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NMFS 90-Day Report for Marine Mammal Monitoring and Mitigation during BPXA's Liberty Shallow Geohazard Seismic and Seabed Mapping Survey

Beaufort Sea, Alaska

July - August 2014

Prepared for

BP Exploration Alaska, Inc.

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25 November 2014

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Cover Photo: Patti Haase

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Acronyms and Abbreviations

2D	two-dimensional
AEWC	Alaska Eskimo Whaling Commission
AKDT	Alaska Daylight Time
ASAMM	Aerial Surveys of Arctic Marine Mammals
ASL	Above Sea Level
Bf	Beaufort sea state
BPXA	BP Exploration (Alaska), Inc.
CAA	Conflict Avoidance Agreement
CC	Communications Center
CPA	closest observed point of approach
dB	decibel
ESA	Endangered Species Act
ft	feet
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
hr	hour(s)
hr/d	hour(s) per day
HR	high-resolution
HSE	Health, Safety, and Environment
Hz	hertz
IC	Inupiat Communicator
in^3	cubic inch(es)
IHA	Incidental Harassment Authorization
kHz	kilohertz(s)
km	kilometer(s)
km^2	square kilometer
km/hr	kilometers per hour
kt	knot(s)
LOA	Letter of Authorization

m	meter(s)
mi	mile(s)
mi^2	square mile(s)
min	minute(s)
MMPA	Marine Mammal Protection Act
M/V	motor vessel
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NSB	North Slope Borough
NVD	night vision device(s)
PC	personal computer
PSO	protected species observer(s)
QA/QC	quality assessment / quality check
rms	root mean square
R/V	research vessel
SAE	SAExploration
SDI	Satellite Drilling Island
sec	second(s)
SPL	sound pressure levels
SSV	sound source verification
™	trademark
Unid	unidentified
U.S.	United States
USFWS	U.S. Fish and Wildlife Service

1. Introduction

BP Exploration (Alaska), Inc (BPXA) conducted a two-dimensional (2D) high-resolution (HR) shallow geohazard survey followed by seabed sonar mapping survey in the Liberty Prospect during the 2014 open water season, hereafter refered to as the *Liberty 2014 Survey.* The Liberty Prospect is located in Foggy Island Bay in the Beaufort Sea, Alaska, between Endicott and Point Thompson (Figure A). The 2D HR survey began on 16 July and was completed 5 August 2014. The sonar mapping survey started 6 August and was fully demobilized on 30 August 2014.

Eight species of marine mammals known to occur in the Beaufort Sea could possibly be encountered in or near the Liberty survey area, including three cetacean (beluga whale, bowhead whale and gray whale), four pinniped (ringed seal, spotted seal, bearded seal and Pacific walrus) and one marine fissiped species (the polar bear). An additional five marine mammal species (narwhal, killer whale, harbor porpoise, minke whale and humpback whale) could occur in the Beaufort Sea but are considered rare or extralimital to the project area and thus are not further addressed herein.

Species considered most likely to be encountered in the *Liberty 2014 Survey* area are ringed seals, followed by bearded and spotted seals. Though possible, beluga, bowhead, and gray whales occurrence is considered very limited given the shallow (<10 meters [m]) water depths in the project area combined with the barrier islands that separate the project area from the offshore Beaufort Sea (Figure A). Most bowhead whales occur farther offshore during July or August, although some animals have been observed in nearshore areas in the past few years (Clarke et al. 2014; 2013, 2014 Aerial Surveys of Arctic Marine Mammals (ASAMM) daily flight summaries). Three species known to occur regularly in the Beaufort Sea are listed under the U.S. Endangered Species Act (ESA): the endangered bowhead whale, the threatened Arctic stock of ringed seals, and the threatened polar bear. A full review of the natural history of the possibly occuring species was provided in the project Incidental Harassment Authorization (IHA) application (BPXA 2014), and in the Letter of Authorization (LOA) application. Although whale species that are rare or extralimital to the Beaufort Sea are not expected to be present in the project area, BPXA requested harassment authorization for a few animals to cover incidental occurrences.

Marine seismic surveys emit sound energy into the water and have the potential to affect marine mammals, given the reported auditory and behavioral sensitivity of many such species to underwater sounds (Richardson et al. 1995). Behavioral, distributional, or (if they occur) auditory effects could constitute a “take” under provisions of the Marine Mammal Protection Act (MMPA) and the Endangered Species Act (ESA). The National Marine Fisheries Service (NMFS) has jurisdiction over the whale and seal species that were likely to be encountered during the shallow geohazard survey. Under the MMPA, BPXA applied for and on June 25, 2014 received from NMFS an IHA authorizing “take”, by Level B harassment, of a small

number of marine mammals incidental to conducting the proposed geohazard survey. This IHA identified associated monitoring, mitigation and reporting measures (BPXA 2014, NMFS 2014). The IHA included provisions to minimize the possibility that cetaceans and pinnipeds (excluding the Pacific walrus, which is managed by the United States (U.S.) Fish and Wildlife Service [USFWS]) would be exposed to potentially harmful airgun sounds and to reduce behavioral disturbances that could be considered as a "take" under the MMPA.

BPXA also requested and was issued a LOA from the USFWS allowing unintentional harassment of polar bears and Pacific walrus incidental to the planned seismic activities (USFWS 2013a). This LOA identified mitigation, monitoring, and reporting measures required specific to these species. Any other project or bear protection harassment activities were to be carried out under a separate general LOA issued by USFWS authorizing intentional harassment through deterrence for the protection of human life (USFWS 2013b).

Regulations in the MMPA also require that IHA applicants planning activities in Arctic waters provide a Plan of Cooperation that identifies measures to minimize adverse effects on the availability of marine mammals for subsistence purposes. BPXA met with representatives of the community of Nuiqsut, the Alaska Eskimo Whaling Commission (AEWC), the North Slope Borough (NSB), and others to discuss appropriate measures to be implemented during the 2014 Liberty survey to avoid potential conflicts with the subsistence hunt. These measures were included in the Conflict Avoidance Agreement (CAA) dated April 2, 2014 (AEWC 2014) (see Appendix A).

Trained, NMFS-approved Protected Species Observers (PSOs) were present aboard the source vessel in compliance with the issued NMFS IHA and FWS LOA. Some of these PSOs also performed a role as Inupiat Communicators (IC). The main goal of the PSOs and ICs was to (1) avoid or minimize potential effects of the *Liberty 2014 Survey* on marine mammals, and (2) communicate regularly with the locally established communication centers. As required by the IHA, this included observing for marine mammals within or about to enter the estimated safety radii (190 decibels [dB] re 1 µPa [rms] for pinnipeds and 180 dB re 1 µPa [rms] for cetaceans) and initiating an immediate power down or shutdown of the airguns, when needed.

This 90-day report describes the methods and resultsof the *Liberty 2014 Survey* marine mammal mitigation and monitoring and addresses specific components required in the IHA and LOA. This includes (1) summarizing PSO effort and sighting data and implemented mitigation measures, (2) estimating numbers of marine mammals potentially exposed to airgun pulses exceeding sound levels of 160 dB re 1 µPa (rms), and (3) describing reactions (if any) of marine mammals potentially exposed to airgun sounds. Note that all references to 160, 180 and 190 dB are re 1 µPa SPL rms and are henceforth indicated simply as dB (rms).

2. Summary of BPXA Liberty Activities

The BPXA *Liberty 2014 Survey* was comprised of two separate chronological phases: (1) Phase 1 (2D HR Site Survey): seismic source acquisition, and (2) Phase 2 (Seabed Mapping Sonar Survey): a geohazard survey involving operation of a multibeam echosounder, sidescan sonar, subbottom profiler, and magnetometer but no seismic operations. Note that Phase 1 also included operation of the multibeam echosounder. A chronological table of notable survey events, including dates associated with each survey phase, is provided in Table 1. A detailed map of the Phase 1 and Phase 2 survey boundaries is depicted in Figure A. Details on project activities are described below.

Table 1. Chronological summary of *Liberty 2014 Survey* events.

Date	Activity
25 June	BPXA received National Marine Fisheries Service Incidental Harasment Authorization valid 1 July through 30 September 2014
Late June	Transportation of the research vessel (R/V)*Thunder* to West Dock by road
14 July	R/V *Thunder* launched at West Dock
26 July	Motor vessel (M/V) *Freedom* joins project to conduct crew transfers (this vessel is capable of beach landings)
16 July – 05 August	Phase 1 – Two-dimensional high-resolution *Site Survey*
06 August – 25 August	Phase 2 - *Seabed Mapping Sonar Survey* Note: To limit potential impacts on bowhead whale migration and the subsistence hunt, no survey activity occurred after midnight on 25 August, in accordance with the Conflict Avoidance Agreement.
07 August – 17 August	*R/V Thunder* anchored west of West Dock and no vessel operations due to inclement weather. Beaufort sea state 6-7 (winds 25-30 knots, gusts to 40) from the East to Northeast. The only exception to this was from 15 July through 6 August when the vessel was stationary (anchored or docked) including during adverse weather conditions; during these times Protective Species Observers (PSOs) watched opportunistically for marine mammals, which allowed them a break to manage fatigue. Beginning 7 August, when vessels returned from 10 days of down time due to weather, PSOs were on watch 24 hour/day during all vessel activity
26 August	*R/V Thunder* demobilized from West Dock. M/V *Freedom* returned to support operations for other North Slope projects.
30 August	*R/V Thunder* began transiting south by road

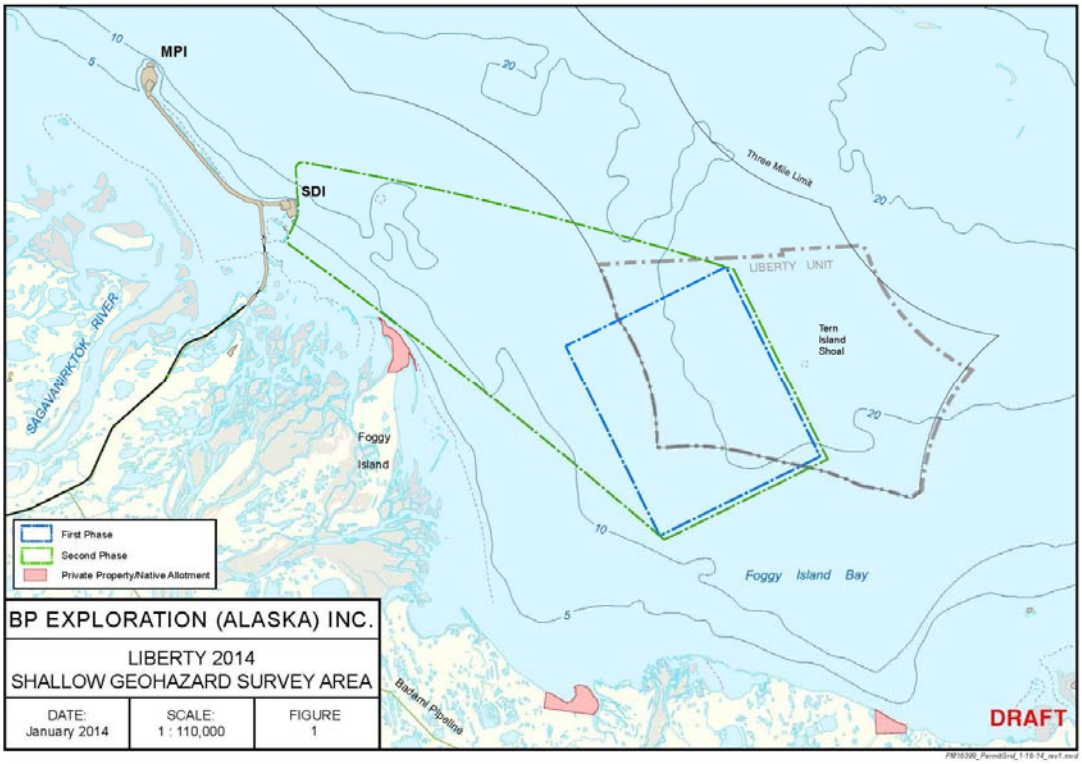

Figure A Location and boundaries of Phase 1 and Phase 2 components of the *Liberty 2014 Survey* in Foggy Island Bay in the Beaufort Sea, Alaska.

2.1. Purpose

The purpose of the *Liberty 2014 Survey* was for BPXA to evaluate potential development of the Liberty oil reservoir, located in state and federal waters of Foggy Island Bay, Alaska. The project is considering options to build a gravel island in marine waters situated over the reservoir. In support of the preferred alternative, the *Liberty 2014 Survey* conducted a site survey to obtain 2D HR shallow geohazard data using an airgun array and a towed streamer. Additional infrastructure associated with this option is a subsea pipeline. Thus, a seabed mapping survey was conducted over the subsea pipeline corridor area under consideration and the Liberty prospect to evaluate the potential existence and location of archaeological resources and geological hazards on the seafloor and in the shallow subsurface.

2.2. Project Area

The Liberty Prospect area lies within Foggy Island Bay about 19 kilometers (km) northeast of Prudhoe Bay and about 15 km east of the Endicott Satellite Drilling Island (SDI) (Figure B) extending from the shoreline up to 10.5 km offshore.

Portions of the Liberty reservoir are located within the Duck Island Unit as well as non-unit areas (Figure B). The entire survey is located inside the barrier islands in water depths up to ~8.5 m deep. Activity that occurred outside the project boundary delineated in Figure B included vessel turning while using airguns, vessel transit, and other vessel movements for project support and logistics.

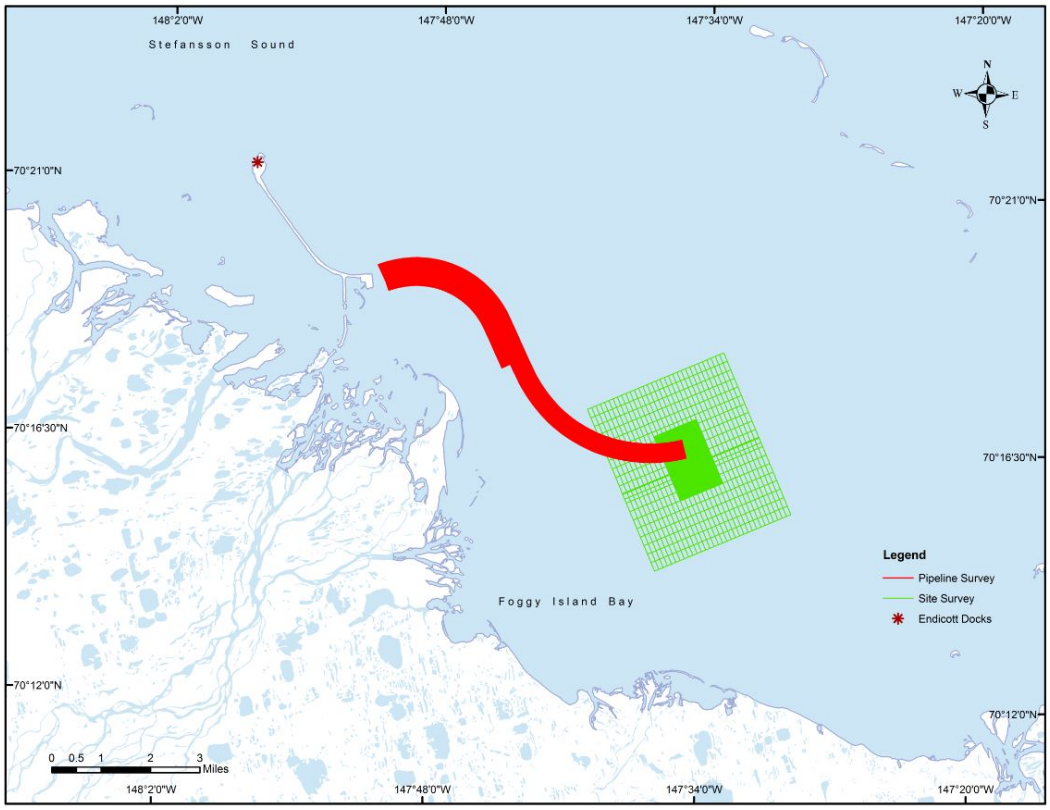

Figure B. Location of Phase 1 2DHR Site Survey (green gridlines) and Phase 2 Seabed Mapping Sonar Survey (green gridlines plus red pipeline corridor area) in Foggy Island Bay, Beaufort Sea.

2.3. Survey Equipment and Phases

Two vessels were used throughout the *Liberty 2014 Survey*: one source vessel and one crew change vessel (Table 2). The source vessel, the R/V *Thunder* (*Thunder*) is a power catamaran. The airgun source and streamer, side scan sonar, and magnetometer were deployed from this vessel. The multibeam echosounder and sub-bottom profiler were hull-mounted on the *Thunder*. No equipment was placed on the sea floor as part of survey activities. The *Thunder* was transported to the North Slope by truck, prepared in the Peak yard in Deadhorse, and launched at West Dock. Vessel preparation included assembling navigation, acoustic, and safety equipment. Positions of all sensors were surveyed for accuracy using a Total station

and land survey techniques while the vessel was in the Peak yard. Initial fueling and stocking of recording equipment were also part of vessel preparations. The navigation and acoustic systems were tested at West Dock and the project site.

The M/V *Freedom* (*Freedom*) was hired to conduct crew transfers to improve safety and save time for crew transfers. The *Freedom* is a landing craft capable of landing on the beach at Endicott without the need for a dock structure. The *Freedom* was brought over to Endicott from West Dock on 26 July to be on standby and for boat-to-dock/land crew transfers as necessitated by the weather.

Table 2. Characteristics of vessels used for the *Liberty 2014 Survey*.

Vessel Name	Vessel Type	Dimensions	Main Activity	Operation Frequency
R/V *Thunder*	Source vessel	68 feet (ft) x 20 ft	Acquire seismic and sonar data	24-hour (hr) operation
M/V *Freedom*	Crew transport vessel	38 ft x 13 ft	Vessel-to-vessel transfers for maximum 6 crew	Intermittently, maximum once every 12 hr

2.4. Phase 1: 2DHR Site Survey

During Phase 1 of the survey, 2DHR seismic data were acquired on two grids. Grid 1 contained lines spaced 150 m apart with perpendicular 300-m spaced lines (Figure A). Grid 2 contained lines spaced 20 m apart. The *Thunde*r source vessel traveled along these predetermined survey transect lines at an average speed of 5.5-7.5 km/hr.

The *Thunder* towed one array containing three 10-cubic-inch (in^3) airguns with a total array volume of 30 in^3. The array was towed approximately 22 m behind the source vessel at a depth of 1.5 m. The estimated sound source level of the airgun array was approximately 209 dB re 1 µPa [rms]. One of the 10-in^3 airguns was used as a single mitigation airgun. The pulse interval was 6.25 m, with shot fired every 3 to 4 seconds (sec). Table 3 summarizes specifications of the airgun array.

During the 2D HR seismic operations, the *Thunder* also towed a 300-m-long streamer the receivers were embedded. The streamer contained 48 receiver groups

at 6.25-m spacing. When weather and operational conditions allowed, seismic data were acquired 24 hr per day (hr/d). The total line length acquired in both grids was 510.4 km.

Table 3. Configuration and source signatures of the *Liberty 2014 Survey*'s 30 in³ airgun array as predicted by the Gundalf Airgun Array Model for 1 m depth.

Array Specifics	Description
Total array volume	30 cubic inches (in³)
Number of airguns	Three 2000 pounds per square inch sleeve airguns (3 x 10 in³)
Zero to peak	4.89 bar-m (~234 decibels (dB) relative to 1 microPascal at 1 meter (re µPa @1 m)
Peak to peak	9.75 bar-m (~240 dB re µPa @1 m)
Root mean square (rms) pressure	0.28 bar-m (~209 dB re µPa @1 m)
Dominant frequencies	About 20-300 hertz (Hz)

2.5. Phase 2: Seabed Mapping Sonar Survey

During Phase 2, a multibeam echosounder, sidescan sonar, sub-bottom profiler, as well as a magnetometer (that does not create sound) were used to conduct the Seabed Mapping Sonar Survey from aboard the *Thunder*. No airgun operations occurred during Phase 2. Specifications of the Phase 2 survey equipment are described below and summarized in Table 4. Data were acquired over the same Grids 1 and 2 as for Phase 1, as well as along the proposed pipeline corridor from the primary survey site to the existing Liberty onshore drill site. Total line length acquired during Phase 2 of the *Liberty 2014 Survey* was 624.3 km.

The multibeam echosounder and sidescan sonar were used to obtain high accuracy information on bathymetry and isonification of the seafloor. The sidescan sonar survey was required to obtain accurate object detection, complementing multibeam data. Multibeam and sidescan data were acquired along Grids 1 and 2 and the proposed pipeline survey route in the Sonar Survey area. Additional multibeam and sidescan infill lines were added to obtain 150 percent coverage over certain areas.

The multibeam echosounder operated at an rms source level of approximately 220 dB re 1 µPa @1m. The multibeam emits high-frequency energy in a fan-shaped pattern of equidistant or equiangular beam spacing. The beam width of the emitted sound energy along the track direction is 2 degrees at 200 kilohertz (kHz) and 1 degree at 400 kHz; the across-track beam width is 1 degree at 200 kHz and 0.5 degrees at 400 kHz (Table 4). The maximum ping rate of the multibeam was 60 Hz.

The sidescan sonar system operated at frequencies of approximately 120 to 135 kHz and 400 to 450 kHz. The estimated rms source level was approximately 215 dB re 1 µPa @1 m (Table 4). Sound energy was emitted in a narrow fan-shaped pattern, with a horizontal beam width of 1.5 degrees for 100 kHz and 0.4 degrees at 400 kHz, and a vertical beam height of 50 degrees. The maximum ping rate of this sidescan sonar was 30 Hz.

The sub-bottom profiler was used to provide an accurate digital image of the shallow sub-surface sea bottom below the mud line. Sub-bottom profiler data were acquired continuously along all grids during Phase 2. The sub-bottom profiler used in this survey emits energy in frequency bands of 2 to 16 kHz (Table 4). The beam width was 15 to 24 degrees depending on the center frequency. Typical pulse rate was between 3 and 6 Hz.

Table 4. Source characteristics of the geophysical survey equipment used on Phase 2 of the *Liberty 2014 Survey*.

Equipment	Operating Frequency	Along Track Beam Width	Across Track Beam Width	Sound Pressure Level
Multibeam echosounder	200 - 400 Kilohertz (kHz)	1 - 2°	0.5 - 1°	~220 decibels relative to 1 microPascal at 1 meter (dB re 1 µPa @1m)
Sidescan sonar	120 - 135 kHz	1.5°	50°	~215 dB re 1 µPa @1m
Sidescan sonar	400 - 450 kHz	0.4°	50°	~215 dB re 1 µPa @1m
Subbottom profiler	2 - 16 kHz	15-24°	15-24°	~216 dB re 1 µPa @1m

A marine magnetometer was used to detect magnetic deflection generated by geologic features or by buried or exposed ferrous objects potentially related to archaeological artifacts or modern human-made debris. Magnetometers measured changes in magnetic fields over the seabed and did not produce sounds. The magnetometer was towed at 62.5 m behind the *Thunder* to avoid data pollution by the vessel's magnetic properties.

2.6. Navigation Data Collection and Management

Several types of equipment were used to assist with navigation. The *Thunder* was equipped with Redundant Differential Global Navigation Satellite System (GNSS) receivers capable of recording both Global Positioning System (GPS) satellite

constellations and Starfix HP broadcast differential corrections. Differential-corrected positions were fed into an inertial positioning system that logged vessel position, pitch, roll, heading, heave, and inertial accelerations. These logged positions and accelerations were used in conjunction with a terrestrial kinematic base station to compute a smoothed vessel trajectory.

A navigation software suite displayed local bathymetry, known obstructions, islands and shoals, and identified sensitive areas. The software also displayed pre-determined source line positions within the two survey phase areas. Navigation software recorded all measured equipment offsets, corrections, and vessel and equipment position at a frequency of one position per sec for the duration of the project.

Multibeam echosounder soundings were corrected for position and vessel motion using the calculated smoothed vessel trajectory. Soundings were reduced for tide by computing the ellipsoidal height from GNSS observations and then applying an ellipsoid-geoid separation model. This reduced the soundings to Mean Lower Low Water as defined by National Oceanic and Atmospheric Administration (NOAA) at the nearby Prudhoe Bay West water level station.

2.7. Housing and Logistics

Approximately 25 people were involved in *Liberty 2014 Survey* operations on a day-to-day basis. Five individuals were housed 24 hr/d on the *Thunder*. The remaining crew (including two PSOs) was accommodated at existing camps. Support activities, such as crew transfers, vessel resupply of water, and pumping off of sewage primarily occurred at Endicott. However, fueling and some crew transfers occurred at West Dock. Equipment staging and onshore support primarily occurred at West Dock and occasionally at Endicott. The vessel anchored on the west side of Endicott or the west side of West Dock for protection from weather.

3. Safety/Disturbance Radii and Sound Monitoring Program

Safety radii (i.e., “exclusion zones”) and disturbance radii as identified in the NMFS-issued IHA and the USFWS-issued LOA were applied during the *Liberty 2014 Survey* (NMFS 2014; USFWS 2013a). These radii are based on current NMFS guidelines (e.g., 65 FR 16374) indicating that the “safety radii” for marine mammals around airgun arrays are customarily defined as the distances within which received sound pressure levels are ≥ 180 dB (rms) for cetaceans and ≥ 190 dB (rms) for pinnipeds. The USFWS-issued LOA identified a ≥ 180 dB (rms) safety radius for walrus and a ≥ 190 dB (rms) safety radius for polar bears in water. The NMFS criteria assume that

pulsed sounds at lower received levels will not injure these animals or impair their hearing ability, but that higher received levels could potentially have such effects. In addition, NMFS assumes that marine mammals exposed to ≥ 160 dB (rms) are potentially subject to behavioral disturbance.

As summarized in the *Liberty 2014 Survey* IHA application (BPXA 2014) there is poor agreement between modeled and measured distances to received SPLs; this is due to natural variability in the marine environment, application of precautionary correction factors, and data interpretation in the generation of circular isopleths (Aerts et al. 2013). Thus, for the *Liberty 2014 Survey*, existing sound source verification (SSV) measurements for 20-40 in^3 airgun arrays or a 10 in^3 single gun in shallow Beaufort Sea waters were used to establish distances to received SPLs of 190, 180, and 160 dB re 1µPa (rms). The safety radii for the project's 30 in^3 airgun array and 10 in^3 airgun were derived from the average distance of the 20-40 in^3 and the 10 in^3 SSV measurements, respectively (Table 5). These radii were applied during the *Liberty 2014 Survey* and were also identified in the project's NMFS-issued IHA. The applied safety radii are shown in Table 5.

To satisfy the monitoring requirements of the MMPA, NMFS requested that BPXA conduct a fish and airgun sound monitoring program as proposed in BPXA's IHA application and further refined in consultation with an expert panel. BPXA conducted this program during 2014 in close coordination with the concurrent *North Prudhoe Bay Seismic Survey*, the preliminary results of which are summarized in Appendix B.

Table 5. Safety and disturbance radii distance in meters (m) applied during the *Liberty 2014 Survey*.

Airgun Discharge Volume	**Safety Radii**		**Disturbance Radius**
	190 dB re 1 µPa (rms)	180 , re 1 µPa (rms)	160 dB re 1 µPa (rms)
30 cubic inches (in^3)	70 m	200 m	2,000 m
10 in^3	20 m	50 m	1,000 m

re 1 µPa (rms) = relative to 1 microPascal at 1 meter (dB re 1 µPa) root mean square (rms)
190 dB: seals and polar bear
180 dB: cetaceans and walrus
160 dB: any marine mammal without permitted "takes" from NMFS

4. Marine Mammal Mitigation Program

This section describes the mitigation monitoring and measures implemented to address requirements specified in the NMFS-issued IHA and USFWS-issued LOA for the *Liberty 2014 Survey* (NMFS 2014, USFWS 2013a). Data analyses, methods, and results are provided in Section 5. The main purpose of the vessel-based PSOs was to ensure compliance with provisions of the issued IHA and LOA. Note that, where necessary, human safety took precedence over mitigation measures related to avoidance, disturbance, and harassment of marine mammals. PSOs on board the vessels had two primary areas of responsibility:

> **Monitoring:** Record numbers, behavior and locations of marine mammals at all times during daylight conditions both during and in absence of airgun activity and document their reactions (where applicable). In addition, document selected environmental variables that may affect the ability to detect marine mammals.
>
> **Mitigation:** Detect marine mammals within, or approaching, the applicable EZ and initiate immediate shutdown or power down of the airguns. Use visual monitoring to estimate the number of marine mammals potentially exposed to airgun sounds at specified levels.

4.1. Mitigation Measures

Mitigation measures implemented during the *Liberty 2014 Survey* consisted of the following four groups as discussed in ensuing subsections and Appendix C:

1) **General mitigation measures:** These applied to all vessels involved in the survey.
2) **Mitigation measures for support vessel:** These applied only to the *Freedom*, the support and crew-change vessel.
3) **Seismic survey mitigation measures:** These applied only to the source vessel that operated the airguns, the *Thunder*.
4) **Mitigation measures for subsistence activities**: These applied to all vessels involved in the survey.

4.1.1. General Mitigation Measures

The general mitigation measures (Appendix C), as identified in the issued IHA and LOA, were implemented where applicable by the captains and crew of all survey vessels and aircraft during the duration of the survey. These general measures were designed to help avoid disturbance to marine mammals and birds. The source vessel

operated under an additional set of specific mitigation measures during airgun operations. Because the *Freedom* joined the project after it was underway and was not written into the IHA, specific mitigation measures were applied to its operations (see following subsection).

During Phase 2, no airguns were used, and mitigation measures were the same as General Mitigation Measures (i.e., no additional mitigation measures were implemented during Phase 2). PSOs monitored for and recorded all marine mammals observed throughout the entire survey during daylight periods with airgun operations (seismic period) and without airgun operations (non-seismic periods) except during inclement weather.

4.1.2. Mitigation Measures for Support Vessel

The *Freedom* was not included in the original IHA; thus, NMFS and AEWC were approached to discuss the appropriate mitigation measures to implement while using the support vessel. Consequently, additional vessel mitigation regulations were specified for *Freedom*'s use to avoid any potential exposures to earlier defined sound levels.

1) Speed was restricted to 5 kt unless a dedicated PSO was on board. If a PSO was on board, speed remained ≤ 7 kt.
2) Vessel tracklines were recorded between West Dock and Endicott.
3) *Freedom* avoided marine mammals.

4.1.3. Seismic Survey Mitigation Measures

Four standard seismic-related mitigation measures were implemented for marine mammal sightings during the seismic program: ramp ups, power downs, shutdowns, and operation of a single 10 in^3 airgun (i.e., mitigation airgun). These mitigation measures are identified in Appendix C, with further information found in the issued IHA (NMFS 2014). Safety and disturbance radii distances are summarized in Table 3. These safety radii were monitored by PSOs on the source vessel at all times. Power down or shutdown procedures were implemented when a marine mammal was sighted within or approaching the applicable radii when any airguns operated.

An additional mitigation measure to standard seismic mitigation measures required that airguns be shut down for the first bowhead whale observed within the 160 dB (rms) zone. (The project was allowed a single exposure of a bowhead whale to seismic sounds ≥ 160 dB (rms)). However, no bowhead whales were observed during the project. In addition, the IHA stipulated that if any marine mammal species not listed on the IHA was encountered during seismic survey operations and was likely to be exposed to sound pressure levels > 160 dB (rms) for impulse sources, then BPXA was required to shut down the sound source to avoid "take". As no such species were seen, this procedure did not need to be implemented. Specific

procedures were also implemented for poor visibility conditions and for groups of marine mammals (see Appendix C).

During Phase 1 of the survey, 24-hr seismic operations occurred as possible, except during adverse weather conditions, equipment maintenance, and marine mammal mitigation periods. PSOs were on the bridge for all hours of operation, even though visual observations had limited effectiveness during civil twilight conditions (defined in Section 4.1 Data Definitions). Night vision devices (NVDs) were not used by PSOs during civil twilight periods based on communications between BPXA and NMFS determining they were not needed (were not useful) under the survey conditions (see Appendix D).

4.1.4. Mitigation Measures for Subsistence Activities

Two PSOs were present on the *Thunder* source vessel during each 12-hr shift. One of these PSOs was an Iñupiat Communicator (IC), as specified in the CAA (Appendix A). An IC is an Alaska Native resident who is knowledgeable about Arctic marine mammals and the subsistence hunt. Since duties of ICs were identical to PSOs, "PSO" here-in refers to both ICs and non-IC PSOs. No surveys were conducted after midnight on 25 August, as specified in the CAA. In accordance with the CAA, PSOs on the *Thunder* communicated with Deadhorse Communication Center (CC) beginning 18 August. During 18 August through 25 August, PSOs attempted communication four times per day (at 0000, 0600, 1200, and 1800 Alaska Daylight Time [AKDT]) to exchange information. Information reported to the Com-Center included PSO name, vessel name, vessel position, vessel speed, and planned activity for the next 6 hr.

4.2. Monitoring Procedures

The visual monitoring protocol implemented during the project was designed in accordance with the IHA and LOA provisions (NMFS 2014, USFWS 2013a). Prior to the survey's start, all PSOs (including ICs) participated in a two-day PSO training course taught by PSO project managers or field leaders highly experienced (over 5 years) in implementing seismic mitigation for marine mammals. This training served to familiarize PSOs with the monitoring protocol, identification and differentiation of Arctic marine mammals, and operational procedures. In addition, all PSOs participated in a two-day BPXA orientation seminar, a one-day cold water survival training, a two-day North Slope Training Cooperative training, and a two-day Health, Safety, and Environment (HSE) training required by the contractor, SAE. During these trainings, all PSOs were informed of operational and HSE procedures.

Five PSOs were on-site during survey operations: one Lead PSO who was land-based 24 hr/d and four PSOs (two of which who were ICs) who commuted every 12 hr from their land-based accommodations to the *Thunder.* The four PSOs rotated on-watch periods with another PSO throughout a 12-hr shift. Responsibilities of the

Lead Observer included daily data quality assessment / quality check (QA/QC) and management, writing daily reports to BPXA, communicating among agencies and operations personnel, scheduling, and filling in as a vessel observer if needed. Two PSOs were on watch aboard the *Thunder* at all times during all vessel activity (24 hr/d), including during civil twilight conditions. PSOs were on board for 12 hr/d for their shift, but they observed for a maximum of 4 hr at a time before rotating with the other PSO. Shorter on-watch shifts minimize observer fatigue. Provisions in the issued IHA did not require PSOs to maintain watch during nighttime activities, but PSOs remained on-watch to maintain shift schedules and in case a marine mammal could be observed close to the vessel during civil twilight conditions.

PSOs observed from the bridge of the *Thunder* source vessel where average observer's eye height was measured to be 4.14 m above sea level (ASL). Visibility was unrestricted ahead of and to the sides of this vessel. However, behind the observer, visibility was obscured for approximately 90 degrees due to vessel superstructure. While on-watch, one PSO systematically scanned using the naked eye and/or Fujinon 7 x 50 reticle binoculars during all vessel activities.

PSOs used *Mysticetus*™ software to record all data systematically onto a laptop personal computer (PC). *Mysticetus* software increased efficiency and accuracy of observations by instantly displaying positions and distances to marine mammal sightings when the PSO entered a binocular reticle or estimated visual distance. In addition, *Mysticetus* displayed vessel and sighting locations in real-time relative to the exclusion and disturbance zone distances based on the seismic source location. All data parameters identified as required in the NMFS-issued IHA were recorded along with supplemental data into a customized *Mysticetus* data form (with dropdown menus) as follows.

Effort and vessel activity data: date, time, airgun activity (i.e., seismic or non-seismic periods), array volume, Beaufort sea state (Bf), visibility, glare, cloud cover, and sea-ice percentage, as well as the location, speed, and activity of the vessel. These data were recorded at least every 30 min, or whenever conditions changed significantly.

Seismic Period was defined as the time any airguns were operating. This included ramp-up, mitigation airgun activity, and times when the full airgun array was operational.

Non-seismic Period was defined as periods when no airguns were operational. This included transits and time when the magnetometer or the sonar equipment (multibeam echosounder, sidescan sonar, sub-bottom profiler) were operational.

Marine mammal sighting data: whenever marine mammal(s) were sighted, the following data were recorded: date, time, species, total number of individuals, number of juveniles, clock-face bearing of the sighting relative to

vessel's heading (e.g., 10:00), direction of movement relative to the vessel, initial distance from the vessel, closest observed point of approach to the vessel, behavior state when sighted, secondary behavior, whether the animal was in the water or hauled-out on ice or land, pace (i.e., animal's speed of movement), vessel position, water depth, number and location of other vessels within a 5-km radius, and the time that mitigation measures were requested and implemented (if necessary). Juvenile beluga whales were identified by their off-white color and juvenile seals were identified by their smaller size relative to adults.

Mysticetus did not allow entry of nonsensical data (e.g., misspellings), which increased data accuracy and assisted with QA/QC. Data were checked by PSOs at the start and end of each watch shift. This provided multiple reviews of data, as PSOs looked at both their and their watch partner's entries. The PSO Supervisor checked the data the following day and ensured any additional QA/QC issues were resolved.

As identified in the IHA (NMFS 2014), the on-site PSO supervisor monitored the ASAMM website regularly to obtain related information as available. This was done primarily to determine if any bowhead whales were seen near or approaching the survey area and seismic operations and survey activities were never modified based on ASAMM results.

5. Analyses and Results

This section describes data analysis methods and the results of the PSO monitoring implemented during the *Liberty 2014 Survey*. The minimum and maximum estimated numbers of marine mammals potentially exposed to ≥ 160 dB re 1 µPa (rms) during the Phase 1 2D HR seismic survey is also provided as a proxy for level B harassment. Numeric values in this section are presented in metric units only unless conventional use dictates imperial units (e.g., in^3). Definitions of terms used in this document are presented in Table 6.

Table 6. Definitions of data collection and analysis terminology.

Off-watch Effort	Periods when Protective Species Observers (PSOs) were not on active watch duty and thus were not consistently looking for marine mammals. Any sightings made during these periods were considered opportunistic. For example, when PSOs were sitting in the bridge and occasionally looking for marine mammals, or were taking a break on or off the bridge but made a sighting.
On-watch Effort	Periods when at least one PSO was on active watch duty and dedicated to looking for marine mammals.
Seismic Effort	Periods when at least one PSO was on watch while airguns were operating from the *Thunder* source vessel. This included ramp ups, power downs, and when the single mitigation airgun was operating. PSOs were on watch during all hours of airgun operation (no darkness occurred during Phase 1 of the survey period).
Non-Seismic Effort	Periods when no airguns were operating from the *Thunder* during Phase 1 or periods when sonar equipment (including the multibeam echosounder, sidescan sonar, and/or sub-bottom profiler) and the magnetometer were active during Phase 2 (e.g., transits, at dock). PSOs sometimes opportunistically watched for marine mammals during transport to and from the *Thunder* and any sightings made during these times were considered opportunistic non-seismic sightings.
Civil Twilight	The phase of twilight when the sun is less than 6° below the horizon based on the rotation of the earth. Civil twilight began 16 August, increasing through the last survey day on 25 August from 0.5 to 4.5 hours. Darkness/night did not occur during the project. From 16-25 August civil twilight occurred each night increasing from 0.5 to 45 hrs.
Visibility	Visibility refers to the clarity of the atmosphere between the observer's position and the horizon and is adversely affected by such environmental conditions as fog, rain, snow, haze, and the degree of light. Based on an average observer eye height of 4.1 meter (m) on the *Thunder's* bridge, distance to the horizon was 7.3 kilometers (km). However, the effective viewing distance with unobscured visibility was considered to be 3.9 km equivalent to 0.1 binocular reticle down from the horizon, due to the effects of earth curvature beyond that distance. For data analysis purposes, we categorized visibility data as **unobscured** (≥1 km and ≤ 3.9 km) **or obscured** (<1 km).
Group (i.e., sighting)	One or more individuals seen close together and coordinated in a similar manner (e.g., coordinated surfacings, orientation, etc.).
Sighting Rate	The number of marine mammal groups (or individuals) seen per hour of "usable" PSO effort
Useable Effort	PSO effort limited to specific viewing conditions to facilitate comparison of sighting rates under standardized sighting conditions. Useable data was limited to periods when PSOs were on-watch under the following conditions: vessel speed ≥ 2 knots; visibility > 1 km; daylight; Beaufort sea state (Bf) < 5; glare <60° within the forward 180° of the vessel.

5.1. Analysis Methods

5.1.1.1. Seismic Activity

To distinguish potential differences in reported parameters with project 2D HR seismic activity, data were separated into two categories based on airgun status. These separations characterized all data collected for this survey.

- **Seismic**. These data were collected from the source vessel while any airgun was operating, such as during ramp ups, power downs, and periods when only a single (mitigation) airgun (10 in^3) was active.
- **Non-seismic**. These data were obtained from the source vessels when the airguns were deactivated (i.e., not operating), such as during transit or while at anchor.

5.1.2. Observer Effort and Sightings

Mysticetus software was used throughout the project to collect field data, run daily, weekly, monthly and final summaries of effort and sightings, and plot sightings on bathymetric maps relative to mitigation radii in real-time during data collection and post-project analyses. For example, daily summaries were produced with the touch of a few buttons and reported totals for user-selected variables and units. At the end of the field project, daily data were merged into one "master" database, which could then be filtered and analyzed. Herein, we summarize PSO effort based on both the number of hours and kilometers that PSOs were on-watch. PSO effort was further summarized by selected project activities (e.g., seismic and non-seismic periods), environmental conditions (e.g., Bf, visibility), and other factors (e.g., number of PSOs simultaneously on watch, project phase, date). This section provides summaries of report parameters requested in the IHA and includes additional summary data as applicable.

General summaries of effort and data included all sightings and effort. In other words, effort totals were not filtered or restricted by environmental conditions in the general summaries presented in graphs and figures. However, these data were filtered to certain "useable" conditions for sighting rates to standardize comparisons as described later in section 5.1.5.

Data on the number of marine mammal sightings are presented to the species level whenever possible in species summary tables. However, some sightings were not identified to species or genus if the PSO did not feel confident in their identification (i.e., because of poor environmental conditions, or an animal at the surface for just a split second, etc.), as instructed to do during the PSO training conducted prior to the project start. Environmental factors including high Bf, poor visibility, ice coverage, distance from the observer, observer eye height ASL, and glare can limit the ability

to identify marine mammals to species. During the project, pinnipeds (seals) in particular, could not always be identified to species with a high level of certainty. Distinguishing ringed seals from spotted seals was especially challenging; therefore, this survey included a ringed/spotted seal category. PSOs labeled animals as "unidentified" if unsure of species identification.

After totaling sightings by species and unidentified categories, all pinnipeds (i.e., pinnipeds identified to species plus any unidentified pinnipeds) were combined for analysis purposes. This was done to increase sample size, facilitating more meaningful comparisons across selected observation conditions. As no walrus were seen, pinnipeds only included seals. Beluga whales were the only cetacean seen during the project and were treated separately from pinnipeds given their much larger body size and separate taxonomic order. No polar bears were seen from project vessels, though they are briefly mentioned in their own subsection below relative to USFWS LOA project requirements. Addressing both IHA and LOA reporting requirements within this same report follows summary analyses done in other 90-day reports submitted to NMFS and USFWS (e.g., Smultea et al. 2004; Aerts et al. 2008; Blees et al. 2010; Hartin et al. 2011; Lomac-MacNair et al. 2013; Cate et al. 2014).

5.1.3. Marine Mammal Distribution

Distribution of sightings around the source vessel was assessed relative to several variables. These included bearing from the PSO to the sighting, initial and subsequent resight distances of the sighting from the PSO, and closest observed point of approach (CPA) of the animal(s) to the PSO. Bearing was recorded as a clock-face value (with the direction of the vessel's bow representing the 12:00 position). In the field, sighting distances and locations relative to the PSO, observation vessel, and NMFS- and USFWS-regulated sound isopleths were instantly calculated and displayed on a map on the PC screen by *Mysticetus*. After the field season, these calculated data were used for analysis purposes.

5.1.4. Marine Mammal Behavior

Marine mammal movements relative to the vessel and initial and secondary behaviors were recorded for each marine mammal sighting based on pre-defined protocol and ethograms provided to the PSOs during training and available on the project vessels. Marine mammal movements included swim away, swim towards, swim parallel, no movement, and unknown. Initial behaviors included swim, look, dive, sink, rest, surface active (engaging in behavioral events that created splashing at the surface), mill, and unknown/other. These parameters followed those presented in numerous other 90-day reports associated with seismic operations (e.g., Aerts et al. 2008; Blees et al. 2010; Cate et al. 2014).

The terms "reaction" vs. "no reaction" *per se* were not recorded by PSOs. This was due to the difficulty in standardizing the interpretation of a reaction across multiple observers with a wide range of experiences. Instead, PSOs were instructed to record any unusual or sudden changes in behavior as a secondary behavior and/or in the notes field of *Mysticetus*.

5.1.5. Sighting Rates based on Useable Data

Sighting rates of marine mammals were calculated as the number of groups seen per hour of "useable" effort as defined in Table 6. Sighting rates were based on hours of effort because distance (i.e., km) was not considered appropriate for the survey conditions where survey lines were spaced closely together in the same small region (see Figure A).

5.1.6. Mitigation Measures Implemented

Mitigation measures implemented during the *Liberty 2014 Survey* were described in Section 3 and Appendix C and are identifed in detail in the issued IHA and LOA (NMFS 2014, USFWS 2013a). All mitigation measures were implemented throughout Phase 1. During Phase 2, only General Mitigation Measures were implemented as no airgun activities occurred. The only mitigation identified in the issued IHA for the sound-producing sonar equipment used during the *Liberty 2014 Survey* (the multibeam echosounder, sidescan sonar, and sub-bottom profiler) was that operation of this equipment must conclude by midnight on 25 August 2014, and this stipulation was followed. This was because the sounds generated by this equipment are either outside the hearing range of marine mammals, or not strong enough to propagate at distances far enough to expect marine mammals to be present and to respond in a manner that would constitute a "take" under the MMPA (BPXA 2014). PSOs did not record whether sonar equipment was active or inactive except at the end of all survey operations when operation of this equipment ceased.

5.1.7. Estimated Number of Exposures

NMFS considers exposures of cetaceans and pinnipeds to anthropogenic received sound levels ≥ 160 dB (rms) to be a "take" by harassment (Level B harassment) that could potentially result in disturbance of marine mammals (NMFS 2005, 71 FR 50027). For polar bears in water, USFWS applies only a 190 dB (rms) safety radius isopleth per the LOA. Given the nature of the survey design, it was not reasonable to apply standard survey density data to estimate exposures as reported in other seismic surveys (e.g., Richardson 1998; Funk et al. 2008). The project design involved repeated coverage of closely spaced survey lines within the same small 10 square mile (mi^2) area over approximately five weeks. This design violated a basic assumption of line-transect sampling requiring independence of sightings (i.e., no

repeated sighting of the same individual during a survey) (Buckland et al. 2001). For example, it is highly likely that seals were re-sighted from adjacent closely-spaced survey lines and also during periods when the survey vessel was docked or moving at slow speed (< 2 kt). Especially when animals dive for several min and resurface several hundred m away, it is not possible to confirm whether or not it is the same animal. The minimum and maximum number of marine mammals potentially exposed to received airgun SPLs ≥ 160 dB (rms) was therefore estimated following Aerts et al. (2008). Except for periods during which the single mitigation airgun was operating, all periods with airgun sounds were assumed to be a full array. Thus, ramp-up periods with 1 to 2 airguns operating were treated as if the full array was operating.

Methods for estimating the potential minimum and maximum number of exposures to project seismic sounds ≥ 160 dB (rms) were as follows:

1. The estimated **minimum** number of exposures was based on direct observations/counts of cetaceans and pinnipeds during seismic activities. This approach has been applied previously by various seismic monitoring studies in the Chukchi and Beaufort seas (e.g., Aerts et al. 2008; Blees et al. 2010), as well as other oceans around the world (e.g., Smultea et al. 2004; 2005; MacLean and Koski 2005).

2. The estimated **maximum** number of exposures was calculated using marine mammal sighting rates (sightings/hr) calculated for non-seismic daylight hr during the project period. This approach assumes that the non-seismic sighting rate represents numbers that would have been seen had there been no seismic sounds occurring (similar to previous 90-day reports cited above). This non-seismic sighting rate was then multiplied by the total number of hr of daylight and darkness with seismic operations. The resulting number was considered the maximum number of potentially exposed individuals. Separate sighting rates were calculated for cetaceans and pinnipeds.

5.2. Results

5.2.1. Observer Effort

Throughout the project period, PSOs were on the Thunder for a total of 764.8 km. PSOs were actively on-watch 632 hr (83%) of survey time (Tables 7 and 8) (see Table 6 for definitions of PSO effort types). Most on-watch PSO effort (75%) occurred during non-seismic periods, with the remaining (25%) occurring during seismic periods (Table 8 and Figure C).

Chronological timing of project Phases 1 and 2 relative to types of PSO effort are presented in Table 7. Phase 1 consisted of both seismic and non-seismic periods while all of Phase 2 was considered non-seismic periods since only sonar equipment was operated (i.e., no seismic operations occurred). Two PSOs were on-watch together only 1.3% of all on-watch periods, with the remaining time consisting of one PSO on-watch (Table 9).

Most (95%) on-watch effort occurred during daylight (i.e., light), with the remaining 5% during civil twilight. There was 24-hr daylight from when the project began on 16 July through 15 August. Beginning 16 August, there were increasing short periods of civil twilight until project operations ended on 25 August. Overall, there was a total of 28.4 hr of civil twilight (range 0.5 to 4.5 hr/d).

Table 7. Chronological summary of selected project events and types of PSO effort by project phase during the 2014 *Liberty 2014 Survey*.

2014 Date	Project Phase	Event	PSO Effort Type*
16 Jul (morning) – 5 Aug (evening)	1	Phase 1	24 hour/day (hr/d) PSO effort (both seismic or non-seismic, and on and off watch periods)
5 Aug (evening) – 7 Aug (early morning)	2	Phase 2 begins, sonar equipment testing and start of related data acquisition	24 hr/d PSO effort: No seismic operations occurred after Aug 5; thus, all PSO effort during this period considered non seismic, either as Off-Watch (opportunistic) or On-Watch
7 Aug (early morning) – 17 Aug (afternoon)	2	*Thunder* anchored west of West Dock. No vessel operations due to inclement weather. Beaufort sea state = 6-7 (winds 25-30 knot (kt), gusts to 40 kt from the E to NE.	No PSO Effort due to inclement weather
17 Aug (afternoon) – 25 Aug (midnight)	2		24 hr/d PSO Non-seismic effort only; activities using any sound source were completed at midnight on 25 Aug.
25 Aug (midnight) – 26 Aug (morning)	2	*Thunder* transit to West Dock, vessel operations complete at 03:20.	PSOs on non-seismic effort only.

*See Table 6 for definitions of PSO effort types.

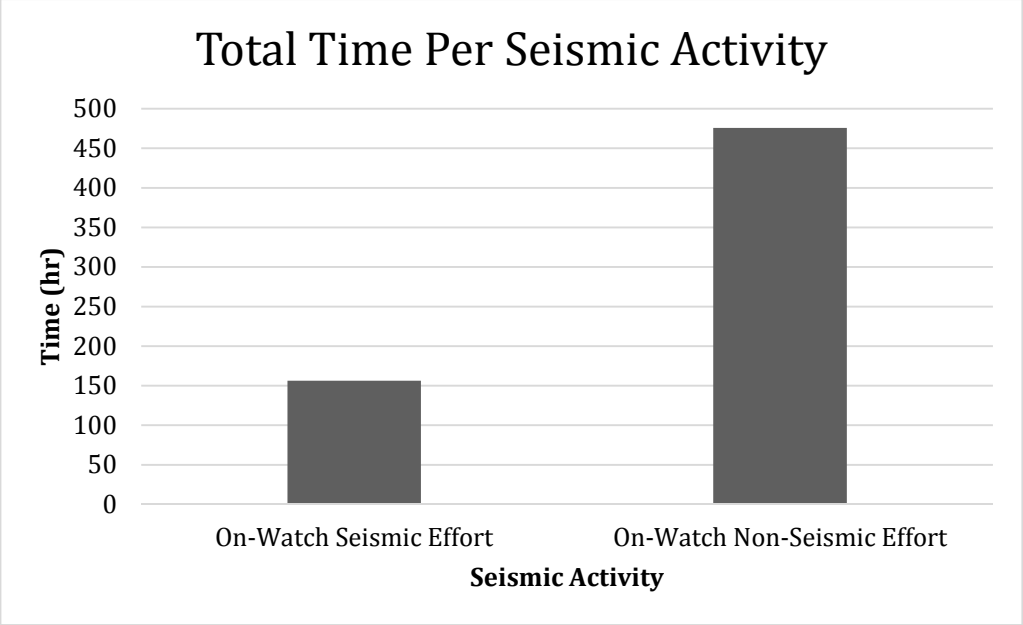

Figure C. Total time (hr) PSOs were on watch during seismic and non-seismic periods from aboard the *Thunder* source vessel during the *Liberty 2014 Survey*.

Table 8. Total on-watch PSO effort (in hours [hr] and kilometers [km]) during seismic and non-seismic periods from aboard the *Thunder* source vessel during Phase 1 and Phase 2 of the *Liberty 2014 Survey*.

	Time (hr)	Distance (km)
Phase 1		
Seismic Effort	156.9 (25%)	949.2 (22%)
Non-Seismic Effort	265.3 (42%)	2,225.7 (52%)
Phase 2 **Seismic Effort**	NA[1/]	NA[1/]
Non-Seismic Effort	210.4 (33%)	1,117.7 (26%)
Total On-Watch	**632.1**	**4,293.3**

[1/] NA = Phase 2 had no seismic operations but included sonar operations (e.g., multi-beam, sub-bottom profiler – see Section 2) which is categorized as non-seismic effort.

Table 9. Total effort (hour [hr] and kilometer [km]) by number of observers on watch during the *Liberty 2014 Survey*.

	Time (hr)	Distance (km)
One PSO On-Watch	624.6	4,245.6
Two PSOs On-Watch	7.5	47.7
Total PSO Effort	**632.1**	**4,293.3**

Bf 0 - 4 predominated during PSO effort periods (Figure D). Overall, visibility was clear (unobscured) within 1 km of the vessel during the majority of on-watch PSO effort (89%; Figure E). Furthermore, PSO visibility was completely unobstructed with a view to the horizon during 46% of all on-watch periods. Ice coverage was very light during the project. Overall, 88% of on-watch periods were ice-free followed by < 5% ice coverage, with < 1% of periods with more than 5% ice coverage (Figure F). Ten sightings occurred in a Bf > 5 and were excluded and considered not useable data.

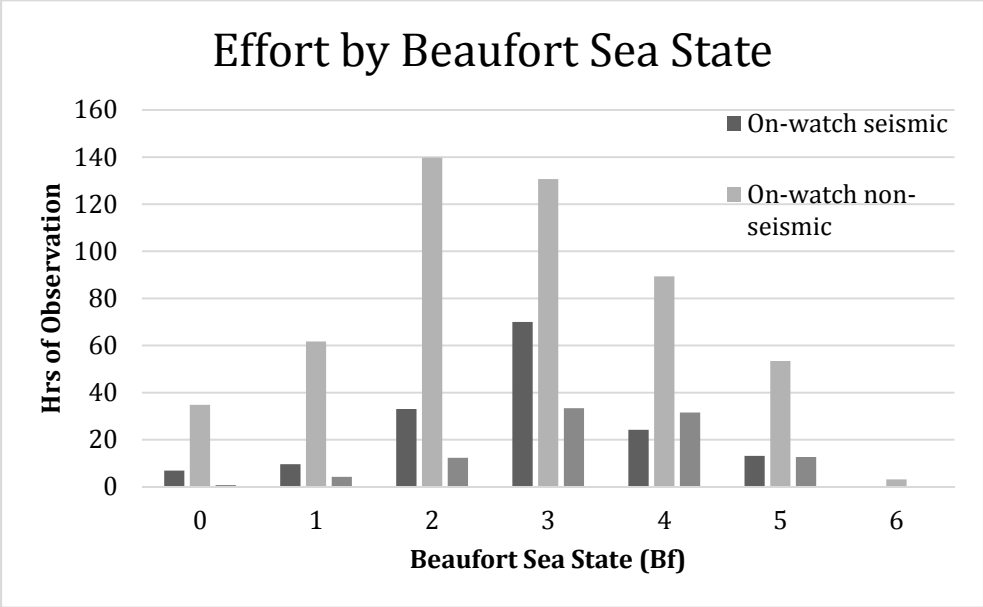

Figure D. Total hours of PSO effort by Beaufort sea state and effort type from the *Thunder* during the *Liberty 2014 Survey*. Percentages are totals for each Beaufort sea state (Bf), all effort combined. Off-watch effort consisted of opportunistic effort (see Table 6).

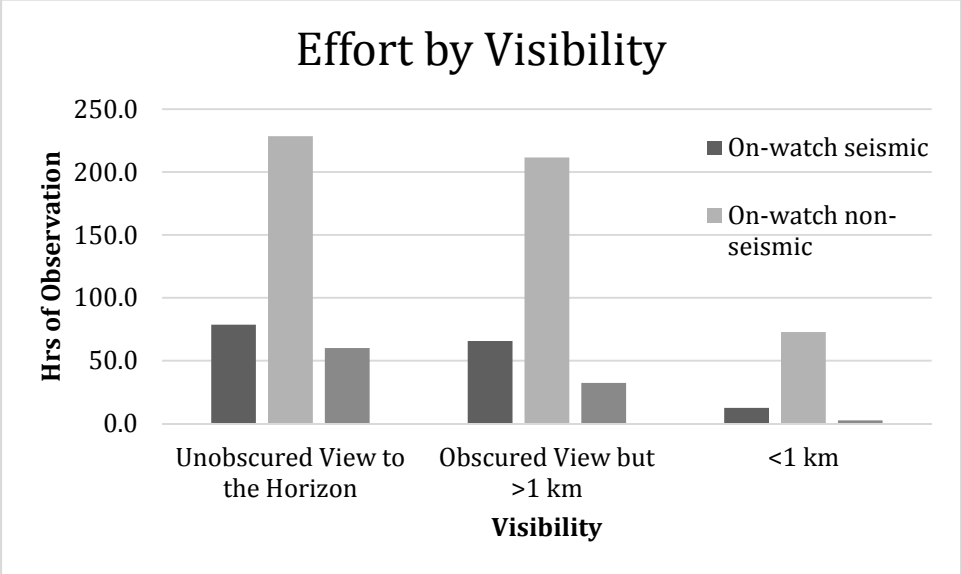

Figure E. Total hours of PSO effort by visibility category and effort type from the *Thunder* during the *Liberty 2014 Survey*. Percentages are totals for each visibility category, all effort combined.

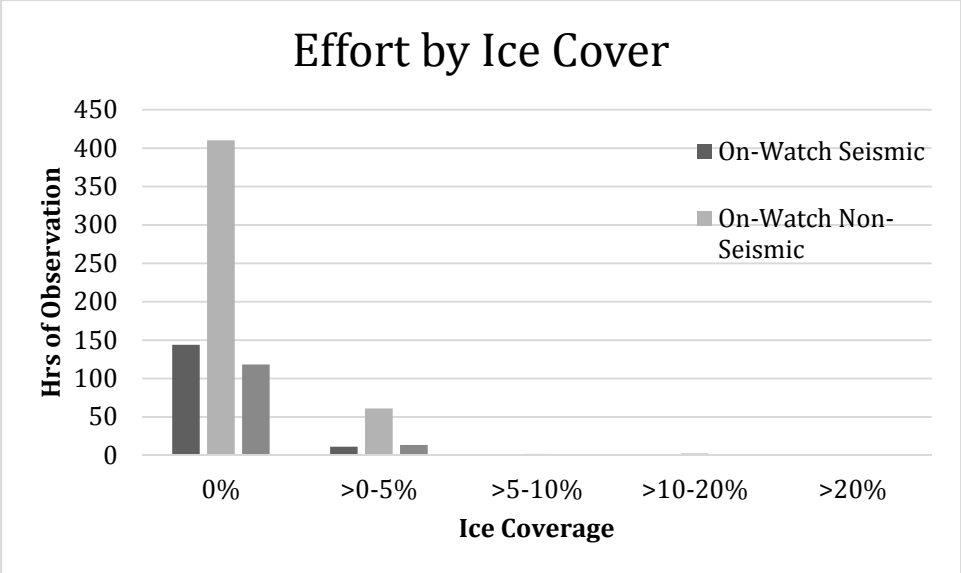

Figure F. Total hours of PSO effort by visibility category and effort type from the *Thunder* during the *Liberty 2014 Survey*. Percentages are totals for each ice coverage category, all effort combined.

5.2.2. Marine Mammal Sightings

A total of 197 sightings of an estimated 213 individual marine mammals were observed (Table 10). Four marine mammal species were recorded: the spotted, ringed, and bearded seal and the beluga whale. No marine mammal carcasses were seen. The spotted seal was the most frequently observed species (79 sightings or 37%), followed by the category ringed/spotted seal (45 sightings or 21%) and the bearded seal (8 sightings or 4%). A total of 48 sightings (23%) of unidentified pinnipeds were seen. A detailed list of all cetacean and pinniped sightings made during the project is provided in Appendix F. Eight groups (4%) of approximately 19 individual beluga whales were seen, some of which were considered re-sights (further details on beluga sightings are provided in Appendix G). Relatively few confirmed ringed seals were observed (six single individuals or 3%) (Table 10).

It is important to note that an unknown, though relatively high number of sightings were likely re-sights of the same individuals within or across days. Although only 15 of 197 sightings (8%) were confirmed re-sights, monitoring protocol and typical cryptic seal behavior were not conducive to quantitatively documenting the number of re-sights. This is because seals generally spend a brief time at the water's surface. In addition, PSOs were trained to focus on monitoring the entire safety zone rather than concentrating on re-sights of individual animals. When re-sights were recorded, it was because the animal was sighted closer to the vessel than initially observed in order to note the CPA. Thus, the total number of different individual seals within the survey area is likely considerably lower than the total sightings reported herein. The latter assumption is based on the small size of the project area, repeated transits within the same area over the approximate five-week project period, closely spaced survey lines, and considerable PSO effort expended while the vessel was docked or moving very slowly (< 2 kt). Although these conditions likely contributed to a high number of re-sights, it is not possible to quantify this number given the above protocol limitations combined with the difficulty of identifying individual animals at distance.

Nearly all sightings (194 sightings) (98%) were made from the source vessel; only two sightings (1%) (two single ringed seals) were made opportunistically from the Freedom during a crew vessel transfer. Locations of all sightings are shown in Figure G. All beluga whales (8 sightings) were observed within the survey area from the source vessel Thunder (Figure H and Table 12). Locations of all pinniped sightings are shown in Figure I.

Most sightings occurred during non-seismic periods when the majority of PSO effort also occurred (Table 11). Sighting rates by seismic and non-seismic periods that account for differential effort during these two periods are discussed later. When possible, juvenile pinnipeds and cetaceans were differentiated (Table 11).

Table 10. Summary of all pinnipeds and cetaceans seen during the *Liberty 2014 Survey*.

Species	No. of Groups	No. Estimated Individuals
Pinnipeds	**186**	**191**
Spotted Seal	79	80
Ringed/Spotted	45	47
Unid Pinniped	48	50
Bearded Seal	8	8
Ringed Seal	6	6
Cetaceans	**8**	**19**
Beluga Whale	8	19
Unid Marine Mammal	**3**	**3**
Total*	**197**	**213**

*All sightings, all efforts but excludes 15 re-sights.

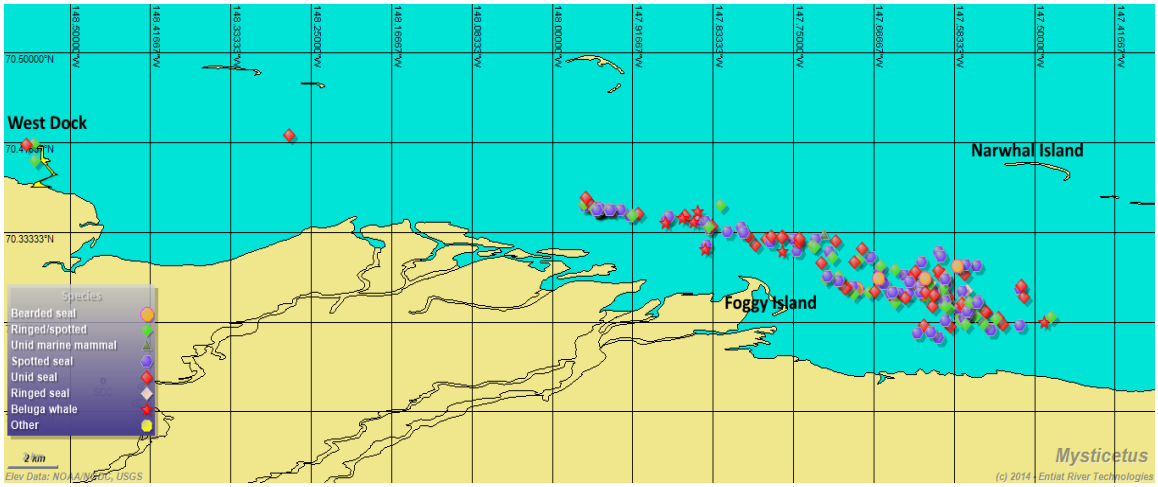

Figure G. Locations of all marine mammal sightings made by PSOs from vessels during the *Liberty 2014 Survey*.

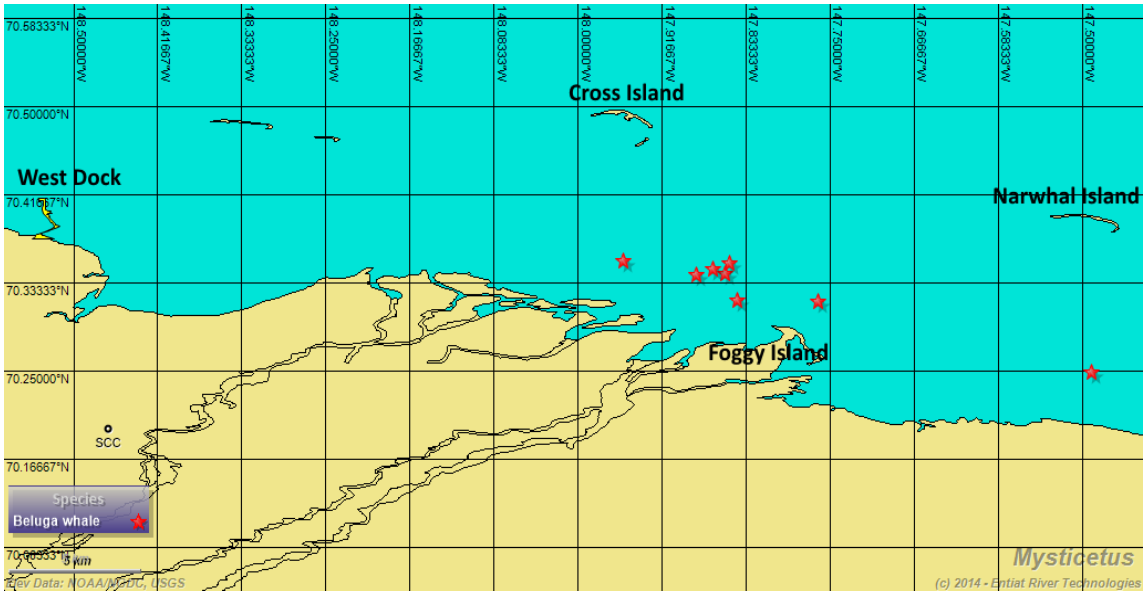

Figure H. Locations of beluga whale sightings made by PSOs from vessels during the *Liberty 2014 Survey*.

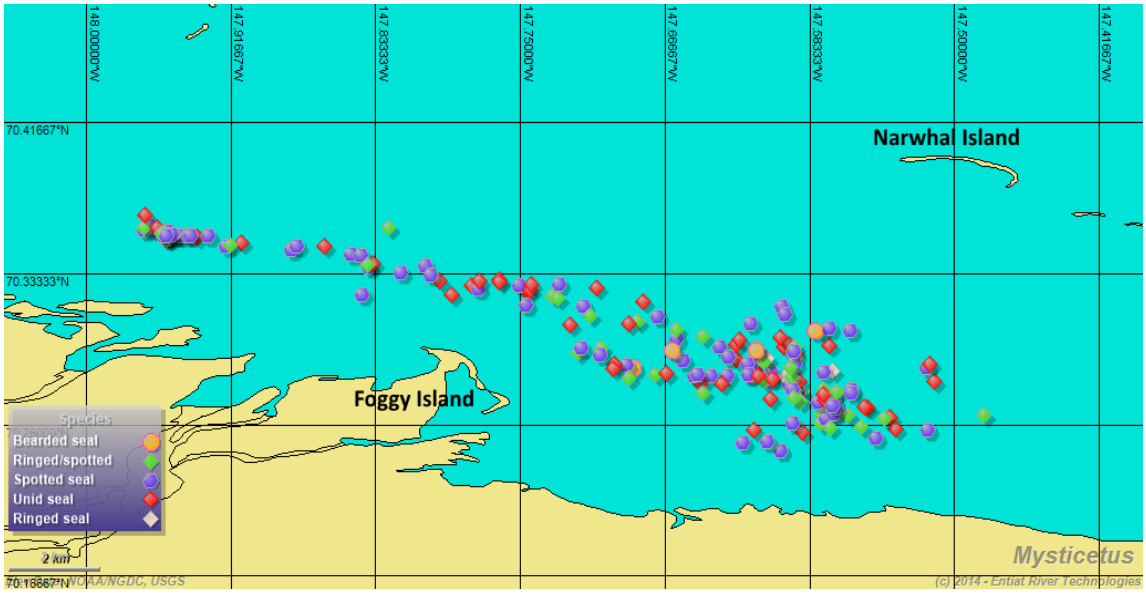

Figure I. Locations of pinniped sightings made by PSOs from vessels during the *Liberty 2014 Survey* within the primary survey area.

Table 11. Overall total pinnipeds and cetaceans seen during on-watch seismic, on-watch non-seismic, and off-watch (opportunistic) effort during the *Liberty 2014 Survey*.

	On-Watch Seismic			On-Watch Non-Seismic			Off-Watch (Opportunistic)		
Species	**No. Groups**	**No. Est. Indiv.**	**No. Juveniles**	**No. Groups**	**No. Est. Indiv.**	**No. Juveniles**	**No. Groups**	**No. Est. Indiv.**	**No. Juveniles**
Pinnipeds	**5**	**5**	**0**	**173**	**178**	9	**8**	**8**	**1**
Spotted Seal	3	3	0	71	72	6	5	5	1
Ringed Seal	0	0	0	6	6	0	0	0	0
Ringed/Spotted	1	1	0	44	46	0	0	0	0
Bearded Seal	0	0	0	7	7	0	1	1	0
Unid Pinniped	1	1	0	45	47	3	2	2	0
Cetaceans	**1**	**1**	**0**	**7**	**18**	**5**	**0**	**0**	**0**
Beluga Whale	1	1	0	7	18	5	0	0	0
Unid Marine Mammal	**0**	**0**	**0**	**3**	**3**	**0**	**0**	**0**	**0**
Total*	**6**	**6**	**0**	**183**	**199**	**14**	**8**	**8**	**1**

*Total of 197 sightings, but does not include 15 re-sights

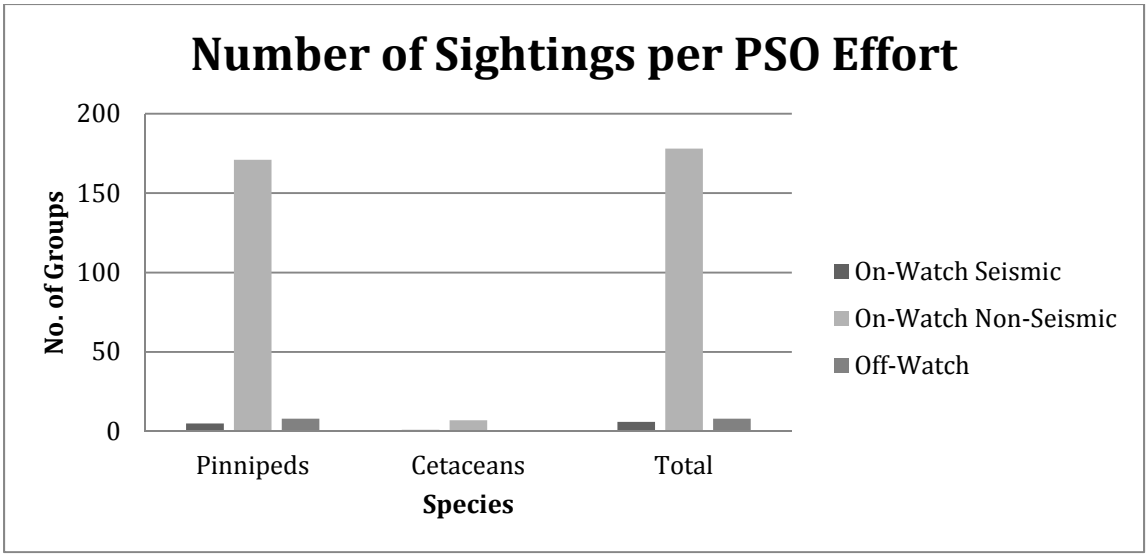

Figure J. Total number of sightings of cetaceans (all beluga whales) and pinnipeds by PSO effort type. Percentages are per each species group category.

Other vessels were within 5 km of the source vessel during 17 sightings (9%) and these were made from the *Thunder* (Table 12). This includes two sightings when the *Freedom* support vessel was 1-1.5 km away from the *Thunder*. Non-project vessels were within 5 km of the *Thunder* during the remaining 15 sightings, at a mean distance of 2.9 km (Table 12).

Table 12. Numbers and distances (in kilometers [km] of vessels seen within 5 km of the *Thunder* observation platform when pinnipeds and beluga whales were seen.

Vessel	Number of sightings	Mean distance from *Thunder* observation platform (km)
Project Vessel (*Freedom*)	2	1.3
Non-Project Vessels	15	2.9
Total	**17**	**2.7**

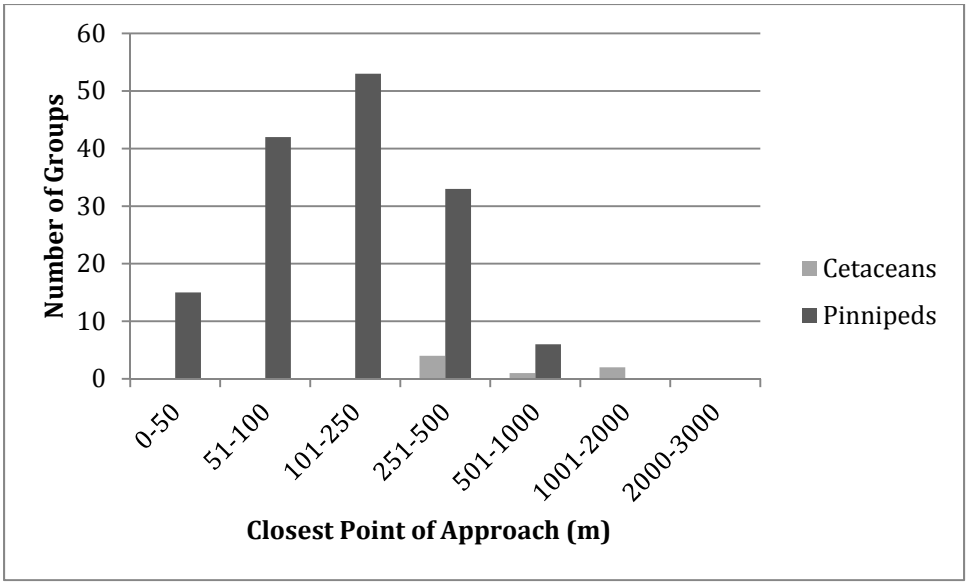

Figure K. Frequency of distance to sightings by distance category and species grouping. Beluga whales were the only cetaceans observed.

All pinnipeds were seen within 10 to 1,000 m of the source vessel (Figure K). However, the number of pinniped sightings decreased after a distance of approximately 250 m, and further decreased at distances of 251-500 m; very few sightings were made beyond 500 m (Table 13). This suggests that seals were unlikely to be seen more than 500 m away, with the vast majority seen within 250 m, and none seen more than 700 m away. Beluga whales were seen farther away, up to approximately 2,000 m from the vessel. Belugas were seen farther away than seals due to their larger body size, white body coloration, and more time spent at the surface.

Two observers (one on dedicated watch) were on-watch only 1.3% of time on-effort (seismic and non-seismic effort) (Table 9); this likely contributed to why no sightings were made while two observers were on-watch. This is probably also because when two observers were on-watch, one was usually helping the other with data, concentrating on the computer, so there were not two sets of eyes watching for animals; thus, the level of search effort was essentially the same with two observers as with one.

Communications with ASAMM scientists conducting aerial surveys in the Beaufort Sea region and monitoring of the associated web page indicated that bowhead whales were not seen within the 160 dB (rms) isopleth associated with active seismic operations. However, bowhead whales were observed during the ASAMM surveys in the general region beyond this distance. ASAMM surveys were flown either in Block 1, adjacent blocks or transiting over the survey area on 4 days during the 2D HR Liberty survey: 20 July, 2, 6, and 17 August.

5.2.3. Polar Bears and Walrus

There were no sightings of polar bears or Pacific walrus from the *Thunder* or from any other project vessel in Foggy Island Bay during the *Liberty 2014 Survey*. Information on land-based sightings of polar bears as required by the project LOA will be provided under separate cover to the USFWS to meet associated annual reporting document requirements.

5.2.4. Sighting Rates

Calculations of sighting rates are limited to useable data for effort and sightings as described in Table 6 to facilitate comparison of sighting rates under standardized sighting conditions. Useable data was limited to periods when PSOs were on-watch under the following conditions: vessel speed ≥ 2 kts; visibility > 1 km; daylight; Bf < 5; glare < 60° within the forward 180° of the vessel. A total of 174 (88%) of 197 sightings were considered useable and thus used to calculate sighting rates: 8 beluga and 166 pinniped sightings (i.e., groups) (Table 13).

The 23 total sightings excluded from useable sightings were as follows. Two unidentified marine mammal sightings were excluded because they could not be grouped into the cetacean or pinniped category. Two sightings of single ringed seals were made from the crew vessel *Freedom* and are not included in further analyses because they were not part of the standardized PSO monitoring effort. The remaining 19 sightings did not meet the useable criteria defined in Section 4.2 as follows: nine sightings were made opportunistically off-effort and the remaining 10 sightings occurred in Bf > 5.

5.2.5. Seismic and Non-seismic Sighting Rates

Overall sightings rates during seismic and non-seismic periods by project phase are shown in Table 13. During Phase 1, sighting rates were higher during non-seismic vs. seismic periods. Based on only non-seismic periods, sighting rates were higher during Phase 2 vs. Phase 1 (Table 13). Daily sighting rates showed that in general, sighting rate increased over the project period (Figure L). Sighting rates increased around 18 August toward the end of the project period. However, the end of seismic operations was followed by 9 days of inclement weather when there was no PSO effort and no project vessel operations with any seismic or sonar equipment; instead, the vessel was largely docked to avoid the rough seas. Thus, it cannot be determined if seal numbers remained relatively low, increased, or decreased during this 90-day period. Furthermore, given this relatively long stretch of time with no data, it is unknown if the increase in seal numbers near the end of the project period was related to the lack of seismic operations, changes in food supply, behavior, or a combination of factors, including environmental influence. The sonar equipment operated throughout Phase 2.

Table 13. Sighting (groups) rates per hour during Phase 1 and 2 and overall mean sighting rates by seismic and non-seismic periods for the *Liberty 2014 Survey* based on usable sightings and effort.

	Phase 1		Phase 2*	Overall On-Watch Non-Seismic
	On-Watch Seismic	On-Watch Non-Seismic	On-Watch Non-Seismic	
Time (hr)	135.2	151.8	106.1	257.9
Pinnipeds	**0.04 (n = 5)**	**0.18 (n = 28)**	**1.25 (n = 133)**	**0.62 (n= 161)**
Spotted Seal	0.02 (n = 3)	0.09 (n = 13)	0.53 (n = 56)	0.27 (n = 69)
Ringed Seal	0	0.01 (n = 2)	0.02 (n = 2)	0.16 (n = 4)
Ringed/Spotted Seal	0.01 (n = 1)	0.04 (n = 6)	0.33 (n = 35)	0.16 (n = 41)
Bearded Seal	0	0.01 (n = 1)	0.05 (n = 5)	0.02 (n = 6)
Unid Pinniped	0.01 (n = 1)	0.04 (n = 6)	0.33 (n = 35)	0.16 (n = 41)
Beluga Whale	**0.01 (n = 1)**	**0.00 (n = 0)**	**0.07 (n = 7)**	**0.03 (n = 7)**
Total**	**0.04 (n = 6)**	**0.18 (n = 28)**	**1.32 (n = 140)**	**0.66 (n = 168)**

* No seismic operations occurred during Phase 2.
**A total of 197 sightings where 5 were not useable, 8 off-effort and 10 at a Bf of 5, for a useable total of 174. Does not include 15 re-sights.

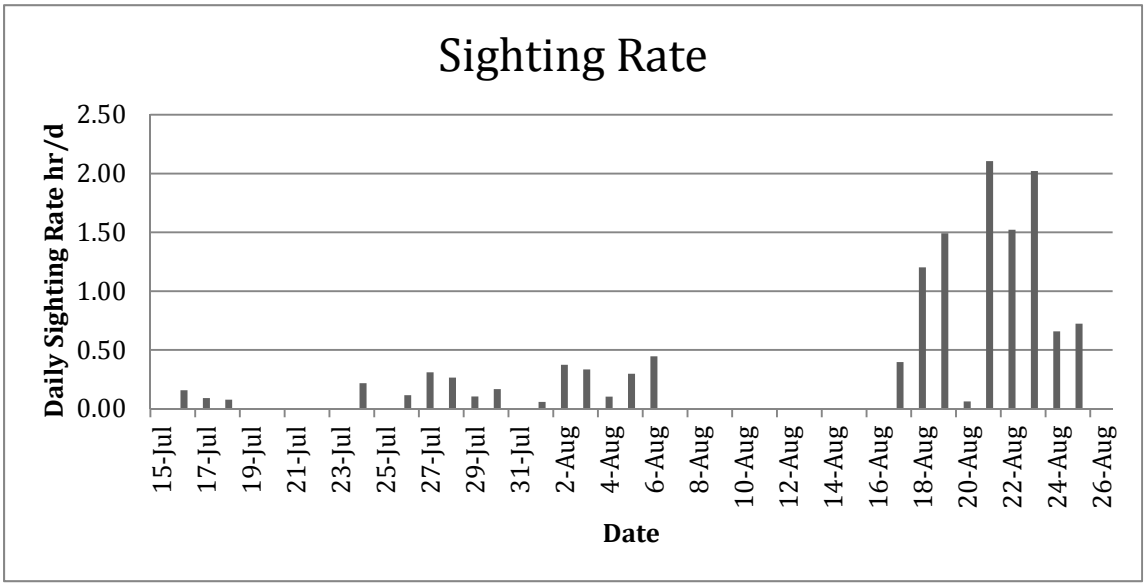

Figure L. Daily sighting rates of marine mammals seen from the source vessel based on date in 2014.

5.2.6. Sighting Rates/Sightings and Environmental Conditions

Sighting rates (based on usable effort) were compared across various environmental conditions to identify factors potentially influencing the occurrence of or the ability to see marine mammals. During both seismic and non-seismic conditions, sighting rates decreased with increasing Bf (Table 14). Sighting rates during flat seas (Bf 0 - 1) were two to three times higher than in Bf 2 or Bf 3 and were lowest during Bf 4. As expected, sighting rates were higher when visibility to the horizon was not obscured compared to when visibility was partially obscured beyond 1 km distance (Table 15).

Table 14. Sighting (groups) rates per hour (hr) for cetaceans and pinnipeds during different Beaufort sea states (Bf) during the *Liberty 2014 Survey*.

			No. of Groups Sighted					Sighting Rates (No. Groups/Hr)			
	Hr of Effort		Cetaceans		Pinnipeds			Cetaceans		Pinnipeds	
Bf	Seismic	Non-Seismic	Seismic	Non-Seismic	Seismic	Non-Seismic	Total	Seismic	Non-Seismic	Seismic	Non-Seismic
0-1	13.5	50.5	0	3	2	85	**90**	0	0.059	0.015	1.683
2	32.6	73.6	1	2	2	38	**43**	0.031	0.027	0.061	0.516
3	63.6	86.8	0	2	1	21	**24**	0	0.023	0.016	0.242
4	25.5	58.8	0	0	0	17	**17**	0	0	0	0.289
Total	**135.2**	**269.7**	**1**	**7**	**5**	**161**	**174**	**0.031**	**0.109**	**0.092**	**2.730**

*A total of 197 sightings where 5 not useable, 8 off-effort, and 10 at a Bf of 5. Does not include 15 re-sights.

Table 15. Sighting rates per hour (hr) for beluga whales and pinnipeds during different visibilities during the *Liberty 2014 Survey*.

		No. Groups Sighted			Sighting Rates (No. Groups/Hr)	
	Effort (hr)	Beluga Whale	Pinnipeds		Beluga Whale	Pinnipeds
Visibility Partially Obscured at > 1 km	196.7	1	62		0.005	0.325
Full Visibility to Horizon	208.2	7	112		0.034	0.538
Total	404.9	**8**	**174**		**0.039**	**0.863**

*A total of 197 sightings where 15 not useable and 8 off-effort for a total of 174

Water depths within the project area were very shallow, ranging from 0.9 to 8.5 m in depth. Marine mammal sightings were seen throughout these waters depths (Figure M). Most sightings occurred where water depth was 2 – 6 m deep; however, this was not standardized by effort and water depth. Thus, these patterns likely simply reflect that most effort occurred over these water depths and/or most of the project area waters were at this depth.

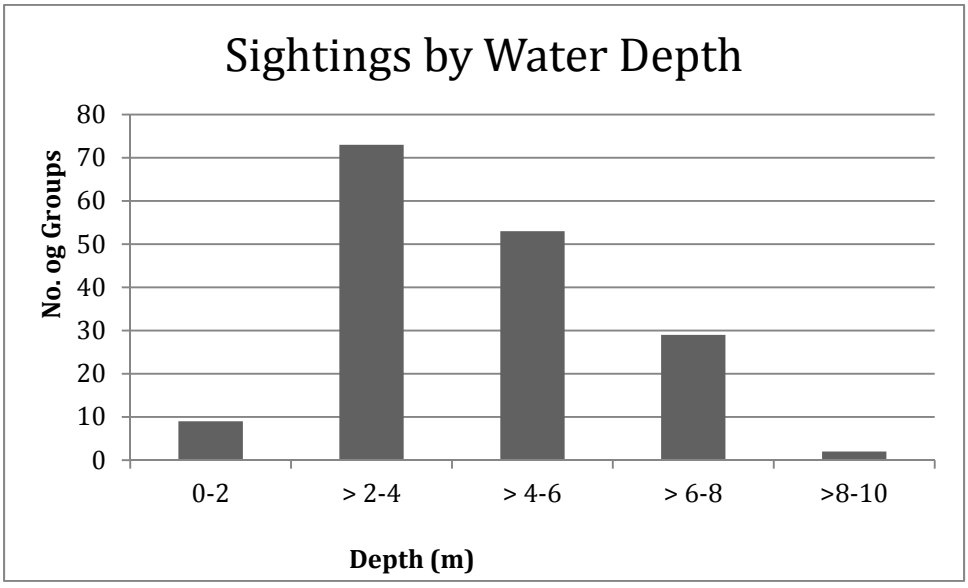

Figure M. Number of usable marine mammal sightings by water depth categories (in meters [m]) during the *Liberty 2014 Survey*. Sightings were not seen in waters deeper than 8.5 m.

5.2.7. Marine Mammal Behavior

Due to the limited number of sightings during seismic periods (n = 6) (Table 13), a meaningful analysis of behavior relative to seismic operations was not possible for either pinnipeds or beluga whales. However, 178 seal sightings were made during non-seismic periods. All sightings, usable and non-useable data, are included herein to maximize sample size.

Seven (88%) of the eight beluga sightings were made during non-seismic periods. Based on these data, initial recorded behavior state for beluga groups was swimming followed by similar proportions of milling and surface-active behavior (Figure N). The one beluga whale sighting made during seismic operations was swimming.

Only five pinnipeds (3%) were seen during seismic periods (all single animals) (Table 14). During both seismic and non-seismic periods, "look" behavior was commonly observed and thus may have been a reaction to vessel presence/activity in both cases. Behavior was more variable during non-seismic than seismic periods; in addition, swimming was more common during seismic vs. non-seismic periods (Figure O). However, again, small sample size during seismic (n = 5) limits the ability to interpret potential pinniped reactions to seismic operations.

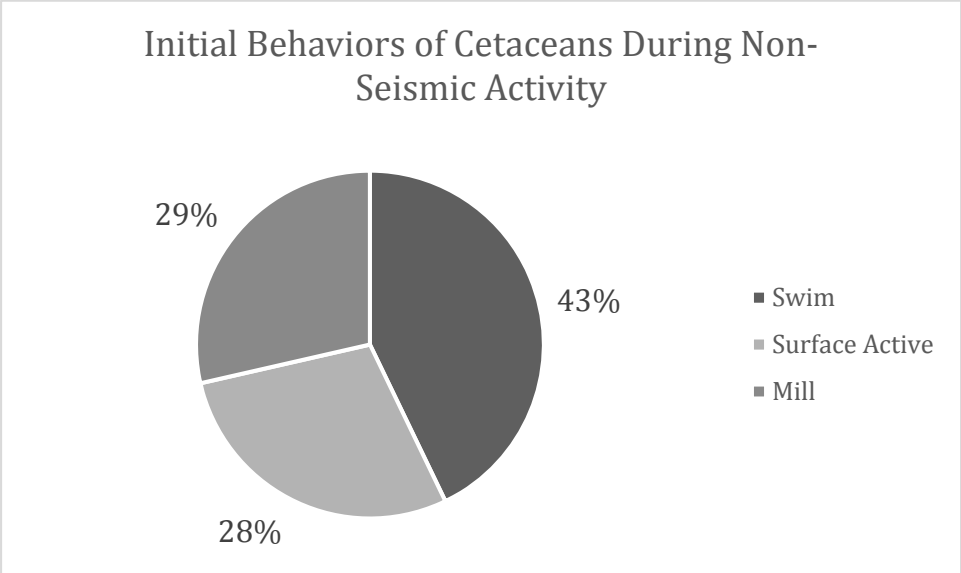

Figure N. Initial behaviors of cetaceans observed during non-seismic period (*n* = 7) from the *Thunder* during the *Liberty 2014 Survey*. The one cetacean sighting observed during seismic period was recorded as swimming.

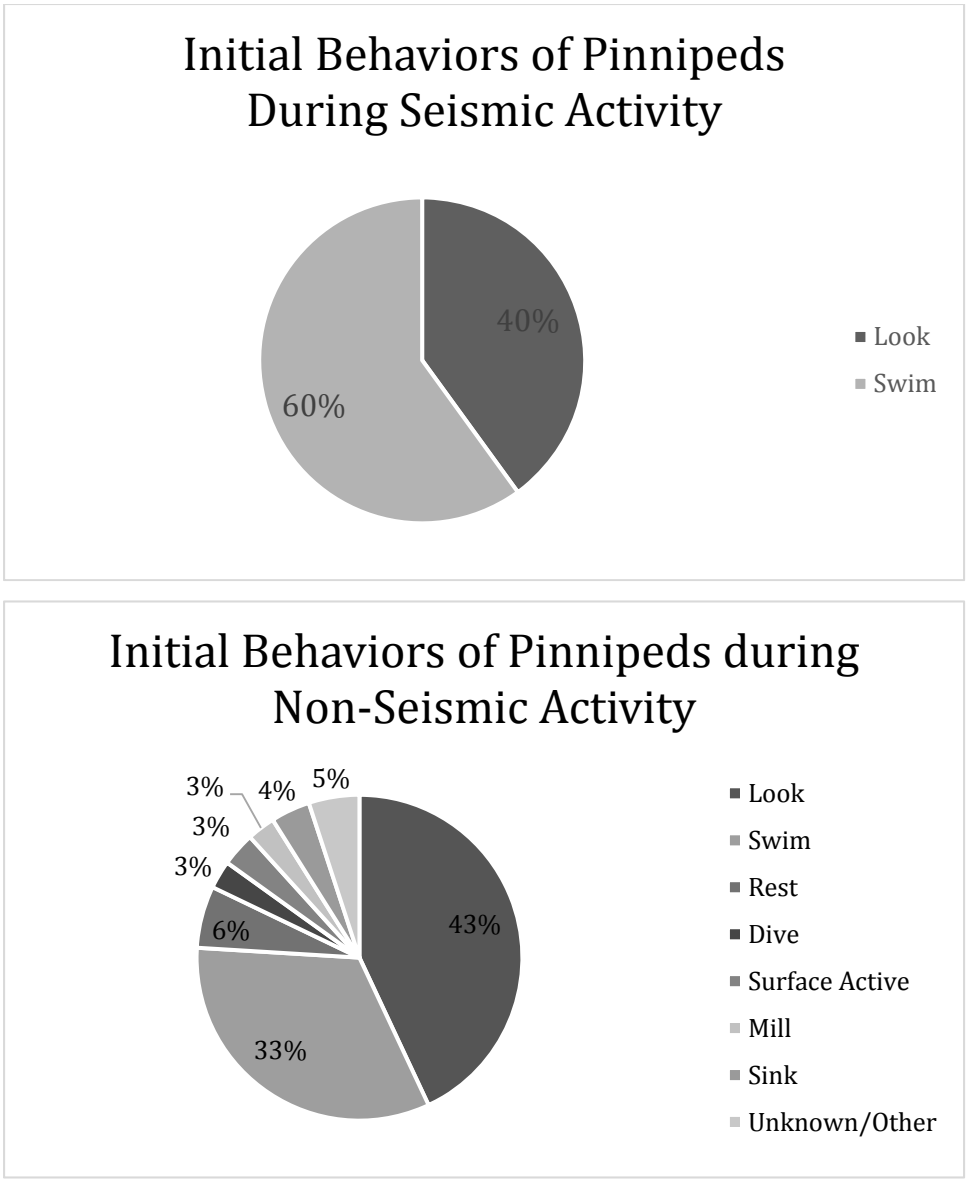

Figure O. Initial behaviors of pinnipeds observed during (a) seismic (*n* = 5) (top panel) and (b) non-seismic periods (*n* = 178) (bottom panel) from the *Thunder* during the *Liberty 2014 Survey*.

With respect to direction of movement, the seven beluga sightings during non-seismic periods were first observed swimming parallel to, towards, or perpendicular to the observation vessel (Figure P). The single beluga seen during seismic period was traveling away from the vessel. This animal was 1.4 km from the source, and may have been exposed to seismic sounds < 160 dB (rms). Pinniped movement during seismic and non-seismic periods was variable (Figures Q). However, two of the five pinnipeds observed during seismic period swam away (40%) from the vessel (Figure Q(a)), while only 12% of 178 sightings were observed swimming away during non-seismic period (Figure Q(b)). More movement away during airgun operations could be indicative of disturbance, but the latter sample size is so small (*n*=5) that again, valid interpretation is not possible.

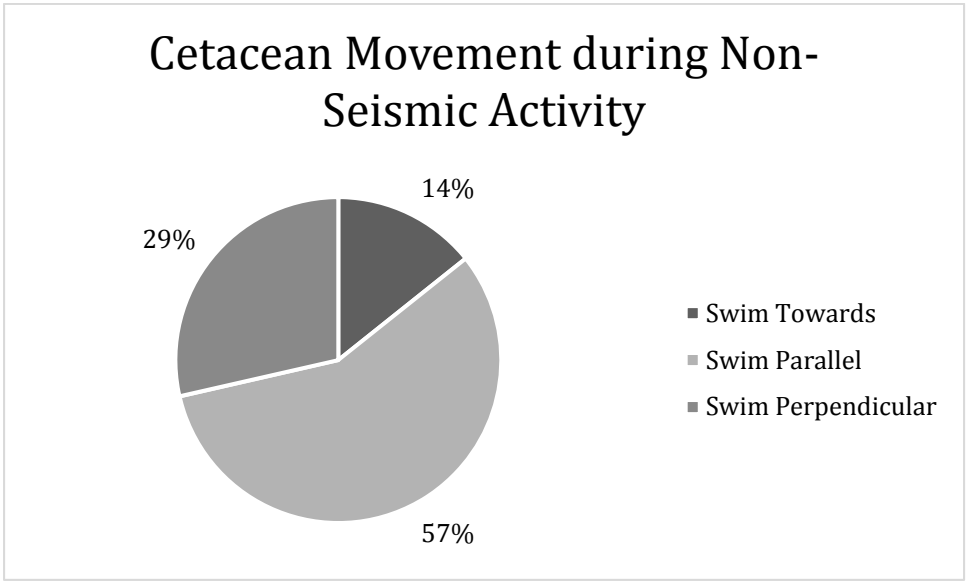

Figure P. Movement of cetacean groups (all beluga whales) observed during non-seismic period (*n* =7) from the *Thunder* during the *Liberty 2014 Survey*. The one beluga seen during seismic period was traveling away from the vessel.

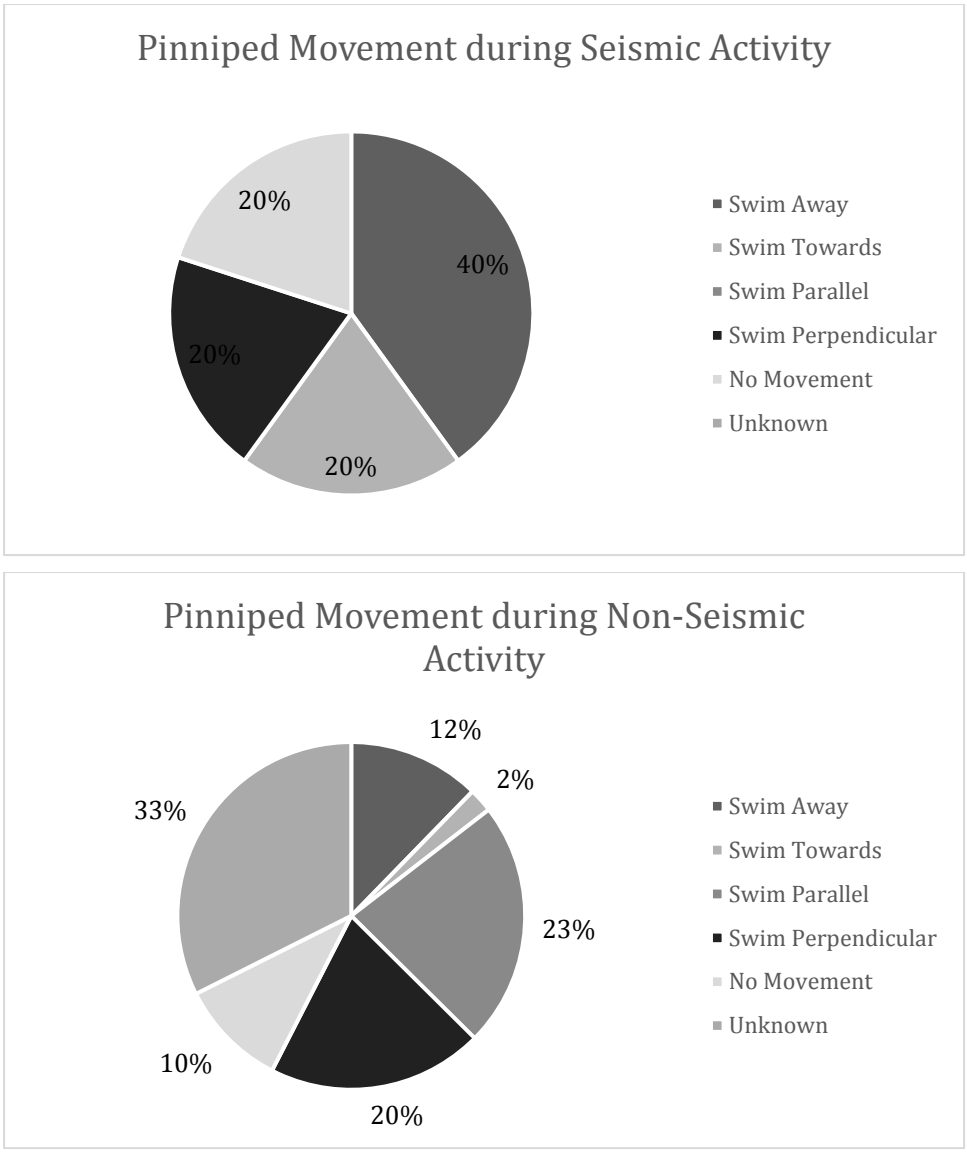

Figure Q. Pinniped movement observed during (a) seismic (*n* = 5) and (b) non-seismic period (*n* = 178) from the *Thunder* during the *Liberty 2014 Survey*.

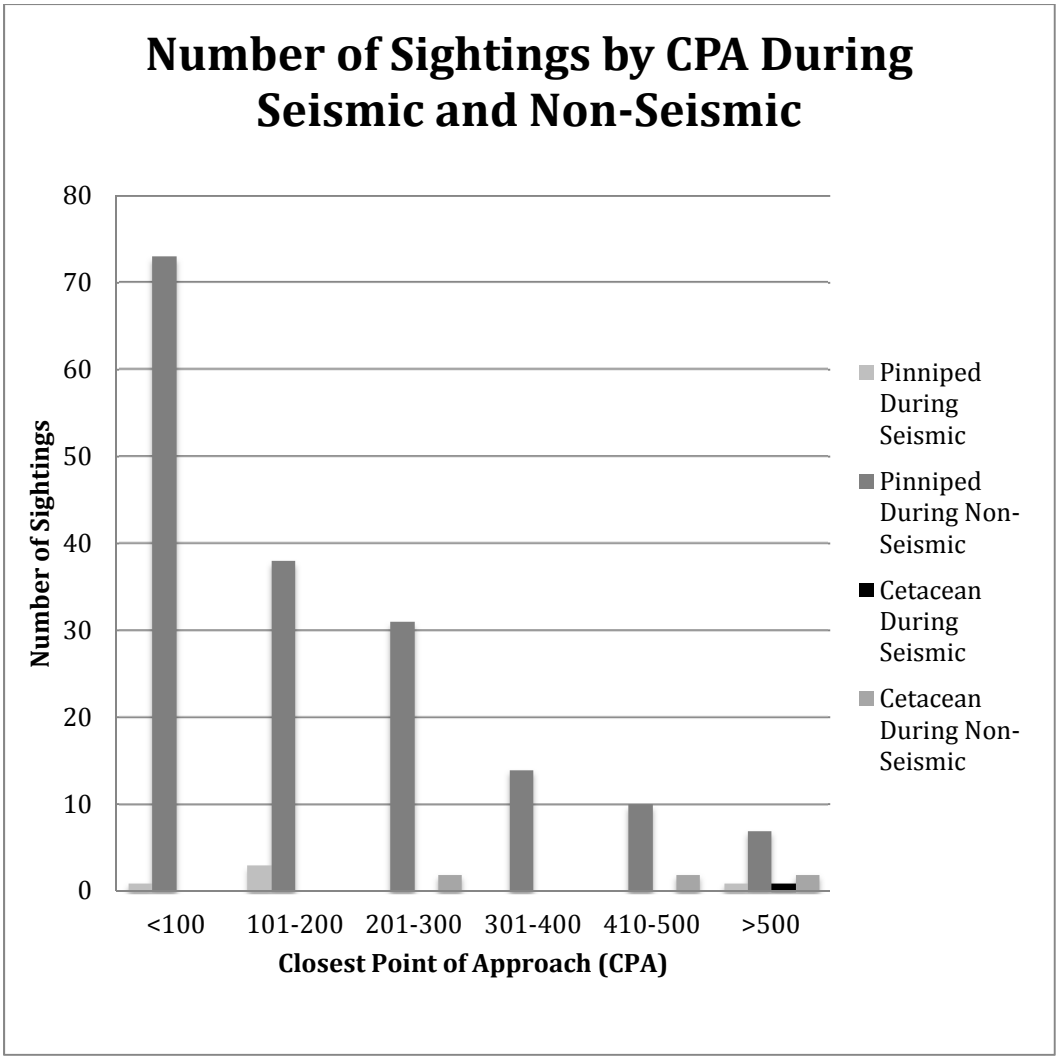

Figure R. Number of cetacean (all belugas) and pinniped sightings by closest observed points of approach (CPA) category during seismic and non-seismic conditions during the *Liberty 2014 Survey*.

Sample sizes were too small during seismic periods to facilitate meaningful interpretation of potential difference in the CPA distance for pinnipeds and beluga whales. During non-seismic periods, pinniped CPA decreased with increasing distance from the PSO and/or source vessel (Figure R). The latter result was likely related to increased ability to see pinnipeds closer to the vessel, as discussed previously for closest initial sighting distance and pinnipeds. During seismic, four of five (80%) pinniped sightings occurred within 200 m of the operating source vessel, suggesting little if any displacement of pinnipeds based on this very limited sample size (Figure R). The CPA among the seven non-seismic beluga sightings was < 300 m and ranged to > 500 m away; the one beluga seen during seismic was > 500 m away (Figure R).

In summary, sample sizes during seismic periods for both pinnipeds and beluga whales were too small (n = 6) to allow meaningful interpretation of potential effects of seismic operations on behavior. However, the relatively large (n = 178) number of pinniped sightings during non-seismic periods suggests that behavior and movement was generally variable, with no clear trends for any avoidance or adverse reactions to the vessel with the exception of pinnipeds often looking toward the vessel.

5.3. Mitigation Measures Implemented

5.3.1. General and Support Vessel Mitigation Measures

The captain and crew of the source vessel, the *Thunder*, complied with all general mitigation measures as identified in the NMFS-issued IHA and USFWS-issued LOA (BPXA 2014). The captain and crew of the support vessel, the *Freedom*, also complied with all support vessel mitigation measures described in Section 3. To assist with the latter compliance, the PSO Supervisor was aboard the *Freedom* during two trips from West Dock to Endicott under charter on 26 July and 17 August to monitor the vessel mitigation procedures. Average speed during these trips was 7.5 kt. When a single ringed seal was observed, *Freedom* slowed to 5 kt until well past the animal. The latter measures were complied with required support vessel mitigation measures.

5.3.2. Seismic Survey Mitigation Measures

Specific seismic survey mitigation measures implemented during the *Liberty 2014 Survey* included two shutdowns and one power down due to marine mammal observations, ramp-up procedures, and use of the mitigation airgun (Table 16). Ramp-up procedures occurred on 44 separate occasions for a total of 8.2 hr of operations. The mitigation airgun was implemented on three occasions, three separate days for a total of 3.3 hr (Table 16).

A power down was implemented for 3 min when a spotted seal was observed stationary 150 m from the source vessel. After a couple of min the seal began to swim toward the source vessel; a 15 min shutdown was called when it was approximately 60 m from the vessel and no change in behavior was observed (Table 16). Airgun activity did not resume that day due to equipment malfunction.

A shutdown was implemented when a ringed seal was observed swimming away from the source vessel at 70 m. Ramp-up began 19 min after the shutdown was implemented and airgun operations continued. During the ramp up, no marine mammal was seen during those 19 min.

Table 16. Details of mitigation activity for the *Thunder* source vessel during airgun operations.

Mitigation Activity	Number of Occurrences	Duration Per Occurrence	Circumstances
Ramp-up	44	Range: 10-13 minutes (min)	Conducted prior to commencement of all airgun operations after a shutdown of more than 10 minutes
Power Down	1	3 min	For a spotted seal at 150 meters, followed by a shutdown.
Shutdown	2	15 min	For a ringed seal at 60 m. Airgun activity did not resume due to equipment malfunction.
		19 min	For a ringed seal at 70 m, followed by a ramp-up.
Mitigation Airgun	3	27 min- 2.3 hour	Twice for encroaching fog and once while surveyors worked on equipment.

5.3.3. Mitigation Measures for Subsistence Activities

Mitigation measures for subsistence activities, as agreed upon in the CAA (Appendix A) were correctly followed throughout the project and are discussed in further detail in Section 6.

5.4. Estimated Number of Potential Exposures

It is required under the IHA to provide estimates of the amount and nature of potential harassment of marine mammals. Meaningful estimates of the number of marine mammals potentially exposed to airgun sounds are difficult to obtain for several reasons:

- The relationship between numbers of marine mammals that are observed and the number actually present is uncertain;
- The distance to which a received sound level exceeds a specific criterion such as 190 dB and 180 dB re 1 µPa (rms) is variable, especially in the shallow water environment in which the *Liberty 2014 Survey* took place (Section 3;

see also Greene 1998; Greene et al. 1998; Burgess and Greene 1999; Caldwell and Dragoset 2000; Tolstoy et al. 2004a,b);

- The sounds received by marine mammals vary depending on their depth in the water, and will be considerably reduced for animals near the surface (Greene and Richardson 1988; Tolstoy et al. 2004a,b); and
- Behavioral responses due to sounds exposures are uncertain and vary among different species and situations (e.g., Southall et al 2007; Ellison et al. 2012). In addition to these reasons, there were relatively few marine mammal sightings during the survey, which further complicates the provision of meaningful estimates.

The method applied to estimate the number of marine mammals exposed to airgun sounds strong enough that they might have caused a disturbance or other potential impacts includes:

- Minimum estimates based on the direct observations of marine mammals by PSOs, and
- Maximum estimates based on pinniped and cetacean sighting rates obtained during this survey.

The actual number of individuals exposed to, and potentially impacted by, seismic survey sounds likely was between the minimum and maximum estimates provided in the following sections and summarized in Table 17.

5.4.1. Minimum Estimate

The actual number of marine mammals observed within the applicable 160 dB safety radius of the *Thunder* during airgun operations provides a minimum estimate of the number potentially exposed to airgun sounds regulated by NMFS. This likely underestimates the actual number potentially exposed because PSOs were likely unable to detect all marine mammals near the vessel. During daylight, animals are missed if they are below the surface when the vessel is nearby. Other marine mammals, even if they surface near the vessel, could be missed because of limited visibility due to conditions such as fog, rain, snow, haze, darkness or sea state.

Minimum beluga whale exposures — Only one beluga was seen while the airguns were operating and it was outside the 160 dB (rms) exposure radius (approximately 1.4 km from the operating source vessel). The minimum number of beluga exposures to survey airgun sounds ≥ 160 dB (rms) is therefore 0 animals.

Minimum pinniped exposures — Five pinnipeds were seen within the 160 dB (rms) exposure radius during airgun activity. The minimum number of pinniped exposures to ≥ 160 dB (rms) is therefore five animals.

5.4.2. Maximum Estimate

The maximum number of potential pinniped and beluga whale exposures to ≥160 dB (rms) was calculated as listed below. These exposure estimates were based on sighting rates during non-seismic periods because (1) the highest sighting rates occurred during non-seismic periods, and (2) non-seismic periods are considered the best estimate of numbers of animals that would have occurred during seismic periods if there had been no seismic operations during those periods.

> Maximum number of exposures = Total duration of seismic operations (daylight seismic hr + nighttime seismic hr) x Average group size observed during survey x Non-seismic sighting rate (No. groups observed/hr during useable non-seismic conditions)

Beluga whale exposures — The overall sighting rate for belugas (based on seven beluga whale sightings) during usable non-seismic operations was 0.03 sightings (i.e., groups)/hr, and was higher than the 0.01 sighting rate during seismic (based on one beluga group sighting) (Table 13). The higher non-seismic rate was thus used to calculate the potential number of beluga whales that could have been present during the daylight and low-light (civil twilight) periods when airguns were operating. Rather than just include non-seismic effort from the 2D HR survey (Phase 1), we combined non-seismic effort from Phase 1 and Phase 2 so as to ensure a maximum estimate (given that non-seismic sighting rates were higher during Phase 2 than Phase 1). The seismic survey was completed on 5 August, before civil twilight began in 2014; therefore, all seismic effort was in daylight.

The maximum number of potential cetacean exposures to ≥ 160 dB (rms), which is the number of sightings one might have expected in the absence of airguns, was calculated as follows:

- Total daylight seismic effort (Table 13) = 135.2 hr
- Total nighttime seismic effort = 0 hr
- Average group size observed during survey = 2.375
- Sighting rate during usable non-seismic operations was 0.03 sightings (i.e., groups)/hr
- Maximum number of potential exposures = (135.2 hr + 0 hr) x 2.375 x 0.03 sightings/hr = 9.63 sightings

Pinniped exposures — The overall pinniped sighting rate during usable non-seismic operations was 0.62 sightings/hr (Table 13). Again, we combined non-seismic effort from Phase 1 and Phase 2 so as to ensure a maximum estimate. The maximum estimated number of potential pinniped exposures to ≥ 160 dB (rms), which is the number of sightings one might have expected in the absence of airguns, was calculated as follows. (However, this estimate likely contains an undetermined number of resights of the same individuals, given the small survey area, particularly across days and hours).

- Total daylight seismic effort (Table 13) = 135.2 hr

- Total nighttime seismic effort = 0 hr
- Average group size observed during survey = 1.026
- Sighting rate during usable non-seismic operations was 0.62 sightings (i.e., groups)/hr
- Maximum number of potential exposures = (135.2 hr+ 0 hr) x 1.026 x 0.62 sightings/hr = 86.00 sightings

Table 17. Summary of minimum observed and estimated maximum number of potential marine mammal exposures to airguns sounds of ≥ 160 (rms) from the *Thunder* source vessel during the *Liberty 2014 Survey*. The estimated number of pinniped and cetacean exposures as per the IHA are provided for comparison.

	Potential calculated exposures to ≥ 160 dB (rms)		Estimated exposures to ≥ 160 dB (rms) as per IHA
Species	Minimum	Maximum	
Beluga Whale	0	10 (9.63)	79
Pinnipeds*	5	86 (86.00)	114
Total	**5**	**96 (95.63)**	**193**
Spotted Seal	*5 (4.25)*	*73 (73.1)*	*23*
Bearded Seal	*1 (0.43)*	*8 (7.40)*	*19*
Ringed Seal	*1 (0.32)*	*6 (5.50)*	*71*

*A total of 93 pinniped sightings were identified to species, n=79 were spotted seals (85.0%), n = 8 were bearded seal (8.6%), n=6 were ringed seal (6.4%). These percentages were multiplied by the minimum and a maximum potential calculated pinnipeds exposures (>160 dB (rms)) to obtain exposure by species.
**All minimum and maximum potential calculated exposures (>160 dB (rms)) were rounded up to the next highest whole number (i.e., 0.32 = 1). Actual calculation is shown parenthetically.

In summary, the maximum number of cetaceans and pinnipeds potentially exposed to project seismic sounds ≥ 160 dB (rms) based on actual sightings was 13% and 75% of the estimated numbers allowed per the IHA, respectively, based on available literature and associated assumptions (see IHA application, BPXA 2014).

6. Impact on Subsistence

The *Liberty 2014 Survey* began in 2014 prior to the fall bowhead whale migration and the corresponding subsistence hunt by the village of Nuiqsut. Calls to the Deadhorse CC were required to begin on 18 August and to continue through the end of the survey on 25 August. One Iñupiat-speaking PSO was on board the source vessel at all times except for the last three 12-hr day shifts from 23-25 August. An Iñupiat Communicator was not available for the latter three days, so a trained non-Iñupiat PSO filled in. Calls to the CC were made every 6 hrs, primarily by the Iñupiat Communicators and occasionally by a non-Iñupiat PSO. Each call to the CC provided the position (latitude and longitude) of the *Thunder* and a brief description of planned activities. The first call was made at 0000 hours on 18 August. The last such call was made at 0000 hours on 26 August reporting that the sonar survey had been completed and that vessel operations would end approximately three hours later when the *Thunder* finished transiting to West Dock. On 22 August, the CC informed PSOs on the *Thunder* that whaling crews from Nuiqsut were likely heading to Cross Island on 28 August and that whaling was expected to begin 30 August. There was no indication that any of the Liberty survey activities resulted in an impact to the subsistence resources of the local community.

7. References

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APPENDIX A. CONFLICT AVOIDANCE AGREEMENT (CAA)

2014 CAA FINAL FOR SIGNATURE

2014 OPEN WATER SEASON PROGRAMMATIC CONFLICT AVOIDANCE AGREEMENT

BETWEEN

BP EXPLORATION (ALASKA), INC.
ENI US OPERATING CO INC.
EXXON MOBIL CORPORATION
GX TECHNOLOGY CORP.
CAELUS ENERGY ALASKA
SAExploration
SHELL OFFSHORE, INC
TGS-NOPEC Geophysical Company

AND

THE ALASKA ESKIMO WHALING COMMISSION
THE BARROW WHALING CAPTAINS' ASSOCIATION
THE GAMBELL WHALING CAPTAINS' ASSOCIATION
THE KAKTOVIK WHALING CAPTAINS' ASSOCIATION
THE KIVALINA WHALING CAPTAINS' ASSOCIATION
THE LITTLE DIOMEDE WHALING CAPTAINS' ASSOCIATI(
THE NUIQSUT WHALING CAPTAINS' ASSOCIATION
THE PT. HOPE WHALING CAPTAINS' ASSOCIATION
THE PT. LAY WHALING CAPTAINS' ASSOCIATION
THE SAVOONGA WHALING CAPTAINS' ASSOCIATION
THE WAINWRIGHT WHALING CAPTAINS' ASSOCIATIOI
THE WALES WHALING CAPTAINS' ASSOCIATION

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TITLE I – GENERAL PROVISIONS

SECTION 101. APPLICATION.

Title I applies to all Participants, except as provided in Title VI.

Title II applies to all Participants, except as provided in Titles III or VI.

Title III applies to those Participants who operate barge or transit vessels in the Beaufort Sea or Chukchi Sea.

Titles IV and V apply only to those Participants who engage in oil and gas operations, except as provided in Title VI.

Title VI applies to those Participants who engage exclusively in geophysical activities that are conducted at least 5 miles or more from the Alaska coast in the Beaufort Sea or Chukchi Sea and begin on or after October 1, 2014.

Provisions that apply to a specific activity or are designated as specific to either the Beaufort Sea or Chukchi Sea apply only to Participants that engage in that activity or operate in that area, and provisions applicable to activities a Participant does not engage in or areas in which a Participant does not operate do not apply to that Participant.

SECTION 102. PURPOSE.

The purpose of this Agreement is to provide:

(1) Equipment and procedures for communications between Subsistence Participants and Industry Participants;

(2) Avoidance guidelines and other mitigation measures to be followed by the Industry Participants working in or transiting the vicinity of active subsistence hunters, in areas where subsistence hunters anticipate hunting, or in areas that are in sufficient proximity to areas expected to be used for subsistence hunting that the planned activities could potentially adversely affect the subsistence bowhead whale hunt through effects on bowhead whales;

(3) Measures to be taken in the event of an emergency occurring during the term of this Agreement; and

(4) Dispute resolution procedures.

SECTION 103. DEFINITIONS.

(a) Defined Terms.

For the purposes of this Agreement:

(1) The term "Agreement" means this 2014 Open Water Season Programmatic Conflict Avoidance Agreement and any attachments to such agreement.

(2) The term "at-sea oil and gas operations" does not include gravel islands or fixed platform developments located near shore (for example Northstar or Oooguruk) or Near Shore Operations Support Vessels.

(3) The term "barge" means a non-powered vessel that is pushed or towed, and the accompanying pushing or towing vessel, which is used solely to transport materials through the Beaufort Sea or Chukchi Sea. Such term does not include any vessel used to provide supplies or support to at-sea oil and gas operations or Near Shore Operations Support Vessels.

(4) The term "Com-Center" means a communications systems coordination center established under Section 203.

(5) The term "geophysical activity" means any activity the purpose of which is to gather data for imaging the marine subsurface environment, including but not limited to use of air guns, sonar, and other geophysical equipment used for seismic exploration or shallow hazard identification. "Geophysical activity" does not include support vessels that are not actively employing geophysical equipment, or other supporting activities that do not generate sound waves for the purposes of imaging the subsurface marine environment.

(6) The term "geophysical equipment" means equipment, such as air gun arrays over 300 cubic inches or sparker arrays over 20,000 kJ, employed on a vessel or a towed array, that generates sound waves for the purpose of imaging the subsurface marine environment for exploration and development purposes. The term does not include vessel engines, generators, or sources such as fathometers, fish finders, side-scan sonar, or other sources intended for engineering and /or transportation purposes.

(7) The term "Industry Participants" means all parties to this Agreement who are not Subsistence Participants.

(8) The term "Marine Mammal Observer / Inupiat Communicator" or "MMO/IC" means an observer hired by an Industry Participant for the purpose of spotting and identifying marine mammals in the area of that Industry Participant's operations during the Open Water Season. The MMO/IC also serves as the on-board Inupiat communicator who can communicate directly with whaling crews.[1]

(9) The term "Near Shore Operations Support Vessels" means vessels (including aircraft) used to support related activities (such as supply, re-supply, crew movement, and facility maintenance) for near shore oil and gas operations by an Industry Participant.

(10) The terms "NSB" and "NSB DWM" mean the North Slope Borough and the North Slope Borough Department of Wildlife Management, respectively.

(11) The term "oil and gas operations" means all oil and gas exploration, development, or production activities (including, but not limited to, geophysical activity, exploratory drilling, development activities (such as dredging or construction), production drilling, or production, and related activities (such as supply, re-supply, crew movements, and facility maintenance) by or for any Industry Participant, including aircraft and vessels of whatever kind used in support of such activities, occurring in the Beaufort Sea or Chukchi Sea, whether occurring near shore or offshore, but does not include barge traffic, transit vessel traffic, cable laying vessel traffic, or research vessel traffic (i.e. traffic by a vessel which is only conducting research and is not conducting any geophysical activities) by or for any Participant.

(12) The term "Open Water Season" means the period of the year when ice conditions permit navigation or oil and gas operations to occur in the Beaufort Sea or Chukchi Sea, as appropriate.

[1] Following the 2013 CAA meeting, a request was put in to change the title of MMO/IC to "Protected Species Observer," to make the term consistent with the terminology used by the National Science Foundation. The AEWC will raise this suggestion during the 2014 CAA meeting.

(13) The term "Participants" means all parties identified in this Agreement by name and whose representative(s) has signed the Agreement, and all contractors of such parties. When used alone the term includes both Industry Participants and Subsistence Participants.

(14) The term "Primary Sound Source Vessel" means a vessel owned or operated by or for an Industry Participant that (A) employs air gun arrays greater than 300 cubic inches or sparkers greater that 20,000 kJ, for imaging the subsurface environment, (B) is used to monitor any safety zone around a vessel described in subsection (A), (C) is engaged in ice-breaking, or (D) is the lead vessel in a group of barge or transit vessels.

(15) The term "sonar" means equipment, employed as hull mounted or towed array, intended for the active location of surface or underwater vessels. The term does not include vessel engines, generators, or sources such as fathometers, fish finders, side-scan sonar, or other sources intended for engineering, cable laying or routing, and/or transportation purposes.

(16) The term "Subsistence Participants" means the Alaska Eskimo Whaling Commission (AEWC) and its members, including the whaling captains' associations identified on the cover of this Agreement, as well as any individual members of those associations.

(17) The term "transit vessel" means a powered vessel that is used solely to transport materials through the Beaufort Sea or Chukchi Sea. Such term does not include a vessel used to provide supplies or other support to at-sea oil and gas operations or Near Shore Operations Support Vessels.

(b) Geographically Limited Terms.

For the purposes of this Agreement:

(1) The term "Beaufort Sea" means all waters off the northern coast of Alaska from Point Barrow to the Canadian border.

(2) The term "Chukchi Sea" means all waters off the western and northern coasts of Alaska from Cape Prince of Wales to Point Barrow.

SECTION 104. TERMS, SCOPE, AND LIMITATIONS.

(a) Term.

The term of this Agreement shall commence with the signing of this document by the Participants and shall terminate upon completion of the Nuiqsut, Kaktovik, Barrow, Wainwright, Pt Lay, and Pt. Hope Fall Bowhead Hunts or the Beaufort Sea Post Season Meeting required under Section 108(a) and Chukchi Sea Post-Season Meetings in Barrow, Wainwright, Pt. Lay, and Pt. Hope required under Section 108(b), whichever is later.

(b) Scope.

The Participants agree that, unless otherwise specified:

(1) The mitigation measures identified in this Agreement, which are intended to mitigate interference by oil and gas operations and barge and transit vessel traffic with the Alaskan Eskimo subsistence bowhead whale hunt, are designed to apply to all activities of each Participant during the 2014 Open Water Season, whether referenced specifically or by category, and to all vessels and locations covered by this Agreement, whether referenced specifically or by category.

(2) This Agreement is intended to apply to all oil and gas operations and barge and transit vessel traffic during the 2014 Open Water Season in the Beaufort Sea or Chukchi Sea.

(3) Vessels and locations covered by this Agreement include those identified in the Agreement, as well as any other vessels or locations that are employed by or for the Industry Participants in the Beaufort Sea or Chukchi Sea during the 2014 Open Water Season.

(c) Limitations of Obligations.

The following limitations apply to this Agreement.

(1) No cooperation among the Participants, other than that required by this Agreement, is intended or otherwise implied by their adherence to this Agreement. In no event shall the signatures of any representative of the Alaska Eskimo Whaling Commission (AEWC), or of the Barrow, Nuiqsut, Kaktovik, Wainwright, Pt. Hope, or Pt. Lay Whaling Captains' Associations, or of any other Whaling Captains' Association be taken as an endorsement of any Arctic operations or Beaufort Sea or Chukchi Sea OCS operations by any oil and/or gas operator or contractor.

(2) Adherence to the procedures and guidelines set forth in this Agreement does not in any way indicate that any Inupiat or Siberian Yupik whalers or the AEWC agree that industrial activities are not interfering with the bowhead whale migration or the bowhead whale subsistence hunt. Such adherence does not represent an admission on the part of the Industry Participants or their contractors that the activities covered by this Agreement will interfere with the bowhead whale migration or the bowhead whale subsistence hunt.

(3) No member of the oil and gas industry or any contractor has the authority to impose restrictions on the subsistence hunting of bowhead whales or associated activities of the AEWC, residents of the Villages of Nuiqsut, Kaktovik, Barrow, Wainwright, Pt. Lay, or Pt. Hope, or residents of any other village represented by the AEWC.

(4) In the event additional parties engage in oil and gas operations in the Beaufort Sea or Chukchi Sea during the summer or fall of 2014 the Participants shall exercise their good-faith efforts to encourage those parties to enter into this Agreement. Should additional parties enter into this Agreement at a date subsequent to the date of the signing of this document and before the termination of the 2014 bowhead whale subsistence hunting season, the AEWC will provide to all Participants a supplement to this document with the added signatures.

(5) No Participant is responsible for enlisting additional parties to adhere to the terms and conditions of the Agreement. Similarly, **THE AEWC IS NOT RESPONSIBLE FOR, OR A PARTY TO, ANY AGREEMENT AMONG THE INDUSTRY PARTICIPANTS** concerning the apportionment of expenses necessary for the implementation of this Agreement.

(6) In adhering to this Agreement, none of the Participants waives any rights existing at law. All Participants agree that the provisions of this document do not establish any precedent as between them or with any regulatory or permitting authority.

(7) **PARTICIPANTS' OBLIGATIONS SHALL BE SEPARABLE**: All Participants to this Agreement understand that each Participant represents a separate entity. The failure of any Participant to adhere to this Agreement or to abide by the terms and conditions of this Agreement shall not affect the obligation of other Participants to adhere to this Agreement and to proceed accordingly with all activities covered by this Agreement. Nor shall any Participant's adherence to this Agreement affect that Participant's duties, liabilities, or other obligations with respect to any other Participant beyond those stated in this Agreement. If an Industry Participant does not receive permit approvals from regulatory agencies to conduct its proposed activities, then that company may withdraw from this Agreement.

SECTION 105. REGULATORY COMPLIANCE.

(a) United States Coast Guard Requirements.

The Participants shall comply with all applicable United States Coast Guard requirements for safety, navigation, and notice.

(b) Environmental Regulations and Statutes.

The Participants shall comply with all applicable environmental regulations and statutes.

(c) Other Regulatory Requirements.

The Participants shall comply with all applicable federal, state, and local government requirements.

SECTION 106. DISPUTE RESOLUTION.

Subject to the terms of Section 104(c)(7) of this Agreement, all disputes arising between any Industry Participants and any Subsistence Participants shall be addressed as follows:

(1) The dispute shall first be addressed between the affected Participant(s) in consultation with the affected village Whaling Captains' Association and the Industry Participant(s)' Local Representative.

(2) If the dispute cannot be resolved to the satisfaction of all affected Participants, then the dispute shall be addressed with the affected Participants in consultation with the AEWC.

(3) If the dispute cannot be satisfactorily resolved in accordance with paragraphs (1) and (2) above, then the dispute shall be addressed with the AEWC and the affected Participants in consultation with representatives of NOAA Fisheries.

(4) All Participants shall seek to resolve any disputes in a timely manner, and shall work to ensure that requests for information or decisions are responded to promptly.

SECTON 107. EMERGENCY AND OTHER NECESSARY ASSISTANCE.

(a) Emergency Communications.

ALL VESSELS SHOULD NOTIFY THE APPROPRIATE COM-CENTER IMMEDIATELY IN THE EVENT OF AN EMERGENCY. The appropriate Com-Center operator will notify the nearest vessels and appropriate search and rescue authorities of the problem and advise them regarding necessary assistance. (See attached listing of local search and rescue organizations in Attachment I.)

(b) Emergency Assistance for Subsistence Whale Hunters.

Section 403 of Public Law 107-372 (16 U.S.C. 916c note) provides that "Notwithstanding any provision of law, the use of a vessel to tow a whale, taken in a traditional subsistence whale hunt permitted by Federal law and conducted in waters off the coast of Alaska is authorized, if such towing is performed upon a request for emergency assistance made by a subsistence whale hunting organization formally recognized by an agency of the United States government, or made by a member of such an organization, to prevent the loss of a whale." Industry Participants will advise their vessel captains that, under the circumstances described above, assistance to tow a whale is permitted under law when requested by a Subsistence Participant. Under the circumstances described above, Industry Participants will provide such assistance upon a request for emergency assistance from a Subsistence Participant, if conditions permit the Industry Participant's vessel to safely do so.

SECTION 108. POST-SEASON REVIEW / PRESEASON INTRODUCTION.

(a) Beaufort Sea Post-Season Joint Meeting.

Following the end of the fall 2014 bowhead whale subsistence hunt and prior to the 2015 Pre-Season Introduction Meetings, the Industry Participant that establishes the Deadhorse and Kaktovik Com Centers will offer to the AEWC Chairman to host a joint meeting with all whaling captains of the Villages of Nuiqsut, Kaktovik and Barrow, the Marine Mammal Observer / Inupiat Communicators stationed on the Industry Participants' vessels in the Beaufort Sea, and with the Chairman and Executive Director of the AEWC, at a mutually agreed upon time and place on the North Slope of Alaska, to review the results of the 2014 Beaufort Sea Open Water Season, unless it is agreed by all designated individuals or their representatives that such a meeting is not necessary.

(b) Chukchi Sea Post-Season Village Meetings.

Following the completion of the 2014 Chukchi Sea Open Water Season and prior to the 2015 Pre-Season Introduction Meetings, the Industry Participants involved, if requested by the AEWC or the Whaling Captain's Association of each village, will host a meeting in each of the following villages: Wainwright, Pt. Lay, Pt. Hope, Kivalina, Little Diomede, Wales, Savoonga, and Barrow (or a joint meeting of the whaling captains from all of these villages if the whaling captains agree to a joint meeting) to review the results of the 2014 operations and to discuss any concerns residents of those villages might have regarding the operations. The meetings will include the Marine Mammal Observer / Inupiat Communicators stationed on the Industry Participants' vessels in the Chukchi Sea. The Chairman and Executive Director of the AEWC will be invited to attend the meeting(s).

(c) Pre-season Introduction Meetings.

(1) Immediately following each of the above meetings, and at the same location, the Industry Participants will provide a brief introduction to their planned operations for the 2015 Open Water Season. Each Industry Participant should provide hand-outs explaining their planned activities that the whaling captains can review.

(2) Subsistence Participants understand that any planned operations discussed at these Pre-Season Introduction Meetings, and the corresponding maps, will represent the Industry Participant's best estimate at that time of its planned operations for the coming year, but that these planned operations are preliminary, and are subject to change prior to the 2015 Open Water Season Meeting.

(d) Map of Planned Industry Participant Activities.

As practicable, Industry Participants shall jointly prepare and provide the AEWC with a large-scale map of the Beaufort and Chukchi Seas showing the locations and types of oil and gas and barge and transit activities planned by each Industry Participant. This map will be for use by the AEWC and Industry Participants during the 2015 CAA Meeting.

SECTON 109. INDIVIDUAL NOTIFICATION.

In the event that any Industry Participant does not become a signatory to this Agreement, the local Whaling Captains' Associations shall be notified by the AEWC, no later than March 31, 2014, so that the local Whaling Captains' Associations can prepare to talk with the non-signatories to avoid conflict during that association's fall subsistence bowhead whaling season.

TITLE II -- OPEN WATER SEASON COMMUNICATIONS

SECTION 201. MARINE MAMMAL OBSERVERS / INUPIAT COMMUNICATORS.

(a) Marine Mammal Observer / Inupiat Communicator Required.

(1) In General. Each Industry Participant agrees to employ a Marine Mammal Observer / Inupiat Communicator (MMO/IC) on board each Primary Sound Source Vessel owned or operated by such Industry Participant in the Beaufort Sea or Chukchi Sea. Native residents of the eleven villages represented by the Alaska Eskimo Whaling Commission shall be given preference in hiring for MMO/IC positions.

(2) Special Rule for Inside Beaufort Sea Barrier Islands. Industry Participants whose seismic acquisition operations are limited to an area exclusively within the barrier islands need employ an MMO/IC on one Primary Sound Source Vessel only.

(3) Near Shore Operations Support Vessels. Industry Participants are not required to employ an MMO/IC on Near Shore Operations Support Vessels.

(4) Sealift Operations. For Industry Participants conducting sealift operations in which two tugs towing barges are accompanied within ½ mile by a third light tug at all times, a MMO/IC is required to be employed on the light tug only.

(b) Duties of Marine Mammal Observer / Inupiat Communicator.

(1) Each MMO/IC is to be employed as an observer and Inupiat communicator for the duration of the 2014 Open Water Season on the vessel on which he or she is stationed.

(2) As a member of the crew, the MMO/IC will be subject to the regular code of employee conduct on board the vessel and will be subject to discipline, termination, suspension, layoff, or firing under the same conditions as other employees of the vessel operator or appropriate contractor.

(3) Once the source vessel on which the MMO/IC is employed is in the vicinity of a whaling area and the whalers have launched their boats, the MMO/IC's primary duty will be to carry out the communications responsibilities set out in this Title.

(4) At all other times, the MMO/IC will be responsible for keeping a lookout for bowhead whales and/or other marine mammals in the vicinity of the vessel to assist the vessel captain in avoiding harm to the whales and other marine mammals.

(5) It is the MMO/IC's responsibility to call the appropriate Com-Center as set out in Sections 202 and 203.

(6) The MMO/IC will be responsible for all radio contacts between vessels owned or operated by each of the Industry Participants and whaling boats covered under Section 207 of this Agreement and shall interpret communications as needed to allow the vessel operator to take such action as may be necessary pursuant to this Agreement.

(7) The MMO/IC shall contact directly subsistence whaling boats that may be in the vicinity to ensure that conflicts are avoided to the greatest possible extent.

(8) The MMO/IC will maintain a record of his or her communications with each Com-Center and the subsistence whaling boats, as well as any marine mammal sightings by the MMO/IC.

SECTION 202. COM-CENTER GENERAL COMMUNICATIONS SCHEME.

(a) Reporting Positions for Vessels Owned or Operated by the Industry Participants.

(1) All vessels (other than vessels covered under sections 302 and 602) shall report to the appropriate Com-Center at least once every six hours commencing with a call at approximately 06:00 hours. Each call shall report the following information:

(A) Vessel name, operator of vessel, charter or owner of vessel, and the project the vessel is working on.

(B) Vessel location, speed, and direction.

C) Plans for vessel movement between the time of the call and the time of the next call. The final call of the day shall include a statement of the vessel's general area of expected operations for the following day, if known at that time.

EXAMPLE: This is the Arctic Endeavor, operated by _____ for _____ at Chukchi Sea prospect. We are currently at ___'___ north ___'___ west, proceeding SE at ____ knots. We will proceed on this course for ___ hours and will report location and direction at that time.

(2) The appropriate Com-Center shall be notified if there is any significant change in plans, such as an unannounced start-up of operations or significant deviations from announced course, and such Com-Center shall notify all whalers of such changes. A call to the appropriate Com-Center shall be made regarding any unsafe or unanticipated ice conditions.

(3) In the event that the Industry Participant's operation includes seismic data acquisition, the operator reserves the right to restrict exact vessel location information and provide more general location information.

(b) Reporting Positions for Subsistence Whale Hunting Crews.

(1) All subsistence whaling captains shall report to the appropriate Com-Center at the time they launch their boats from shore and again when they return to shore.

(2) All subsistence whaling captains shall report to such Com-Center the initial GPS co-ordinates of their whaling camps.

(3) Additional communications shall be made on an as needed basis.

(4) Each call shall report the following information:

(A) The crew's location and general direction of travel.

EXAMPLE: This is _____. We are just starting out. We will be traveling north-east from _____ to scout for whales. I will call if our plans change.

(B) The presence of any vessels or aircraft owned or operated by any of the Industry Participants, or their contractors, that are not observing the specified guidelines set forth in Title V on Avoiding Conflicts.

(C) The final call of the day shall include a statement of the whaling captain's general area of expected operations for the following day, if known at the time.

(5) Any subsistence whale hunter preparing to tow a caught whale shall report to the appropriate Com-Center before starting to tow.

EXAMPLE: This is Archie Ahkiviana. I am ___'___ north, ___'___ west. I have a whale and am towing it into _____.

(6) Each time a subsistence whaling camp is moved, it shall be reported promptly to the appropriate Com-Center, including the new GPS coordinates.

(7) Subsistence whale hunters shall notify the appropriate Com-Center promptly if, due to weather or any other unforeseen event, whaling is not going to take place that day.

(8) Subsistence whaling captains shall contact the appropriate Com-Center promptly and report any unexpected movements of their vessel.

(c) Responsibilities of Participants.

(1) Monitoring VHF Channel 16.

All vessels covered by Sections 207, 301, and 401 of this Agreement shall monitor marine VHF Channel 16 at all times.

(2) Avoidance of Whale Hunting Crews and Areas

It is the responsibility of each vessel owned or operated by any of the Industry Participants and covered by Sections 301 or 401 of this Agreement to determine the positions of all of their vessels and to exercise due care in avoiding any areas where subsistence whale hunting is active.

(3) Vessel-to-Vessel Communication

After any vessel owned or operated by any of the Industry Participants and covered by Sections 301 or 401 of this Agreement has been informed of or has determined the location of subsistence whale hunting boats in its vicinity, the MMO/IC shall contact those boats in order to coordinate movement and take necessary avoidance precautions.

SECTION 203. THE COMMUNICATIONS SYSTEM COORDINATION CENTERS (COM-CENTERS).

(a) Chukchi Lead System Included in Com-Center Coverage.

In addition to the Beaufort Sea and Chukchi Sea, the communications scheme shall apply in the Chukchi Sea lead system, as identified and excluded from leasing in the current MMS Five-Year Leasing Program, 2007-2012.

(b) Set Up and Operation.

(1) Subject to the terms of Section 104(c) and Section 601 of this Agreement, the Industry Participants conducting operations during the Com-Center operational window specified in Section 203(c) in:

(A) the Beaufort Sea jointly will arrange for the funding of Com-Centers in Deadhorse and Kaktovik; and

(B) the Chukchi Sea jointly will arrange for the funding of Com-Centers in Barrow, Wainwright, Pt. Lay, Pt. Hope, Kivalina, Wales, and St. Lawrence Island.

(2) All nine Com-Centers will be staffed by Inupiat operators. **GROUND TRANSPORTATION MUST BE PROVIDED FOR COM-CENTER OPERATIONS IN KAKTOVIK FOR POLAR BEAR AND BROWN BEAR SAFETY**. The Com-Centers will be operated 24 hours per day during the 2014 subsistence bowhead whale hunt. One Industry Participant in the Beaufort Sea and one Industry Participant in the Chukchi Sea, or their respective contractor, will be designated as the operator of the Com-Centers for that Sea, in consultation with the AEWC.

(3) Each Industry Participant shall contribute to the funding of the Com-Centers covering the areas in which it conducts oil and gas operations. The level of funding for the Com-Centers provided by each of the Industry Participants is intended to be in proportion to the scale of their respective activities, and shall be mutually agreed by the Industry Participants.

(4) The procedures to be followed by the Com-Center operators are set forth in subsection (d) below.

(c) Staffing.

(1) Each Com-Center shall have an Inupiat operator ("Com-Center operator") on duty 24 hours per day from August 15, or one week before the start of the fall bowhead whale hunt in each respective village, until the end of the bowhead whale subsistence hunt in villages listed in subparagraphs (A) through (G) and until the completion of all Industry Participant vessel transits (other than a vessel covered under Title V) in villages listed in subparagraphs (G) through (I):

(A) Kaktovik for the Kaktovik Com-Center;

(B) Nuiqsut for the Deadhorse Com-Center;

(C) Barrow for the Barrow Com-Center;

(D) Wainwright for the Wainwright Com-Center.

(E) Pt. Lay for the Pt. Lay Com-Center, which will be located in the Pt. Lay Whaling Captains' Association building; and

(F) Pt. Hope for the Pt. Hope Com-Center, which will be located in the Pt. Hope Whaling Captains' Association building.

(G) Kivalina for the Kivalina Com-Center.

(H) Wales for the Wales Com-Center.

(I) Gambell or Savoonga for the St. Lawrence Island Com-Center.

(2) All Com-Center staff shall be local hire.

(d) Duties of the Com-Center Operators.

(1) The Com-Center operators shall be available to receive radio and telephone calls and to call vessels as described below. A record shall be made of all calls from every vessel covered by Sections 207, 301, and 401 of this Agreement. Information reported regarding whales struck, lost, landed, or the location of whales struck, lost, or landed, or the number of strikes remaining, shall be confidential and shall not be disclosed to anyone other than the AEWC or the local Whaling Captains' Association. The record of all reporting calls should contain the following information:

(A) Industry Participant Vessel:

(i) Name of caller and vessel.

(ii) Vessel location, speed, and direction.

(iii) Time of call.

(iv) Anticipated movements between this call and the next report.

(v) Reports of any industry or subsistence activities.

(B) Subsistence Whale Hunting Boat:

(i) Name of caller.

(ii) Location of boat or camp.

(iii) Time of call.

(iv) Plans for travel.

(v) Any special information such as caught whale, whale to be towed, or industry vessel conflicts with whale or whaler. Any report of the number of whales struck, lost, or landed, or of the number of strikes remaining, shall be kept confidential and shall not be disclosed by the Com-Center or any Com-Center operator to anyone other than the AEWC or the local Whaling Captains' Association. The location of whales struck, lost, or landed shall be kept confidential and shall not be disclosed except to the extent needed to avoid an Industry/Subsistence Whale Hunter conflict.

(2) Report of Industry/Subsistence Whale Hunter Conflict. In the event an industry/subsistence whale hunter conflict is reported, the appropriate Com-Center operator shall record:

(A) Name of industry vessel.

(B) Name of subsistence whaling captain.

(C) Location of vessels.

(D) Nature of conflict, data, and time.

(3) If all vessels and boats covered by Sections 207, 301, and 401 of this Agreement have not reported to the appropriate Com-Center within one hour of the recommended time, that Com-Center operator shall attempt to call all non-reporting vessels to determine the information set out above under the Duties of the Com-Center operator.

(4) As soon as location information is provided by a vessel covered by Sections 207, 301, or 401 of this Agreement, the appropriate Com-Center operator shall plot the location and area of probable operations on the large map provided at the Com-Center.

(5) If, in receiving information or plotting it, a Com-Center operator observes that operations by Industry Participants might conflict with subsistence whaling activities, such Com-Center operator shall contact the industry vessel involved and advise the Industry Participant's Local Representative(s) and the vessel operators of the potential conflict.

SECTION 204. STANDARDIZED LOG BOOKS.

The Industry Participants will provide the Com-Centers and Marine Mammal Observer / Inupiat Communicators with identical log books to assist in the standardization of record keeping associated with communications procedures required pursuant to this Agreement.

SECTION 205. COMMUNICATIONS EQUIPMENT.

(a) Communications Equipment to be Provided to Subsistence Whale Hunting Crews.

(1) In General. The Industry Participants will provide (or participate in the provision of) the communications equipment described in paragraphs (4) and (6) of this subsection and subsection (b) of this section.

(2) Beaufort Sea. The Industry Participants funding Com-Centers in Deadhorse and Kaktovik will fund the provision of communications equipment for the whaling captains of Kaktovik and Nuiqsut in the same proportion as they fund those Com-Centers.

(3) Chukchi Sea. The Industry participants conducting operations in the Chukchi Sea will coordinate with each other to participate in funding the provision of communications equipment for the whaling captains of Barrow, Wainwright, Pt. Hope, and Pt. Lay.

(4) All-Channel, Water-Resistant VHF Radios.

These VHF radios are specifically designed for marine use and allow monitoring of Channel 16 while using or listening to another channel.

(A) Kaktovik Subsistence Whaling Boats: 8

(B) Kaktovik Base and Search and Rescue: 2

(C) Nuiqsut Subsistence Whaling Boats: 12

(D) Nuiqsut Base and Search and Rescue: 3

(E) Barrow Base and Search and Rescue: 2

(F) Wainwright Base and Search and Rescue: 2

(G) Wainwright Subsistence Whaling Boats: 4

(H) Pt. Hope Base and Search and Rescue: 2

(I) Pt. Hope Subsistence Whaling Boats: 10

(J) Pt. Lay Base and Search and Rescue: 2

(K) Pt. Lay Subsistence Whaling Boats: 4

(5) Specific VHF Channels For Each Village.

The whaling boats from each of the villages have been assigned individual VHF channels for vessel-to-vessel and vessel-to-Com-Center communications as follows:

(A) Nuiqsut whaling crews will use Channel 68.

(B) Kaktovik whaling crews will use Channel 69.

(C) Barrow whaling crews will use Channel 72.

(D) Wainwright Whaling Crews will use Channel 12.

(E) Pt. Lay Whaling Crews will use Channel 72.

(F) Pt. Hope Whaling Crews will use Channel 68.

(6) Satellite Telephones.

The satellite telephones are to be used as backup for the VHF radios. The satellite telephones for use on subsistence whaling boats are for emergency use only and should be programmed for direct dial to the nearest Com-Center.

A. Kaktovik Base Phones: 2

B. Kaktovik Subsistence Whaling Boats: 8

C. Nuiqsut Base Phones: 2

D. Nuiqsut Subsistence Whaling Boats: 12

E. Barrow Subsistence Whaling Boats: 2

F. Wainwright Subsistence Whaling Boats: 4

G. Pt. Lay Subsistence Whaling Boats: 2

(7) Distribution and Return of Equipment.

The distribution of the VHF radios and satellite telephone equipment to whaling captains for use during the 2014 fall bowhead subsistence whale hunting season shall be completed no later than August 15, 2014. All such units and telephone equipment provided under this Agreement, whether in this section or otherwise, will be returned promptly by the Subsistence Participants to the Industry Participant or the person providing such units and equipment at the end of each Village's 2014 fall bowhead whale subsistence hunt.

(b) Communications Equipment on Vessels Owned or Operated by the Industry Participants and/or their Contractors.

The Marine Mammal Observer / Inupiat Communicators onboard source vessels owned or operated by the Industry Participants and/or their contractors will also be supplied with all-channel VHF radios. The MMO/ICs have been assigned Channel 7 for their exclusive use in communicating with the Com-Center. Such radios shall be returned upon the completion or termination of the MMO/IC's assignment.

(c) Radio Installation and User Training.

The Whaling Captains of Nuiqsut, Kaktovik, Wainwright, Pt. Lay, and Pt. Hope, with assistance from the Industry Participants, will be responsible for the installation of the VHF radio equipment. The Industry participants will provide (or participate in the provision of) on-site user training for the VHF and satellite telephone equipment on or before August 15, 2014, if requested and as scheduled by the Whaling Captains' Associations of Nuiqsut, Kaktovik, Barrow, Wainwright, Pt. Lay, and Pt. Hope, and the Industry Participant operating the Beaufort Sea Com-Centers or Chukchi Sea Com-Centers, as appropriate.

SECTION 206. INDIVIDUALS TO CONTACT.

Listed below are the primary contact names and phone numbers for each of the Participants.

(1) BP Exploration (Alaska), Inc.'s (BP) Local Representative

LOWRY BROTT will be BP's local representative on the North Slope during the Term of this Agreement and will be stationed at Northstar Island and will be available by telephone at (907) 670-3520 and when Mr. Brott is not available, his alternate, Jeff Carter, will be stationed at Northstar Island and will be available by telephone at the above number.

(2) Eni 's Local Representative

Robert Province: Robert.Province@enipetroleum.com 907-865-3350

(3) Exxon Mobil's Local Representative

Anthony Pennino: anthony.pennino@exxonmobil.com (907) 334-2929

Brien Reep: Brien.e.reep@exxonmobil.com (907) 564-3617

(4) GX Technology's Local Representative

Ed Nelson (832) 344-6852

(5) CAELUS Energy Alaska Local Representative

DALE HOFFMAN will be Caelus's local representative during the Term of this Agreement and will be stationed in Anchorage and will be available by telephone at (907) 343-2108.

(6) Shell Offshore Inc.'s (Shell) Local Representatives

CRAIG BLANCHARD and HOWARD HILL will be Shell's local representatives on the North Slope during the Term of this Agreement and will be stationed at Barrow during Chukchi Sea operations and at Deadhorse during Beaufort Sea operations and will be available by telephone at (907) 770-3700.

(7) STATOIL's Local Representative

Ella Ede: eede@statoil.com (907) 444-3473

(8) SAExploration, Inc.

Sue Simonds: ssimonds@saexploration.com (907)522-4499

(9) TGS-NOPEC Geophysical Company

Troy Nelson, 403-781-1448, Troy.Nelson@tgs.com

(10) The Village of Kaktovik

For purposes of this Agreement, the individuals to contact for the Village of Kaktovik will be: JOSEPH KALEAK at (907) 640-6213 or 640-6515, and CHRISTOPHER GORDON at (907) 640-0022.

(11) The Village of Nuiqsut

For purposes of this Agreement, the individuals to contact for the Village of Nuiqsut will be: ISAAC NUKAPIGAK at (907) 480-6220 (Work), (907) 480-2400 (Home); CARL BROWER at (907) 242 -1013.

(12) The Village of Barrow

For purposes of this Agreement, the individuals to contact for the Village of Barrow will be: HARRY BROWER, JR. at (907) 852-0350 (Work), and EUGENE BROWER at (907) 852-3601.

(13) The Village of Wainwright

For purposes of this Agreement, the individuals to contact for the Village of Wainwright will be: JOHN HOPSON JR. at (907) 231-9178 (cell), and WALTER NAYAKIK at (907)763-2915 (Work); OLIVER PEETOOK at (907) 763-0220, (907) 763-0295.

(14) The Village of Pt. Hope

For purposes of this Agreement, the individuals to contact for the Village of Pt. Hope will be: JOE OKTOLLIK. at (907) 368-2088 (Home), (907) 368-1430 (cell); CLARK LANE at (907) 368-2453, (907) 947-5190 (cell).

(15) The Village of Pt. Lay

For purposes of this Agreement, the individuals to contact for the Village of Pt. Lay will be: JULIUS REXFORD (907) 833-4592 (Home), (907) 833-2214 (Work), (907) 833-2320 (Fax), THOMAS NUKAPIAK (907) 833-0191 (Home).

(16) The Village of Kivilina

For the purposes of this Agreement, the individuals to contact for the Village of Kivilina will be: RAYMOND HAWLEY at (907) 645-2164 (Home); KALEB WESLEY at (907) 645-2150 (Home), (907) 444-8905 (cell).

(17) The Village of Little Diomede

For the purposes of this Agreement, the individuals to contact for the Village of LIttle Diomede will be: RONALD OZENNA at (907) 434-1436.

(18) The Village of Wales

For the purposes of this Agreement, the individuals to contact for the Village of Wales will be: RAYMOND SEETOOK at (907) 664-2356 (Home), (907) 634-0320 (cell); WINTON WEYAPUK at (907) 664-8139 (cell).

(19) The Village of Savoonga

For the purposes of this Agreement, the individuals to contact for the Village of Savoonga will be: GEORGE NOONGWOOK at (907) 984-2461 and THOMAS AKEYA at (907) 984-6649, (907) 984-6414 (Home).

(20) The Village of Gambell

For the purposes of this Agreement, the individuals to contact for the Village of Gambell will be: MERLIN KOONOOKA at (907) 985-5113 or (907) 434-1180 (cell), and BRUCE BOOLOWON at (907) 985-5212.

(21) The AEWC

For purposes of this Agreement, the individuals to contact for the AEWC shall be: PRICE LEAVITT at (907) 852-2392.

SECTION 207. SUBSISTENCE WHALE HUNTING BOATS.

The following is a list of the number of boats each of the Subsistence Participants plan to use:

(1) Boats Owned/Used by Whaling Captains of Nuiqsut (NWCA)

The subsistence whaling crews of the Village of Nuiqsut plan to use (16) twelve boats for subsistence whale hunting during the late summer and fall of 2014.

(2) Boats Owned/Used by Whaling Captains of Kaktovik (KWCA)

The subsistence whaling crews of the Village of Kaktovik plan to use (6) eight boats for subsistence whale hunting during the late summer and fall of 2014.

(3) Boats Owned/Used by Whaling Captains of Barrow (BWCA)

The subsistence whaling crews of the Village of Barrow plan to use (34) forty boats for subsistence whale hunting during the late summer and fall of 2014.

(4) Boats Owned/Used by Whaling Captains of Wainwright (WWCA)

The subsistence whaling crews of the Village of Wainwright plan to use (4) four boats for subsistence whale hunting during the fall of 2014.

(5) Boats Owned/Used by Whaling Captains of Pt. Hope (Pt. HWCA)

The subsistence whaling crews of the Village of Pt. Hope plan to use (14) ten boats for subsistence whale hunting during the late fall of 2014.

(6) Boats Owned/Used by Whaling Captains of Pt. Lay (Pt. LWCA)

The subsistence whaling crews of the Village of Pt. Lay plan to use (4) four boats for subsistence whale hunting during the fall of 2014.

If any additional boats are put in use by subsistence whaling crews, the Industry Participants will be notified promptly through the Com-Center.

TITLE III – BARGE AND TRANSIT VESSEL OPERATIONS

SECTION 301. IN GENERAL.

A Participant may employ barges or transit vessels to transport materials through the Beaufort Sea or Chukchi Sea during the term of this Agreement. Any Industry Participant who employs a barge or transit vessel to transport materials through the Beaufort Sea or Chukchi Sea during the term of this Agreement shall require the barge or transit vessel operator to comply with Sections 201, 205(b) and 302 of this Agreement while providing services to that Industry Participant.

SECTION 302. BARGE AND TRANSIT VESSEL OPERATIONS.

(a) Reporting Positions for Barge or Transit Vessels Owned or Operated by industry Participants.

(1) All barge, transit, or cable laying vessels shall report to the appropriate Com-Center at least once every six hours commencing with a call at approximately 06:00 hours. Each call shall report the following information:

(A) Barge, transit, or cable laying vessel name, operator of vessel, charterer or owner of vessel, and the project or entity the vessel is transporting materials for.

(B) Barge, transit, or cable laying vessel location, speed, and direction.

(C) Plans for barge, transit, or cable laying vessel movement between the time of the call and the time of the next call. The final call of the day shall include a statement of the barge or transit vessel's general area of expected operations for the following day, if known at that time.

EXAMPLE: This is the Arctic Endeavor, operated by _____ for _____ in the Chukchi Sea. We are currently at ___'___ north ___'___ west, proceeding SE at ____ knots. We will proceed on this course for ___ hours and will report location and direction at that time.

(2) The appropriate Com-Center also shall be notified if there is any significant change in plans, such as an unannounced start-up of operations or significant deviations from announced course, and such Com-Center shall notify all whalers of such changes. A call to the appropriate Com-Center shall be made regarding any unsafe or unanticipated ice conditions.

(b) Operator Duties.

All barge or transit vessel operators are responsible for the following requirements.

(1) Monitoring VHF Channel 16. All barge and transit vessel operators shall monitor marine VHF Channel 16 at all times.

(2) Avoidance of Whale Hunting Crews and Areas. It is the responsibility of each Industry Participant and barge or transit vessel operator to determine the positions of their barge or transit vessels and to exercise due care in avoiding any areas where subsistence whale hunting is active.

(3) Vessel-to-Vessel Communication. After any barge or transit vessel owned or operated by any Industry Participant has been informed of or has determined the location of subsistence whale hunting boats in its vicinity, the Marine Mammal Observer / Inupiat Communicator shall contact those boats in order to coordinate movement and take necessary avoidance precautions.

(c) Routing Barge and Transit Vessels.

(1) All barge or transit vessel routes shall be planned so as to minimize any potential conflict with bowhead whales or subsistence whaling activities. All barges and transit vessels shall avoid areas of active or anticipated whaling activity, as reported pursuant to Section 202.

(2) Beaufort Sea. Vessels transiting east of Bullen Point to the Canadian border should remain at least five (5) miles offshore during transit along the coast, provided ice and sea conditions allow.

(3) Chukchi Sea. Vessels should remain as far offshore as weather and ice conditions allow, and at all times at least five (5) miles offshore during transit.

(4) Safe Harbor / Loitering. Notwithstanding paragraphs 2 and 3, from August 31 to October 31 vessels in the Chukchi Sea or Beaufort Sea shall remain at least 20 miles offshore of the coast of Alaska from Icy Cape in the Chukchi Sea to Pitt Point on the east side of Smith Bay in the Beaufort Sea whether in transit or engaging in activities in support of oil and gas operations, unless ice conditions or an emergency that threatens the safety of the vessel or crew prevents compliance with this requirement. This paragraph shall not apply to vessels actively engaged in transit to or from a coastal community to conduct crew changes or logistical support operations.

(d) Vessel Speeds.

Barge and transit vessels shall be operated at speeds necessary to ensure no physical contact with whales occurs, and to make any other potential conflicts with bowhead whales or whalers unlikely. Vessel speeds shall be less than 10 knots in the proximity of feeding whales or whale aggregations.

(e) Vessels Operating in Proximity of Bowhead Whales.

If any barge or transit vessel inadvertently approaches within 1.6 kilometers (1 mile) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

(1) reducing vessel speed to less than 5 knots within 900 feet of the whale(s);

(2) steering around the whale(s) if possible;

(3) operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;

(4) operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and

(5) checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

(f) Marine Mammal Sighting Data.

Industry Participants whose operations are limited exclusively to barge or vessel traffic will submit to the AEWC and NSB DWM all marine mammal sighting data.

TITLE IV – VESSELS, TESTING, AND MONITORING

SECTION 401. INDUSTRY PARTICIPANT VESSELS AND EQUIPMENT.

(a) List of Vessels and Equipment Required.

Each Industry Participant engaged in oil and gas operations shall provide a list identifying all vessels or other equipment (including but not limited to boats, barges, aircraft, or similar craft) that are owned and/or operated by, or that are under contract to the Industry Participants, for use in the Beaufort Sea or Chukchi Sea for oil and gas operations or for implementation of such Industry Participant's monitoring plan. Vessels and equipment used for oil and gas operations shall be listed in Attachment II, and vessels and equipment used for monitoring plans shall be listed in Attachment III.

(b) Only Listed Vessels and Equipment (or Like Vessels and Like Equipment) May Be Used.

(1) **NONE OF THE INDUSTRY PARTICIPANTS INTENDS TO OPERATE ANY VESSEL OR EQUIPMENT (EXCEPT FOR LIKE VESSELS OR LIKE EQUIPMENT) NOT IDENTIFIED IN THE LISTS REQUIRED UNDER SUBSECTION (a) DURING THE TERM OF THIS AGREEMENT.**

(2) Notwithstanding paragraph 1, if any Industry Participant decides to use different vessels or equipment or additional vessels or equipment, such vessels and equipment shall be used only for purposes identified in Attachments II or III; and the AEWC and the whaling captains of Nuiqsut, Kaktovik, Barrow, Wainwright, Pt. Hope, and Pt. Lay shall be notified promptly through the appropriate Com-Center, as identified in Section 203 of this Agreement, and in writing, of their identity and their intended use, including location of use.

SECTION 402. SOUND SIGNATURE TESTS.

Unless the AEWC approves an alternate approach for providing sound source verification, the following testing shall be required:

(a) Sound Source Verification Testing.

(1) Geophysical Equipment. For purposes of obtaining a sound signature for Industry Participants' geophysical equipment, the Industry Participants shall have initiated a test of all geophysical equipment within 72 hours of initiating or having initiated operations in the Beaufort Sea or Chukchi Sea. Such tests shall be conducted as set forth in section 402(b).

(2) Vessels. For vessels engaged in geophysical activity, Industry Participants will conduct a sound source verification test for all geophysical equipment used for geophysical activity. Each Industry Participant shall establish a sound source verification range or Industry Participants may participate jointly in establishing a range for the Chukchi Sea and Beaufort Sea, or both. A separate range shall be used for the Chukchi Sea and Beaufort Sea, and vessels shall use the appropriate range for each sea in which they operate. For testing each vessel shall proceed through the range and record information on the date, time, vessel speed, vessel route, vessel load, weather conditions, and equipment operating on the vessel (all noise generating equipment on the vessel, other than geophysical equipment subject to separate testing under paragraph (1), shall be in operation while the vessel is proceeding through the range). The range should be established near a location where details on wind speed and direction are regularly monitored and archived.

(b) Mutual Agreement on Site for Testing; Advance Notice Required.

(1) In General. Each geophysical equipment sound signature test shall be conducted at a site mutually agreed upon by the Industry Participant conducting such test and the AEWC. Each Industry Participant conducting such sound signature test(s) will make a good faith effort to provide three (3) weeks advance notice to the AEWC and the NSB DWM of its intent to perform each test.

(2) Beaufort Sea Testing. For geophysical equipment sound signature tests conducted in the Beaufort Sea, the Industry Participant conducting such tests shall provide transportation for an appropriate number of representatives from: the AEWC, the whaling captains of the Villages of Barrow, Nuiqsut, and Kaktovik, and the NSB DWM to observe the sound signature tests.

(3) Chukchi Sea Testing. For geophysical equipment sound signature tests conducted on vessels to be used in the Chukchi Sea, the Industry Participant(s) conducting such tests shall provide transportation for an appropriate number of representatives from: the AEWC, the whaling captains of the Villages of Barrow, Wainwright, Pt. Lay, and Pt. Hope, and the NSB DWM to observe the sound signature tests.

(c) Chukchi Sea Monitoring Plans.

In the Chukchi Sea, the monitoring plans should focus on the identity, timing, location, and numbers of marine mammals and their behavioral responses to the noise source. The monitoring plans will place emphasis on understanding potential impacts from industrial sounds on bowhead whales.

(d) Use of Prior Information and Peer Reviewed Data.

(1) Prior impact study results shall be incorporated into the monitoring plans prepared by each Industry Participant as applicable.

(2) Each monitoring plan for oil and gas operations shall be subject to peer review by stakeholders on a peer review panel identified by NOAA Fisheries at the 2014 Open Water Season Peer Review Meeting, convened by NOAA Fisheries. Draft plans will be submitted to the NSB DWM and AEWC no later than two weeks prior to the 2014 Open Water Peer Review Meeting.

(e) Raw Data, Communication, and Summary Required.

(1) Each Industry Participant conducting site-specific monitoring will:

(A) after quality control reviews are completed, make electronic data, available to the NSB DWM at the end of the season.

(B) permit and encourage open communications among their contractors and the AEWC and NSB DWM.

(2) Each Industry Participant will submit a summary of monitoring plan results and progress to the AEWC and NSB DWM every two weeks during the operating season.

SECTION 404. CUMULATIVE NOISE IMPACTS STUDY.

Each Industry Participant further agrees to provide its monitoring plan and sound signature data, for use in a cumulative effects analysis of the multiple sound sources and their possible relationship to any observed changes in marine mammal behavior, to be undertaken pursuant to a Cumulative Noise Impacts Study.

The study design for the Cumulative Impacts Study shall be developed through a Cumulative Impacts Workshop to be organized by the North Slope Borough in the winter of 2014/2015. The results of this workshop will be presented at the 2015 Open Water Meeting.

TITLE V – AVOIDING CONFLICTS DURING THE OPEN WATER SEASON

Industry Participants are reminded that Sections 101(a)(5)(A) and (D) of the Marine Mammal Protection Act provide, among other things, that the Secretary can authorize the incidental taking of small numbers of marine mammals of a species or population stock if the Secretary finds, among other things, that the total of such takings during the authorized period **will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.**

The following Operating Guidelines apply in the Beaufort Sea and Chukchi Sea, except as otherwise specified and in all cases with due regard to environmental conditions and operational safety. These Operating Guidelines are in addition to any permit restrictions or stipulations imposed by the applicable governmental agencies.

SECTION 501. GENERAL PROVISIONS FOR AVOIDING INTERFERENCE WITH BOWHEAD WHALES OR SUBSISTENCE WHALE HUNTING ACTIVITIES.

(a) Routing Vessels and Aircraft.

(1) All vessel and aircraft routes shall be planned so as to minimize any potential conflict with bowhead whales or bowhead subsistence whaling activities. All vessels shall avoid areas of active or anticipated whaling activity (as reported pursuant to Section 202).

(2) Beaufort Sea. Vessels transiting east of Bullen Point to the Canadian border should remain at least five (5) miles offshore during transit along the coast, provided ice and sea conditions allow.

(3) Chukchi Sea. Vessels should remain as far offshore as weather and ice conditions allow, and at least five (5) miles offshore during transit.

(4) Safe Harbor / Loitering. Notwithstanding paragraphs 2 and 3, from August 31 to October 31 vessels in the Chukchi Sea or Beaufort Sea shall remain at least 20 miles offshore of the coast of Alaska from Icy Cape in the Chukchi Sea to Pitt Point on the east side of Smith Bay in the Beaufort Sea whether in transit or engaging in activities in support of oil and gas operations unless ice conditions or an emergency that threatens the safety of the vessel or crew prevents compliance with this requirement. This paragraph shall not apply to vessels actively engaged in transit to or from a coastal community to conduct crew changes or logistical support operations.

(b) Aircraft Altitude Floor and Flight Path.

(1) AIRCRAFT SHALL NOT OPERATE BELOW 1500 FEET unless the aircraft is engaged in marine mammal monitoring, approaching, landing or taking off, or unless engaged in providing assistance to a whaler or in poor weather (low ceilings) or any other emergency situations. Aircraft engaged in marine mammal monitoring shall not operate below 1500 feet in areas of active whaling; such areas to be identified through communications with the Com-Centers.

(2) Except for airplanes engaged in marine mammal monitoring, aircraft shall use a flight path that keeps the aircraft at least five (5) miles inland until the aircraft is directly south of its offshore destination, then at that point it shall fly directly north to its destination.

(c) Vessel Speeds.

Vessels shall be operated at speeds necessary to ensure no physical contact with whales occurs, and to make any other potential conflicts with bowhead whales or whalers unlikely. Vessel speeds shall be less than 10 knots in the proximity of feeding whales or whale aggregations.

(d) Vessels Operating in Proximity of Bowhead Whales.

If any vessel inadvertently approaches within 1.6 kilometers (1 mile) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

(1) reducing vessel speed to less than 5 knots within 900 feet of the whale(s);

(2) steering around the whale(s) if possible;

(3) operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;

(4) operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and

(5) checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

SECTION 502. GEOPHYSICAL ACTIVITY LIMITATIONS.

The following operating limitations are to be observed and the operations are to be accompanied by a monitoring plan as set forth in Section 403 and Attachment III of this Agreement. The Industry Participants conducting geophysical activity agree to co-ordinate the timing and location of such activity so as to reduce, by the greatest extent reasonably possible, the level of noise energy entering the water from such activity at any given time and at any given location.

(a) Limitations on Geophysical Activity in the Beaufort Sea.

All geophysical activity in the Beaufort Sea shall be conducted in accordance with the terms set forth below.

(1) Kaktovik: No geophysical activity from the Canadian Border to the Canning River (146 deg. 4 min. W) from 25 August to close of the fall bowhead whale hunt in Kaktovik and Nuiqsut.[2] From August 10 to August 25, Industry Participants will communicate and collaborate with AEWC on any planned vessel movement in and around Kaktovik and Cross Island to avoid impacts to whale hunt.

(2) Nuiqsut:

A. Pt. Storkerson(~148 deg. 42 min. W) to Thetis Island (~150 deg. 10.2 min. W).

(i) *Inside the Barrier Islands*: No geophysical activity prior to July 25. Geophysical activity is allowed from July 25 until completion of operations[3]

(ii). *Outside the Barrier Islands:* No geophysical activity from August 25 to close of fall bowhead whale hunting in Nuiqsut. Geophysical activity is allowed at all other times.

b. Canning River (~146 deg. 4 min. W) to Pt. Storkerson (~148 deg. 42 min. W): No geophysical activity from August 25 to the close of bowhead whale subsistence hunting in Nuiqsut.

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[2] The bowhead whale subsistence hunt will be considered closed for a particular village when the village Whaling Captains' Association declares the hunt ended or the village quota has been exhausted (as announced by the village Whaling Captains' Association or the AEWC), whichever occurs earlier.

[3] Geophysical activity allowed in this area after August 25 shall include a source array of no more than 12 air guns, a source layout no greater than 8 m x 6 m, and a single source volume no greater than 880 in^3.

(3) Barrow: No geophysical activity from Pitt Point on the east side of Smith Bay (~152 deg. 15 min. W) to a location about half way between Barrow and Peard Bay (~157 deg. 20 min. W) from September 15 to the close of the fall bowhead whale hunt in Barrow.

(b) Limitations on Geophysical Activity in the Chukchi Sea.

All geophysical activity in the Chukchi Sea shall be conducted in accordance with the terms set forth below.

(1) Beginning September 15, and ending with the close of the fall bowhead whale hunt,[4] if Wainwright, Pt. Lay, or Pt. Hope intend to whale in the Chukchi Sea, no more than two geophysical activities employing geophysical equipment within 60 miles of the coastline will occur at any one time in the Chukchi Sea. During the fall bowhead whale hunt, geophysical equipment will not be used by Participants within 30 miles of any point along the Chukchi Sea coastline. Industry Participants will contact the Whaling Captains' Associations of each of those villages to determine if a village is prepared to whale and will notify the AEWC of any response.

(2) Safe harbor will be at sites selected by the Industry Participants and the AEWC. Safe harbor sites will be agreed upon no later than the beginning of operations and shall be listed in Attachment IV. However, a vessel captain will seek safety for his assets (vessel and personnel) as is his duty under the Law of the Sea.

(3) Any vessel operating within 60 miles of the Chukchi Sea coast will follow the communications procedures set forth in Title II of this Agreement. All vessels will adhere to the conflict avoidance measures set forth in Section 501 of this Agreement.

(4) If a dispute should arise, the resolution process set forth in Section 106 of this Agreement shall apply.

(5) Barrow: Within 100 miles of the coastline, no geophysical activity from Pitt Point on the east side of Smith Bay (~152 deg. 15 min. W) to a location about half way between Barrow and Peard Bay (~157 deg. 20 min. W) from September 15 to the close of the fall bowhead whale hunt in Barrow.

[4] The bowhead whale subsistence hunt will be considered closed when village Whaling Captains' Associations of Wainwright, Pt. Lay, and Pt. Hope have each declared that (A) they do not intend to hunt, (B) their village hunt has ended, or (C) the village quota has been exhausted (as announced by the village Whaling Captains' Association or the AEWC), whichever occurs earlier.

(6) Notwithstanding any other provision of this Agreement, any Industry Participant who engages exclusively in geophysical activities that are conducted at least 45 miles or more from the Alaska coast in the Chukchi Sea shall only be responsible for complying with Title I (excluding Sections 104(c)(4) and 108(a) and (b)) and Sections 201, 205(b), 206, 501, and this subsection 502(b) of this Agreement. For the avoidance of doubt, an Industry Participant described in this subsection 502(b) shall be subject to the requirements of Section 203 only to the extent of one Com-Center at the closest community to the seismic acquisition area.

SECTION 503. DRILLING AND PRODUCTION.

(a) Camden Bay.

For exploratory drilling and production between 144 deg. W and the Canning River (~146 deg. 4 min. W), zero discharge of:

(1) drilling fluids;

(2) cuttings after 20" casing;

(3) treated sanitary and gray water; and

(4) ballast and bilge water.

(b) Drilling Operations in the Beaufort Sea East of Cross Island.

No drilling equipment or related vessels used for at-sea oil and gas operations shall be onsite at any offshore drilling location east of Cross Island from 25 August until the close of the bowhead whale hunt in Nuiqsut and Kaktovik. However, such equipment may remain within the Beaufort Sea in the vicinity of 71 degrees 25 minutes N and 146 degrees 4 minutes W., or at the edge of the Arctic ice pack, whichever is closer to shore.

(c) Drilling Operations in the Beaufort Sea West of Cross Island.

In 2014, no drilling equipment or related vessels used for at-sea oil and gas operations shall be moved onsite at any location outside the barrier islands west of Cross Island until the close of the bowhead whale hunt in Barrow.

(d) Oil Spill Mitigation Agreement.

Industry Participants engaged in drilling operations agree to enter into a binding oil spill mitigation agreement with the Alaska Eskimo Whaling Commission, the North Slope Borough, and the Inupiat Community of the Arctic Slope to provide for hunter transport to alternate hunting locations in the event of an oil spill. The agreement shall be attached as Attachment V.

SECTION 504. SHORE-BASED SERVICE AND SUPPLY AREAS.

Shore-based service and supply areas used by Industry Participants shall be located and operated so as to ensure compliance with the terms of this Agreement.

SECTION 505. TERMINATION OF OPERATIONS AND TRANSIT THROUGH THE BERING STRAIT.

Except as provided in Title VI, all Industry Participant vessels shall complete operations in time to allow such vessels to complete transit through the Bering Strait to a point south of 59 degrees North latitude no later than November 15, 2014. Any Industry Participant vessel that encounters weather or ice that will prevent compliance with the date in the preceding sentence shall coordinate its transit through the Bering Strait to a point south of 59 degrees North latitude with the appropriate Com-Centers listed in Section 203. All Industry Participant vessels shall, weather and ice permitting, transit east of St. Lawrence Island and no closer than 10 miles from the shore of St. Lawrence Island.

TITLE VI – LATE SEASON SEISMIC OPERATIONS

SECTION 601. IN GENERAL.

Notwithstanding any other provision of this Agreement, any Industry Participant who engages exclusively in geophysical activities that are conducted at least 5 miles or more from the Alaska coast in the Beaufort Sea or Chukchi Sea and begin on or after October 1, 2014 shall only be responsible to comply with Title I (excluding Sections 104(c)(4) and 108(a) and (b)) and Sections 201, 205(b), 206, 502(a), and 602 of this Agreement. For the avoidance of doubt, an Industry Participant described in this Section 601 shall not be subject to the requirements of Section 203 including but not limited to funding of Com-Centers, providing certain equipment, training and providing representatives as designated operators of Com-Centers.

SECTION 602. VESSEL OPERATIONS.

(a) Reporting Positions When Vessels Come Within 40 Miles of the Coast.

(1) A vessel subject to this section operating within 40 miles of the Alaska coast shall report to the appropriate Com-Center, if open, at least once every six hours commencing with a call at approximately 06:00 hours. Each call shall report the following information:

(A) Vessel name, operator of vessel, charter or owner of vessel, and the project or entity the vessel is conducting operations for.

(B) Vessel location, speed, and direction.

(C) Plans for vessel movement between the time of the call and the time of the next call. The final call of the day shall include a statement of the vessel's general area of expected operations for the following day, if known at that time.

EXAMPLE: This is the Arctic Endeavor, operated by _____ for _____ in the Chukchi Sea. We are currently at ___'___ north ___'___ west, proceeding SE at ____ knots. We will proceed on this course for ___ hours and will report location and direction at that time.

(2) The appropriate Com-Center, if open, also shall be notified if there is any significant change in plans, such as an unannounced start-up of operations or significant deviations from announced course, and such Com-Center shall notify all whalers of such changes. A call to the appropriate Com-Center shall be made regarding any unsafe or unanticipated ice conditions.

(b) Operator Duties.

All vessel operators subject to this title are responsible for the following requirements.

(1) Monitoring VHF Channel 16. All vessel operators shall monitor marine VHF Channel 16 at all times.

(2) Avoidance of Whale Hunting Crews and Areas. It is the responsibility of each Industry Participant and vessel operator to determine the positions of their vessels and to exercise due care in avoiding any areas where subsistence whale hunting is active.

(3) Vessel-to-Vessel Communication. After any vessel owned or operated by any Industry Participant has been informed of or has determined the location of subsistence whale hunting boats in its vicinity, the Marine Mammal Observer / Inupiat Communicator shall contact those boats in order to coordinate movement and take necessary avoidance precautions.

(c) Routing Vessels.

(1) All vessel routes within 40 miles of the Alaska coast shall be planned so as to minimize any potential conflict with bowhead whales or subsistence whaling activities. All vessels shall avoid areas of active or anticipated whaling activity, as reported pursuant to Section 202.

(2) Beaufort Sea. Vessels transiting east of Bullen Point to the Canadian border should remain at least five (5) miles offshore during transit along the coast, provided ice and sea conditions allow.

(3) Chukchi Sea. Vessels should remain as far offshore as weather and ice conditions allow, and at all times at least five (5) miles offshore during transit.

(4) Safe Harbor / Loitering. Notwithstanding paragraphs 2 and 3, from August 31 to October 31 vessels in the Chukchi Sea or Beaufort Sea shall remain at least 20 miles offshore of the coast of Alaska from Icy Cape in the Chukchi Sea to Pitt Point on the east side of Smith Bay in the Beaufort Sea whether in transit or engaging in activities in support of oil and gas operations unless ice conditions or an emergency that threatens the safety of the vessel or crew prevents compliance with this requirement.

(d) Vessel Speeds.

Vessels shall be operated at speeds necessary to ensure no physical contact with whales occurs, and to make any other potential conflicts with bowhead whales or whalers unlikely. Vessel speeds shall be less than 10 knots in the proximity of feeding whales or whale aggregations.

(e) Vessels Operating in Proximity of Bowhead Whales.

If any vessel inadvertently approaches within 1.6 kilometers (1 mile) of observed bowhead whales, except when providing emergency assistance to whalers or in other emergency situations, the vessel operator will take reasonable precautions to avoid potential interaction with the bowhead whales by taking one or more of the following actions, as appropriate:

(1) reducing vessel speed to less than 5 knots within 900 feet of the whale(s);

(2) steering around the whale(s) if possible;

(3) operating the vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;

(4) operating the vessel(s) to avoid causing a whale to make multiple changes in direction; and

(5) checking the waters immediately adjacent to the vessel(s) to ensure that no whales will be injured when the propellers are engaged.

(f) Marine Mammal Sighting Data.

Industry Participants whose operations are subject to this title will submit to the AEWC and NSB DWM all marine mammal sighting data.

TITLE VII – PARTICIPANTS

This Agreement shall be binding and effective when signed by the duly authorized representatives of the Participants. Signatures may be by facsimile on separate pages.

George Noongwook	Harry Brower, Jr.
AEWC Chairman	AEWC Commissioner for Barrow
Dated: _____	Dated: _____
Merlin Koonooka	Joseph Kaleak
AEWC Commissioner for Gambell	AEWC Commissioner for Kaktovik
Dated: _____	Dated: _____
Raymond Hawley	Ronald Ozenna, Jr.
AEWC Commissioner for Kivalina	AEWC Commissioner for Little Diomede
Dated: _____	Dated: _____

Isaac Nukapigak	Herbert Kinneeveauk
AEWC Commissioner for Nuiqsut	AEWC Commissioner for Pt. Hope
Dated: _____	Dated: _____
Julius Rexford	George Noongwook
AEWC Commissioner for Pt. Lay	AEWC Commissioner for Savoonga
Dated: _____	Dated: _____
John Hopson, Jr.	Raymond Seetook
AEWC Commissioner for Wainwright	AEWC Commissioner for Wales
Dated: _____	Dated: _____

Name: BP Exploration (Alaska) Inc. Dated: _____	Name: Eni US Operating Co Inc. Dated: _____
Name: Exxon Mobil Corporation Dated: _____	Name: GX Technology Corp. Dated: _____
Name: Caelus Energy of Alaska Dated: _____	Name: Shell Offshore, Inc. Dated: _____
Name: SAExploration Dated: _____	Name: TGS-NOPEC Geophysical Company Dated: _____

ATTACHMENT I -- LOCAL SAR CONTACTS

LOCAL SEARCH AND RESCUE ORGANIZATIONS -

CONTACT PERSONS
(IN EMERGENCIES, ALWAYS DIAL 911)

North Slope Borough
Search and Rescue (Pilots)

Director Price E. Brower		852-2822 WK 367-3225 Home

Barrow Volunteer
Search and Rescue Station 852-2808 OFS

President	Crawford Patkotak	852-3798 HM 360-3477 Cell
Vice-Pres.	Johnny Adams	852-7761 HM 878-2411 Cell
Secretary	Isabelle Kanayurak	852-2822 Wk
Treasurer	James Patkotak	852-4686 HM 855-0733 Cell
Coordinator	Roy Ahmaogak	367-4184 Cell

Director	Stephanie Lozano	244-4011 WK 382-6304
Director	Vernon Edwardsen	852-0521 WK 855-1264 Cell

Nuiqsut Volunteer
Search and Rescue Station 480-6613 (Fire Hall)

Fire Chief	Steven Kunaknana	480-6613 WK
Coordinator	Gordon Brown	480-6225/6223 480-0040 Cell
Volunteer	Winford Ipalook	480-0046 Cell
Volunteer	Willie Sielak	480-0003 Cell
Volunteer	Larry Kasak Sr.	480-0020 Cell

Kaktovik Volunteer
Search and Rescue Station 640-6212 (Fire Hall)

President	Lee Kayotuk 640-0033 Cell	640-5893 HM 640-6213 Home
Vice-Pres.	Tom Gordon 640-	
Secretary	Nathan Gordon	640-6925
Treasurer	Don Kayotuk	640-2947
Fire Chief	Sheldon Brower	640-6212 WK

Wainwright Volunteer Search and Rescue 763-2728 (Fire Station)

President	Joe Ahmaogak Jr.	763-2826 Home
Vice President	John Hopson, Jr.	763-3464 Home
Secretary	Raymond Negovanna	763-2102 Home
Treasurer	Ben Ahmaogak, Jr.	763-3030 Home
Director	Artic Kittick	763-2534 Home
Director	Raymond Negovanna	763-2826

Pt. Lay Volunteer Search and Rescue 833-2714 (Fire Hall)

President	Warren H Lampe	833-0049
Vice Pres.	Leo Ferreira	833-3185
Secretary	Misty Plymale	833-1209
Treasurer	Lily Anniskett	833-0060
Fire Chief	Anthony Neakok	833-2714/833-2253
Coordinator 1	Marie Tracey	833-2127/2428/350-9712
Coordinator 2	Cyrus Nukapigak	833-1209/2318

Pt. Hope Volunteer Search and Rescue

Coordinator	Midas Koenig	.368-2774Work

Fire Chief	Art Oomittuk	368-2774 Work (Note: Only contact for Pt. Hope)

North Slope Borough Disaster Relief Coordinator

Frederick Brower	852-0284 OFS

ATTACHMENT II -- OPERATIONS VESSELS

VESSELS TO BE USED FOR AND IN SUPPORT OF INDUSTRY PARTICIPANTS' OPERATIONS AS IDENTIFIED IN SECTION 401(b)(1)(B)

[ALL VESSELS TO BE IDENTIFIED BY COMPANY]

NOTE:

COPY OF PRESENTATION OF THE INDUSTRY PARTICIPANT ATTACHED IDENTIFYING VESSELS TO BE USED FOR AND IN SUPPORT OF THE INDUSTRY PARTICIPANTS' OPERATIONS.

ATTACHMENT III -- MONITORING VESSELS

VESSELS TO BE USED
FOR AND IN SUPPORT
OF THE INDUSTRY PARTICIPANTS MONITORING PLANS
AS IDENTIFIED IN SECTION 401(b)(1)(B)

[ALL VESSELS TO BE IDENTIFIED BY COMPANY]

NOTE:

COPY OF PRESENTATION OF THE INDUSTRY PARTICIPANT ATTACHED IDENTIFYING VESSELS TO BE USED FOR AND IN SUPPORT OF THE INDUSTRY PARTICIPANTS' MONITORING PLAN.

ATTACHMENT IV -- SAFE HARBOR

ATTACHMENT V -- OIL SPILL MITIGATION

APPENDIX B. PROGRESS ON FISH ACOUSTICS STUDY

PROGRESS ON FISH ACOUSTICS STUDY, 2014

Provided by Bill Streever (BPXA), Katherine Kim (Greeneridge Sciences), and Scott Raborn (LGL).

Introduction

As part of the 2014 Liberty Geohazard Seismic and Seabed Mapping Survey, BPXA (BP Exploration, Alaska, Inc.) considered a number of monitoring and reporting opportunities that could contribute to the collective knowledge of marine mammals, marine mammal prey, and marine mammal habitat. BPXA and others recognized that the potential to undertake meaningful research on direct impacts to marine mammals that might result from the seismic operation would be limited due to the small number of marine mammals in the project area and other factors. However, BPXA and others also recognized the potential value of research on fish responses to airgun sounds. Since ice seals prey on at least some of the fish species occurring in the area around the seismic operation, a study of fish responses was seen as relevant to marine mammal issues, in keeping with guidance provided by the NMFS in Section 5.3.1(e) of the 2013 Supplemental Draft Environmental Impact Statement (SDEIS), which calls for "an increase in our understanding of how the activity affects marine mammal habitat, such as through effects on prey sources or acoustic habitat."

BPXA has collected fish in permanently established fyke nets at four locations in shallow water close to the project area for three decades (Figure 1). The juxtaposition of the seismic operation with the fish sampling locations provided an opportunity to assess changes in fish abundance and mortality with changing levels of received sounds.

The effect of airgun sounds on fish displacement and mortality is an issue of concern not only for marine mammal conservation but also for the Inupiat traditional Arctic cisco fishery in Nuiqsut, Alaska. In addition, it is an issue of growing importance in various locations around the world where fishing coexists with oil and gas exploration.

This summary provides an overview of progress on the fish acoustics study available as of 1 November 2014. As proposed prior to the project, full processing and analyses of fish and acoustic data will not be completed until sometime in 2015.

Fish Sampling

During the first two months of the open water season from 1981 through 2013 (with the exception of 1999 and 2000), biologists have checked fyke nets daily at four locations:

Niakuk, West Beach, West Dock, and Endicott. During the two-month study period each year, fish are counted and sized every day, unless sampling is prevented by weather, the presence of bears, or other events. Fish mortality is also noted. In a typical year, more than 50,000 fish representing 18 species are caught in the fyke nets. Primary species caught in the fyke nets are Arctic cisco (*Coregonus autumnalis*), least cisco (*Coregonus sardinella*), northern dolly varden (*Salvalinus malma*), broad whitefish (*Coregonus nasus*), humpback whitefish (*Coregonus pidschian*), Arctic flounder (*Liopsetta glacialis*), fourhorn sculpin (*Myoxocephalus quadricornis*), and rainbow smelt (*Osmerus mordax*).

In 2014, fish-sampling began on 30 June 2014 (26 days before airgun operations began on 26 July 2014). Fish sampling continued until 1 September 2014 (7 days after airgun operations ceased on 25 August 2014). During a cumulative (all four fyke nets combined) 183.3 days of fishing, a total of 82,569 fish representing 19 species were captured and released (Table 1).

As of 1 November 2014, fish data had not been completely assessed. However, initial assessments did not suggest the presence of increased mortality of fish in nets or unusual catch rates. For example, initial assessments of Arctic cod abundance show catch levels within the range found in earlier years (Figure 2). Similarly, initial assessments of juvenile Arctic cisco abundance, which is heavily influenced by winds, was somewhat low for 2014 but within the range found in earlier years (Figure 3).

These initial assessments would not detect anything less than severe impacts. More sophisticated statistical analyses described below will incorporate acoustic data and account for day-to-day changes in sound levels in an attempt to detect subtle relationships between fish catches and airgun sounds.

Acoustic Records

Throughout the seismic project, airgun operations were intermittently stopped due to factors related to weather conditions, logistical issues, and the presence of marine mammals. In addition, the location of airgun support vessels in the region varied throughout the seismic project as transects, or source lines, were completed. In keeping with these realities, received airgun sound levels at each fish sampling location varied through the sampling period.

Because fishes detect sounds as changes in pressure (analogous to human hearing), as particle motion (the movement of water molecules that accompanies fluctuating pressures, which cannot be detected by human hearing), or as changes in both pressure and particle motion, sound pressure measurements and particle motion measurements

may be related to fish responses to airgun sounds. With that in mind, sound pressure levels and particle motion (in the terms of particle velocity via particle acceleration) in the water were recorded from 13 July 2014 (13 days before airgun operations began) until 29 August 2014 (four days after airgun operations ceased) at locations within about 50 m of each fish sampling location. All in-water recorders were placed on the seabed at a depth of about 1 m. Also, in an effort to overcome challenges associated with waves in shallow water, particle motion was recorded using "nails" (a type of geophone sometimes used in seismic data acquisition) placed about 20 cm underground near three of the four fish sampling locations (Niakuk, West Beach, and West Dock locations). Nails recorded particle motion from 26 July 2014 until 25 August 2014. As of 1 November 2014, data quality in all recorders had not been completely assessed.

Sound Pressure Measurements

Sound pressures were measured using Autonomous Submersible Acoustic Recorders, or ASARs (Model C08 ASAR-Cs built by Greeneridge Sciences). Each ASAR is equipped with two omnidirectional sensors of different sensitivities, enabling measurement of a wide dynamic range of acoustic sound pressures and, therefore, providing the ability to record very loud sounds from nearby airgun shots and quieter sounds from more distant airgun shots. For this study, the ASARs recorded at a 24 kHz sampling rate for each of its two sensors, providing a record of sounds ranging in frequency from a few Hz to about 12 kHz.

Early assessment shows that ASARs performed reliably for more than 97% of their deployment. Early comparisons of ASAR data to airgun shot records show that many airgun shots were not audible at the fish sampling locations, presumably because the shallow water environment restricted sound propagation, especially at low frequencies, in the water column. Figure 4 illustrates an airgun pulse received on an ASAR, confirming that, at least for this pulse, the low frequencies normally associated with airgun pulses were not received at the recorder.

Particle Motion Measurements

In-water particle motion was measured using Directional Autonomous Seafloor Acoustic Recorders, or DASARs (Model C08 DASAR-Cs built by Greeneridge Sciences). DASARs, originally developed for BPXA's Northstar bowhead whale research (Greene et al. 2004, MacDonald et al. 2012), are equipped with an omnidirectional sensor that measures acoustic pressure and a pair of orthogonal directional sensors that measure acoustic particle motion along two horizontal axes. For the fish acoustics study, only the directional sensors were used, since sound pressures were measured using ASARs.

Early assessment of DASAR data suggests that wave motion during windy days overwhelmed in-water particle motion measurements. Further assessment will be needed to determine the usefulness of in-water particle motion measurements.

In-ground particle motion measurements using "nails" deployed near three of the fish sampling locations may provide more useful data than in-water particle motion measurements. For each nail, recorded data were extracted for the 6-sec period following each airgun shot. Early assessment shows that all shots reported in shot logs were captured in nail recordings.

Planned Analyses

Complex statistical analyses will be needed to determine if the catch rate or mortality of numerically dominant fish species was related to airgun sounds associated with BPXA's project activities during the summer of 2014. Details regarding the analytical approach will evolve as analyses progress, and the overall approach could change dramatically as analyses progress. Nevertheless, the analyses currently planned are described below.

Simply put, the analyses will test for relationships between independent variables (received sound levels at each net as well as other environmental variables) and dependent variables (fish mortality and the catch-per-unit-effort (CPUE) of the numerically dominant fish species).

Conceptually, analyses of changes in mortality and CPUE will be undertaken at three levels:

(1) year-to-year differences to determine the degree to which 2014 differed from previous years,

(2) days with and without airgun sounds to determine changes in daily fluctuation outside of the normal range, and

(3) location-specific differences with respect to airgun sounds.

The third approach, assessing the relationship between mortality and CPUE and summary acoustic metrics for each day, will be the most complex and the most likely to detect subtle relationships that may be of interest. The general experimental design will follow the before-after-control-gradient (BACG) approach described by Ellis and Schneider (1997) with variables outlined in Table 2. Independent variables describing potential disturbance probably will include

acoustic metrics collected at fyke net locations as well as distances to the nearest airgun sources each day. Many natural environmental influences affect mortality and the daily catch rates of various species. Moreover, these influences affect age classes within certain species differently. In order to detect a response signal caused by acoustic disturbance, these natural influences must be included in size-specific models of species mortality and catch rates. For example, important natural influences for Arctic cod (all ages), age-0 Arctic cisco, and least cisco include daily and cumulative seasonal wind patterns, as well as daily salinity. As a second example, older age cohorts of Arctic cisco, least cisco, and broad whitefish may be affected by these influences in addition to an index of winter severity and an index of the cohort's abundance from the previous year.

Parameters quantifying disturbance related influences and natural environmental variables will be valuated within the context of a generalized linear mixed model (GLMM) using the GLIMMIX Procedure of the statistical software SAS 9.4 (SAS Institute, Inc. 2012). The relative fit of various model specifications (combinations of independent variables) will be compared based on their respective Akaike Information Criteria (AIC) values as per Burnham and Anderson (2002). Absolute model fit will be assessed with cumulative residual plots (Lin et al. 2002).

Although statistical analyses will assess both mortality and CPUE, it should be noted that received sound levels found in initial acoustic data processing are low compared to levels known to kill fish. Also, previous work on airgun arrays in shallow water near Prudhoe Bay have not detected fish mortality.

Catch and effort will enter statistical models separately as has been done in recent literature (e.g., Terceiro 2003, Ver Hoef and Boveng 2007, Dunn 2009). Catch is discrete by nature due to being generated by the Poisson process of counting individuals. However, a Poisson distribution will likely be inadequate as CPUE data tend to be overdispersed and better represented with a negative binomial distribution (Stroup 2013).

Schedule

As data processing and statistical analyses progress, the three key principle scientists (Bill Streever of BPXA, Katherine Kim of Greeneridge Sciences, and Scott Raborn of LGL) will collaborate on a draft manuscript, with input as needed from the study's advisory panel (Arthur Popper of the University of Maryland, Tony Hawkins of the Scottish Environmental Research Institute, and Craig George of the

North Slope Borough). The draft manuscript should be ready for review by about 1 April 2015. The initial draft review will be limited to the study's advisory panel. After review comments are returned, revisions will address comments. The revised manuscript will be submitted to the National Marine Fisheries Service (NMFS) and to a peer-reviewed journal simultaneously by about 15 July 2015. Additional comments from NMFS and peer reviewers will be addressed as needed, with the hope of acceptance for publication by the end of 2015.

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Table 1. Preliminary summary catch data for four fyke net locations.

	Fyke Net Location					
Common Name	1	2	3	4	Total	%
Arctic cisco	5,291	2,108	4,263	5,121	16,783	20
Broad Whitefish	3,902	1,175	517	7,496	13,090	16
Least cisco	2,704	4,686	3,919	1,380	12,689	15
Arctic flounder	3,556	3,370	1,154	690	8,770	11
Arctic cod	893	336	3,374	2,569	7,172	9
Saffron cod	1,507	3,734	775	365	6,381	8
Fourhorn sculpin	1,379	2,742	1,448	810	6,379	8
Rainbow smelt	1,998	530	873	1,675	5,076	6
Humpback whitefish	684	795	1,002	223	2,704	3
Dolly Varden	1,807	363	275	229	2,674	3
Round whitefish	293	8	6	354	661	1
Ninespine stickleback	32	6	21	63	122	0
Arctic grayling	12	4	4	11	31	0
Capelin	1	5	6		12	0
Pink salmon	7		1		8	0
Burbot	5			1	6	0
Threespine stickleback	3		3		6	0
Pacific herring	1	1	2		4	0
Kelp snailfish			1		1	0

Total	24,075	19,863	17,644	20,987	82,569	

Table 2. Acoustic, fish, and environmental variables that may be considered in statistical analyses.

Fish variables*	**Disturbance and acoustic variables**	**Environmental variables**
Daily fish abundance per net (in log of Catch-per-Unit-Effort) for numerically dominant species and size classes	Daily maximum rms and peak sound pressure levels	Julian day
Daily number of fish mortalities for each species in each net for numerically dominant species and size classes	Daily maximum per pulse sound exposure levels	Daily wind conditions
	Daily cumulative sound exposure levels	Daily water temperatures
	Daily average such as Leq (equivalent continuous noise level)	Daily salinity
	Daily average and maximum particle motion values	Tide conditions
	Distance to nearest airgun activities	Index of previous winter conditions

* Fish abundance and fish mortalities will have to be assessed separately for each species.

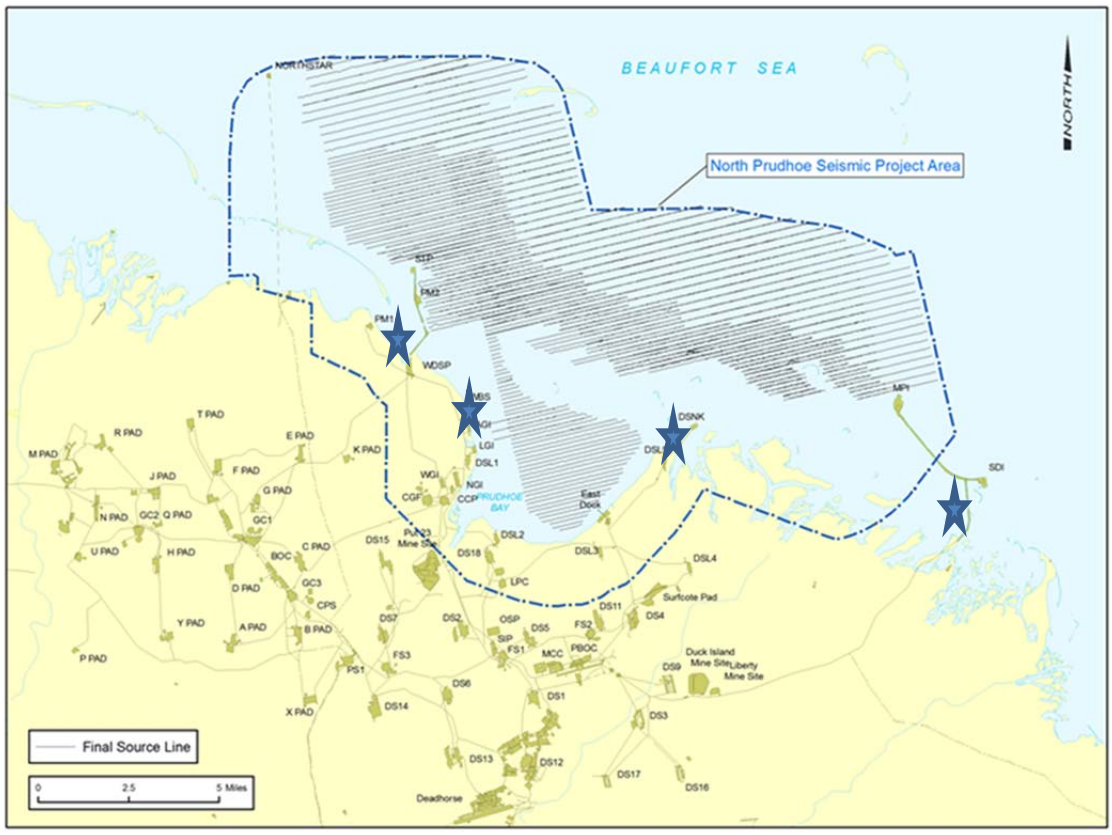

Figure 1. Location map showing outline of the project region, airgun transects associated with 2014 BPXA seismic operations (lines running east and west within the seismic project area), and approximate locations of fyke nets (stars).

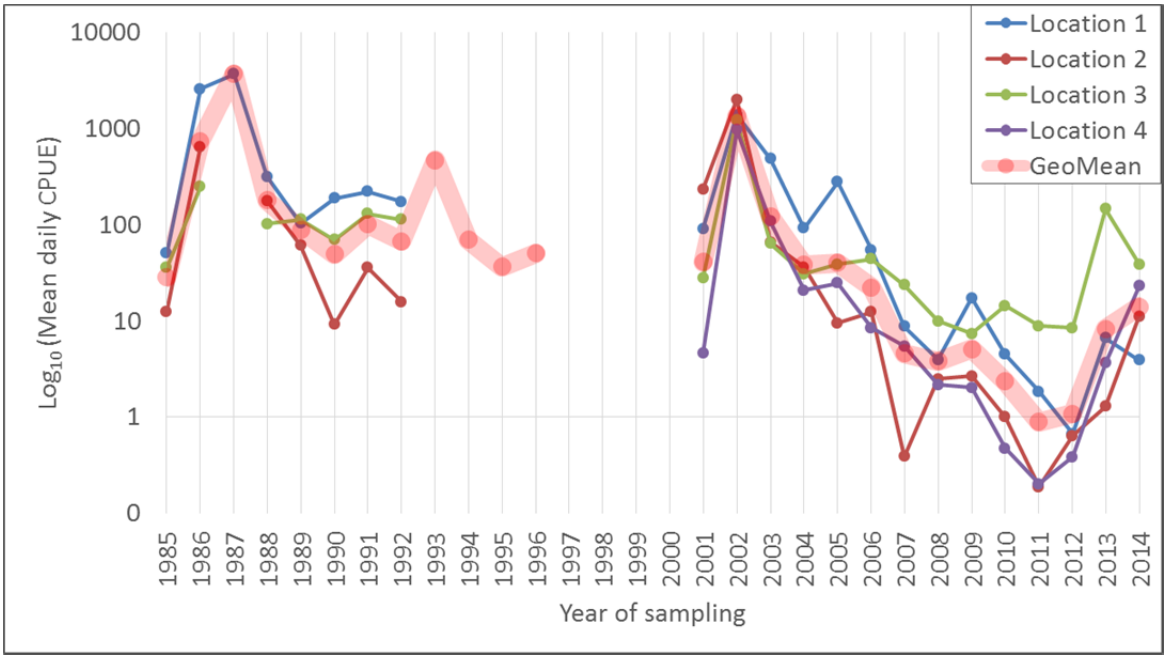

Figure 2. Abundance of Arctic cod based on preliminary counts for summer 2014 at four fyke net locations and earlier reported data for the same fyke net locations, expressed as the log of the daily catch per unit effort, along with the geometric mean for each year.

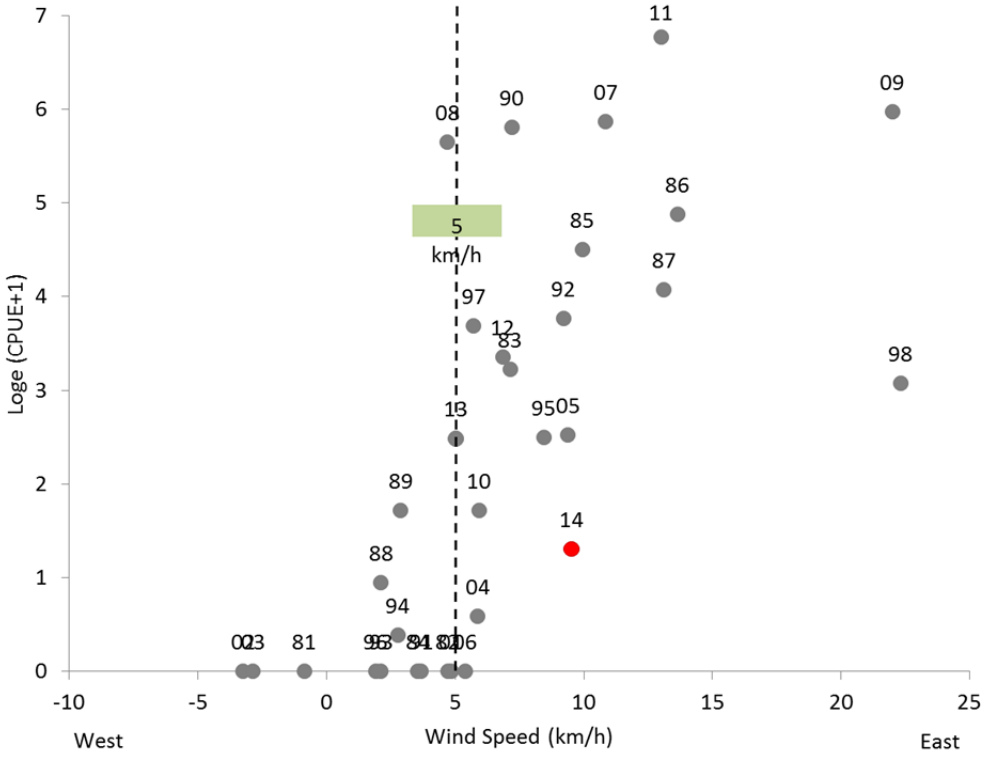

Figure 3. Abundance of juvenile (young of year) Arctic cisco based on preliminary counts for summer 2014 at four fyke net locations and earlier reported data for the same fyke net locations, expressed as the log of the daily catch per unit effort and plotted against wind. Juvenile Arctic cisco are carried on wind-driven currents from the MacKenzie Delta to the west when consistent winds blow from the east, as was the case in 2014.

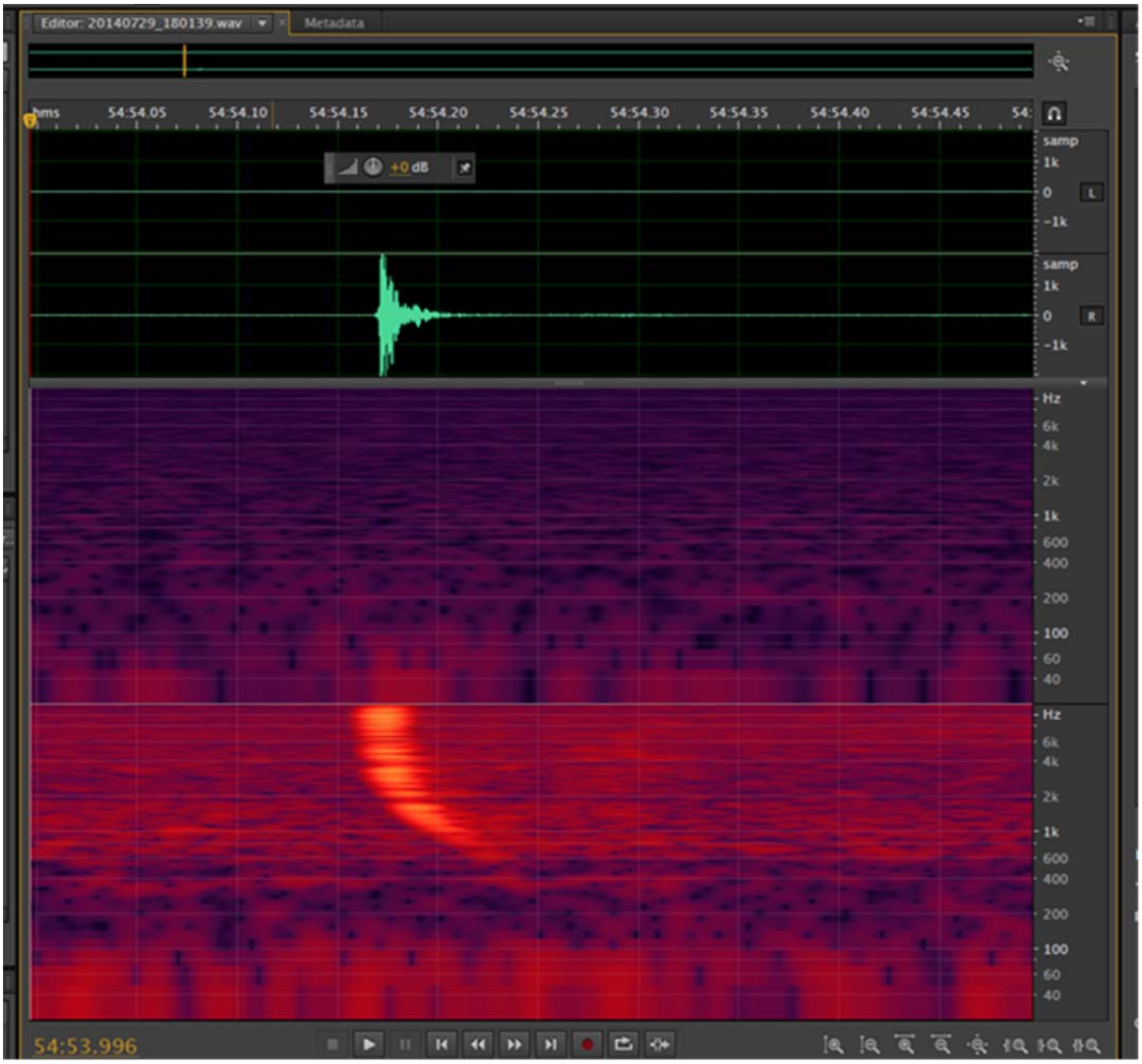

Figure 4. Airgun pulse received on an ASAR. The top panel shows the received time series, the middle panel shows the spectrogram from the "insensitive" sensor (i.e., the sensor intended to record high received sound pressures that would occur during close approaches by source vessels), and the bottom panel shows the spectrogram from the "sensitive" sensor. Note the curved shape of the impulsive broadband airgun pulse, a result of the dispersive nature of the shallow-water waveguide. In addition, the lowest frequencies typically associated with airguns, which should have relatively high sound pressures well below 500 Hz, are not present, since low frequency sounds below a depth-dependent "cutoff frequency" cannot propagate in shallow water.

APPENDIX C. MITIGATION MEASURES

General Mitigation Measures from IHA and LOA which apply to all vessels in the survey.

1. To minimize collision risk with marine mammals, the vessel shall not be operated at speeds that would make collisions with whales likely. When weather conditions require, such as when visibility drops, the vessel shall adjust speed accordingly to avoid the likelihood of collisions.
2. Vessel operators shall check the waters immediately adjacent to the vessel to ensure that no marine mammals will be injured when the vessel's propellers (or screws) are engaged.
3. Vessel operators shall avoid concentrations or groups of whales and the vessel shall not be operated in a way that separates members of a group. In proximity of feeding whales or aggregations, vessel speed shall be less than 10 kt.
4. When within 300 m (900 ft) of whales vessel operators shall take every effort and precaution to avoid harassment of these animals by:

    - Reducing speed and steering around (groups of) whales if circumstances allow, but never cutting off a whale's travel path; and

    - Avoiding multiple changes in direction and speed.

5. Sightings of dead marine mammals will be reported immediately to the BP HSSE Representative. The BP HSSE Representative is responsible for ensuring reporting of the sightings according to the guidelines provided by NMFS.
6. In the event that any aircraft (such as helicopters) are used offshore to support the planned survey, the mitigation measures below will apply:

    - Under no circumstances, other than an emergency, shall aircraft be operated at an altitude lower than 1,000 ft above sea level (ASL) when within 0.3 mile (0.5 km) of groups of whales.

    - Helicopters shall not hover or circle above or within 0.3 mile (0.5 km) of groups of whales.

Ramp-up procedures following a shutdown exceeding 10 minutes were as follows:

1. Ramp up can be started if the safety zone (200 m for 180 dB) has been free of marine mammals for a consecutive 30-minute period. The entire safety zone must be visible and under observation by PSOs during the 30-minute period. If the entire safety zone was not visible through the entire 30-minute period, ramp up from a shutdown cannot begin. This is called a 30-minute "clear".
2. The 30-minute period will be extended if a marine mammal is sighted within the safety zone. If a marine mammal is seen in the safety zone but is then observed to leave the safety zone, the 30-minute period will resume uninterrupted. Otherwise, the 30-minute observation period has to be restarted from the time of the last sighting of the marine mammal inside the safety zone.
3. If the shutdown is required because of the presence of a marine mammal in the safety zone during sound source operations, ramp up can be started if the marine mammal(s) for which the shutdown occurred have been observed to leave the safety zone or have not been sighted for at least 15 minutes (pinnipeds) or 30 minutes (cetaceans). This assumes that there was continuous observation effort by PSOs prior to the shutdown and that the entire safety zone was visible.
4. The airgun operator and PSOs will maintain records of the times when ramp-ups started and when the airgun arrays reached full power.

Power Down Procedures:

1. The array was immediately powered down whenever a marine mammal was sighted approaching close to or within the applicable safety zone of the full array (70 m for pinnipeds, 200 m for cetaceans), but was outside the applicable safety zone of the single airgun (20 m for pinnipeds, 50 m for cetaceans).
2. Likewise, if a marine mammal was already within the safety zone of the full array when first detected, the airgun array was powered down to one operating airgun immediately.
3. If a marine mammal was sighted within or about to enter the applicable safety zone of the single airgun, it too was shutdown.
4. Following a power down, ramp up to the full airgun array did not resume until the marine mammal had cleared the safety zone. The animal was considered to have cleared the safety zone if it had been visually observed leaving the safety zone of the full array, or had not been seen within the zone for 15 minutes (seals) or 30 minutes (whales).

APPENDIX D. EMAIL CORRESPONDENCE BETWEEN BPXA AND NMFS REGARDING THE EFFECTIVENESS OF NIGHT VISION DEVICES (NVDS) ON THE *LIBERTY 2014 SURVEY* 2014

From: "May, Christina H" <Christina.May@bp.com>
Date: Wednesday, July 2, 2014 at 12:10 PM
To: "Lisanne Aerts (lisanne@LAMAECOLOGICAL.COM)" <lisanne@LAMAECOLOGICAL.COM>, "Wyman, Larry" <Larry.Wyman@bp.com>, "Perrin, Gwen E. (Petrotechnical Resources Of AK)" <Gwen.Perrin@bp.com>, "Brock, Mike" <mike.brock@uk.bp.com>, Kate Lomac-MacNair <kate@smulteasciences.com>
Cc: "Streever, Bill J" <Bill.Streever@bp.com>, Candace Nachman - NOAA Federal <candace.nachman@noaa.gov>
Subject: FW: Talk with NMFS today

Hi team,

Bill and I spoke with Candace at NMFS yesterday and got her concurrence on three issues, as summarized below:

. Language/interpretation around stipulation 3 a)iv. from the IHA, which basically states that BP must shut down sound sources to avoid take of any species not listed in IHA table 1 that are likely to be exposed to SPLs greater than or equal to 160dB re 1µPa(rms) for impulse sources.
. Our interpretation is that this shutdown will only occur if a positive ID is made of a species not listed inTable 1, in this case a humback, minke, fin or Nawhal. If the i.d. is uncertain it is reasonable to consider the whales bowheads for mitigation purposes.
. NMFS is confirming their concurrence with this stipulation but their initial reaction was supportive.
. We've drafted language for the PSO handbook calling for:

- Immediately call for **power down** of the active airguns to one operating airgun (40 CI or 10 CI mitigation gun) when a positively identified whale species not included in Table 1 is seen within or about to enter the zone where they may be exposed to SPLs greater than or equal to 160 dB re 1µPa (rms) of the full array (2 km), but is outside the exclusion zone of the single active airgun (1 km for 40 CI; 0.5 km for 10 CI).

and

-Immediately call for a **shutdown** of all active airguns when a positively identified whale species not included in Table 1 is seen within or about to enter the zone where they may be exposed to SPLs greater than or equal to 160 dB re 1µPa (rms) of the single airgun (1 km for 40 CI ; 0.5 km for 10 CI).

. Night vision equipment as described in stipulation 7. We will be operating in periods of civil and possibly nautical twilight by the end of our survey period (August 25). Night vision goggles will not be particularly useful/helpful, but we do have one set that we can send North and will be made available to PSOs should they choose to use them. If PSOs request additional night vision equipment, it will be provided as quickly as possible.

. Reporting: the ITS statement has some odd language around reporting. At this point we (i.e., me) are required to call John Kurland weekly in Juneau and follow the phone call up with a written report. Candace is seeking clarification on this internally and will let us know if there is a change. In the meantime, we will plan to send our weekly report to both John Kurland and Candace Nachman. During data acquisition we'll include Candace on our daily PSO reports as a courtesy.

Please let me know if you have any questions,
Chrissy

Chrissy May
Wildlife Compliance Advisor
BP Exploration (Alaska), inc
office: 907.564-4132

From: Patti Haase <Patti@SmulteaSciences.com> **Date:** Friday, August 8, 2014 at 11:32 AM **To:** Lisanne Aerts <lisanne@lamaecological.com> **Cc:** Bridget Watts <bridgetwatts@smulteasciences.com> **Subject:** Re: FW: Night Vision Goggle Info

Hi Lisanne. A few thoughts about NVDs that you're welcome to forward to whomever. Bridget and I have used NVD PVS-7 Gen 3 goggles on Scripps' seismic cruises only to clear the exclusion zone when airguns need to start up at night. You can probably see 100-200 m under the best conditions: no cloud cover, calm seas. When ambient light decreases due to increased cloud cover, visibility decreases dramatically and at these times we were unable to see even 50 m with the goggles. Also, any light coming from the ship has to be extinguished. The reflection off structures of any light coming out of windows, for example, can be blinding, blacking out the water behind.

---------- Forwarded message ---------- From: "Mark Cotter" <markpcotter@hotmail.com>

Date: Aug 8, 2014 2:14 PM Subject: NVDs To: "bridgetwatts@smulteasciences.com" <bridgetwatts@smulteasciences.com> Cc:

My personal experience with night vision devices has been limited to generation 1 and 2 binoculars. I have used them on several occasions from both shorebased and vessel based platforms, but with both scenarios involving searching water for marine mammals - as opposed to pure terrestrial (urban or rural) settings. My overall opinion is that although the technology has come a long way in the last 10 years, they are not a critical piece of equipment and probably not worthwhile unless you were to use generation 3 or 4 NVD. The limitation in my experience has been because the technology of gen 1 and 2 is to use an infrared illuminator to amplify all available light as it converts photons into electrons to give you the image; it is similar to a flashlight beam (albeit barely visible to human eye) and the effective reach is typically less than ~100 meters. These NVD typically work better when there is ambient light like stars or a bright moon, but tend to fail miserably when there is direct man-made light such as streetlights, cars, boat lights, etc. anywhere near the field of view.
Lastly, there is a big difference between detection ranges (seeing something enough to know it is there) versus recognition range and the clarity that you can see your subject to know exactly what it is. Ideally, if these devices were to be useful the detection ranges would have to be greater, and recognition ranges would have to be great enough to consider using them for marine mammal monitoring. Ultimately, the price points start to increase dramatically with the best devices, and makes me think again if they are really worth much past the novelty of having them.

APPENDIX E. ALL SIGHTINGS TABLE

Sgt Id	Time (AKDT)	Species	Distance to Source (m)	Beh 1	Beh 2	Count	Juveniles	Pace	Movement	Depth (m)	Vessels Near	Sgt Lat	Sgt Lon	Vessel Activity	Effort
T1	2014-07-16 9:03:40	Bearded Seal	46.3	Looking	Diving	1	0	Unknown	Swim Parallel	5.5	0	70.28168	-147.68452	Transit	Non-Seismic Effort
T2	2014-07-17 0:50:59	Ringed/Spotted	66.7	Looking	Unknown	1	0	Unknown	Swim Perpendicular	5.2	0	70.35861	-147.82543	Transit	Non-Seismic Effort
T3	2014-07-17 16:00:17	Unid Marine Mammal	57.2	Diving	Unknown	1	0	Unknown	Unknown	5.5	0	70.33046	-147.71835	Transit	Non-Seismic Effort
T4	2014-07-17 18:34:28	Bearded Seal	117.8	Looking	Unknown	1	0	Sedate	Swim Perpendicular	2.4	0	70.35445	-147.95080	Anchor/Dock	Off-Watch
T5	2014-07-18 6:13:14	Spotted Seal	80.1	Swimming	Diving	1	0	Moderate	Swim Parallel	1.8	1	70.35381	-147.95356	Transit	Off-Watch
T6	2014-07-18 20:12:46	Spotted Seal	114.6	Resting	Swimming	1	0	Sedate	Swim Parallel	4.9	1	70.30993	-147.67043	Transit	Non-Seismic Effort
T7	2014-07-21 5:14:22	Unid Marine Mammal	271.6	Swimming	None	1	0	Moderate	Unknown	2.1	0	70.35735	-147.95490	Transit	Non-Seismic Effort
T8	2014-07-24 1:58:23	Spotted Seal	138.0	Looking	Diving	1	0	Moderate	Swim Perpendicular	5.8	0	70.28274	-147.61235	Shooting ON Line	Seismic Effort
T9	2014-07-24 9:23:02	Ringed/Spotted	44.8	Swimming	Diving	1	0	Unknown	Swim Towards	2.1	5	70.40013	-148.53690	Transit	Non-Seismic Effort
T10	2014-07-26 6:22:06	Spotted Seal	155.0	Swimming	Diving	1	0	Moderate	Swim Parallel	3.5	0	70.33707	-147.83697	Transit	Non-Seismic Effort
T11	2014-07-26 9:20:28	Spotted Seal	55.9	Swimming	Diving	1	0	Moderate	Swim Parallel	7.0	0	70.28163	-147.51565	Transit	Non-Seismic Effort
F1	2014-07-26 19:46:00	Ringed Seal	10000.0	Swimming	Unknown	1	0	Sedate	Unknown	5.5	0	70.37780	-148.04295	Transit	Non-Seismic Effort
T12	2014-07-27 0:20:46	Spotted Seal	95.8	Swimming	Unknown	1	0	Moderate	Swim Towards	5.5	0	70.24717	-147.51543	Power Down (mammal)	Seismic Effort
T13	2014-07-27 1:34:00	Unid Seal	98.2	Swimming	Unknown	1	0	Moderate	Swim Away	5.5	0	70.29406	-147.57219	Transit	Non-Seismic

															Effort
T14	2014-07-27 3:10:53	Spotted Seal	386.6	Swimming	Unknown	1	0	Moderate	Swim Parallel	5.5	0	70.26942	-147.55929	Transit	Non-Seismic Effort
T15	2014-07-27 15:00:00	Spotted Seal	155.0	Looking	Diving	1	0	Moderate	Swim Perpendicular	5.6	0	70.35845	-147.96300	Transit	Non-Seismic Effort
F2	2014-07-28 6:50:47	Ringed Seal	500.0	Looking	Sink	1	0	Moderate	Swim Away	2.4	0	70.35792	-147.96235	Anchor/Dock	Non-Seismic Effort
T16	2014-07-28 17:22:17	Ringed/Spotted	76.3	Looking	Sink	1	0	Unknown	Unknown	4.6	0	70.35474	-147.94823	Transit	Non-Seismic Effort
T17	2014-07-28 21:03:14	Spotted Seal	172.8	Swimming	Unknown	1	0	Moderate	Swim Away	5.5	0	70.24289	-147.54497	Ramp Up	Seismic Effort
T18	2014-07-28 21:53:26	Ringed/Spotted	163.0	Swimming	Diving	1	0	Sedate	Swim Away	5.5	0	70.25546	-147.57659	Shooting OFF Line	Seismic Effort
T19	2014-07-28 22:21:40	Unid Seal	680.7	Looking	Sink	1	0	Sedate	No Movement	5.5	1	70.28631	-147.62518	Shooting OFF Line	Seismic Effort
T20	2014-07-29 0:44:41	Ringed Seal	115.4	Swimming	Unknown	1	0	Unknown	Swim Away	5.5	0	70.27730	-147.59693	Shutdown (mammal)	Non-Seismic Effort
T21	2014-07-30 3:53:20	Spotted Seal	175.3	Swimming	Diving	1	0	Moderate	Swim Away	4.6	1	70.27727	-147.63077	No/Slow speed	Off-Watch
T22	2014-07-30 3:55:35	Spotted Seal	253.0	Swimming	Diving	1	0	Moderate	Swim Parallel	4.6	1	70.27769	-147.62458	No/Slow speed	Off-Watch
T23	2014-07-30 4:24:00	Spotted Seal	334.3	Resting	Diving	1	0	Sedate	Unknown	5.2	0	70.29334	-147.63485	Transit	Non-Seismic Effort
T24	2014-07-30 15:20:50	Spotted Seal	43.8	Looking	Sink	1	0	Sedate	Unknown	5.2	0	70.30588	-147.61734	Transit	Non-Seismic Effort
T25	2014-08-01 7:38:20	Ringed/Spotted	77.3	Sink	Unknown	1	0	Unknown	Swim Parallel	4.0	0	70.35408	-147.94682	Transit	Non-Seismic Effort
T26	2014-08-02 7:51:18	Unid Seal	33.8	Looking	Sink	1	0	Unknown	Unknown	3.4	0	70.35404	-147.95438	Anchor/Dock	Off-Watch
T27	2014-08-02 10:29:24	Spotted Seal	60.8	Swimming	Diving	1	0	Moderate	Swim Away	2.4	0	70.35480	-147.95488	Anchor/Dock	Off-Watch
T28	2014-08-02 12:43:21	Spotted Seal	41.8	Looking	Sink	1	0	Unknown	Unknown	3.4	0	70.32210	-147.84067	Transit	Non-Seismic Effort
T29	2014-08-02 12:57:21	Unid Seal	46.9	Looking	Sink	1	0	Unknown	Unknown	2.7	2	70.32206	-147.78950	Transit	Non-Seismic Effort

T30	2014-08-02 14:09:21	Ringed/Spotted	47.9	Looking	Sink	1	0	Unknown	Swim Parallel	6.7	0	70.27218	-147.59457	Transit	Non-Seismic Effort
T31	2014-08-02 19:59:48	Unid Seal	19.5	Looking	Sink	1	0	Sedate	Unknown	6.1	0	70.29464	-147.62539	Transit	Non-Seismic Effort
T32	2014-08-03 5:25:35	Unid Seal	109.0	Unknown	Sink	1	0	Vigorous	Unknown	2.4	0	70.31807	-147.67895	Transit	Non-Seismic Effort
T33	2014-08-03 16:46:53	Ringed Seal	33.8	Looking	Sink	1	0	Unknown	Swim Parallel	6.4	0	70.27947	-147.57014	Transit	Non-Seismic Effort
T34	2014-08-03 17:32:52	Unid Seal	27.1	Sink	Unknown	1	0	Unknown	Unknown	2.7	0	70.32695	-147.77789	Transit	Non-Seismic Effort
T35	2014-08-03 17:54:13	Spotted Seal	46.3	Looking	Sink	1	0	Unknown	Unknown	4.9	1	70.34874	-147.91957	Transit	Non-Seismic Effort
T36	2014-08-03 18:21:25	Spotted Seal	174.5	Swimming	Sink	1	0	Sedate	Swim Away	3.7	0	70.35430	-147.94618	Transit	Non-Seismic Effort
T37	2014-08-03 18:30:21	Spotted Seal	223.2	Swimming	Sink	1	0	Sedate	Swim Away	6.1	0	70.34651	-147.88202	Transit	Non-Seismic Effort
T38	2014-08-03 21:54:43	Beluga Whale	1425.2	Swimming	None	1	0	Moderate	Swim Away	6.0	0	70.24535	-147.51628	Shooting OFF Line	Seismic Effort
T39	2014-08-04 19:35:52	Spotted Seal	71.6	Looking	Diving	1	0	Vigorous	Swim Away	4.9	0	70.36031	-147.96543	Transit	Non-Seismic Effort
T40	2014-08-04 19:36:00	Spotted Seal	95.7	Looking	Diving	1	0	Vigorous	Swim Away	4.9	0	70.36029	-147.96363	Transit	Non-Seismic Effort
T41	2014-08-05 5:41:21	Unid Seal	135.2	Unknown	Unknown	1	0	Unknown	Unknown	4.0	0	70.32403	-147.74580	Transit	Non-Seismic Effort
T42	2014-08-05 6:18:58	Spotted Seal	139.0	Looking	Unknown	1	0	Sedate	No Movement	1.8	0	70.35782	-147.96640	Transit	Non-Seismic Effort
T43	2014-08-05 16:31:09	Unid Seal	40.9	Looking	Sink	1	0	Unknown	Unknown	3.7	0	70.30528	-147.72100	Transit	Non-Seismic Effort
T44	2014-08-05 17:09:19	Ringed/Spotted	55.9	Looking	Sink	1	0	Unknown	Unknown	2.7	1	70.35908	-147.96691	Transit	Non-Seismic Effort
T45	2014-08-06	Unid Seal	75.0	Looking	Sink	1	0	Unknown	Unknown	3.7	0	70.35901	-147.95877	Transit	Non-

	7:05:36														Seismic Effort
T46	2014-08-06 7:09:19	Spotted Seal	34.6	Looking	Sink	1	0	Sedate	Unknown	1.8	0	70.35458	-147.95453	Transit	Non-Seismic Effort
T47	2014-08-06 7:59:10	Spotted Seal	75.9	Swimming	Diving	1	1	Moderate	Swim Perpendicular	1.8	0	70.35395	-147.95386	Anchor/Dock	Off-Watch
T48	2014-08-06 12:42:00	Unid Seal	185.3	Swimming	Sink	1	0	Moderate	Swim Parallel	7.3	1	70.27379	-147.51115	Transit	Non-Seismic Effort
T49	2014-08-06 17:36:34	Unid Seal	90.1	Looking	Sink	1	0	Moderate	Swim Parallel	3.4	0	70.35072	-147.91049	Transit	Non-Seismic Effort
T50	2014-08-06 19:30:13	Spotted Seal	419.8	Swimming	Sink	1	0	Sedate	Swim Perpendicular	6.7	0	70.31528	-147.59961	Transit	Non-Seismic Effort
T51	2014-08-06 21:43:12	Ringed/Spotted	183.6	Looking	Unknown	1	0	Sedate	No Movement	6.1	0	70.30170	-147.57706	Transit	Non-Seismic Effort
T52	2014-08-07 1:17:51	Ringed/Spotted	128.1	Looking	Sink	1	0	Unknown	Unknown	6.1	0	70.26822	-147.58765	Transit	Non-Seismic Effort
T53	2014-08-07 4:34:09	Unid Seal	124.2	Unknown	Unknown	1	0	Unknown	Unknown	6.7	0	70.29342	-147.59790	No/Slow speed	Off-Watch
T54	2014-08-07 5:19:26	Unid Seal	135.2	Looking	Sink	1	0	Unknown	Unknown	4.0	0	70.33915	-147.83444	Transit	Non-Seismic Effort
T55	2014-08-07 10:09:43	Unid Seal	33.8	Sink	Unknown	1	0	Unknown	Unknown	6.1	1	70.42394	-148.27327	Transit	Non-Seismic Effort
T56	2014-08-07 10:42:51	Ringed/Spotted	52.5	Swimming	Diving	1	0	Moderate	Swim Parallel	3.0	0	70.41577	-148.53758	Transit	Non-Seismic Effort
T57	2014-08-17 14:18:25	Spotted Seal	98.6	Looking	Sink	1	1	Sedate	Swim Towards	2.1	0	70.35661	-147.95345	Transit	Non-Seismic Effort
T58	2014-08-17 20:18:21	Spotted Seal	54.0	Looking	Sink	1	0	Sedate	Swim Away	1.8	0	70.35411	-147.95432	Anchor/Dock	Non-Seismic Effort
T59	2014-08-17 20:25:38	Beluga Whale	266.9	Milling	Unknown	3	0	Moderate	Swim Towards	2.4	0	70.35483	-147.95497	Transit	Non-Seismic Effort
T60	2014-08-18 4:46:06	Unid Seal	620.4	Swimming	Diving	1	0	Moderate	Swim Away	3.0	0	70.32556	-147.70603	Transit	Non-Seismic Effort

T61	2014-08-18 5:07:23	Unid Seal	334.3	Looking	Sink	1	0	Moderate	Unknown	3.0	0	70.34885	-147.86285	Transit	Non-Seismic Effort
T62	2014-08-18 5:21:08	Ringed Seal	124.2	Resting	Diving	1	0	Sedate	No Movement	2.4	0	70.35406	-147.94929	Transit	Non-Seismic Effort
T63	2014-08-18 5:32:00	Spotted Seal	203.8	Sink	Diving	1	0	Sedate	Swim Parallel	0.9	0	70.35248	-147.95298	Anchor/Dock	Non-Seismic Effort
T64	2014-08-18 5:37:53	Ringed/Spotted	239.0	Looking	Other	2	0	Sedate	No Movement	0.9	0	70.35247	-147.95307	Anchor/Dock	Non-Seismic Effort
T65	2014-08-18 7:59:34	Unid Seal	697.1	Surface Active	Swimming	1	0	Moderate	Swim Parallel	3.4	0	70.35357	-147.93623	Anchor/Dock	Non-Seismic Effort
T66	2014-08-18 8:18:57	Spotted Seal	124.3	Surface Active	Diving	1	0	Moderate	Swim Perpendicular	2.9	0	70.34851	-147.87885	Transit	Non-Seismic Effort
T67	2014-08-18 8:23:33	Spotted Seal	55.6	Looking	Diving	1	1	Sedate	Unknown	2.9	0	70.34415	-147.84730	Transit	Non-Seismic Effort
T68	2014-08-18 8:24:05	Spotted Seal	120.7	Looking	Diving	1	0	Sedate	Swim Perpendicular	3.0	0	70.34341	-147.84178	Transit	Non-Seismic Effort
T69	2014-08-18 8:29:27	Spotted Seal	73.4	Looking	Diving	1	0	Unknown	Unknown	2.1	0	70.33804	-147.80458	Transit	Non-Seismic Effort
T70	2014-08-18 8:39:59	Spotted Seal	107.3	Swimming	Diving	1	0	Moderate	Swim Parallel	3.7	0	70.32732	-147.72746	Transit	Non-Seismic Effort
T71	2014-08-18 9:55:51	Spotted Seal	114.0	Swimming	Diving	1	0	Moderate	Swim Perpendicular	5.8	0	70.30195	-147.56002	Transit	Non-Seismic Effort
T72	2014-08-18 14:36:54	Unid Seal	733.8	Looking	Diving	1	0	Moderate	Swim Perpendicular	4.9	0	70.25444	-147.53706	Transit	Non-Seismic Effort
T73	2014-08-18 14:47:50	Unid Seal	67.9	Swimming	Diving	1	0	Moderate	Swim Away	4.6	0	70.24792	-147.53337	Transit	Non-Seismic Effort
T74	2014-08-18 15:11:12	Spotted Seal	130.6	Looking	Diving	1	0	Moderate	Swim Perpendicular	4.9	0	70.25742	-147.56725	Transit	Non-Seismic Effort
T75	2014-08-18 17:40:54	Spotted Seal	63.4	Looking	Swimming	1	0	Moderate	Swim Towards	3.7	0	70.31621	-147.74631	Transit	Non-Seismic Effort

T76	2014-08-18 17:45:37	Spotted Seal	59.0	Looking	Sink	1	0	Unknown	Unknown	2.4	0	70.32474	-147.77411	Transit	Non-Seismic Effort
T77	2014-08-18 17:48:52	Unid Seal	235.8	Sink	Unknown	1	0	Unknown	Unknown	4.0	0	70.32972	-147.79663	Transit	Non-Seismic Effort
T78	2014-08-18 17:58:47	Beluga Whale	282.5	Surface Active	Swimming	3	2	Moderate	Swim Parallel	3.0	1	70.34264	-147.85380	Transit	Non-Seismic Effort
T79	2014-08-18 18:58:36	Spotted Seal	45.3	Swimming	Diving	1	0	Sedate	Swim Parallel	1.8	0	70.35418	-147.95510	Anchor/Dock	Non-Seismic Effort
T80	2014-08-18 20:41:08	Ringed/Spotted	419.8	Swimming	Unknown	1	0	Moderate	Swim Perpendicular	2.4	1	70.33836	-147.83795	Transit	Non-Seismic Effort
T81	2014-08-18 20:44:40	Spotted Seal	234.6	Swimming	Diving	1	0	Moderate	Swim Away	2.4	1	70.33374	-147.81857	Transit	Non-Seismic Effort
T82	2014-08-18 20:47:11	Spotted Seal	95.8	Looking	Diving	2	0	Moderate		2.1	1	70.33281	-147.80155	Transit	Non-Seismic Effort
T83	2014-08-18 21:50:04	Spotted Seal	66.7	Swimming	Diving	1	0	Sedate	Swim Parallel	4.9	0	70.31078	-147.59733	Transit	Non-Seismic Effort
T85	2014-08-19 5:49:07	Ringed/Spotted	289.0	Looking	Unknown	1	0	Unknown	Unknown	1.2	1	70.35533	-147.95631	Transit	Non-Seismic Effort
T86	2014-08-19 6:44:38	Beluga Whale	416.3	Surface Active	Swimming	2	1	Moderate	Swim Perpendicular	3.4	0	70.34671	-147.86519	Transit	Non-Seismic Effort
T87	2014-08-19 6:48:53	Beluga Whale	1171.5	Swimming	Unknown	2	0	Moderate	Swim Perpendicular	3.7	0	70.35246	-147.84925	Transit	Non-Seismic Effort
T88	2014-08-19 7:02:28	Spotted Seal	222.1	Surface Active	Swimming	1	0	Moderate	Swim Parallel	4.0	0	70.32681	-147.75030	Transit	Non-Seismic Effort
T89	2014-08-19 14:25:13	Unid Seal	167.3	Looking	Swimming	1	0	Sedate	Swim Parallel	4.9	0	70.24598	-147.58748	Transit	Non-Seismic Effort
T90	2014-08-19 14:48:33	Unid Seal	262.7	Swimming	Diving	1	0	Moderate	Swim Perpendicular	4.0	0	70.24743	-147.61492	Transit	Non-Seismic Effort
T91	2014-08-19 15:12:39	Unid Seal	350.9	Swimming	Diving	1	0	Moderate	Swim Perpendicular	5.5	0	70.27282	-147.64610	Transit	Non-Seismic Effort

T92	2014-08-19 15:13:40	Unid Seal	384.0	Swimming	Diving	1	0	Moderate	Swim Parallel	5.5	0	70.27273	-147.63393	Transit	Non-Seismic Effort
T93	2014-08-19 15:19:22	Spotted Seal	77.3	Swimming	Diving	1	0	Moderate	Swim Perpendicular	5.5	0	70.27722	-147.64968	Transit	Non-Seismic Effort
T94	2014-08-19 15:27:32	Spotted Seal	203.8	Swimming	Diving	1	0	Moderate	Swim Parallel	4.6	0	70.28563	-147.65636	Transit	Non-Seismic Effort
T95	2014-08-19 15:56:39	Ringed/Spotted	84.5	Swimming	Diving	1	0	Moderate	Swim Parallel	4.6	0	70.26777	-147.64480	Transit	Non-Seismic Effort
T96	2014-08-19 16:17:48	Spotted Seal	49.0	Other	Diving	1	0	Moderate	Swim Away	4.0	0	70.24090	-147.61163	Transit	Non-Seismic Effort
T97	2014-08-19 16:29:07	Spotted Seal	92.9	Looking	Sink	1	0	Unknown	Unknown	4.3	0	70.24092	-147.60760	Transit	Non-Seismic Effort
T98	2014-08-19 16:56:35	Spotted Seal	117.7	Swimming	Milling	1	1	Sedate	Swim Perpendicular	3.4	0	70.28314	-147.68877	Transit	Non-Seismic Effort
T99	2014-08-19 20:57:04	Spotted Seal	333.1	Looking	Sink	1	0	Sedate	No Movement	4.0	0	70.24017	-147.62138	Transit	Non-Seismic Effort
T100	2014-08-19 21:13:11	Ringed/Spotted	416.3	Resting	Unknown	1	0	Sedate	No Movement	4.0	0	70.24895	-147.55357	Transit	Non-Seismic Effort
T101	2014-08-19 21:35:09	Ringed/Spotted	285.0	Looking	Sink	1	0	Unknown	Unknown	4.0	0	70.25531	-147.48272	Transit	Non-Seismic Effort
T102	2014-08-19 22:18:09	Ringed/Spotted	297.9	Diving	Looking	1	0	Unknown	Unknown	4.0	0	70.25120	-147.57666	Transit	Non-Seismic Effort
T103	2014-08-19 22:23:45	Spotted Seal	240.2	Looking	Diving	1	0	Sedate	Swim Away	4.0	0	70.25113	-147.59286	Transit	Non-Seismic Effort
T104	2014-08-20 11:16:50	Bearded Seal	49.0	Looking	Swimming	1	0	Moderate	Swim Perpendicular	8.5	0	70.28858	-147.59141	Transit	Non-Seismic Effort
T105	2014-08-21 9:04:21	Unid Seal	57.2	Other	Diving	1	0	Unknown	Unknown	2.1	1	70.41450	-148.54499	Transit	Non-Seismic Effort
T106	2014-08-21 16:01:40	Unid Marine Mammal	61.3	Diving	Unknown	1	0	Moderate	Unknown	3.5	0	70.27412	-147.61347	Transit	Non-Seismic Effort

T107	2014-08-21 17:18:39	Ringed/Spotted	302.5	Looking	Diving	1	0	Unknown	Swim Perpendicular	4.0	0	70.32123	-147.73104	Transit	Non-Seismic Effort
T108	2014-08-21 19:04:41	Unid Seal	93.5	Looking	Diving	1	0	Unknown	Unknown	2.7	0	70.32976	-147.77332	Transit	Non-Seismic Effort
T109	2014-08-21 21:35:12	Spotted Seal	184.8	Swimming	Diving	1	0	Moderate	Swim Parallel	4.0	0	70.25385	-147.57369	Transit	Non-Seismic Effort
T110	2014-08-21 21:47:11	Spotted Seal	138.0	Resting	Diving	1	0	Sedate	Swim Away	4.0	0	70.26775	-147.59005	Transit	Non-Seismic Effort
T111	2014-08-21 21:54:45	Bearded Seal	271.6	Resting	Diving	1	0	Sedate	No Movement	4.0	0	70.27596	-147.60641	Transit	Non-Seismic Effort
T112	2014-08-21 22:18:15	Unid Seal	384.3	Resting	Diving	1	0	Sedate	No Movement	4.0	0	70.27374	-147.58940	Transit	Non-Seismic Effort
T113	2014-08-21 22:29:11	Spotted Seal	135.2	Looking	Diving	1	0	Sedate	Swim Parallel	4.0	0	70.26240	-147.57838	Transit	Non-Seismic Effort
T114	2014-08-21 22:55:46	Spotted Seal	229.2	Swimming	Diving	1	0	Sedate	Swim Parallel	4.0	0	70.27181	-147.59466	Transit	Non-Seismic Effort
T115	2014-08-21 23:55:51	Unid Seal	95.8	Swimming	Diving	1	0	Sedate	Swim Away	4.0	0	70.26389	-147.57463	Transit	Non-Seismic Effort
T116	2014-08-22 8:47:22	Unid Seal	200.6	Looking	Sink	1	0	Unknown	Unknown	3.8	0	70.32991	-147.76166	Transit	Non-Seismic Effort
T117	2014-08-22 8:55:57	Spotted Seal	75.0	Looking	Sink	1	0	Moderate	Unknown	4.0	0	70.31564	-147.71338	Transit	Non-Seismic Effort
T118	2014-08-22 9:03:49	Spotted Seal	59.9	Looking	Sink	1	1	Sedate	Swim Perpendicular	3.4	0	70.30082	-147.66779	Transit	Non-Seismic Effort
T119	2014-08-22 9:21:02	Spotted Seal	22.3	Swimming	Milling	1	0	Sedate	Swim Perpendicular	3.9	0	70.28438	-147.61608	No/Slow speed	Non-Seismic Effort
T120	2014-08-22 9:24:35	Spotted Seal	46.0	Looking	Sink	1	1	Sedate	Unknown	3.9	0	70.28435	-147.61659	No/Slow speed	Non-Seismic Effort
T121	2014-08-22 9:43:00	Unid Seal	384.0	Milling	Sink	1	0	Sedate	Unknown	4.0	0	70.29461	-147.59476	Transit	Non-Seismic Effort

T122	2014-08-22 9:48:53	Spotted Seal	403.0	Swimming	Diving	1	0	Sedate	Swim Perpendicular	3.9	0	70.28350	-147.59160	Transit	Non-Seismic Effort
T123	2014-08-22 9:56:09	Spotted Seal	51.3	Looking	Swimming	1	1	Sedate	Swim Perpendicular	4.0	0	70.27881	-147.57534	Transit	Non-Seismic Effort
T124	2014-08-22 10:10:24	Unid Seal	735.0	Looking	Sink	1	0	Sedate	Unknown	4.0	0	70.25912	-147.54937	Transit	Non-Seismic Effort
T125	2014-08-22 10:14:32	Unid Seal	197.4	Looking	Sink	3	3	Sedate	Unknown	4.0	0	70.25996	-147.55139	Transit	Non-Seismic Effort
T126	2014-08-22 11:15:27	Ringed/Spotted	618.0	Looking	Sink	1	0	Unknown	Unknown	7.3	0	70.25350	-147.54021	Transit	Non-Seismic Effort
T127	2014-08-22 11:18:00	Ringed/Spotted	334.3	Swimming	Diving	1	0	Moderate	Swim Perpendicular	7.3	0	70.25546	-147.56125	Transit	Non-Seismic Effort
T128	2014-08-22 11:26:44	Ringed/Spotted	271.6	Sink	Unknown	1	0	Unknown	Swim Parallel	7.0	0	70.26769	-147.56810	Transit	Non-Seismic Effort
T129	2014-08-22 11:29:34	Ringed/Spotted	63.4	Swimming	Diving	1	0	Moderate	Swim Perpendicular	7.0	0	70.26926	-147.57518	Transit	Non-Seismic Effort
T130	2014-08-22 11:37:06	Ringed/Spotted	266.4	Surface Active	Swimming	1	0	Moderate	Swim Perpendicular	7.0	0	70.27635	-147.59374	Transit	Non-Seismic Effort
T131	2014-08-22 11:41:21	Ringed/Spotted	49.2	Surface Active	Diving	1	0	Moderate	Swim Perpendicular	7.3	0	70.28187	-147.59429	Transit	Non-Seismic Effort
T132	2014-08-22 12:09:29	Spotted Seal	222.1	Looking	Sink	1	0	Unknown	Swim Parallel	6.7	0	70.26611	-147.56992	Transit	Non-Seismic Effort
T133	2014-08-22 12:51:35	Spotted Seal	403.0	Swimming	Diving	1	0	Moderate	Swim Perpendicular	3.8	0	70.27856	-147.60476	Transit	Non-Seismic Effort
T134	2014-08-22 13:04:42	Unid Seal	223.2	Swimming	Surface Active	1	0	Moderate	Swim Perpendicular	6.9	0	70.26722	-147.57525	Transit	Non-Seismic Effort
T135	2014-08-22 13:49:15	Ringed Seal	90.1	Milling	Sink	1	0	Sedate	No Movement	7.3	0	70.28654	-147.60758	Transit	Non-Seismic Effort
T136	2014-08-22 15:00:35	Ringed/Spotted	66.7	Sink	Unknown	1	0	Unknown	Unknown	6.7	0	70.26868	-147.59150	Transit	Non-Seismic Effort

T137	2014-08-22 15:12:13	Spotted Seal	86.0	Swimming	Sink	1	0	Moderate	Swim Perpendicular	6.4	0	70.25641	-147.56960	Transit	Non-Seismic Effort
T138	2014-08-22 16:42:01	Spotted Seal	100.8	Looking	Diving	1	0	Sedate	Swim Perpendicular	6.4	0	70.28747	-147.62962	No/Slow speed	Non-Seismic Effort
T139	2014-08-22 21:57:00	Spotted Seal	69.0	Looking	Sink	1	0	Sedate	No Movement	3.4	0	70.26978	-147.59295	Transit	Non-Seismic Effort
T140	2014-08-23 5:23:06	Beluga Whale	2033.9	Swimming	Unknown	3	0	Moderate	Swim Parallel	2.7	0	70.33339	-147.84540	Transit	Non-Seismic Effort
T141	2014-08-23 5:41:32	Spotted Seal	184.8	Looking	Sink	1	0	Unknown	Unknown	2.4	5	70.35428	-147.92953	Transit	Non-Seismic Effort
T142	2014-08-23 5:44:47	Spotted Seal	89.0	Looking	Sink	1	0	Unknown	Unknown	2.4	5	70.35499	-147.95079	Transit	Non-Seismic Effort
T143	2014-08-23 6:26:29	Ringed/Spotted	77.3	Swimming	Sink	1	0	Moderate	Swim Parallel	2.7	0	70.34914	-147.91701	Transit	Non-Seismic Effort
T144	2014-08-23 6:30:55	Beluga Whale	520.6	Milling	Unknown	2	1	Moderate	Swim Parallel	3.7	0	70.34173	-147.88245	Transit	Non-Seismic Effort
T145	2014-08-23 6:53:20	Ringed/Spotted	49.2	Swimming	Diving	1	0	Moderate	Swim Parallel	4.0	0	70.32002	-147.72780	Transit	Non-Seismic Effort
T146	2014-08-23 7:00:46	Ringed/Spotted	59.0	Diving	Unknown	1	0	Moderate	Unknown	3.4	0	70.30721	-147.68241	Transit	Non-Seismic Effort
T147	2014-08-23 7:03:20	Ringed/Spotted	320.0	Swimming	Sink	1	0	Moderate	Swim Parallel	4.3	0	70.30247	-147.65962	Transit	Non-Seismic Effort
T148	2014-08-23 7:05:57	Ringed/Spotted	285.0	Swimming	Diving	1	0	Moderate	Swim Parallel	4.3	0	70.29900	-147.64449	Transit	Non-Seismic Effort
T149	2014-08-23 7:12:36	Unid Seal	139.0	Looking	Sink	1	0	Unknown	Unknown	5.8	0	70.29819	-147.59981	Transit	Non-Seismic Effort
T150	2014-08-23 7:16:44	Spotted Seal	172.8	Milling	Diving	1	0	Sedate	Swim Parallel	6.4	0	70.30321	-147.57200	Transit	Non-Seismic Effort
T151	2014-08-23 9:00:53	Bearded Seal	271.6	Unknown	Sink	1	0	Sedate	No Movement	6.1	0	70.29099	-147.66211	Transit	Non-Seismic Effort

T152	2014-08-23 9:22:26	Ringed/Spotted	239.1	Looking	Diving	1	0	Moderate	Swim Away	7.3	0	70.29299	-147.59143	Transit	Non-Seismic Effort
T153	2014-08-23 9:24:45	Spotted Seal	184.8	Swimming	Diving	1	0	Moderate	Swim Away	7.9	0	70.29049	-147.59231	Transit	Non-Seismic Effort
T154	2014-08-23 9:32:57	Bearded Seal	716.3	Milling	Sink	1	0	Moderate	No Movement	8.2	0	70.30204	-147.58005	Transit	Non-Seismic Effort
T156	2014-08-23 10:20:12	Spotted Seal	97.7	Looking	Diving	1	0	Sedate	Swim Away	7.0	0	70.26047	-147.56984	Transit	Non-Seismic Effort
T155	2014-08-23 10:21:21	Spotted Seal	130.5	Swimming	Diving	1	0	Moderate	Swim Away	7.0	0	70.25904	-147.56792	Transit	Non-Seismic Effort
T157	2014-08-23 11:15:44	Unid Seal	95.8	Diving	Unknown	1	0	Unknown	Swim Parallel	7.3	0	70.28390	-147.51399	Transit	Non-Seismic Effort
T158	2014-08-23 11:50:45	Ringed/Spotted	172.8	Looking	Sink	1	0	Unknown	Unknown	5.2	0	70.26827	-147.56734	Transit	Non-Seismic Effort
T159	2014-08-23 12:36:36	Ringed/Spotted	77.3	Swimming	Diving	1	0	Moderate	Swim Towards	4.3	0	70.27762	-147.67212	Transit	Non-Seismic Effort
T160	2014-08-23 14:41:26	Bearded Seal	86.0	Milling	Sink	1	0	Sedate	No Movement	4.6	0	70.27879	-147.61802	Transit	Non-Seismic Effort
T161	2014-08-23 15:34:19	Ringed/Spotted	451.3	Looking	Sink	2	0	Unknown	Unknown	4.0	0	70.27623	-147.68753	Transit	Non-Seismic Effort
T162	2014-08-23 16:08:52	Ringed/Spotted	135.2	Swimming	Diving	1	0	Unknown	Unknown	4.0	0	70.28975	-147.71689	Transit	Non-Seismic Effort
T163	2014-08-23 17:51:38	Ringed/Spotted	474.8	Swimming	Diving	1	0	Sedate	Swim Parallel	1.8	0	70.35532	-147.94203	Anchor/Dock	Non-Seismic Effort
T164	2014-08-23 18:18:01	Spotted Seal	55.7	Swimming	Diving	1	0	Sedate	Swim Parallel	1.8	1	70.35405	-147.95394	Transit	Non-Seismic Effort
T165	2014-08-23 18:54:16	Unid Seal	289.0	Looking	Diving	1	0	Moderate	Unknown	4.3	0	70.32904	-147.76206	Transit	Non-Seismic Effort
T166	2014-08-23 19:13:25	Unid Seal	139.0	Unknown	Diving	1	0	Unknown	Unknown	5.2	0	70.29668	-147.62363	Transit	Non-Seismic Effort

T167	2014-08-23 20:12:10	Spotted Seal	230.4	Swimming	None	1	0	Sedate	Swim Perpendicular	5.2	0	70.28338	-147.61917	Transit	Non-Seismic Effort
T168	2014-08-23 20:55:29	Ringed/Spotted	184.8	Unknown	Sink	1	0	Moderate	Unknown	4.3	0	70.24827	-147.57123	Transit	Non-Seismic Effort
T169	2014-08-23 21:07:21	Ringed/Spotted	297.9	Resting	Sink	1	0	Moderate	No Movement	4.3	0	70.26287	-147.58824	Transit	Non-Seismic Effort
T170	2014-08-23 21:08:50	Ringed/Spotted	337.8	Looking	Sink	1	0	Sedate	No Movement	4.3	0	70.26493	-147.59244	Transit	Non-Seismic Effort
T171	2014-08-23 21:23:46	Spotted Seal	203.8	Resting	Sink	1	0	Sedate	No Movement	4.3	0	70.27812	-147.61825	Transit	Non-Seismic Effort
T172	2014-08-23 21:28:00	Ringed/Spotted	339.0	Resting	Sink	1	0	Sedate	Swim Perpendicular	4.3	0	70.28478	-147.60981	Transit	Non-Seismic Effort
T173	2014-08-23 21:36:12	Ringed/Spotted	222.1	Swimming	Diving	1	0	Sedate	Swim Parallel	4.3	0	70.27488	-147.60950	Transit	Non-Seismic Effort
T174	2014-08-23 21:56:34	Unid Seal	222.1	Diving	None	1	0	Moderate	Swim Parallel	4.3	0	70.27733	-147.61256	Transit	Non-Seismic Effort
T175	2014-08-23 22:06:47	Spotted Seal	95.7	Looking	Sink	1	0	Moderate	No Movement	4.3	0	70.27762	-147.64760	Transit	Non-Seismic Effort
T176	2014-08-23 22:18:08	Unid Seal	434.2	Looking	Unknown	1	0	Moderate	Unknown	4.3	0	70.28329	-147.69548	Transit	Non-Seismic Effort
T177	2014-08-24 9:26:55	Unid Seal	88.3	Diving	Diving	1	0	N/A	Swim Perpendicular	3.7	0	70.30621	-147.68705	Transit	Non-Seismic Effort
T178	2014-08-24 10:54:52	Unid Seal	135.2	Looking	Sink	1	0	Unknown	Unknown	5.8	0	70.28123	-147.69614	Transit	Non-Seismic Effort
T179	2014-08-24 12:45:55	Unid Seal	420.7	Swimming	Diving	1	0	Moderate	Swim Perpendicular	4.6	0	70.27556	-147.60416	Transit	Non-Seismic Effort
T180	2014-08-24 12:58:36	Unid Seal	214.6	Looking	Sink	1	0	Sedate	Unknown	5.2	0	70.26448	-147.60598	Transit	Non-Seismic Effort
T181	2014-08-24 14:22:01	Ringed/Spotted	86.0	Looking	Sink	1	0	Unknown	Unknown	5.8	0	70.29239	-147.70323	Transit	Non-Seismic Effort

T182	2014-08-24 15:34:30	Beluga Whale	420.9	Swimming	Diving	3	1	Moderate	Swim Parallel	4.9	0	70.31565	-147.76108	Transit	Non-Seismic Effort
T183	2014-08-24 16:10:07	Spotted Seal	49.2	Swimming	Diving	1	0	Moderate	Swim Parallel	5.5	0	70.28852	-147.70376	Transit	Non-Seismic Effort
T184	2014-08-24 17:32:05	Unid Seal	382.0	Swimming	Diving	1	0	Unknown	Swim Parallel	4.0	0	70.32423	-147.74399	Transit	Non-Seismic Effort
T185	2014-08-24 20:08:11	Unid Seal	78.3	Surface Active	Diving	1	0	Moderate	Swim Away	4.6	0	70.27877	-147.66588	Transit	Non-Seismic Effort
T186	2014-08-24 21:34:59	Spotted Seal	209.0	Looking	Sink	1	0	Moderate	Swim Perpendicular	3.7	0	70.29248	-147.71500	Transit	Non-Seismic Effort
T187	2014-08-25 7:58:07	Ringed/Spotted	145.1	Looking	Swimming	1	0	Unknown	Swim Away	5.2	0	70.29226	-147.61441	Transit	Non-Seismic Effort
T188	2014-08-25 9:04:51	Spotted Seal	59.0	Looking	Sink	1	0	Unknown	Unknown	4.9	0	70.26770	-147.55940	Transit	Non-Seismic Effort
T189	2014-08-25 11:08:20	Ringed/Spotted	64.0	Resting	Diving	1	0	Sedate	No Movement	3.7	0	70.31034	-147.70952	Transit	Non-Seismic Effort
T190	2014-08-25 14:38:10	Spotted Seal	30.2	Looking	Sink	1	0	Unknown	Unknown	3.4	2	70.35453	-147.94084	Anchor/Dock	Non-Seismic Effort
T191	2014-08-25 15:48:15	Spotted Seal	57.2	Looking	Sink	1	0	Unknown	Unknown	3.4	1	70.35463	-147.93967	Anchor/Dock	Non-Seismic Effort
T192	2014-08-25 20:55:09	Unid Seal	234.6	Swimming	Unknown	1	0	Vigorous	Swim Perpendicular	3.0	0	70.32759	-147.74359	Transit	Non-Seismic Effort
T193	2014-08-25 21:18:32	Ringed/Spotted	184.8	Unknown	Unknown	1	0	Vigorous	Unknown	4.3	0	70.29214	-147.61299	Transit	Non-Seismic Effort
T194	2014-08-25 21:18:46	Bearded Seal	138.0	Swimming	Diving	1	0	Sedate	Swim Perpendicular	4.3	0	70.29114	-147.61375	Transit	Non-Seismic Effort
T195	2014-08-26 1:06:27	Unid Seal	68.4	Looking	Unknown	1	0	Unknown	Unknown	4.9	0	70.36607	-147.96569	Transit	Non-Seismic Effort

APPENDIX F. BELUGA SIGHTINGS TABLE

Date and Time (AKDT)	Latitude	Longitude	Distance to Array (m)	Initial Behavior	# Ind	# Juv	Pace	Movement	Depth (m)	Effort	Vessel Activity	Vessels ≤5 km
2014-08-03 21:54:43	70.24535	-147.51628	1425.2	Swimming	1	0	Moderate	Swim Away	6.0	Seismic Effort	Shooting OFF Line	0
2014-08-17 20:25:38	70.35483	-147.95497	266.9	Milling	3	0	Moderate	Swim Towards	2.4	Non-Seismic Effort	Transit	0
2014-08-18 17:58:47	70.34264	-147.85380	282.5	Surface Active	3	2	Moderate	Swim Parallel	3.0	Non-Seismic Effort	Transit	1
2014-08-19 6:44:38	70.34671	-147.86519	416.3	Surface Active	2	1	Moderate	Swim Perpendicular	3.4	Non-Seismic Effort	Transit	0
2014-08-19 6:48:53	70.35246	-147.84925	1171.5	Swimming	2	0	Moderate	Swim Perpendicular	3.7	Non-Seismic Effort	Transit	0
2014-08-23 5:23:06	70.33339	-147.84540	2033.9	Swimming	3	0	Moderate	Swim Parallel	2.7	Non-Seismic Effort	Transit	0
2014-08-23 6:30:55	70.34173	-147.88245	520.6	Milling	2	1	Moderate	Swim Parallel	3.7	Non-Seismic Effort	Transit	0
2014-08-24 15:34:30	70.31565	-147.76108	420.9	Swimming	3	1	Moderate	Swim Parallel	4.9	Non-Seismic Effort	Transit	0

APPENDIX G. PROJECT PHOTOS

Photo 1. Source vessel, *R/V Thunder* by Patti Haase.

Photo 2. Source vessel, *R/V Thunder* by Patti Haase.

Photo 3. Source vessel, *R/V Thunder* by Patti Haase.

Photo 4. Source vessel, *R/V Thunder* by Patti Haase.

Photo 5. Crew transport vessel, *M/V Freedom* by Patti Haase.

APPENDIX H. ENSONIFIED TRACKLINES

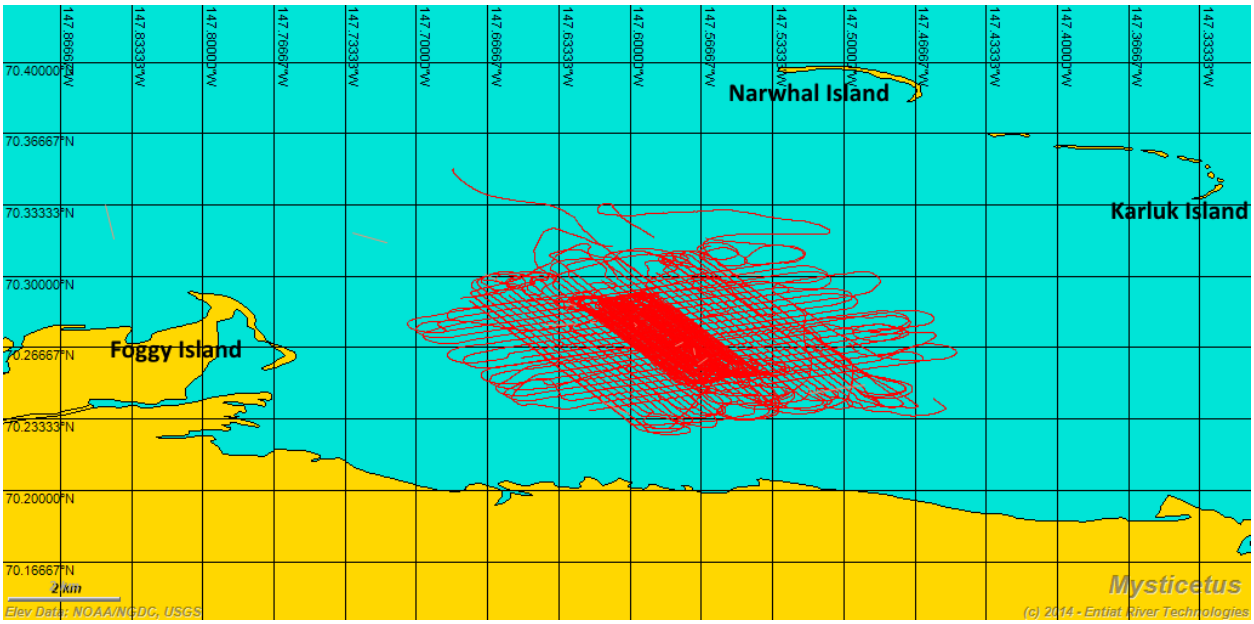

Chart 1. Lines acquired during the *Liberty 2014 Survey*.

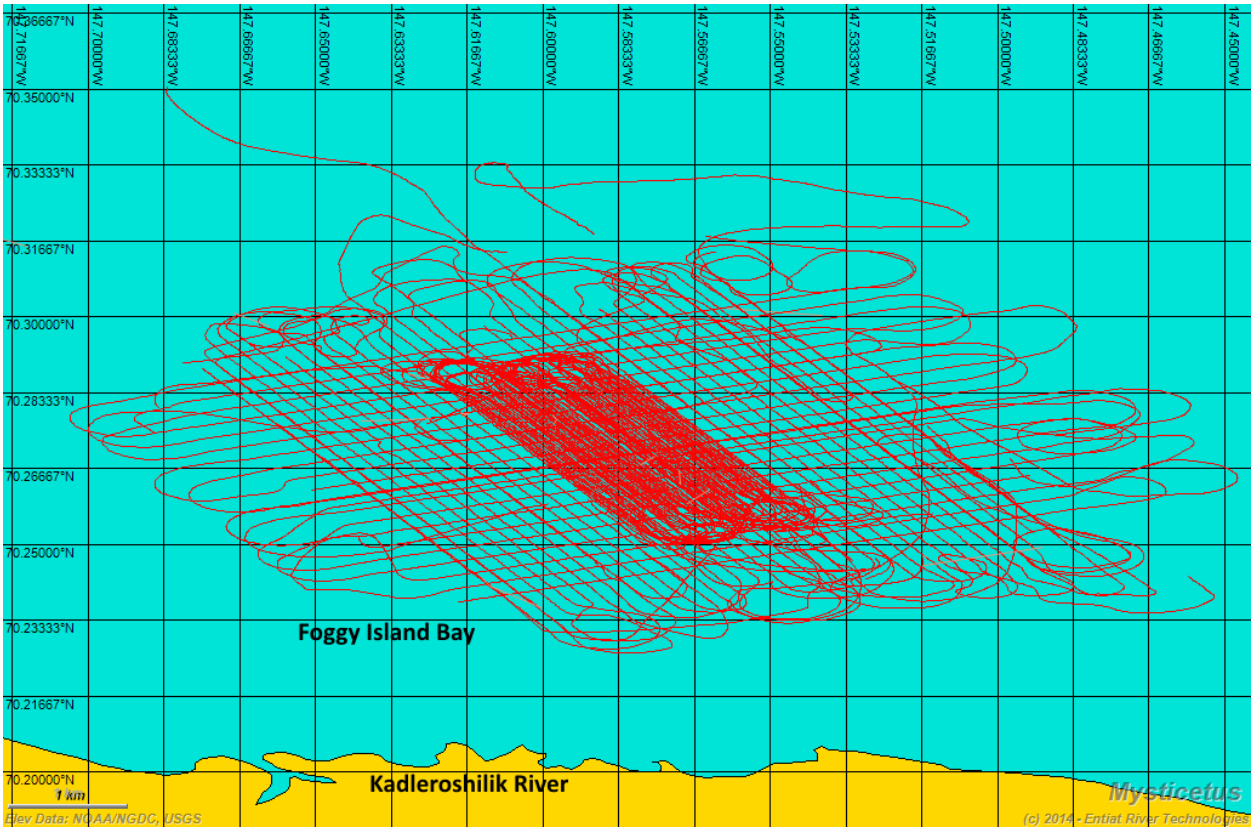

Chart 2. Close-up of the lines acquired in the *Liberty 2014 Survey*.

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