected, a grand total maximum value of 5 individuals was adopted by Statoil. BOEMRE believes the value of 5 is most likely a significant overestimate of the true number of individuals that would be affected in this case.

Source: Statoil USA E&P Inc. IHA request (Statoil, 2009).

**Table 5-2 Number of Anticipated Marine Mammals Exposures to Sound Levels > 160 dB re 1µPA, for Statoil's 2D Seismic Survey.**

| | Summer | | | | | | Fall | | | | | | Grand Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Open Water | | Ice Margin | | Total | | Open Water | | Ice Margin | | Total | | | |
| | Avg | Max | Avg | Max | Avg | Max | Avg | Max | Avg | Max | Avg | Max | Avg | Max[1] |
| **Odontocetes** | | | | | | | | | | | | | | |
| **Belugas** | 14 | 28 | 8 | 16 | 22 | 44 | 17 | 35 | 4 | 8 | 21 | 43 | 43 | 87 |
| **Narwhal** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 |
| **Killer Whale** | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| **Harbor Porpoise** | 5 | 7 | 1 | 1 | 5 | 8 | 1 | 1 | 0 | 0 | 1 | 2 | 5 | 9 |
| **Mysticetes** | | | | | | | | | | | | | | |
| **Bowhead Whale** | 8 | 16 | 1 | 2 | 9 | 17 | 19 | 37 | 4 | 8 | 23 | 46 | 32 | 63 |
| **Fin Whale** | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| **Gray Whale** | 35 | 70 | 4 | 8 | 39 | 78 | 7 | 13 | 1 | 1 | 7 | 15 | 46 | 92 |
| **Humpback Whale** | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| **Minke Whale** | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 5 |
| **Pinnipeds** | | | | | | | | | | | | | | |
| **Bearded Seal** | 46 | 87 | 7 | 13 | 53 | 100 | 11 | 22 | 2 | 3 | 13 | 25 | 66 | 125 |
| **Ribbon Seal** | 1 | 5 | 0 | 1 | 1 | 6 | 0 | 1 | 0 | 0 | 0 | 1 | 2 | 7 |
| **Ringed Seal** | 1,579 | 2,616 | 234 | 388 | 1,813 | 3,003 | 265 | 438 | 39 | 65 | 304 | 503 | 2,117 | 3,506 |
| **Spotted Seal** | 32 | 52 | 5 | 8 | 36 | 60 | 5 | 9 | 1 | 1 | 6 | 10 | 42 | 70 |

Note: Where population data does not support the conclusion that more than 5 individuals would be affected, a grand total maximum value of 5 individuals was adopted by Statoil. BOEMRE believes the value of 5 is most likely a significant overestimate of the true number of individuals that would be affected in this case.

Source: Statoil USA E&P Inc. IHA request, 2009

#### 5.2.3.1. Pinnipeds

**Ringed, Spotted, Ribbon, and Bearded Seals**. Ice seals use the acoustic properties of seawater to aid in navigation, social communication, and possibly, predator avoidance. Ice seals may spend >80% of their time submerged in the water (Gordon et al., 2004) depending upon the season; consequently, they may be exposed to noise from seismic surveys. Southall et al. (2007) estimated the functional hearing of seals to be 75 Hz - 75 kHz underwater and 75 Hz - 30 kHz in the air. Likewise Southall et al. (2007) found that pinnipeds in the water exhibited little if any reactions to sound pulses between 150 and 180 dB re: 1 µPa, noting that it took Received Levels (RL) ≥190 dB re: 1 µPa to elicit responses in some ringed seals. The authors concluded:

> Thus, in the case of ringed seals exposed to sequences of airgun pulses from an approaching seismic vessel, most animals may show little avoidance unless the noise level is high enough for mild TTS to be likely.

Reported seal responses to seismic surveys have been variable and often contradictory, although they do suggest that pinnipeds frequently do not avoid the area within a few hundred meters of operating airgun arrays (Richardson, 2000). However, Brueggeman et al. (1991) reported that 96% of the seals they encountered during seismic operations in the Beaufort Sea were encountered during non-seismic activities, suggesting avoidance of active seismic operations. Miller and Davis (2002) reported on average, seals sighted during active seismic surveys in the Beaufort Sea were substantially farther from the vessel (210 m [689 ft]) than those sighted during periods without airgun use (150 m [492 ft]). At the 210-m (689-ft) distance, seals would have been exposed to noise levels of about 190 dB re: 1 µPa (rms), supporting Southall et al.'s (2007) position.

Sighting rates of ringed seals from another seismic vessel in the Beaufort Sea showed no difference between periods with the full array, partial array, or no guns firing (Harris, Miller, and Richardson, 2001). Mean distances to seals sighted did increase during full airgun array operations, suggesting some local avoidance at levels between 190 and 200 dB rms. By contrast, telemetry work by Thompson et al. (1998, as cited in Gordon et al., 2004) suggests avoidance and behavioral reactions to small airgun sources may be more dramatic than ship-based visual observations indicate. Instrumented gray seals (*Halichoreus grypus*) and harbor seals exhibited avoidance behavior of small airguns, swimming rapidly away from the seismic source. Many ceased feeding and some hauled out, possibly to avoid the noise. The behavior of most of the seals seemed to return to normal within 2 hours after the event had concluded. Consequently the discharging of airgun arrays in the proposed area is expected to result in brief, temporary disturbances with no long-lasting effects, leading the BOEMRE to conclude there is a negligible level of effects to ice seals.

**Pacific Walrus.** Based on previous monitoring efforts in the Chukchi Sea, seismic surveys are expected to result in the take (Level B harassment) of small numbers of walrus (FWS, 2008). Seismic operations occur in open water, where walrus may be feeding or passing through but are less likely to be present in large numbers. Seismic operators are required to have marine mammal observers on board to avoid large aggregations of walrus and to shut down if walrus enter the safety zone, identified as the zone where noise levels reach or exceed 180 dB. Effects from seismic activity would be negligible due to Statoil's (2009b) proposed mitigation measures. There is very little information addressing the effects of seismic activities on walrus hearing or behavior. Some walrus may be temporarily displaced or may experience temporary threshold shifts (TTS) in hearing with no lasting effects (FWS, 2008). Impacts from seismic-survey activities to walrus in the Chukchi Sea are anticipated to be negligible.

#### 5.2.3.2. Polar Bears

Polar bears generally swim with their heads above water. They dive below the surface when hunting. Polar bears are not likely to have their heads underwater near an active airgun and no adverse effects from airgun noise are anticipated.

**Odontocetes (Beluga Whale, Killer Whale, Harbor Porpoise).** Few belugas are expected to occur in the proposed survey area during the open water season. During the open water season most belugas occur along the coast or the ice front north of the survey area; however, some individuals may opt to visit the survey area for unknown reasons. Mitigation measures incorporated in the proposed activities and any additional mitigation imposed through the MMPA authorization process are expected to reduce potential effects to a level of negligible adverse impacts to beluga whales.

The rarity of killer whales in the proposed survey area leads the BOEMRE to conclude there is a very low likelihood of encountering an individual or pod during the survey. Odontocetes including killer whales and porpoises are most sensitive to high frequency noise, not the low-frequency noise produced by seismic surveying and vessel traffic. Consequently, killer whales and harbor porpoises would be affected negligibly by seismic survey noise.

**Mysticetes (Bowhead whale, fin whale, gray whale, humpback whale, minke whale).**

Bowhead, fin, gray, humpback, and minke whales could reasonably be expected to occur in the Chukchi Sea during the open water season, and a small number may occur in the proposed survey area.

Bowheads appear to continue normal behavior when exposed to the noise generated by high-resolution seismic surveys. In a study by Richardson, Wells, and Würsig (1985), four controlled tests were conducted by firing a single 40 $in^3$ airgun at a distance of 2 - 5 km (1.2 - 3.1 mi) from the whales. Bowheads sometimes continued normal activities (skim feeding, surfacing, diving, and travel) when the airgun began firing 3 - 5 km (1 - 3 mi) away (received noise levels at least 118 - 133 dB re: 1 µPa rms). Some whales oriented away during an experiment at a range of 2 - 4.5 km (1.2 - 2.8 mi), and another experiment at a range of 0.2 - 1.2 km (0.12 - 0.75 mi) (received noise levels at least 124 - 131 and 124 - 134 dB, respectively). Frequencies of turns, pre-dive flexes, and fluke-out dives were similar with and without airguns; and surfacing and respiration variables and call rates did not change substantially during the experiments.

It is unlikely there would be adverse effects from noise and disturbance associated with seismic-survey activities in the proposed survey area on fin whales because of their low numbers and rare occurrence in the Alaska Chukchi Sea, and distance (hundreds of kilometers) from the majority of the Northeastern Pacific fin whale population. Negligible population-level impacts are likely for fin whales, but effects to individuals could occur, although it is very unlikely.

Effects of such noise detection on fin, humpback, and minke whales would to be brief, resulting in minor behavioral changes, amounting to negligible population-level effects. Long distances between the survey area and populations of fin whales would put received survey noise levels below the noise-exposure-criteria levels that could result in injury or the onset of detrimental behavioral responses. The most probable effects would be some increased attentiveness to the survey noise, slightly increased attentiveness to other sounds, and possible vocalization changes.

Humpback whale observations during the open-water periods from 2006-2009 in the western Beaufort Sea and southern and eastern Chukchi Sea indicate the presence of this species in the planning areas during times that seismic-survey activities would be conducted. Assuming humpbacks continue to use habitats in the Chukchi Sea, individuals could be affected by seismic-survey-related noise.

During one study, the mean airgun noise level at which avoidance was observed was 140 dB re 1 µPa (rms), the mean standoff range was 143 dB re 1 µPa (rms), and the startle response was observed at 112 dB re 1 µPa (rms) (McCauley et al., 2000). Standoff ranges were 1.22 - 4.4 km (0.76 - 2.73 mi). McCauley found that adult male humpbacks were much less sensitive to airgun noise than were females. At times, they approached the seismic-survey source vessel. McCauley et al. (2000)

speculated that males that did so may have been attracted by the sound because of similarities between a single airgun signal and a whale-breaching event.

Malme et al. (1985) noted approaches by humpback whales to a single 100 $in^3$ airgun source at ranges corresponding to sound-exposure levels of up to 172 dB re: 1 µPa rms, but they did not speculate on gender or similarity of a single airgun noise and the potential attraction response to the sound to a breaching whale. Based on the aforementioned, it is likely that any humpback whales feeding or resting in areas within and adjacent to areas within the proposed survey area could have their movement and feeding behavior affected by noise associated with seismic surveys. The most likely demographic group to be impacted in that humpback population would be females with calves.

Humpbacks make a variety of sounds. Their song is complex, with components ranging from <20 Hz-4 kHz, and occasionally up to 8 kHz. Songs can be detected by hydrophones up to 13 - 15 km (8.1 - 9.3 mi). Songs can last as long as 30 minutes. Humpbacks can make general sounds as high as 192 dB at the source. They typically are heard on low-latitude wintering grounds and occasionally have been heard on northern feeding grounds (McSweeney et al., 1989). It is unlikely that seismic-survey noise would interfere with hearing these songs in the open-water season in the Chukchi Sea. Humpbacks on high-latitude summer grounds are less vocal. Calls, clicks, and buzzes are made while feeding and may serve to manipulate prey and as "assembly calls" (Richardson et al., 1995a; NMFS, 2007a). These calls are between 20 and 2,000 Hz.

No studies that address the effects of seismic survey noise on minke whales are available; however, the BOEMRE expects the reactions of minke whales to be similar to those of other mysticete whales because of similar physiologies, shared evolutionary lineages, similar environmental challenges, and similar adaptations to meet those challenges.

Gray whales are low-frequency hearing specialists, with an auditory range starting at 10 Hz and possibly moving as high as 30 kHz (Ketten, 1998). Erbe (2002), inferring from gray whale vocalizations, suggested they would be sensitive to frequencies between 20 Hz and 4.5 kHz, with best sensitivity around 20 Hz - 1.2 kHz. Clicks are reported up to 10 kHz, with main energy between 1.4 and 4 kHz. The lowest response threshold reported was 82 - 95 dB at 800 Hz (Erbe, 2002). By comparison, minke whales appear most sensitive to sound between 100 and 200 Hz, with good sensitivity extending from 60 Hz - 2 kHz. High-frequency clicks were published in two studies, indicating some sensitivity between 4 and 7.5 kHz, up to 20 kHz (Erbe, 2002). The PEA outlines the potential effects of noise and disturbance that can be expected from marine mammals, with a particular focus on cetaceans (USDOI, MMS, 2006a: Sections III.F.3.f(3), III.F.3.f(5), III.F.3.f(6), and III.F.3.f(8)).

Overall, studies of gray, bowhead, and humpback whales have shown that received levels of impulses in the 160-170 dB re 1 µPa rms range appear to cause avoidance behavior in a significant portion of the animals exposed. Dahlheim (1987) reported that in noisy environments, gray whales increase the timing and level of their vocalizations and use more frequency-modulated signals. Malme et al. (1986) studied the responses of feeding eastern Pacific gray whales to pulses from a single 100-$in^3$ airgun off St. Lawrence Island in the northern Bering Sea. Based on small sample sizes, these authors estimated that 50% of feeding gray whales ceased feeding at an average received pressure level of 173 dB re 1 µPa on an (approximate) rms basis, and that 10% of feeding whales interrupted feeding at received levels of 163 dB. Malme at al. (1986) estimated that an average pressure level of 173 dB occurred at a range of 2.6 - 2.8 km (1.4 - 1.5 mi) from an airgun array with a source level of 250 dB (0-peak) in the northern Bering Sea. These findings generally were consistent with the results of experiments conducted on larger numbers of gray whales that were migrating along the California coast.

Malme and Miles (1985) concluded that, during migration, changes in swimming pattern occurred for received levels of about 160 dB re 1 µPa and higher, on an approximate rms basis. The 50%

probability of avoidance was estimated to occur at a closest point of approach distance of 2.5 km (1.3 mi) from a 4,000-in³ array operating off central California. This would occur at an average received sound level of about 170 dB (rms). Some slight behavioral changes were noted at received sound levels of 140 - 160 dB (rms). However, these slight behavioral changes at levels below 160 dB may have been more relevant to the location of the noise source as the seismic array was placed in the middle of the gray whale migratory pathway. In Würsig et al. (1999), observations of gray whales near Sakhalin Island found no indication that western gray whales exposed to seismic noise were displaced from these feeding grounds in 1999 and 2001. However, there were indications of subtle behavioral effects and, in 2001, whales shifted their distribution away from a region where geophysical seismic surveys were being conducted (Johnson, 2002; Weller et al., 2002).

Currently, some gray whales are believed to use offshore shoals in the Chukchi Sea for feeding during the summer months. Feeding whales have been reported at these shoals. It is likely that shallow coastal and offshore shoal areas provide habitat rich in gray whale prey, and their association and congregation in larger numbers with offshore shoals in the northern Chukchi Sea may indicate that these are important feeding areas for the gray whale population (Moore and DeMaster, 1997). Because gray whales typically have shown documented disturbance reactions at levels at or above 160 dB, the effects of seismic surveys at these feeding sites also must be considered. The 3D survey area lies approximately 8 mi southeast from Hanna Shoal at its closest point (Figures 1-1 and A-1) and in Table 3-1 one can see that the modeled radii for seismic noise indicate 160 dB levels would not extend to Hanna Shoal. Moreover the ability of gray whales to detect these sounds would allow them to detect an operating airgun array and detour around the survey without any significant side effects. Consequently, the BOEMRE anticipates a negligible level of effects to gray whales from the proposed action as mitigated.

There is no specific evidence that exposure to pulses of airgun noise have caused PTS to the hearing of any marine mammal, even with large arrays of airguns. However a PTS injury (Level A Harassment) from seismic surveys could occur if animals were to enter a ≥230-dB zone around an airgun array (Southall et al, 2007). Southall et al. (2007) placed the functional hearing of bowhead, fin, gray, humpback, and minke whales in a group of cetaceans hearing in the low-frequency bandwidth between 7Hz – 22kHz., with a likely PTS Sound Pressure Level threshold of 230 dB re: 1 μPa (peak), and a Temporary Threshold Shift (TTS) Sound Exposure Level threshold of 198 dB re: 1 μPa. These thresholds for mysticete whales were obtained from study data and modeling of morphological measurements. However the 180 dB level remains the established standard for a TTS in cetaceans resulting in a Level A Harassment, while the Level B Harassment standard occurs at 160 dB (NMFS, 2008b).

Consequently Southall et al. (2007) suggests the area posing an actual TTS or PTS threat may be smaller than the 160 dB or 180 dB re: 1 μPa (700 m) radii from operating airguns would suggest. The BOEMRE also believes that with the ramp up mitigation protocols, posted MMOs, and the tendency of mysticete whales to avoid the “noisy” areas by a measure of kilometers, there is a low likelihood of inflicting a TTS or PTS on a mysticete whale. Regardless, the operator shall comply with the standards described in NMFS (2008b).

In summary, mysticete and odontocete cetaceans, with the exception of gray whales, are expected to experience a negligible level of effect from firing airguns using the proposed mitigations. Gray whales are expected to experience a minor level of effect from airgun noises due to their greater presence in the vicinity of Hanna Shoal, one of their feeding areas in the Chukchi Sea.

### 5.2.4. Conclusion on Effects to Biological Resources from the Proposed Action.

Vessel presence is likely to have the greatest impact on the largest number of species, because of the possibility of bird strikes and avoidance behavior by marine mammals. Nevertheless, bird strikes are expected to have a negligible population level effect on spectacled and/or Steller’s eiders, yellow-

billed loons, or long-tailed ducks even in the event of a small number of mortalities. Bird-ship collisions would be limited because of bird scarcity, the low densities of birds expected to be present in the survey area relative to significantly larger numbers present elsewhere, lighting protocols, and the flight behavior of most bird species. Additional avoidance of bird strikes are anticipated as a result of long daylight hours, lighting protocols, and slow vessel speeds. Therefore the effects of birds striking vessels are expected to be negligible for all species except long-tailed ducks.

Discharging airguns would elicit temporary avoidance behaviors from marine mammals at a distance precluding exposures to higher dB levels closer to the survey.

Fall migrating bowheads generally disperse across the Chukchi Sea, with most moving on to Wrangel Island or the Chukotka coastal areas. Survey activity, including the firing of airgun arrays, would result in occasional diversions around the survey as whales migrate west. For mysticete whales, the effects of discharging airguns would mostly be negligible except for gray whales, which would experience a minor level of effect from the proposed action, due to their numbers in the area. Seals and gray whales may be temporarily displaced by seismic surveys; however these exposures are expected to be brief and negligible. Pacific walrus usually avoid vessels and may take days to reoccupy an area, which qualifies as a minor level of effect. Beluga whales tend to aggregate in Ledyard Bay, Kasegaluk Lagoon, and near the ice front over deeper waters and not in the vicinity of Statoil's operations. Likewise, killer whales, minke, fin, humpback whales, and harbor porpoises tend to use areas farther south and/or east, occurring sporadically or rarely in waters near the proposed activity, while polar bears would not be affected by underwater airgun discharges.

Considering vessel noise will be partially masked by discharging airguns, low survey speeds (4 - 5 kts), the expected marine mammal avoidance of sources of airgun noise, and MMO presence on all vessels, the likelihood of injury to marine mammals from vessel collisions expected to extremely low.

## 5.3. Additional Mitigation Considered but Not Recommended for Implementation:

One additional mitigation measure considered was to require aerial monitoring during the survey to detect whales, or any other marine mammals within the 160 dB zone of effect. This measure was considered because NMFS required a similar measure (NMFS, 2007a; 2007b). This measure is not being recommended, because in the subsequent *Federal Register* Notice on issuance of Shell's IHA for seismic surveying in 2009 (NMFS, 2009), NMFS states "aerial monitoring in the Chukchi Sea is not practicable and due to safety concerns, NMFS would not require this level of monitoring in the Chukchi Sea."

Another mitigation measure considered was a requirement for passive acoustic recorders to identify the presence of cetaceans and pinnipeds while underwater. This measure is not being recommended, because review of passive acoustic monitoring during prior seismic surveys has shown that it was ineffective in identifying the presence of marine mammals during seismic surveying in the Chukchi Sea. In 2006, GXT towed a passive acoustic array to attempt to monitor the 120 dB zone. This proved to be ineffective in identifying whale sounds and has not been required by NMFS in MMPA authorizations since.

A third mitigation measure considered was a 9-knot speed limit on the seismic survey vessels during transit to provide slower moving whales more response time in which to avoid vessels while also giving vessels a greater amount of response time in which to avoid incidental takes of marine mammals via whale-ship collisions, noise, and other stressors. The original reference for a speed limit was a NMFS stipulation in the Atlantic for the protection of North Atlantic Right Whale, and it was stated as 10 knots or less. This measure is not being recommended, because NMFS has not made any similar recommendation to BOEMRE for ships in the Arctic Ocean – either in comments on BOEMRE NEPA documents or through ESA consultations; vessel traffic related to the Statoil's

proposed activities will not be across bowhead migration; and limiting speed to 9 knots for Statoil's support vessels on routine transits could result in greater fuel consumption, greater emissions, and longer and potentially greater vessel sound into the marine environment.

The fourth mitigation measure considered was to require survey shutdown during periods of low visibility (darkness, high sea states, and inclement weather) to avoid whale-ship collisions. This measure is not being recommended, because previous NEPA analysis by BOEMRE and NMFS determined that the appropriate mitigation when the full arrays are not operating is the continuous firing of a small airgun to deter approaching marine mammals. The vessel must maintain forward thrust when the receiver streamers are deployed, deployment of the streamers and airgun arrays takes several days, and retrieval of the equipment is likely to take more than 24 hours. Therefore, complete shutdown of operations from data collection to no vessel movement is not possible on a daily basis.

The fifth mitigation measure considered was to require the seismic vessel disengage propellers if a surfacing whale is observed within 300 ft (100 m) of the ship to avoid potential propeller injury to the whale (prop strike) and, to a lesser degree, collision, and that propellers would remain disengaged until the whale moves beyond 300 ft (100 m) from the ship. This measure is not being recommended, because the vessel must maintain forward thrust when the receiver streamers are deployed, and the existing required mitigation calls for marine mammal avoidance.

A sixth mitigation measure considered was to string mist netting over the survey vessels to minimize the effects of bird strikes. This measure is not being recommended, because documented bird strike mortality with vessels is extremely low; the netting could affect vessel navigability and operations such as obscuring views from the bridge; the netting would not prevent strikes to the vessel hull and other exposed areas; the netting could entangle birds that would otherwise miss hard parts of the vessel superstructure, and the handling and banding of birds requires specialized experience and required permits from the National Bird Banding Laboratory and such requirements are impracticable to impose on contract personnel.

The final mitigation measure considered based on comments received on the draft Arctic Multiple-Sale EIS (USDOI, MMS, 2008c) was to require a Conflict Avoidance Agreement between Statoil and the Alaska Eskimo Whaling Commission and potentially affected whaling captains. This measure is not being recommended because Statoil has a POC with the potentially affected North Slope communities that BOEMRE believes is appropriate and sufficient to prevent conflicts between Statoil's' activities and subsistence activities. In addition, BOEMRE cannot require agreements between third parties and BOEMRE would be unable to enforce the provisions of such an agreement because the Federal Government would not be a party to the agreement.

## 5.4. Alternatives

### 5.4.1. No Action Alternative

Under the No Action Alternative, Statoil's application for a geophysical permit would be disapproved. Statoil's seismic survey activities would not occur as proposed. Under the No Action Alternative, seismic survey exploration of Statoil's Chukchi Sea leases would be delayed or may not occur at all. Disapproval of the proposed seismic survey activities could delay or preclude Statoil's evaluation of the hydrocarbon potential of their Chukchi Sea leases. Disapproval of the proposed seismic survey activities could ultimately result in lost opportunity for discovery and production of oil and gas resources and any associated economic benefits for Alaska and the United States of America.

The No Action Alternative would eliminate any potential adverse effects from the acquisition of seismic survey data in the vicinity of Statoil's Chukchi Sea leases during the 2010 open-water season. Potential economic benefits to the communities and residents of Dutch Harbor, Nome, and the North Slope residents would be delayed or would not be realized. Although the number of local residents employed for the proposed activities is expected to be relatively small and the effect to be negligible

at the community level, any BOEMRE disapproval of the proposed activities during the 2010 season would have a considerable adverse effect on individuals who lost potential employment.

### 5.4.2. Alternatives Considered but Not Included for Further Analysis

"Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense…" (CEQ's Question 2a of NEPA's Forty Most Asked Questions). Alternatives must also meet the purpose and need of the proposal (40 CFR 1502.13). The purpose of the proposed seismic survey is to collect geophysical data in the vicinity of Statoil's Chukchi Sea leases for use in evaluating the potential for hydrocarbon accumulations on their leases and making decisions related to leasing and making decisions about future leasing and exploration activities. Statoil's proposed exploration seismic surveys of their Chukchi Sea leases is consistent with the overall objectives of the OCS Lands Act to determine the extent of the oil and natural gas resources of the OCS at the earliest practicable time. No additional alternatives that meet the purpose and need for the proposal were identified by BOEMRE.

One alternative considered was prohibiting the portion of the proposed 2D seismic survey line onto Hanna Shoal. This alternative was not included for further consideration because the segment of the proposed survey that would pass over Hanna Shoal is very short, resulting in a very brief period of disturbance. The anticipated effects to the resources of that particular site would be similar to effects to the resources described in the proposed action.

Another alternative considered was prohibiting firing of the airgun array within 15 mi of any ice management operations related to potential exploration drilling operations. This alternative was not included for further consideration because the survey would need to cease actions in proximity to ice because of operational considerations; and because exploratory drilling in the Alaskan OCS was postponed in response to the Deepwater Horizon oil spill in the Gulf of Mexico.

## 5.5. Cumulative Effects

Cumulative impacts result from individually minor but collectively significant actions taking place over time. The scope of the cumulative impacts for this analysis is the incremental impact from Statoil's proposed seismic surveys plus the aggregate effects of other activities known or reasonably expected to occur in the same timeframe (July-November 2010) in the vicinity of Statoil's activities, and to have potential effects on the same environmental resources. It is not helpful to consider other activities outside of this timeframe, since the notable impacts of seismic surveys are almost entirely temporal in nature, generally lasting only as long as the duration of the seismic surveying activities.

The cumulative effects from OCS activities plus past, current, and reasonable foreseeable activities in the Chukchi Sea OCS and adjacent areas have been assessed in recent BOEMRE NEPA documents. Cumulative effects analyses were included the PEA (USDOI, MMS, 2006b) and the Sale 193 EIS (USDOI, MMS, 2007b). The reasonably foreseeable level of OCS activity in the Chukchi Sea Planning Area during the open-water season in 2010 is within the level of activities evaluated in these prior NEPA documents. This level of activities is also within the scope of the 2008 BO (NMFS, 2008a) and 2009 BO (FWS, 2009).

Currently, Statoil's proposal is the only G&G application to conduct seismic survey activities in the Chukchi Sea OCS during the 2010 open water season. On February 10, 2010, BOEMRE received an application from ION Geophysical to perform late-season seismic surveys in the Beaufort and northeastern Chukchi Sea near Point Barrow in 2010. If approved, ION's operations would begin on or after October 1, 2010, in the eastern portion of the Beaufort Sea, after the out-migration of most species. The area surveyed during October would not overlap with Statoil's proposed activities.

Shell submitted applications to conduct two ancillary activities in the Chukchi Sea for 2010. The first ancillary activity would acquire data for sea floor imagery, and bathymetric data for ice gouge data

collection. This activity would use side-scan sonar, a multi-beam echo sounder, and a dual frequency subbottom profiler to collect the necessary data. The second of Shell's ancillary activities includes performing environmental baseline studies and seafloor soil sampling. Each activity would take approximately 60 days to complete during the 2010 open water season, and occur in state and federal OCS areas, mostly around Shell's Chukchi leases.

Effects on marine mammals, marine birds, and fishes from Statoil's proposed activities would be restricted to disturbance with associated changes in behavior and temporary displacement. Disturbance factors include vessel presence, vessel sound, and sounds produced by discharging airguns. Studies have shown that most such effects on marine mammals are ephemeral, ending within minutes or hours after the disturbance has ceased. Past seismic surveys in the analysis area are not known to have had any lasting deleterious effects on biological resources.

Sound levels and frequency characteristics of vessels are generally related to vessel size and speed. Larger vessels generally emit more sound than smaller vessels, and those underway with a full load, or those pushing or towing a load, are noisier than unladen vessels. The primary sources of sounds are engines, propellers, bearings, and other mechanical parts. The sound from these sources reaches the water through the vessel hull. Other than during icebreaking activities, the loudest sounds from vessels are made by the spinning propellers. Navigation and other vessel-operation equipment also generate subsurface sounds.

Other than vessels associated with the proposed activities, traffic in the project area is expected to include support vessels related Shell's scour and baseline surveys, fishing and hunting, icebreakers, USCG vessels, and supply ships and barges. Vessel traffic in the proposed survey area is expected to be very limited. With the exception of Statoil's seismic surveys and Shell's ancillary activities and research vessels, most vessels are expected to transit through the Chukchi Sea area within 12.5 mi (20 km) of the coast. During ice-free months (June-October), barges are used for supplying the local communities, Alaskan Native villages, and the North Slope oil-industry complex at Prudhoe Bay with larger items that cannot be flown in on commercial air carriers. Usually, one large fuel barge and one supply barge visit the villages per year and one barge per year traverses through the Arctic Ocean to the Canadian Beaufort Sea.

Vessel strikes with marine mammals in the Arctic Ocean are rare, in part because overall vessel traffic in the Alaska Chukchi Sea is very limited. Impacts to marine mammals from Statoil's vessels are expected to be short term and negligible to minor, because of the slow survey speed of the survey vessel and the limited scope of the support vessels' activities.

The proposed activities would result in negligible or minor incremental contributions to the existing environment for marine mammals, birds, fishes, and marine invertebrates by briefly disrupting behaviors in some individuals. Mitigation measures incorporated in the proposed action, and additional measures imposed by NMFS and FWS through ESA consultation and MMPA authorizations, processes would prevent Level A Harassment (injury), minimize Level B Harassment, and mitigate the potential for population-level adverse effects.

The risk of introducing marine invasive species is present in Alaska through vectors and activities such as ships and boats, water-landing aircraft, oil drilling rigs, tourism, and intentional or accidental releases (Fay, 2002). Some of these activities could occur in the Chukchi Sea coastal areas during the period of July-November, 2010. The Statoil vessels will be regulated by USCG, which includes the submittal and adherence to a ballast water management plan and inspection by the USCG. Because of USCG requirements and the limited time and area of the proposed seismic survey, the contribution of the proposed activity to risk of introducing invasive species and any subsequent impacts is expected to be negligible.

Eiders could be disturbed or displaced by vessel traffic associated with Statoil's proposed activities and these effects would be additive to any disturbance from other shipping or barge traffic. Statoil's vessel lighting protocol is expected to reduce the potential for eider strikes as would the distance between the project area and any known eider aggregations.

Statoil's proposed activities are expected to have no effects on subsistence activities and are not expected to add incrementally to cumulative effects on subsistence activities.

The incremental contribution to cumulative impacts from Statoil's proposed activities to overall cumulative effects on biological resources and the marine environment is expected to be negligible. Statoil's proposed activities are not expected to add to cumulative effects on subsistence activities.

# 6.0 CONCLUSIONS

Statoil's proposed 2010 open water seismic survey activities are within the scope of activities covered by the PEA (USDOI, MMS 2006b) and the Sale 193 EIS (USDOI, MMS, 2007b). The PEA and related FONSI concluded four concurrently operating seismic surveys in the Chukchi Sea would result in adverse but not significant effects (USDOI, MMS, 2006b:Table 3.1). Potential cumulative impacts are unlikely to exceed those described in the PEA and the Sale 193 EIS. No proposed action or site-specific circumstances indicate that the proposed activities would have any effects different from those analyzed in the PEA and Sale 193 EIS.

Statoil's proposed monitoring and mitigation (as identified in Statoil's IHA application to NMFS and LOA application to FWS) are expected to reduce adverse effects to marine mammals. Statoil's POC and the distance of the proposed survey area from subsistence harvest areas are expected to avoid adverse effects to subsistence activities.

The potential increment contribution of the proposed action to cumulative impacts is expected to be negligible. Overall, cumulative effects are not likely to exceed those described in the PEA and the Sale 193 EIS.

We have concluded that:

- no major adverse effects as defined in Sections 4 and 5 on the quality of the human environment are expected to occur from Statoil's seismic survey activities as proposed in their G&G permit application (10-01).

# 7.0 CONSULTATIONS AND PUBLIC INPUT

## 7.1. Endangered Species Act Consultation

Section 7(a)(2) of the ESA requires each Federal Agency to ensure that any action that they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the adverse modification of designated critical habitat. The BOEMRE consults with FWS and NMFS for listed species under each Service's jurisdiction. For ESA consultation on proposed lease sales, BOEMRE specifically requests incremental Section 7 consultation. Regulations at 50 CFR 402.14(k) allow consultation on part of the entire action as long as that step does not violate section 7(a)(2), there is a reasonable likelihood that the entire action will not violate section 7(a)(2), and the agency continues consultation with respect to the entire action, obtaining a biological opinion for each step. Thus, at the lease sale stage, BOEMRE consults on the early lease activities (seismic surveying, ancillary activities, and exploration drilling) to ensure that activities under any leases issued will not result in jeopardy to a listed species or cause adverse modification of designated critical habitat.

Consultation with NMFS for the Statoil's proposed seismic activities is covered by the July 17, 2008, BO for Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas,

Alaska and Authorization of Small Takes Under the Marine Mammal Protection Act (NMFS, 2008) (http://www.mms.gov/alaska/ref/BioOpinions/2008_0717_bo.pdf).

Consultation with FWS for the Statoil's proposed exploration activities is covered by the September 3, 2009, BO for Beaufort and Chukchi Sea Program Area Lease Sales and Associated Seismic Surveys and Exploratory Drilling (FWS, 2009) (http://www.mms.gov/alaska/ref/BioOpinions/2009_0903_BO4BFCK.pdf).

## 7.2. Essential Fish Habitat Consultation

The most recent EFH consultation for OCS exploration activities in the Chukchi Sea was conducted concurrently with the preparation and public review of the Arctic Multiple-Sale Draft EIS (2009). NMFS provided conservation recommendations in a letter dated June 26, 2009. On May 4, 2010, after the Department of Commerce adopted the Arctic Fishery Management Plan, BOEMRE re-initiated consultation for Arctic cod, saffron cod, and opilio crab EFH in the Alaskan Chukchi Sea and Beaufort Sea. On June 24, 2010, BOEMRE received NMFS response, which contained no further conservation recommendation but offered additional comments on the EFH analysis regarding contaminant spills and invasive species. BOEMRE sent a response to NMFS to address these additional comments on July 8, 2010.

## 7.3. Opportunities for Public input

Public participation regarding Statoil's proposed activities has been provided for through a combination of notification of receipt of application, community meetings held by the applicant, presentations at the 2010 NMFS Open Water and Scientific Review Committee (Peer Review) meetings in Anchorage, and the NMFS Incidental Harassment Authorization (IHA) process. In addition, opportunities for public input on seismic surveying in the Arctic OCS and related issues have been provided during several prior NEPA processes. These opportunities for public input are briefly summarized below.

**Notification of Application**. The G&G permit application from Statoil was posted on the BOEMRE website at http://www.mms.gov/alaska/re/recentgg/recentgg.htm. The BOEMRE notified by mail stakeholders who may be impacted by the activity of the proposed action. The notification provided the BOEMRE website link to the permit application and contact information for the BOEMRE G&G Permit Coordinator so interested parties could obtain additional information about the application.

**Notification of Preparation of the EA.** On July 1, 2010, a notice of preparation of an EA on Statoil's proposed seismic survey was sent to potentially affected stakeholders and posted on the Alaska OCS Region website. The notice provided "additional opportunity for the public to provide views, prior to a decision being made by the Responsible Official(s), that may inform the decision-making process, including issues or information regarding potential environmental effects that should be considered in the preparation of the EA." The notice stated that written comments would be accepted for consideration through July 15, 2010.

In response to the notice, BOEMRE received timely input from the Alaska Wilderness League (AWL) et al., the North Slope Borough (NSB), and Alaska's Big Village Network. We also received late comments (July 16) from the Alaska Eskimo Whaling Commission (AECW) and the Native Village of Point Hope/Inupiat Community of the Arctic Slope (ICAS). Due to the extenuating circumstances noted by these commenters for the late submissions, the BOEMRE has accepted their comments for consideration. A brief summary of the substantive issues in the comments received and our consideration of them was prepared for the responsible BOEMRE decisionmaker.

**Applicant-Community Meetings.** Statoil met with leaders from the communities of Barrow, Wainwright, Point Lay, Point Hope, and Kotzebue over a two week period in late 2009 to introduce themselves and the discuss the planned 2010 marine seismic acquisition program to community

leaders and to discuss local concerns regarding subsistence activities, timing of operations, discharge, and local hire/workforce development. These meetings include:

- Presentation to the NSB Planning Commission in Barrow, October 27, 2009.
- Leadership meetings in Barrow, Wainwright, Point Lay, Point Hope, and Kotzebue, October 27 through November 5, 2009.
- NSB Wildlife Department and members of the Alaska Eskimo Whaling Commission to discuss proposed activities, potential impacts, and measure for mitigating impacts, December 14, 2009.
- Discussion of Plan of Cooperation (POC) in Barrow, Wainwright, Point Lay, and Point Hope, January 2010. The POC addresses how Statoil plans to avoid conflicts with subsistence hunting. The meeting materials and copies of comments received during the meetings are included in Appendices A and B of the POC.

**NMFS Annual Open Water meetings in Anchorage, Alaska, 2006 through 2010.** At the annual Open Water meetings, industry representatives, the BOEMRE and NMFS, other federal and state agencies; tribal government representatives, subsistence stakeholders, and other interested parties, including the public, participate in presentations and discussions about activities that have occurred during the past open-water season and are proposed for the next open-water season. Highlighted are the lessons learned and opportunities to improve mitigation measures, as well as coordination and communication between all interested parties. The annual Open Water Meetings are intended to inform stakeholders about offshore activities proposed for the following open-water season and to receive stakeholder input. Statoil presented operational, environmental monitoring, mitigation, and POC information for their proposed seismic program at 2010 Open Water Meeting, which was held in Anchorage, Alaska, the week of March 22. NMFS and BOEMRE jointly lead the meeting. The BOEMRE analysts working on the Statoil EA attended the Open Water Meeting and took notes on comments related to Statoil's proposed activities.

**NMFS IHA process.** As described elsewhere in this EA, the applicant has applied for incidental harassment authorization issued under the MMPA by NMFS. The NMFS IHA review and decision process includes opportunities for public participation. The Open Water and Peer Review meetings are part of IHA process. NMFS publishes draft authorizations in the Federal Register for public review and comment.

In addition to the public involvement opportunities related specifically to Statoil's proposed action, the public has participated in the on-going discussion of seismic survey activities throughout preparation of the several environmental analyses and related processes. A brief summary of the public input opportunities with previous BOEMRE NEPA processes is provided below. The environmental documents listed below are available at http://www.mms.gov/alaska/ref/EIS_EA.htm. The BOEMRE has considered the issues, alternatives, and mitigation measures identified from this ongoing process during preparation of this EA.

**Programmatic EA for Arctic Ocean Outer Continental Shelf Seismic Surveys (OCS EIS/EA MMS 2006-038).** The BOEMRE and NMFS jointly prepared the PEA. A draft PEA was circulated for public review. The majority of comments received by BOEMRE addressed similar issues (e.g., EIS versus EA, significance criteria, potential mitigation measures, reasonable alternatives, data quality, and data gaps). A summary of the major categories of comments and our response to those comments can be found in Appendix D of the PEA. After careful consideration and evaluation, many of these substantive comments resulted in modifying the text in the PEA.

**Draft Programmatic Environmental Impact Statement (DPEIS) Seismic Surveys in the Beaufort and Chukchi Seas, Alaska (OCS EIS/EA MMS 2007-001).** BOEMRE and NMFS jointly initiated this Programmatic EIS. Publication of the notice of intent (NOI) began the official scoping period. In addition to the NOI, the NMFS and BOEMRE pursued other avenues for scoping seismic

survey issues. At the October 2006 Open Water Meeting, industry representatives; the BOEMRE and NMFS and other federal and state agencies; tribal government representatives; subsistence stakeholders; and other interested parties participated in presentations and discussions about the 2006 open water seismic survey season. During public hearings for the BOEMRE Chukchi Sea Lease Sale 193 draft EIS and Draft Proposed Program for 2007-2012 OCS Oil and Gas Leasing (5-Year Program), BOEMRE personnel discussed how seismic surveys are conducted. Public hearings on the DPEIS were held in April 2007 in Anchorage, Nuiqsut, Point Hope, Point Lay, Wainwright, and Barrow. Based on verbal requests during the public hearings and two written requests, the DPEIS comment period was extended from May 14, 2007, to June 29, 2007 (72 FR 26788, May 11, 2007). At the request of the Alaska Eskimo Whaling Commission, the comment period was extended a second time, from June 29, 2007, to July 30, 2007 (72 FR 36427, July 3, 2007). NMFS withdrew the DPEIS in 2009 (74 FR 55539, October 28, 2009) and published a Notice of Intent to begin a new EIS process (75 FR 6175, February 8, 2010).

**Final Environmental Impact Statement, Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea (OCS EIS/EA MMS 2007-026).** Scoping meetings for the EIS were held in Barrow, Wainwright, Point hope, Point Lay, and Anchorage, Alaska, in January-February 2006. Government-to-Government Consultation meetings were held with the Native Villages of Point Hope, Point Lay, Wainwright, and Barrow and the Inupiat Community of the Arctic Slope (ICAS) in January-February 2006. Public hearings on the draft EIS were held in Barrow, Wainwright, Point hope, Point Lay, and Anchorage, Alaska, in November-December 2006. See Section VI of the FEIS for a description of public involvement process. Volume II of the Final EIS contains the substantive comments and responses to those comments, which include comments on seismic surveying activities. NMFS was a cooperating agency for this EIS.

**Draft Environmental Impact Statement - Beaufort and Chukchi Sea Planning Areas - Oil and Gas Lease Sales 209, 212, 217, and 221 OCS EIS/EA MMS 2008-055.** Scoping meetings for the EIS were held in Barrow, Kaktovik, Nuiqsut, Wainwright, Point Hope, Point Lay, and Anchorage in September-November 2007. Government-to-Government meetings were held with the Nuiqsut Tribal Council, the Native Village of Point Hope, and ICAS in September and October 2007. The draft EIS was filed with the EPA and the Notice of Availability (NOA) was announced in the *Federal Register* on December 19, 2008. The NOA provided for a 90-day public comment period, which was extended by 2 weeks. Public hearings were held in January-March 2009, in Barrow, Kaktovik, Nuiqsut, Wainwright, Point Hope, Point Lay, and Anchorage. Government-to-Government consultation meetings with the Native Villages of Nuiqsut and Barrow, and ICAS were also held during this period. The Government-to-Government meeting with the Native Village of Point Hope did not occur because of lack of a quorum. The BOEMRE requested Government-to-Government meetings with the Native Villages of Kaktovik, Point Lay, and Wainwright, but the requests were declined or no response was received. A number of comments received on the draft EIS related to seismic surveys and mitigation. Volume III, Chapter V, describes the public involvement process.

**Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean, February 2010.** NMFS, with BOEMRE as a cooperating agency, is preparing an EIS to analyze the environmental impacts of issuing incidental take authorizations pursuant the MMPA to the oil and gas industry for the taking of marine mammals incidental to offshore exploration seismic surveying and exploration drilling activities in the Beaufort and Chukchi Seas including seismic surveys. The Notice of Intent (NOI) to prepare an EIS on the effects of oil and gas activities (seismic surveys and exploratory drilling) in the U.S. Arctic Ocean was published in the *Federal Register* on Monday, February 8, 2010. The NOI announced a 60-day public scooping period. Public scoping meetings for this EIS were held during in February and March, 2010, in Kotzebue, Point Hope, Point Lay, Wainwright, Barrow, Nuiqsut, Kaktovik, and Anchorage. Both NMFS and BOEMRE representatives were at each scoping meeting. Because the EIS will be completed after the 2010 open-water season,

BOEMRE's preparation of EAs for proposed 2010 OCS activities open-water season, including Statoil's proposed seismic survey, was discussed at each meeting. BOEMRE received some comments on the Statoil's proposed seismic survey and BOEMRE's EA during these public scoping meetings.

# 8.0 VERIFICATION

Pursuant to the CEQ regulations (40 CFR 1506.5(a)) that acceptable work by an applicant not be redone but be verified by the agency, the BOEMRE reviewed, evaluated, and verified the information and analysis provided in Statoil's EED (Statoil, 2010b), which BOEMRE considered in preparation of this EA.

# 9.0 REVIEWERS AND PREPARERS

In compliance with 40 CFR 1506.5(a), the persons responsible for the review of Statoil's permit application and supporting information and analysis, and for preparation and review of this EA are listed below:

| Name | Title |
|---|---|
| Augustine, Gene | Biologist |
| Banet, Susan | Chief, Resources Analysis |
| Burwell, Michael | Socioeconomic Specialist |
| Cody, Mary | Wildlife Biologist |
| Cowles, Cleve | Regional Supervisor, Office of Leasing and Environment |
| Cranswick, Deborah | Supervisory Environmental Specialist, Chief, Environmental Analysis Section I |
| Crews, Christopher | Wildlife Biologist |
| Denton, Jeffrey | Wildlife Biologist |
| Deschu, Nancy | Fisheries Biologist |
| Goll, John | Regional Director, Alaska OCS Region |
| Holiday, Dan | Biological Oceanographer |
| Lage, Jana | Geophysicist |
| Lima, James | Supervisory Environmental Specialist, Chief, Environmental Analysis Section II |
| Loman, Jeffery | Deputy Directory, Alaska OCS Region |
| Schroeder, Mark | ESA Coordinator/Wildlife Biologist |
| Sloan, Pete | Geologist |
| Smith, Caryn | Oceanographer / Oil spill Risk Analysis |
| Talbott, Joseph | NEPA Coordinator, Technical Editor |
| Warren, Sharon | Program Analysis Officer |

# 10.0 REFERENCE MATERIAL

## 10.1. Terms (Acronyms & Abbreviations)

| | | | |
|---|---|---|---|
| **2D** | 2 Dimensional Seismic Survey | **ESA** | Endangered Species Act |
| **3D** | 3 Dimensional Seismic survey | **FONSI** | Finding of No Significant Impact |
| **BE** | Biological Evaluation | **ft** | foot |
| **BO** | Biological Opinion | **FWS** | U.S. Fish and Wildlife Service |
| **CEQ** | Council on Environmental Quality | **G&G** | Geological & Geophysical |
| **CFR** | Code of Federal Regulations | **IHA** | Incidental Harassment Authorization |
| **COMIDA** | Chukchi Offshore Monitoring in Drilling Area | **km** | kilometer |
| **dB** | decibel(s) | **$km^2$** | square kilometer |
| **EA** | Environmental Assessment | **l** | liter |
| **EED** | Environmental Evaluation Document | **LOA** | Letter of Authorization |
| **EEZ** | Exclusive Economic Zone | **MJ** | Major Level of Effects |
| **EFH** | Essential Fish Habitat | **MMO** | Marine Mammal Observer |
| **EIS** | Environmental Impact Statement | **MN** | Minor Level of Effects |
| **MMPA** | Marine Mammal Protection Act | **OCS** | Outer Continental Shelf |
| **MMS** | Minerals Management Service | **POC** | Plan of Cooperation |
| **MO** | Moderate Level of Effects | **PEA** | Programmatic Environmental Assessment (USDOI, MMS, 2006b) |
| **M/V** | Motor Vessel | **PTS** | Permanent Threshold Shift |
| **m** | meter | **rms** | Root Mean Square |
| **mi** | mile | **R/V** | Research Vessel |
| **$mi^2$** | square mile | **USC** | United States Code |

| | | | |
|---|---|---|---|
| **NEPA** | National Environmental Policy Act | **USCG** | United States Coast Guard |
| **NG** | Negligible Level of Effects | **TTS** | Temporary Threshold Shift |
| **NMFS** | National Marine Fisheries Service | **USDOC** | U.S. Department of Commerce |
| **NOAA** | National Oceanic and Atmospheric Administration | **USDOI** | U.S. Department of the Interior |

## 10.2. Bibliography

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## 10.3. Appendix A

**List of Figures**

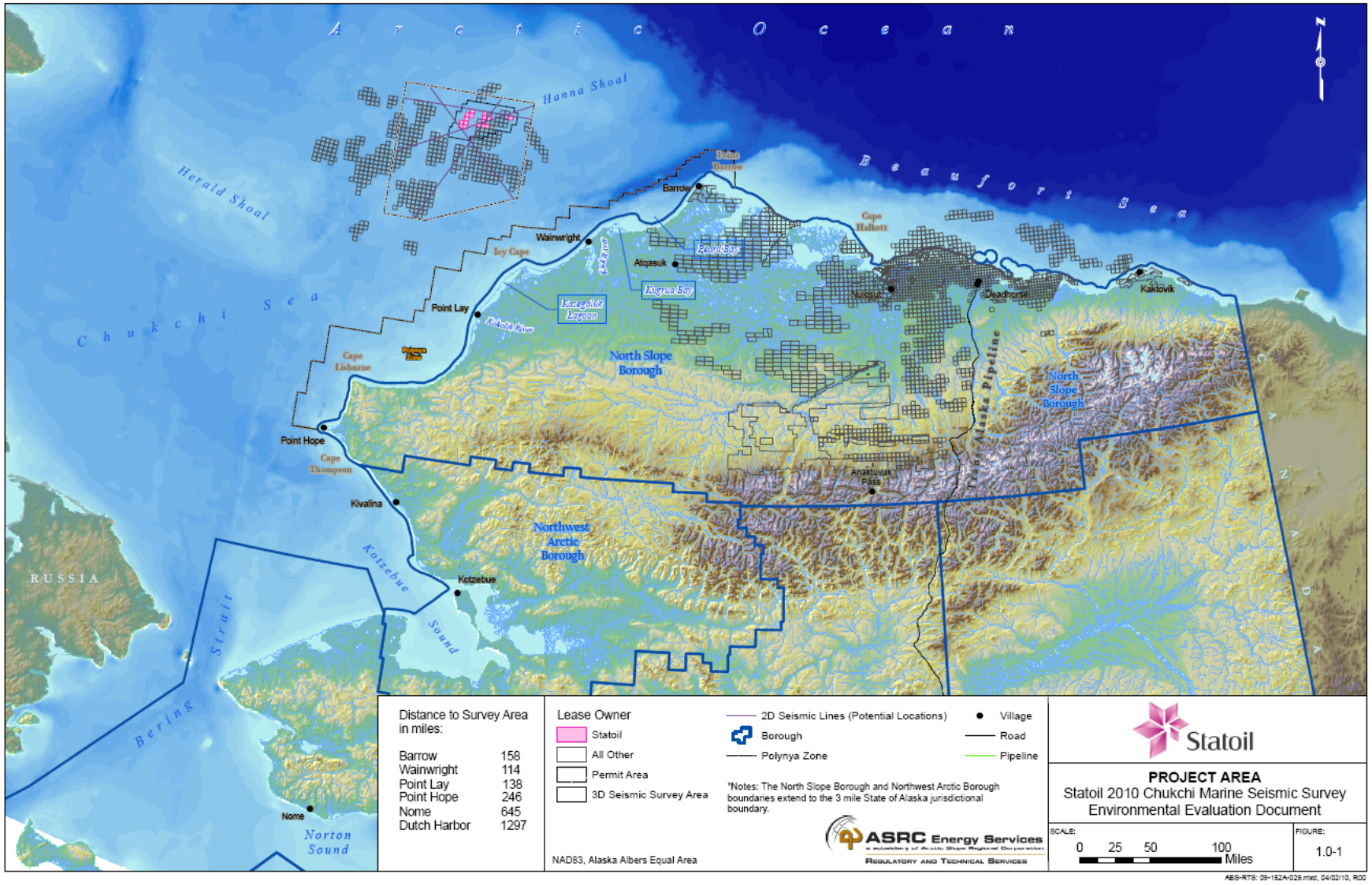


**Figure A-1 Statoil 2010 Chukchi marine survey project area.**

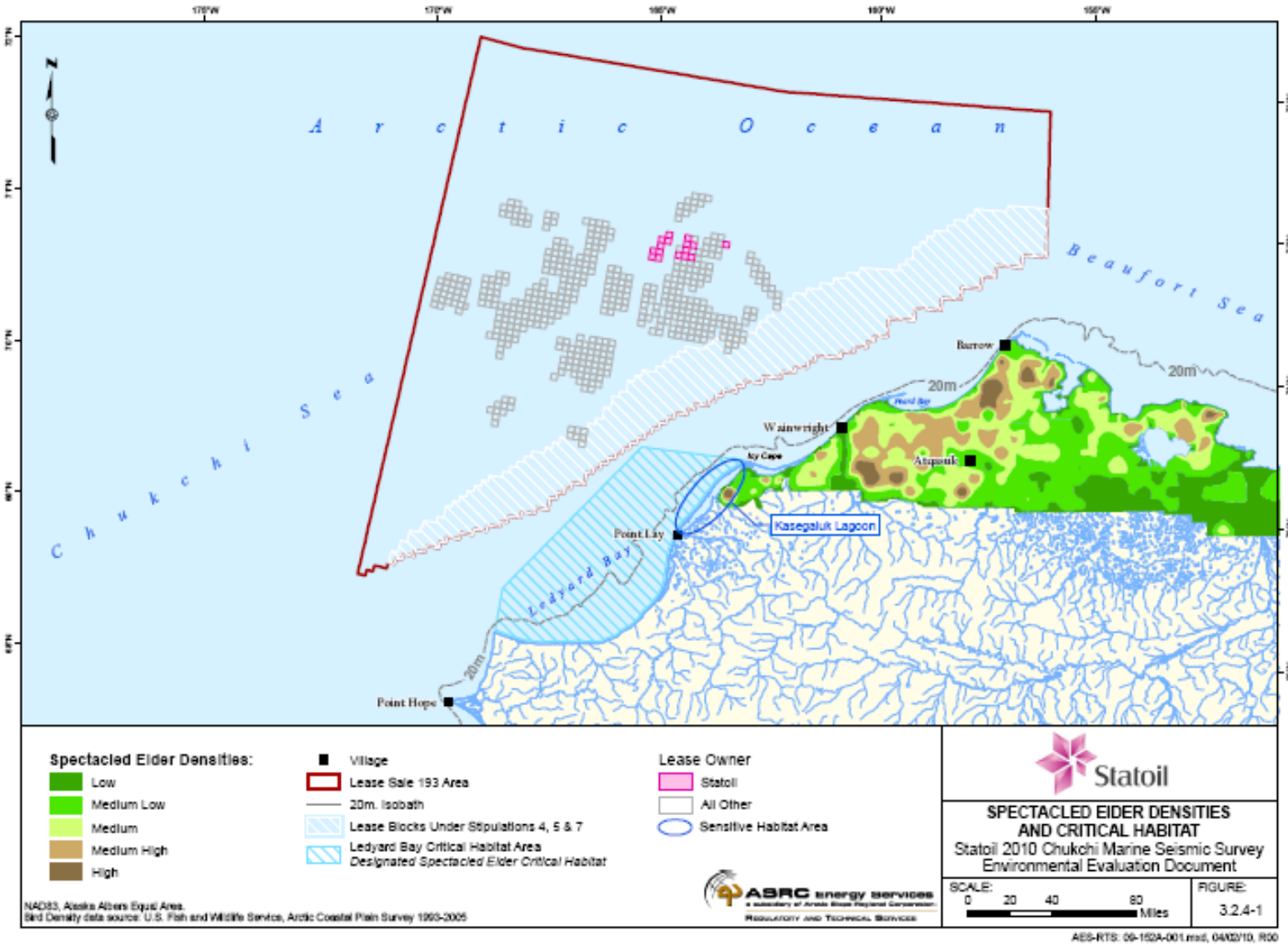


**Figure A-2 Spectacled Eider densities and Ledyard Bay Critical Habitat Unit.**

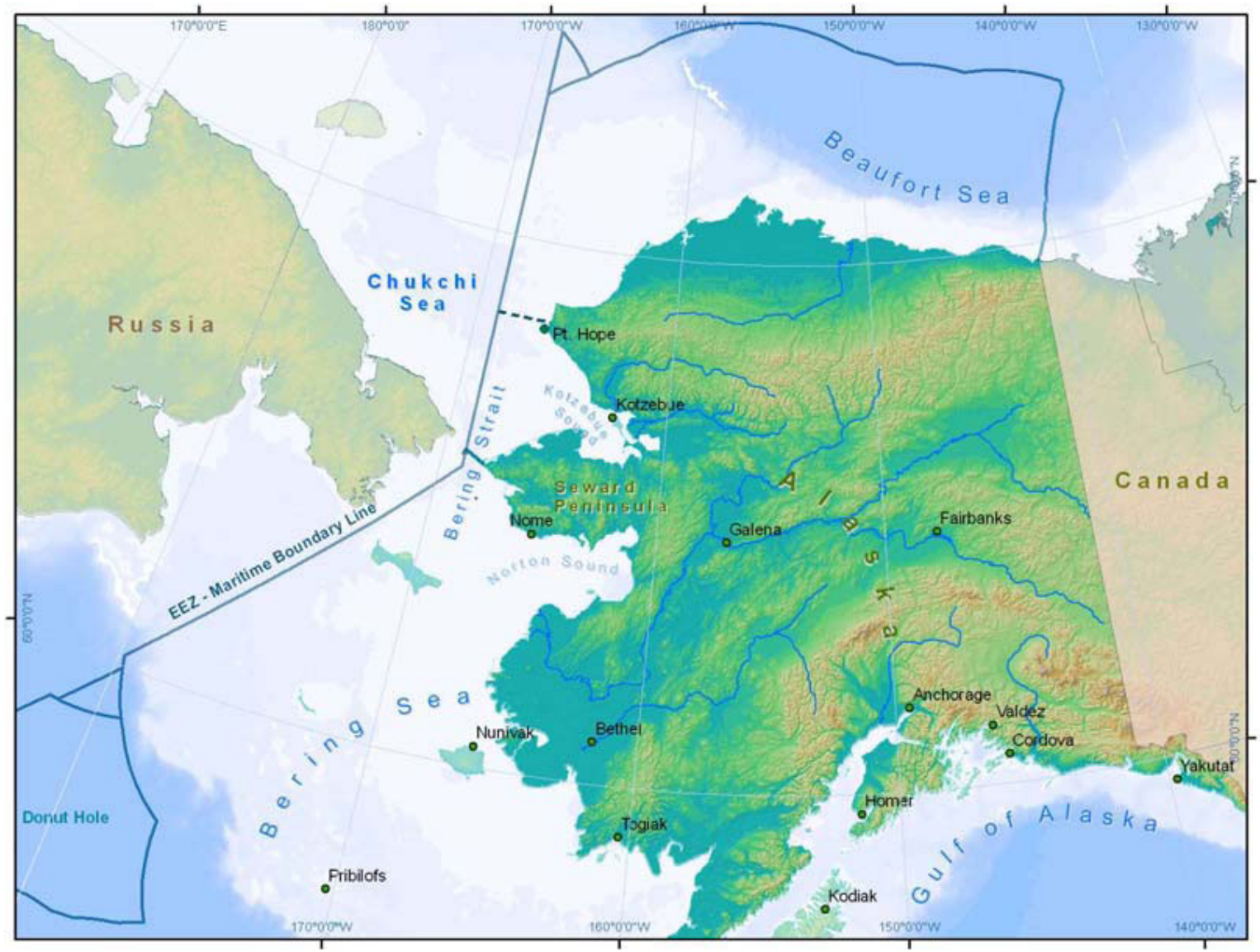


**Figure A-3 EFH for Pacific Salmon.**

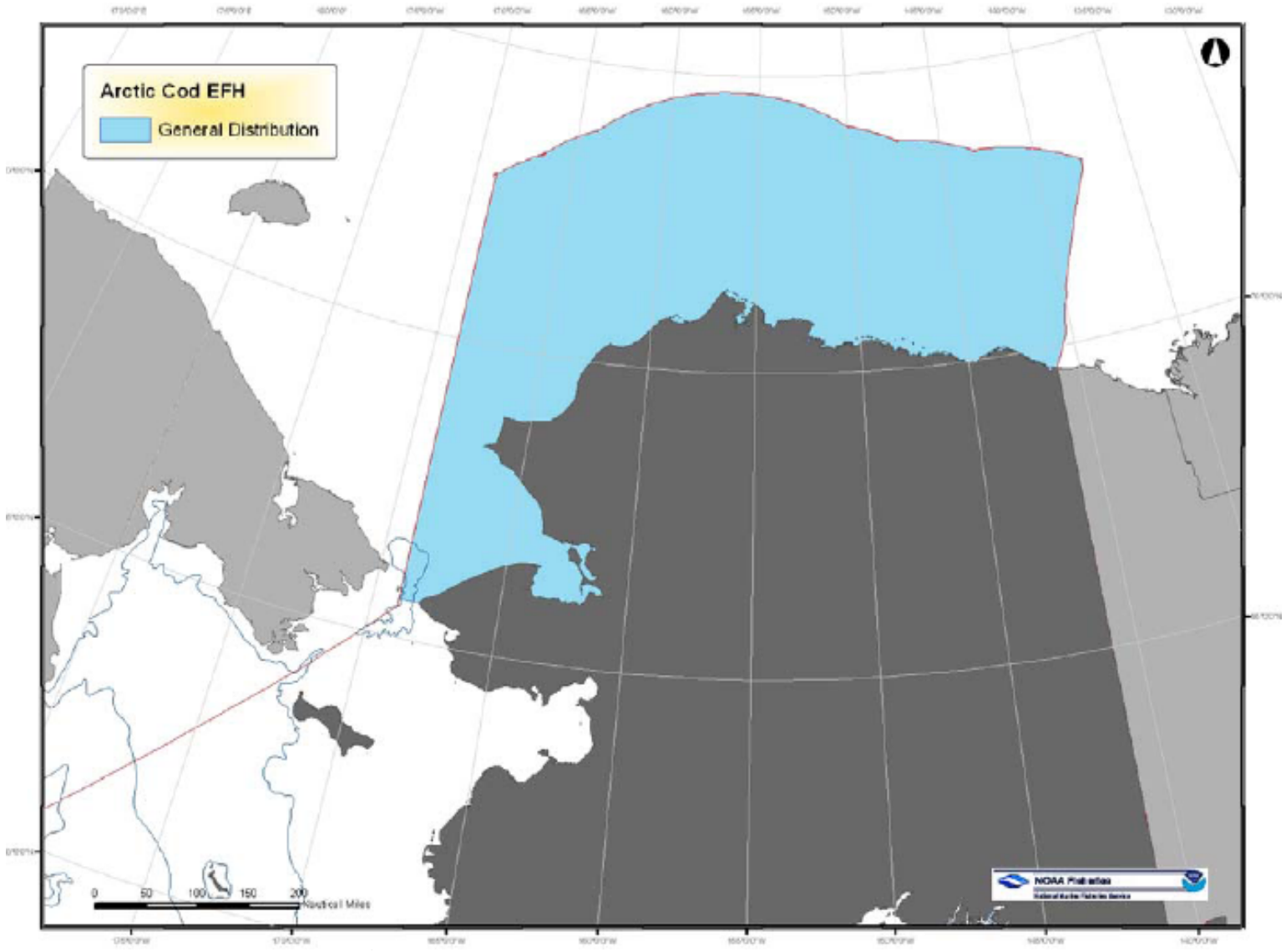


**Figure A-4 EFH for Arctic Cod.**

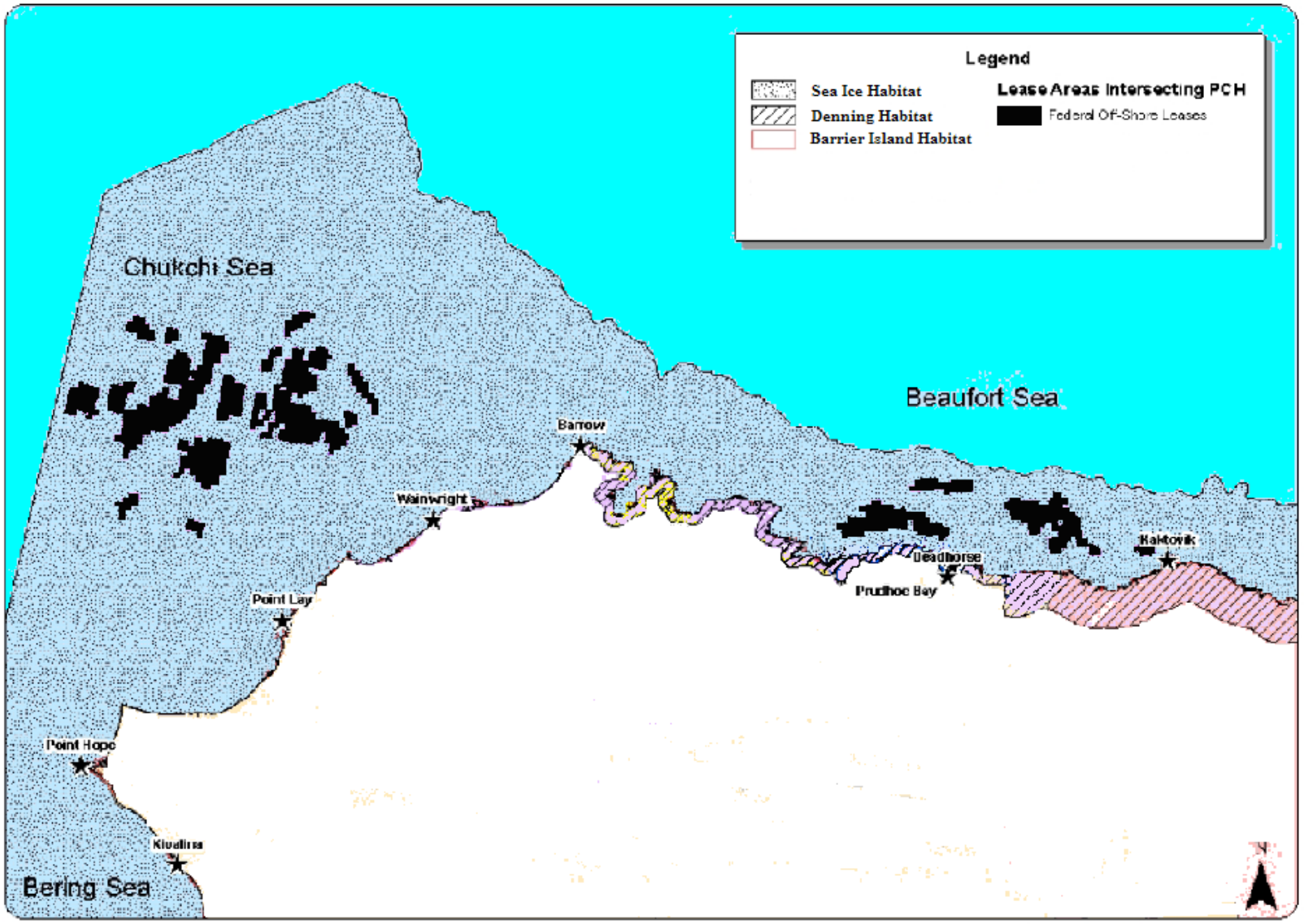


**Figure A-5 Proposed polar bear critical habitats and OCS lease areas (FWS, 2010).**

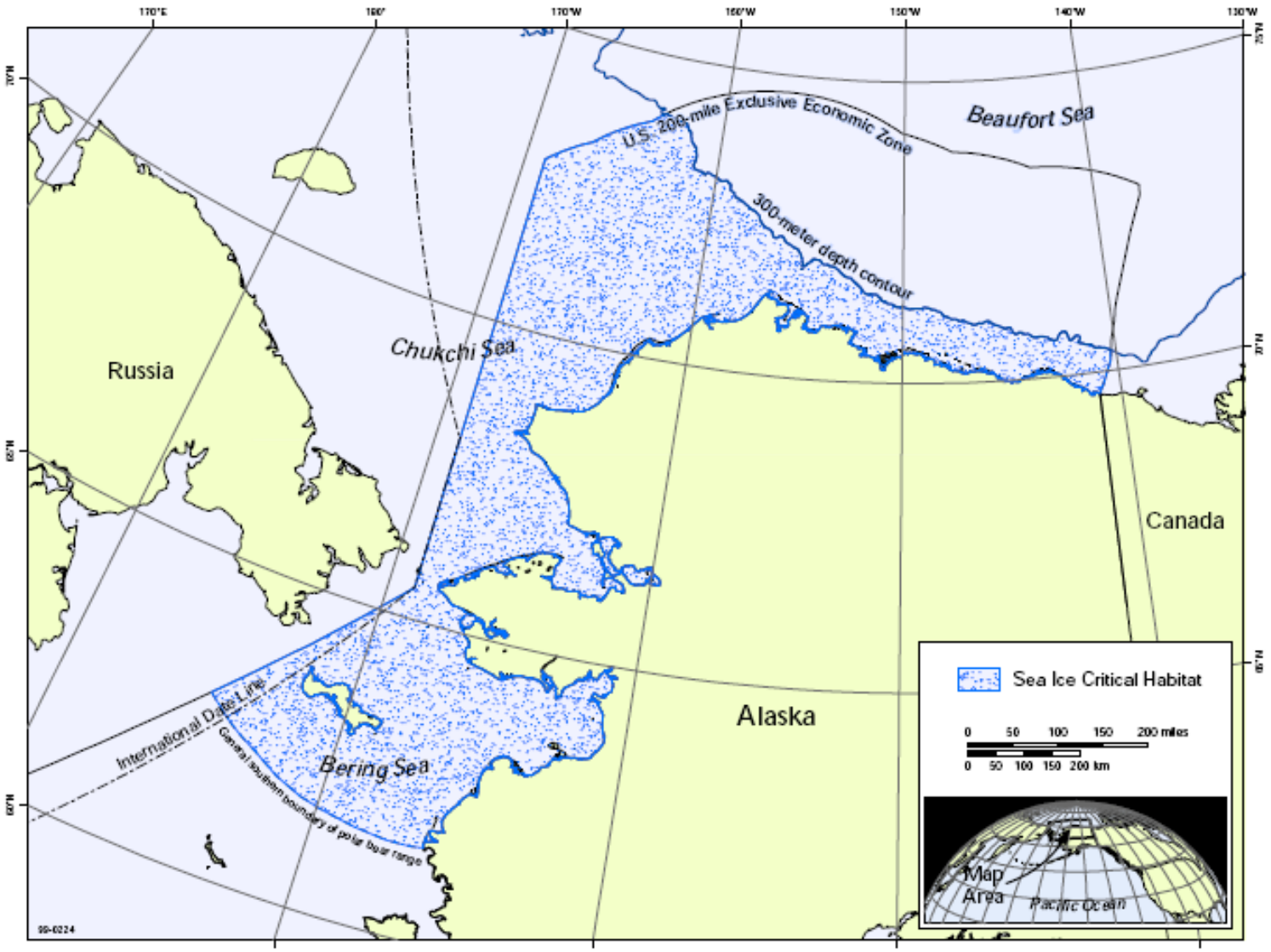


**Figure A-6 Proposed polar bear sea ice critical habitat (FWS, 2010).**

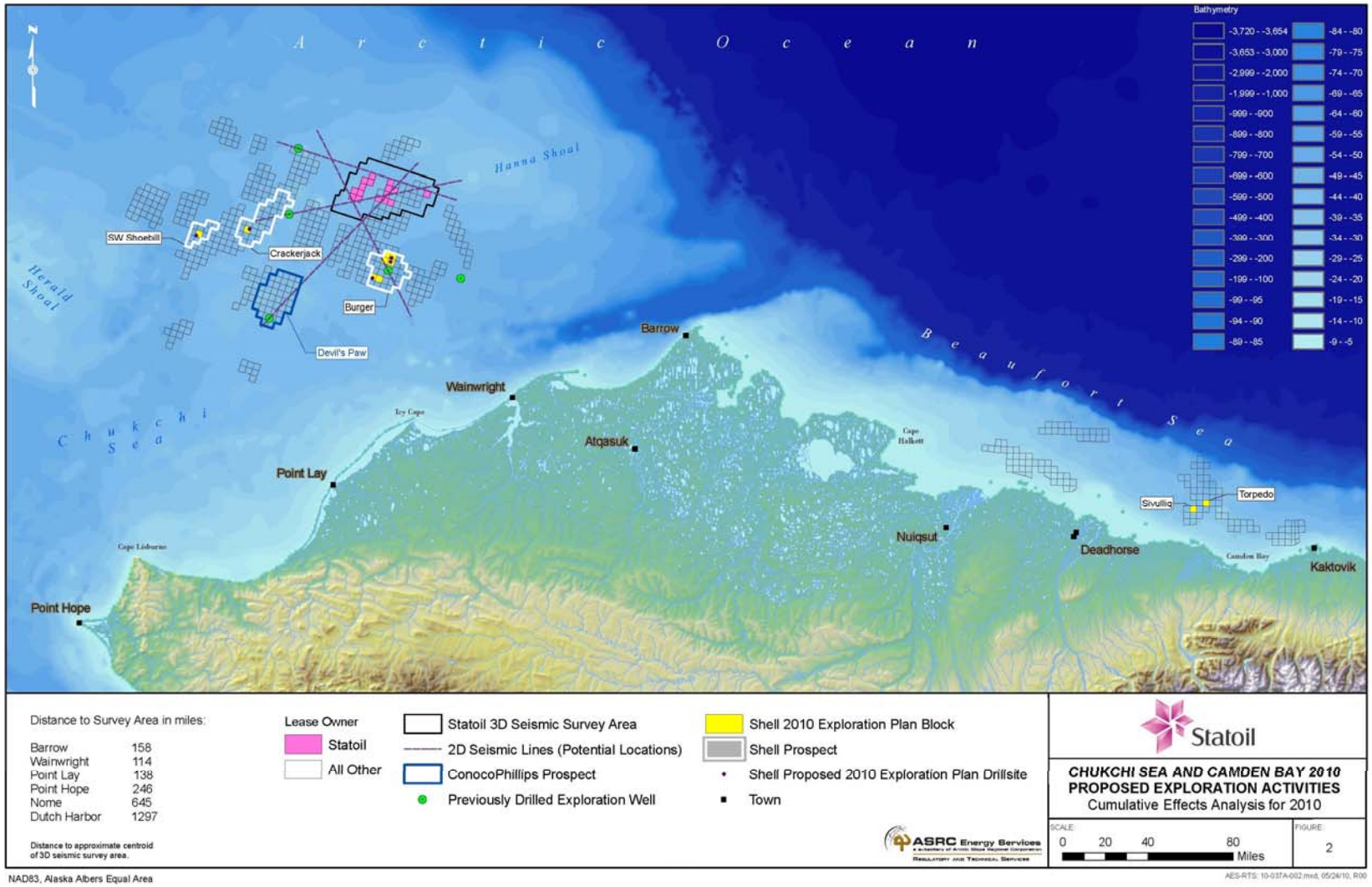


**Figure A-7 Chukchi Sea and Camden Bay 2010 proposed exploration activities.**

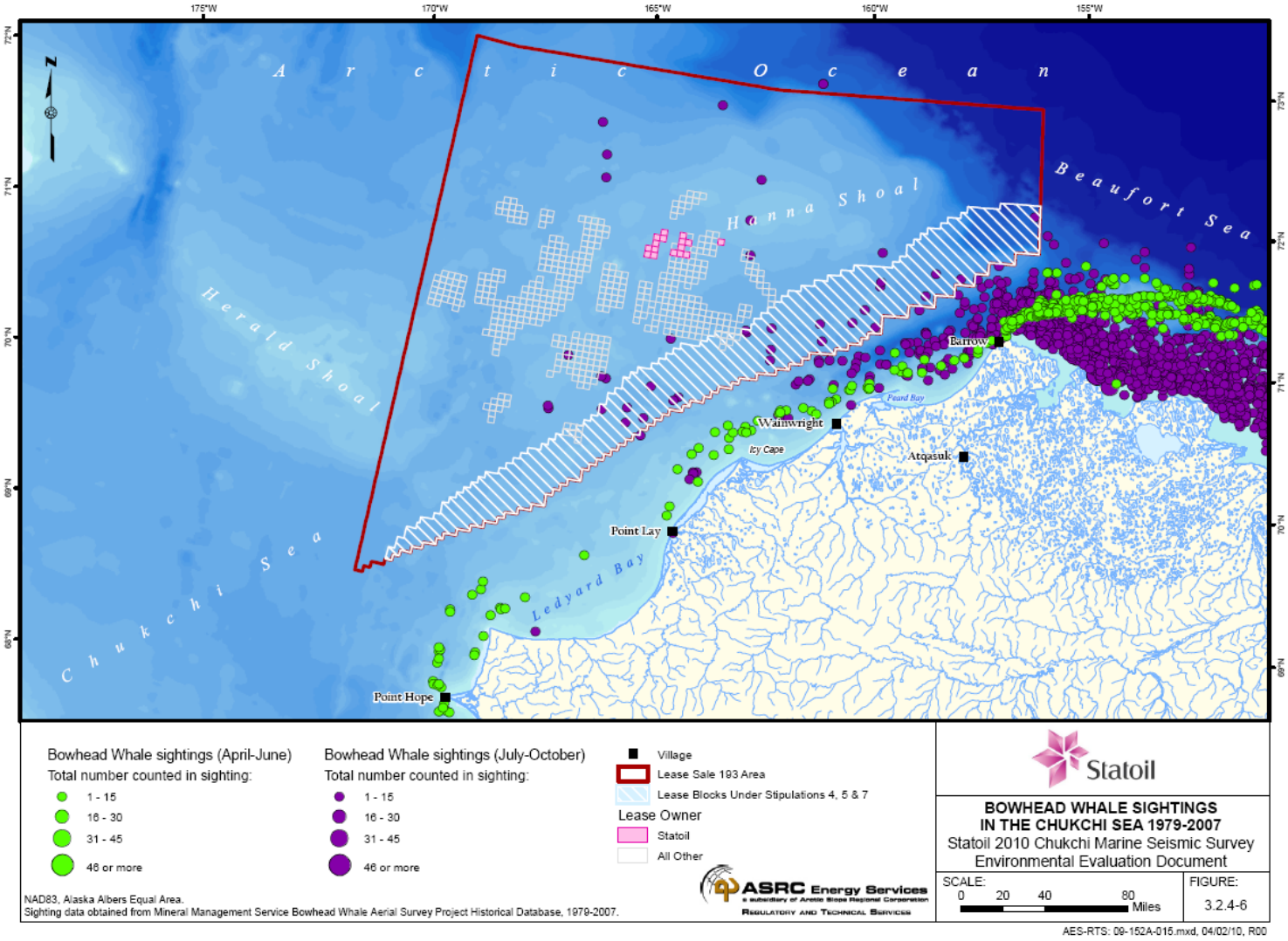


**Figure A-8 Bowhead whale sightings in the Chukchi Sea 1979 - 2007.**

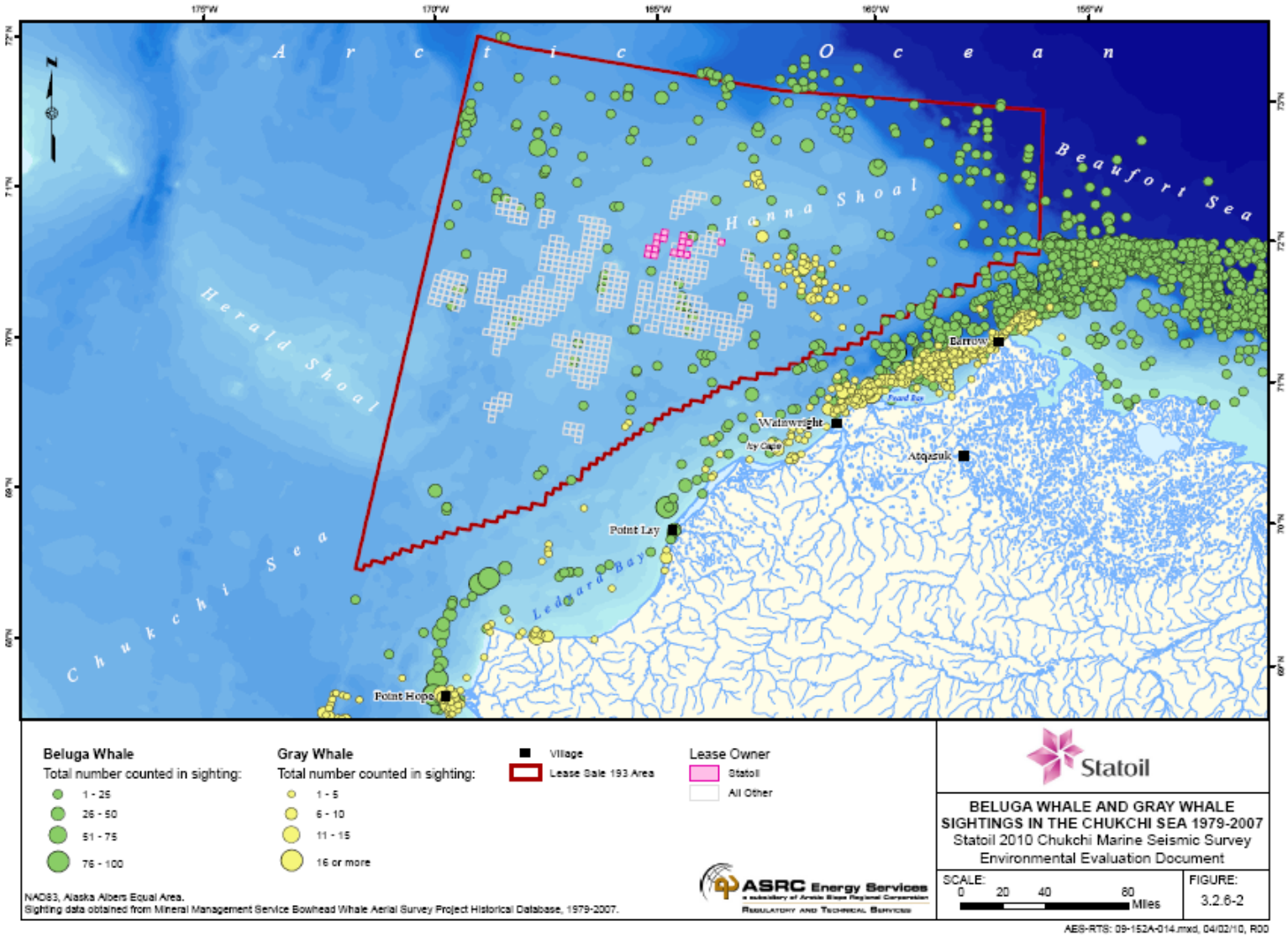


**Figure A-9 Beluga whale and gray whale sightings in the Chukchi Sea 1979 - 2007.**

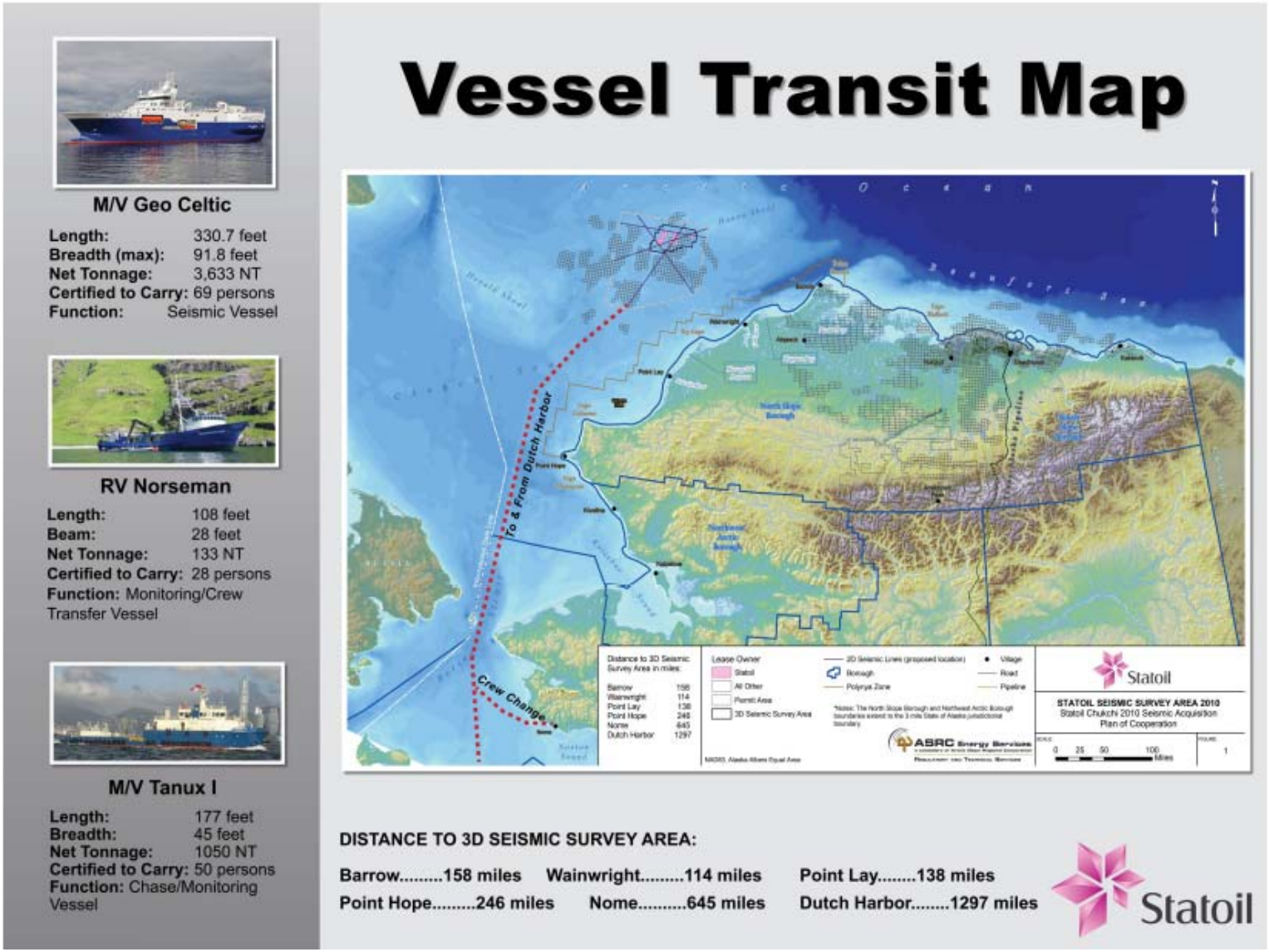


**Figure A-10 Vessel transit map.**

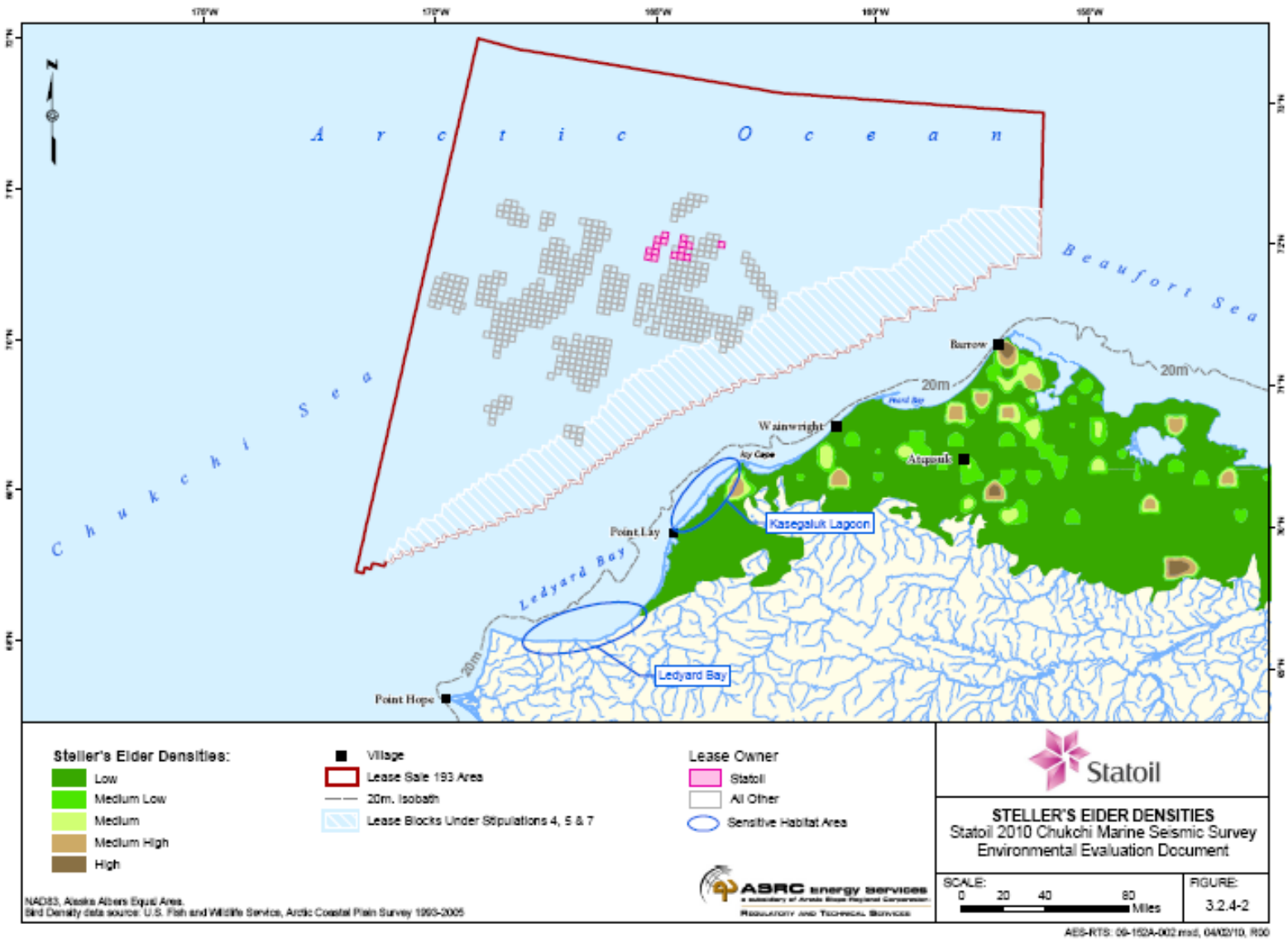


**Figure A-11** **Steller's Eider densities and Ledyard Bay Critical Habitat Unit.**

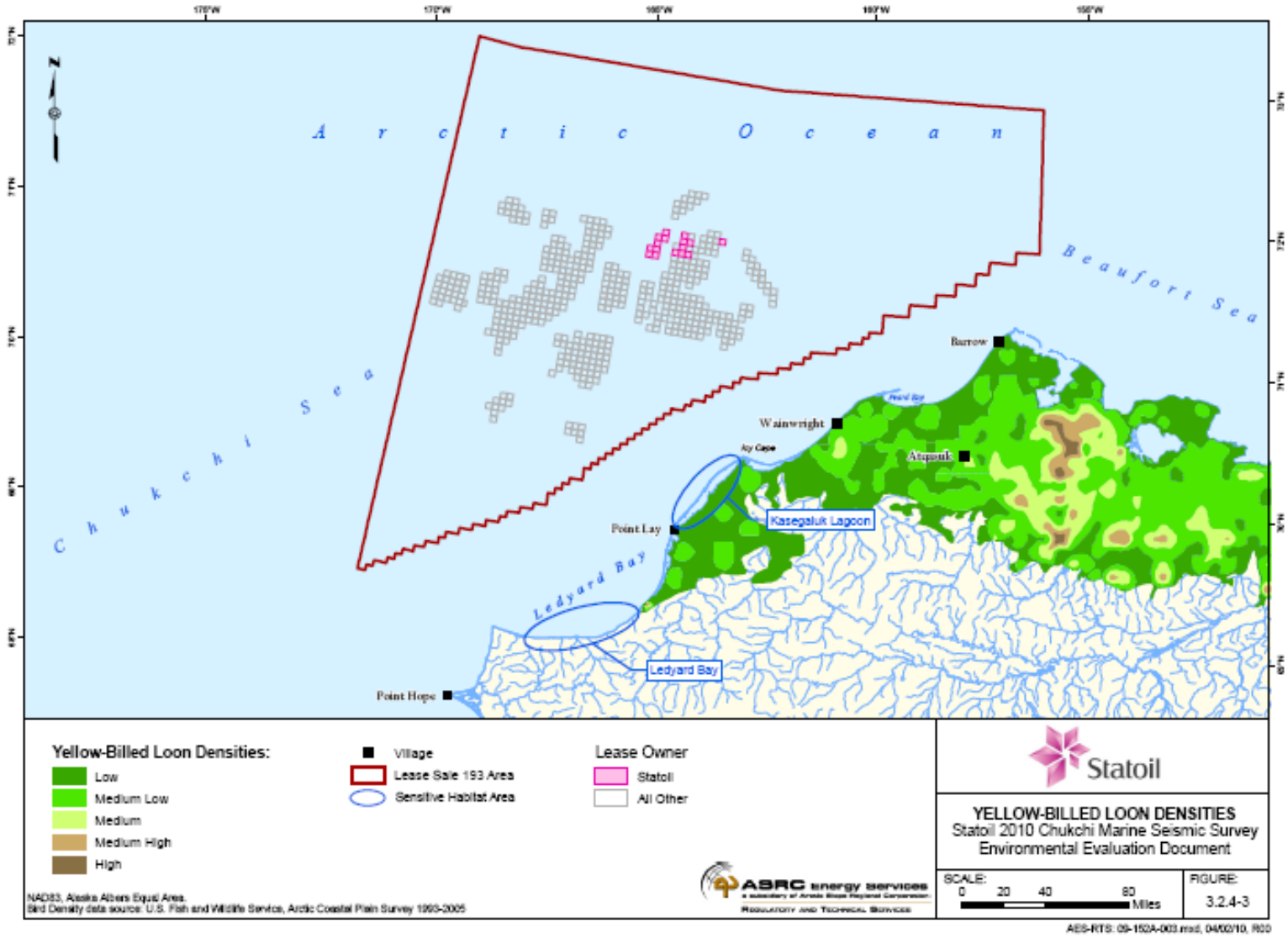


**Figure A-12 Yellow-billed Loon densities and Ledyard Bay Critical Habitat Unit.**

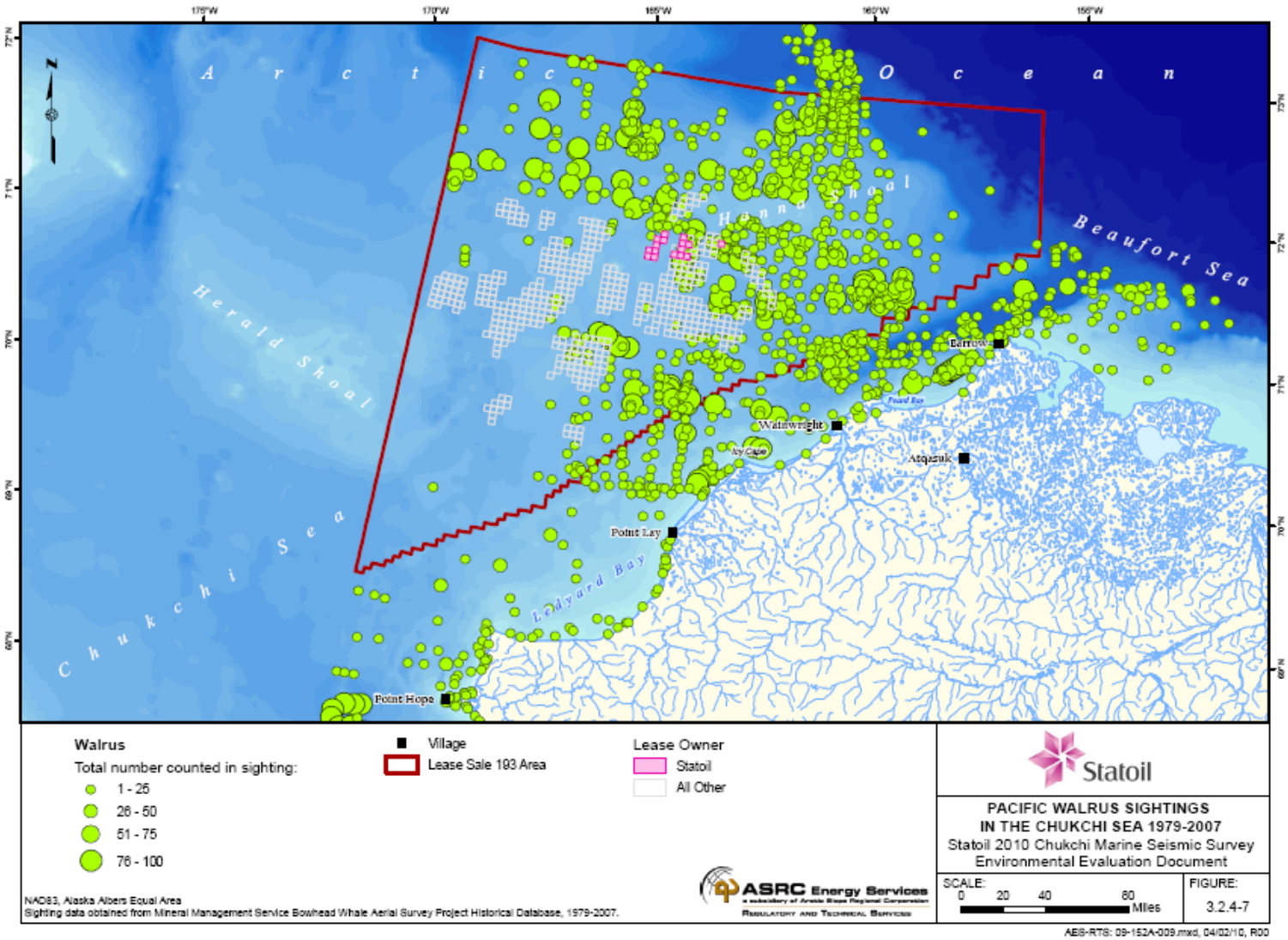


**Figure A-13 Chukchi Sea Pacific walrus sightings, 1979-2007.**