MARINE MAMMAL MONITORING AND MITIGATION DURING OPEN WATER SHALLOW HAZARDS AND SITE CLEARANCE SURVEYS BY SHELL OFFSHORE INC. IN THE ALASKAN CHUKCHI SEA, JULY–OCTOBER 2009: 90-DAY REPORT

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LIST OF ACRONYMS AND ABBREVIATIONS

~	approximately
AASM	Airgun Array Source Model
AEWC	Alaska Eskimo Whaling Commission
Bf	Beaufort Wind Force
BO	Biological Opinion
CAA	Conflict Avoidance Agreement
CFR	(U.S.) Code of Federal Regulations
CITES	Convention on International Trade in Endangered Species
cm	centimeter
CPA	Closest (Observed) Point of Approach
CTD	conductivity, temperature, depth
dB	decibel
EA	Environmental Assessment
EFD	Energy Flux Density
ESA	(U.S.) Endangered Species Act
$f(0)$	sighting probability density at zero perpendicular distance from survey track; equivalently, 1/(effective strip width)
ft	feet
FRC	Fast Rescue Craft
GI	Generator Injector
GIS	Geographic Information System
GMT	Greenwich Mean Time
GPS	Global Positioning System
$g(0)$	probability of seeing a group located directly on a survey line
h	hours
hp	horse power
Hz	Hertz (cycles per second)
IHA	Incidental Harassment Authorization (under U.S. MMPA)
in^3	cubic inches
IUCN	International Union for the Conservation of Nature
kHz	kilohertz
km	kilometer
km^2	square kilometers
km/h	kilometers per hour
kt	knots
LoA	Letter of Authorization
µPa	micro Pascal
m	meters
MBB	Multibeam Bathymetric (sonar)
MCS	Multi-Channel Seismic
min	minutes
MMO	Marine Mammal Observer

MMPA	(U.S.) Marine Mammal Protection Act
MONM	Marine Operations Noise Model
n	sample size
n.mi.	nautical miles
NMFS	(U.S.) National Marine Fisheries Service
No.	number
PD	Power down of the airgun array to one airgun (in this study, from an output of 3147 in^3 to 30 or 155 in^3)
PE	Parabolic Equation
pk-pk	peak-to-peak
RAM	Range-dependent Acoustic Model
re	in reference to
rms	root-mean-square: an average, in the present context over the duration of a sound pulse
s	seconds
SD	Shut Down of airguns not associated with mitigation
s.d.	standard deviation
SEL	Sound Exposure Level: a measure of energy content, in dB re 1 $\mu Pa^2 \cdot s$
SOI	Shell Offshore, Inc.
SPL	Sound Pressure Level; the SPL for a seismic pulse is equivalent to its rms level
SZ	Shut Down of all airguns because of a marine mammal sighting near or within the safety radius
TTS	Temporary Threshold Shift
UNEP	United Nations Environmental Programme

EXECUTIVE SUMMARY

Background and Introduction

Shell Offshore, Inc. (Shell) conducted shallow hazard and site clearance surveys in the Chukchi Sea during the open–water period of 2009 in support of potential future oil and gas exploration and development. The surveys were conducted from the M/V *Mt. Mitchell* which towed a relatively small airgun array and other geophysical equipment.

Marine seismic surveys emit sounds into the water at levels that could affect marine mammal behavior and distribution, or perhaps cause temporary or permanent reduction in hearing sensitivity. These effects could constitute "taking" under the provisions of the U.S. Marine Mammal Protection Act (MMPA) and the U.S. Endangered Species Act (ESA). The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share jurisdiction over the marine mammal species that were likely to be encountered during the project. Shell's seismic surveys and other exploration activities in the Chukchi Sea were conducted under the jurisdiction of Incidental Harassment Authorizations (IHA) issued by NMFS and a Letter of Authorization (LoA) issued by the USFWS. The IHAs and LoA included provisions to minimize the possibility that marine mammals might occur close to the seismic source and be exposed to levels of sound high enough to cause hearing damage or other injuries, and to reduce behavioral disturbances that might be considered as "take by harassment" under the MMPA.

A mitigation program was conducted to avoid or minimize potential effects of Shell's shallow hazard and site clearance survey on marine mammals and subsistence hunting, and to ensure that Shell was in compliance with the provisions of the IHAs and LoA. This required that marine mammal observers (MMOs) onboard the *Mt. Mitchell* detect marine mammals within or about to enter the designated safety radii, and in such cases request an immediate power down (or shut down if necessary) of the airguns.

The primary objectives of the monitoring and mitigation program were to:

1. provide real-time sighting data needed to implement the mitigation requirements;
2. estimate the numbers of marine mammals potentially exposed to strong seismic pulses; and
3. determine the reactions (if any) of marine mammals potentially exposed to seismic sound impulses.

This 90-day report describes the methods and results for the monitoring work specifically required to meet the above primary objectives.

Shallow Hazards and Site Clearance Surveys Described

Measurements of the underwater sound propagation from a 40-in^3 airgun array, a two-airgun 20-in^3 sub-array, and a single 10-in^3 airgun, as well as lower energy geophysical sources on the *Mt. Mitchell* were conducted by JASCO near the Honeyguide prospect on 1 Aug 2009 and near the Burger prospect on 16 Aug 2009. Geophysical data were collected from the *Mt. Mitchell* intermittently from ~1 Aug until the *Mt. Mitchell* departed the project area on 9 Oct. The *Mt. Mitchell's* airguns were operated along 2477 km (1520 mi) of trackline in the Chukchi Sea. Periods of full array firing plus periods of lead in, lead out, and ramp up occurred along 1781 km (1107 mi) of trackline, and the single mitigation gun operated along 696 km (432 mi) of trackline.

The airgun source used by Shell and its survey contractor, Fugro Geo Services Inc., consisted of a 40-in^3 airgun array towed approximately 47 m (154 ft) aft of the *Mt. Mitchell* at a depth of ~2 m (6 ft). The *Mt. Mitchell* also towed two streamers, 30 m (98 ft) and 300 m (984 ft) in length with a 24- and 48-

channel hydrophone, respectively, to record reflected sound energy. Seismic pulses were emitted at intervals of 15 m (16 yd; ~8 sec) while the *Mt. Mitchell* traveled at a speed of 3.2 to 4 knots (5.9–7.4 km/h, 3.7–4.6 mi/h). In addition to the 40-in^3 array, the *Mt. Mitchell* also had low–energy acoustic sources that included an echo sounder, sub-bottom profiler, side scan sonar and magnetometer.

Underwater Sound Measurements

As required by the IHAs for Shell's shallow hazard survey program in the Chukchi Sea in 2009, sound source verification measurements were performed to quantify sound levels as a function of distance from geophysical survey sources and vessel noise from the *Mt Mitchell*, and to verify and possibly revise pre-survey estimates of the size of marine mammal safety exclusion zones. A second purpose of these measurements was to provide sound level information used to calculate actual marine mammal "takes" during a post-field analysis.

Two calibrated Ocean Bottom Hydrophone (OBH) acoustic recording stations were deployed on the seabed near the Honeyguide and Burger prospects. Measurements of underwater sounds produced by the *Mt Mitchell*, the sub-bottom profiler and the 10-, 20- and 40-in^3 airgun configurations were made at distances from 200 m to 1000 m in the broadside (perpendicular to tow) direction and up to 20 km in the endfire direction. The two-direction measurement approach allowed for determination of possible directive characteristics of sound emissions from the airgun array. Distances to root-mean-square (*rms*) sound pressure thresholds from 100 dB re 1 μPa to 190 dB re 1 μPa were determined from the measurements at each site. Further analysis was done on the airgun array data to calculate M-weighted cumulative sound exposure levels (SEL).

Sound levels from the largest airgun configuration with total capacity of 40 in^3 were highest overall, followed by those from the 20-in^3 sub-array, and the 10-in^3 single airgun. Levels recorded for vessel sound from the *Mt. Mitchell* and impulses from a sub-bottom profiler were lower. Measurements performed at the Burger and Honeyguide prospects were conducted on the same sources using identical equipment and methods. However, the measured sound levels, especially at longer distances, were found to be higher at the Burger site than at the Honeyguide site even though water depths were similar. Spectral and waveform analysis of the bottom-reflected signals showed differences in seabed geoacoustic properties between the sites. Table ES 1 provides a summary of the distances from all sources to the *rms* sound levels.

Table ES 1. Sound level distances for all measured sources at the Honeyguide and Burger sites using the 90th percentile fits. The asterisk denotes ranges that were extrapolated from field measurements.

Measurement Site	90% rms SPL (dB re 1 μPa)	190	180	170	160	120
Honeyguide	10-in^3 airgun range (m)	23*	52*	120*	280	7900
Honeyguide	20-in^3 airgun array range (m)	37*	86*	200*	460	14000
Honeyguide	40-in^3 airgun array range (m)	41*	99*	240	600	22000*
Honeyguide	Sub-bottom profiler range (m)	-	-	-	16*	680
Honeyguide	Mt. Mitchell range (m)	-	-	-	13*	1500
Burger	10-in^3 airgun range (m)	8*	34*	140*	570	19000
Burger	40-in^3 airgun array range (m)	39*	150*	530	1800	31000*
Burger	Sub-bottom profiler range (m)	-	-	-	11*	860
Burger	Mt. Mitchell range (m)	-	-	-	11*	7800

The IHA stipulated specific exclusion and safety zones to be monitored during airgun operations. These zones were defined by the distances: 50 m, 160 m, and 1400 m corresponding to 190 dB, 180 dB and 160 dB re 1 µPa *rms* thresholds. The measured and extrapolated ranges for these sound levels are included in Table ES 1.

Vessel-Based Marine Mammal Monitoring

In total, 12 sightings of 18 cetaceans, 69 sightings of 71 seals, and 59 sightings of 114 Pacific walruses were recorded during periods that met the data analysis criteria. Most cetaceans could not be identified to species but were thought to be gray whales. Two gray whales and one bowhead whale sighting were confirmed. Ringed seal was the most abundant seal species identified followed by bearded seal. No other seal species were identified although >40% of the seals observed could not be identified to species.

Cetacean sighting rates were higher in Jul-Aug than Sep-Oct. Only one cetacean sighting was recorded during Sep-Oct and no cetaceans were recorded during seismic periods. Seals were also recorded more frequently during Jul-Aug than Sep-Oct and sighting rates were higher during non-seismic than seismic periods for both seasons. The higher sighting rates during non-seismic periods suggested possible localized seal avoidance of the airgun array during seismic periods.

Pacific walrus sighting rates were also higher in Jul-Aug than Sep-Oct. Walrus sighting rates were much greater during non-seismic than seismic periods during Jul-Aug, but this trend was reversed in Sep-Oct, although overall sighting rates were much lower in Sep-Oct.

No cetaceans displayed any observable reaction to the vessel. Most cetacean movements relative to the vessel were neutral or unknown. One cetacean was recorded as swimming away from the vessel.

The most frequently observed seal reaction to the *Mt. Mitchell* was to "look" at the vessel, followed by "change direction" of travel. Seals changed their direction of travel more frequently during seismic than non-seismic periods. Over 50% of seals however, demonstrated no detectable reaction to the vessel. The majority of seal movement relative to the vessel was neutral or unknown; smaller numbers of seals swam away or toward the vessel.

Over 70% of Pacific walruses demonstrated no detectable reaction to the vessel regardless of seismic activity state. The most commonly observed reaction by walruses to the *Mt. Mitchell* was to "look" at the vessel, followed by "splash," which was recorded more frequently when the airgun array was active. Approximately half of the walruses displayed no movement relative to the vessel with smaller percentages swimming away or toward the vessel. These patterns were similar during seismic and non-seismic periods.

One power down and two shut downs of the airgun array were requested and implemented due to Pacific walruses approaching or within the ≥180 dB (rms) safety radius of the active array. No power downs of the airguns were requested or implemented for cetaceans, seals, or polar bears during the 2009 survey.

Based on direct observations, no cetaceans or seals were exposed to received sound levels ≥180 or 190 dB rms, respectively. It is possible that the two Pacific walruses observed within the ≥180 dB (rms) safety zone were exposed to received sound levels ≥180 dB (rms).

Based on densities calculated from sighting rates during non-seismic periods, less than one individual cetacean would have been exposed one time to seismic sounds ≥180 dB (rms). Based on similar density calculations for seals and Pacific walruses, three individual seals would have been exposed once

each to received levels ≥190 dB (rms), and ~six individual walruses would have been exposed once to received levels ≥180 dB (rms) if these animals did not avoid the active airgun array.

ACKNOWLEDGMENTS

We thank the captains and crews of the R/V *Mt. Mitchell* for their support during this project. Additionally, we appreciate the help of Deanne Hargrave and her team at Fugro Geo Services LLC. We also thank representatives of the National Marine Fisheries Service, U.S. Fish & Wildlife Service, North Slope Borough Department of Wildlife Management, Alaska Eskimo Whaling Commission and Minerals Management Service for their advice and comments during the "open-water meetings." Michael Macrander, Barbara Bohn, Jenny Newton, Jonathan Smith, Susan Childs, Rick Fox, Aaron Merritt, Rebecca Mosquera, Michael Sotak, and Meghan Larson provided valuable support prior to and during the field season. We also thank all of the marine mammal observers (MMOs) who participated in the project. They were essential to the completion and success of this endeavor: Tim Burris, Juan Gracia, Beth Haley, Kris Hartin, Susan Inglis, Jonah Leavitt, Hugh Patkotak, Craig Reiser, Danielle Savarese, and Stephanie Thibideau.

1. BACKGROUND AND INTRODUCTION[1]

Shell Offshore, Inc. (Shell) conducted shallow hazard and site clearance surveys in the Chukchi Sea during the open–water period of 2009 in support of potential future oil and gas exploration and development. The surveys were conducted from the R/V *Mt. Mitchell* which towed a relatively small airgun array and other geophysical survey equipment.

Marine seismic surveys emit sound energy into the water (Greene and Richardson 1988; Tolstoy et al. 2004a,b) 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; Gordon et al. 2004). The effects could consist of behavioral or distributional changes, and perhaps (for animals close to the sound source) temporary or permanent reduction in hearing sensitivity. Potential effects, however, may be reduced by marine mammals moving away from approaching sound sources (Reiser et al. 2009; Richardson et al. 1995, 1999; Stone 2003; Gordon et al. 2004; Smultea et al. 2004). Either behavioral/distributional effects or auditory effects (if they occur) could constitute "taking" under the provisions of the U.S. Marine Mammal Protection Act (MMPA) and the U.S. Endangered Species Act (ESA), at least if the effects are considered to be "biologically significant."

Numerous species of cetaceans and pinnipeds inhabit parts of the Chukchi Sea. The National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS) share jurisdiction over the marine mammal species that could be encountered during the project. Three species under NMFS jurisdiction that are listed as "Endangered" under the ESA, including bowhead whale (*Balaena mysticetus*), humpback whale (*Megaptera novaeangliae*), and fin whale (*Balaenoptera physalus*), do or may occur in portions of the survey area. Additionally, NMFS initiated a status review to determine if listing as endangered or threatened under the ESA was warranted for four other species that occur in the project area including ringed seal (*Phoca fasciata*), spotted seal (*P. largha*), bearded seal (*Erignathus barbatus*), and ribbon seal (*Histriophoca fasciata*; NMFS 2008a,b). Subsequently the NMFS (2008c) announced that listing of the ribbon seal as threatened or endangered was not warranted at this time. More recently NMFS (2009b) determined that no listing action was warranted for the Bering Sea and Okhotsk populations of spotted seal. NMFS (2009b) however proposed a rule to list the southern spotted seal population in the Yellow Sea and Sea of Japan as threatened under the ESA. The USFWS manages two marine mammal species occurring in the Chukchi Sea, the Pacific walrus (*Odobenus rosmarus*) and polar bear (*Ursus maritimus*). The polar bear was recently listed as threatened under the ESA (USFWS 2008) and a petition to list Pacific walrus as threatened or endangered (CBD 2008) is under consideration by USFWS.

NMFS issued an Incidental Harassment Authorization (IHA) to Shell on 19 Aug 2008 to authorize non–lethal "takes" of marine mammals incidental to Shell's planned 3D seismic and shallow hazards survey operations in the Chukchi Sea during the 2008 open–water season that was valid 20 Aug 2008 through 19 Aug 2009 (Appendix A) or until a new IHA was issued to Shell. Pursuant to Section 101(a)(5)(D) of the MMPA, Shell requested that NMFS issue a similar IHA for shallow hazard and site clearance work for the 2009 open–water season. A notice announcing Shell's request for an IHA was published in the *Federal Register* on 1 Jun 2009 and public comments were invited (NMFS 2009a). A new IHA was issued to Shell by NMFS on 19 Aug 2009 (Appendix A). The IHA authorized "potential take by harassment" of various cetacean and seal species during the open-water marine survey program described in this report. This authorization was valid from 19 Aug 2009 through 18 Aug 2010.

[1] By Robert Rodrigues, Beth Haley, Darren Ireland, and Craig Reiser (LGL).

On 26 Mar 2009, Shell requested a Letter of Authorization (LoA) from the USFWS for the incidental "take" of polar bears and Pacific walruses by Shell's proposed open–water exploration program in the Chukchi Sea in 2009. The USFWS issued a LoA to Shell to "take" small numbers of polar bears and Pacific walruses incidental to activities occurring during the 2009 Chukchi Sea open–water exploration programs. The LoA was issued on 7 Jul 2009 and was valid until 30 Nov 2009 (Appendix B).

This document serves to meet reporting requirements specified in the IHAs and LoA. The primary purposes of this report are to describe project activities in the Chukchi Sea, to describe the associated marine mammal monitoring and mitigation programs and their results, and to estimate the numbers of marine mammals potentially exposed to levels of sound generated by the survey activities at or above presumed effect levels.

Incidental Harassment Authorization

IHAs issued to seismic operators include provisions to minimize the possibility that marine mammals close to the seismic source might be exposed to levels of sound great enough to cause short or long–term hearing loss or other injury. During this project, sounds were generated by the *Mt. Mitchell's* small airgun array during the shallow hazards survey activities, and from several types of lower–energy sound sources that included an echo sounder, sub-bottom profiler, side scan sonar and magnetometer. Given the nature of the operations and mitigation measures, no serious injuries or deaths of marine mammals were anticipated from the shallow hazards and site clearance surveys. No such injuries or deaths were attributed to these activities. Nonetheless, the seismic survey operations described in Chapter 2 had the potential to "take" marine mammals by harassment. Behavioral disturbance to marine mammals is considered to be "take by harassment" under the provisions of the MMPA.

Under current NMFS guidelines (e.g., NMFS 2008c), "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which received pulsed sound levels are ≥180 dB re 1 μPa (rms)[2] for cetaceans and ≥190 dB re 1 μPa (rms) for pinnipeds. Those safety radii are based on an assumption that seismic pulses at lower received levels will not injure these mammals or impair their hearing abilities, but that higher received levels *might* have some such effects. The mitigation measures required by IHAs are, in large part, designed to avoid or minimize the numbers of cetaceans and pinnipeds exposed to sound levels exceeding 180 and 190 dB (rms), respectively.

Disturbance to marine mammals could occur at distances beyond safety (shut down) radii if the mammals were exposed to moderately strong pulsed sounds generated by the airguns or perhaps by sonar (Richardson et al. 1995). NMFS assumes that marine mammals exposed to airgun sounds with received levels ≥160 dB re 1 μPa (rms) are likely to be disturbed. That assumption is based mainly on data

[2] "rms" means "root mean square", and represents a form of average across the duration of the sound pulse as received by the animal. Received levels of airgun pulses measured on an "rms" basis (sometimes described as Sound Pressure Level, SPL) are generally 10–12 dB lower than those measured on the "zero–to–peak" basis, and 16–18 dB lower than those measured on a "peak–to–peak" basis (Greene 1997; McCauley et al. 1998, 2000a,b). The latter two measures are the ones commonly used by geophysicists. Unless otherwise noted, all airgun pulse levels quoted in this report are rms levels. Received levels of pulsed sounds can also be described on an energy or "Sound Exposure Level" basis, for which the units are dB re (1 μPa)^2. The SEL value for a given airgun pulse, in those units, is typically 10–15 dB less than the rms level for the same pulse (Greene 1997; McCauley et al. 1998, 2000a,b), with considerable variability (Madsen et al. 2006; see also Chapter 3 of this report). SEL (energy) measures may be more relevant to marine mammals than are rms values (Southall et al. 2007), but the current regulatory requirements are based on rms values.

concerning behavioral responses of baleen whales, as summarized by Richardson et al. (1995) and Gordon et al. (2004). Dolphins and pinnipeds are generally less responsive than baleen whales (e.g., Stone 2003; Gordon et al. 2004), and 170 dB (rms) may be a more appropriate criterion of potential behavioral disturbance for those groups (LGL Ltd. 2005a,b). In general, disturbance effects are expected to depend on the species of marine mammal, the activity of the animal at the time of exposure, distance from the sound source, the received level of sound and the associated water depth. Some individuals may exhibit behavioral responses at received levels somewhat below the nominal 160 or 170 dB (rms) criteria, but others may tolerate levels somewhat above 160 or 170 dB (rms) without reacting in any substantial manner. For example, migrating bowhead whales in the Alaskan Beaufort Sea have shown behavioral responses, at times including avoidance, at received levels substantially lower than 160 dB re 1 μPa rms (Miller et al. 1999; Richardson et al. 1999). However, recently acquired acoustic evidence suggests that some feeding whales may not react as much or in the same manner as suggested by those earlier studies (Blackwell et al. 2008). Beluga whales may, at times, also show avoidance at received levels below 160 dB (rms) (Miller et al. 2005). In contrast, bowhead whales on the summer feeding grounds tolerate received levels of 160 dB or sometimes more without showing significant avoidance behavior (Richardson et al. 1986; Miller et al. 2005; Lyons et al. 2008).

The IHA issued by NMFS to Shell authorized incidental harassment "takes" of three ESA–listed species including bowhead, humpback, and fin whales, as well as several non–listed species including gray whale (*Eschrichtius robustus*), Minke whale (*Balaenoptera acutorostrata*), killer whale (*Orcincus orca*), beluga whale (*Delphinapterus leucas*), harbor porpoise (*Phocoena phocoena*), and ringed, spotted, bearded, and ribbon seals.

NMFS granted the IHA to Shell on the assumptions that

- the numbers of whales and seals potentially harassed (as defined by NMFS criteria) during shallow hazards survey operations would be "small",
- the effects of such harassment on marine mammal populations would be negligible,
- no marine mammals would be seriously injured or killed,
- there would be no unmitigated adverse effects on the availability of marine mammals for subsistence hunting in Alaska, and
- the agreed upon monitoring and mitigation measures would be implemented.

The LoA issued to Shell by USFWS required Shell to observe a 190 dB (rms) safety radius for polar bears and a 180 dB safety radius for walruses. The 180 dB (rms) safety zone for walruses in 2007 and 2008 was also applied to Shell's exploratory activities in 2009, and was more conservative than the 190 dB (rms) zone required in 2006.

Mitigation and Monitoring Objectives

The objectives of the mitigation and monitoring program were described in detail in Shell's IHA application (Shell 2008) and in the IHA issued by NMFS to Shell (Appendix A). Explanatory material about the monitoring and mitigation requirements was published by NMFS in the *Federal Register* (NMFS 2009a).

The primary objectives of the monitoring program were to

- provide real–time sighting data needed to implement the mitigation requirements;
- estimate the numbers of marine mammals potentially exposed to strong airgun pulses; and

- determine the reactions (if any) of marine mammals potentially exposed to airgun sound impulses.

Specific mitigation and monitoring objectives and requirements identified in the IHA and LoA are described in appendices A and B. Mitigation and monitoring measures that were implemented during the activities in the Chukchi Sea are described in detail in Chapter 4.

The purpose of the mitigation program was to avoid or minimize potential effects of Shell's shallow hazard and site clearance survey on marine mammals and subsistence hunting. This required that shipboard personnel detect marine mammals within or about to enter the designated safety radii (190 dB (rms) for pinnipeds and 180 dB (rms) for cetaceans), and in such cases initiate an immediate power down (or shut down if necessary) of the airguns. A power down involves reducing the source level of the operating airguns, in this case by reducing the number of airguns firing. A shut down involves temporarily terminating the operation of all airguns. Additionally, the safety radii were monitored in good visibility conditions for 30 minutes prior to starting the first airgun and during the ramp up procedure to ensure that marine mammals were not near the airguns when operations began (see Appendix A and Chapter 4). The location and timing of survey activities was planned in coordination with representatives of the North Slope communities to avoid adverse impacts to subsistence harvest of marine mammals and other resources.

In 2009, mitigation at the 160 dB (rms) isopleth was also required, as specified in the IHA issued by NMFS, for an aggregation of 12 or more non–migratory mysticete whales. Power down of the seismic airgun array was required if an aggregation of 12 or more non–migratory mysticete whales was detected ahead of, or perpendicular to, the survey vessel track and within the 160 dB (rms) isopleth.

Report Organization

This 90–day report describes the methods and results for the mitigation and monitoring work specifically required to meet the above objectives as required by the IHA and LoA (Appendices A and B). Other marine mammal and acoustic monitoring and research programs not specifically related to the above objectives were also implemented by Shell in the Chukchi and Beaufort seas during 2009. Results of those additional efforts will be reported at a later date.

This report includes five chapters:

1. background and introduction (this chapter);
2. description of Shell's shallow hazard and site clearance survey;
3. acoustic sound source measurements during the field season;
4. description of the marine mammal monitoring and mitigation requirements and methods, including safety radii;
5. results of the marine mammal monitoring and mitigation program for the shallow hazard and site clearance surveys in the Chukchi Sea;

In addition, there are 11 appendices that provide copies of relevant documents and details of procedures that are more–or–less consistent during shallow hazard surveys where marine mammal monitoring and mitigation measures are in place. These procedural details are only summarized in the main body of this report. The appendices include

A. copies of the IHAs issued by NMFS in 2008 and 2009 to Shell for this study;
B. copies of the Chukchi Sea LoA issued by USFWS to Shell for this study;
C. a copy of the Conflict Avoidance Agreement between Shell, the Alaska Eskimo Whaling Commission, and the Whaling Captains Associations;

D. descriptions of the survey vessel and equipment;
E. details of monitoring, mitigation, and analysis methods;
F. Beaufort wind force definitions;
G. background on marine mammals in the Chukchi Sea;
H. underwater sound measurement results and English unit tables from Chapter 3;
I. English unit tables from Chapter 4;
J. marine mammal monitoring results and English unit tables from Chapter 5;
K. list of all marine mammal detections;
L. NMFS Marine Mammal Stranding Reports for carcasses observed in 2009.

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2. SHALLOW HAZARD AND SITE CLEARANCE SURVEYS DESCRIBED[1]

A shallow hazard and site clearance survey is necessary to identify and/or evaluate potentially hazardous or otherwise sensitive conditions and sites at or below the seafloor that could affect the safety or appropriateness of operations before drilling can begin. Examples of such conditions include subsurface faults, fault scarps, shallow gas, steep-walled canyons and slopes, buried channels, current scour, migrating sedimentary bedforms, ice gouging, permafrost, gas hydrates, unstable sediment conditions, pipelines, anchors, ordnance, shipwrecks, or other geophysical or man-made features.

Offshore shallow hazard and site clearance surveys use various geophysical methods and tools to acquire graphic records of seafloor and sub-seafloor geologic conditions. The data acquired and the types of investigations outlined below are performed routinely prior to exploratory drilling and construction of production facilities in marine areas, and for submarine pipelines, port facilities, and other offshore projects. High-resolution geophysical data such as two-dimensional, high-resolution multi-channel seismic, medium penetration seismic, sub-bottom profiler, side scan sonar, multibeam bathymetry, magnetometer, and possibly piston core sediment sampling are typical types of data acquired. These data are interpreted to define geologic, geotechnical and archeological conditions at the site and to assess the potential engineering significance of these conditions. The following section provides a brief description of the operations and instrumentation used during Shell's 2009 shallow hazard and site clearance program in the Chukchi Sea insofar as they may impact marine mammals.

Marine mammal monitoring was conducted from the M/V *Mt. Mitchell* during shallow hazard and site clearance surveys in the Chukchi Sea in 2009. The *Mt. Mitchell* operated a small airgun array comprised of four airguns as well as various types of low-energy acoustic sources. The results of the marine mammal monitoring program were based on observations of marine mammal observers (MMOs) on the *Mt. Mitchell*.

The *Mt. Mitchell* operated in accordance with the provisions of the IHA issued by NMFS (Appendix A) and the LoA issued by the USFWS (Appendix B), as well as a Conflict Avoidance Agreement (CAA) between the seismic industry, the Alaska Eskimo Whaling Commission (AEWC), and the Whaling Captains Associations from Barrow, Nuiqsut, Kaktovik, Wainwright, Pt. Lay, and Pt. Hope (Appendix C). The CAA provided mitigation guidelines, including avoidance, to be followed by Shell while working in or transiting through the vicinity of active subsistence hunts. In particular, it addressed bowhead whale hunts and interactions with whaling crews, but was not limited to whaling activities. Under the terms of the CAA, a communication center (Com Center) was established in Wainwright. The CAA outlined a communication program and specified locations and times when the shallow hazard and site clearance survey could be conducted to avoid conflict with the subsistence hunts.

Operating Areas, Dates, and Navigation

The geographic region where the shallow hazard and site clearance survey occurred was in or near specific Shell lease holdings in the Chukchi Sea Planning Area designated as Oil and Gas Lease Sale 193 (Fig. 2.1). The project area was located in the Chukchi Sea well offshore (>97 km or 60 mi) from the Alaska coast in OCS waters averaging greater than 40 meters (m) or 131 ft deep and outside the polynya zone.

[1] By Robert Rodrigues, Beth Haley, Darren Ireland, and Craig Reiser (LGL).

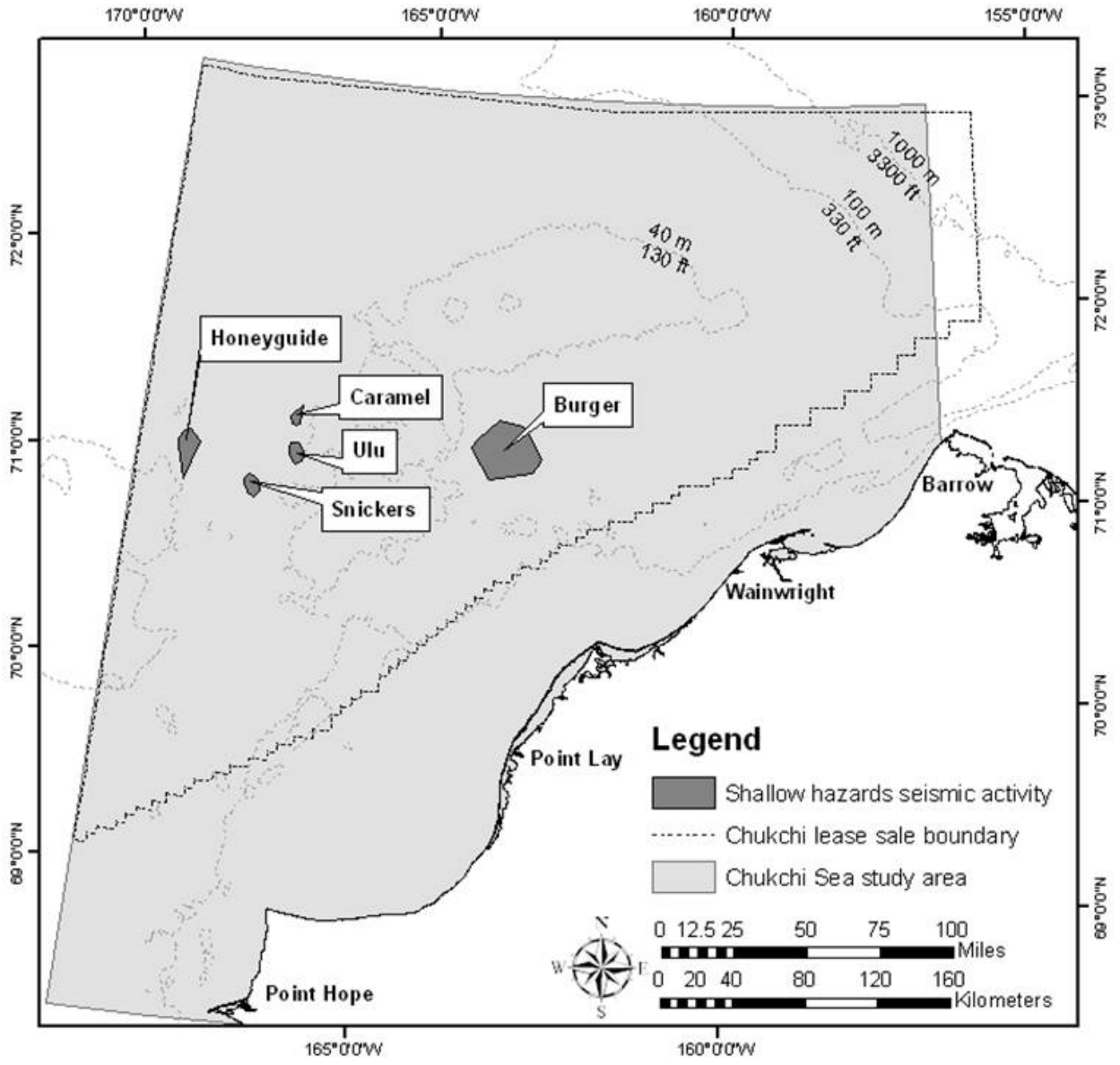

FIGURE 2.1. Location of Shell's shallow hazards surveys in the MMS Chukchi Sea Lease Sale 193 in 2009. Caramel, Ulu, and Snickers are collectively known as Crackerjack.

The *Mt. Mitchell* left Dutch Harbor on 27 Jul 2009 and entered the Chukchi Sea project area (the area north of Point Hope, 68.34ºN latitude) on 30 Jul. Shallow hazard and site clearance surveys were conducted at the Honeyguide, Burger, Ulu, Caramel and Snickers prospects (Fig. 2.1) intermittently from ~1 Aug until the *Mt. Mitchell* ultimately departed the project area on 9 Oct. Within this time period the *Mt. Mitchell* made two transits to Nome (~3–6 Sep and 3–6 Oct) for crew transfers and one transit to Dutch Harbor (~17–25 Sep) for fuel.

Measurements of the underwater sound propagation from the 40-in^3 airgun array and lower energy geophysical sources on the *Mt. Mitchell* were conducted by JASCO near the Honeyguide prospect on 1 Aug 2009 and near the Burger prospect on 16 Aug 2009. Measurements of underwater sound propagation were made for a single 10-in^3 mitigation airgun and the four-gun 40-in^3 full array. JASCO calculated preliminary disturbance and safety radii within five days of completion of the measurements. These radii, and radii calculated during underwater sound measurements near the Crackerjack prospect in 2008 (Laurinolli and Racca 2008), were the basis for mitigation measures during shallow hazard and site clearance survey activities in 2009.

On each shallow hazard and site clearance survey line the airguns were firing for a period of time during ramp up, and during "lead in" periods before the beginning of data acquisition at the start of each survey line. The airguns were also firing during "lead out" periods after completion of each survey line, before the full array was powered down to a single gun for transit to the next survey line. The *Mt. Mitchell's* airguns were operated along 2477 km (1520 mi) of trackline in the Chukchi Sea in 2009. Periods of full array firing plus periods of lead in, lead out, and ramp up occurred along 1781 km (1107 mi) of trackline. The single mitigation gun operated along 696 km (432 mi) of trackline.

Throughout the survey the *Mt. Mitchell's* position, speed, and water depth were logged digitally every ~60 s. In addition, the position of the *Mt. Mitchell*, water depth, and information on the airgun array were logged for every airgun shot while the *Mt. Mitchell* was on a survey line collecting geophysical data. The geophysics crew kept an electronic log of events, as did the MMOs while on duty. The MMOs also recorded the number and volume of airguns that were firing when the *Mt. Mitchell* was offline (e.g., prior to shooting at full volume) or was online but not recording data (e.g., during airgun or computer problems).

Airgun Description

The sound source used by Shell and its survey contractor, Fugro Geo Services Inc., consisted of a 40-in^3 airgun array towed approximately 47 m (154 ft) aft of the *Mt. Mitchell* at a depth of ~2 m (6 ft) during the shallow hazards and site clearance survey operations. This array was similar to the array used during shallow hazard surveys in the Chukchi Sea in 2008. The *Mt. Mitchell* also towed two streamers, 30 and 300 m (33 and 328 yd) in length with a 24- and 48-channel hydrophone, respectively, to record reflected sound energy. A 10-in^3 airgun was used as a mitigation source during power downs when marine mammals were observed within or about to enter the applicable full-array safety radius and during turns. Air compressors aboard the *Mt. Mitchell* were the source of high pressure air used to operate the airgun array. Seismic pulses were emitted at intervals of 15 m (16 yd; ~8 sec) while the *Mt. Mitchell* traveled at a speed of 3.2 to 4 knots (5.9–7.4 km/h, 3.7–4.6 mi/h). In general, the *Mt. Mitchell* towed this system along a predetermined survey track, although course alterations were occasionally made during the field season to avoid obstacles or during repairs to the equipment. Characteristics of the airgun array are detailed in Appendix D.

Geophysical Tools for Site Clearance

In addition to the four 10-in^3 airguns (40-in^3 array) described above, the *Mt. Mitchell* also had low–energy acoustic sources that included an echo sounder, sub-bottom profiler, side scan sonar and magnetometer. Characteristics of this equipment are described in more detail in Appendix D.

Marine Mammal Monitoring and Mitigation

Vessel based monitoring

Vessel–based marine mammal monitoring and mitigation was conducted from the *Mt. Mitchell* throughout the shallow hazard and site clearance survey operations. Chapter 4 provides a detailed description of the methods and equipment used for monitoring and mitigation during survey activities, as well as the data analysis methodology. Results of the vessel–based monitoring program are presented in Chapters 5.

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3. UNDERWATER SOUND MEASUREMENTS[1]

This chapter presents the results of field measurements of the sound levels generated by the R/V *Mt. Mitchell* and its seismic survey sources used for Shell's 2009 Shallow Hazards survey program in the Chukchi Sea. The measurements were conducted near the Honeyguide and Burger prospects in Aug 2009. All of the measurements were performed by JASCO Applied Sciences, working under contract to Shell Offshore Inc. (Shell), using calibrated sound recording equipment that was deployed on the seabed near each of the operations monitored. Two Sound Source Verification (SSV) programs, the first at the Honeyguide prospect and the second at the Burger prospect, were carried out to measure sounds produced by the vessel and the following shallow hazards geophysical survey sources:

- Single 10 in^3 airgun
- 2 x 10 in^3 (total 20 in^3) airgun sub-array (only used at the Honeyguide site)
- Two 2 x 10 in^3 sub-arrays (total 40 in^3) fired simultaneously
- Geopulse 3.5 kHz sub-bottom profiler

The vessel measurements were made by examining sections of the acoustic recordings between individual seismic pulses or after seismic operations had completed. Preliminary field reports presenting sound levels as a function of distance from each sound source measured were prepared and submitted within 5 days of the respective measurements. Those results were also used to define the marine mammal safety distances implemented by marine mammal observers for the shallow hazards survey operations.

The present chapter summarizes the sound level measurement results from the above-mentioned SSV programs and discusses more detailed analyses performed after the field reports were prepared and submitted. In some cases the sound level versus distance values computed in the more detailed analyses differ slightly from the same values presented in field reports. All differences are due to the inclusion of additional data that could not be processed in time for the field report schedule. Additional post-field analysis included more detailed examination of the received seismic pulse characteristics and a spectral analysis. Specifically JASCO computed M-weighted cumulative Sound Exposure Levels (SEL), considered waveform and spectrogram differences, plotted 1/3-octave band received levels versus distance, considered how the pulse durations influenced root-mean-square (*rms*) sound levels, and compared Sound Pressure Levels (SPL) of the present study with those from previous years' shallow hazards SSV measurement programs. These additional analyses provide useful information for characterizing the seismic sources and ocean environments in terms of sound production. For example, the sound levels received at the Honeyguide site at long ranges from the airgun array were much lower than comparable measurements at the Burger site. The analysis showed that site-specific geoacoustic properties quite strongly affected the sound propagation, and that those geoacoustic properties can vary between continental shelf locations less than 100 km apart.

Sound radii from the R/V *Cape Flattery* 2008 SSV were implemented until 2009 SSV results were available, or when 2008 SSV sound radii were the most site-specific data available.

[1] By Graham Warner, Christine Erbe, and Dave Hannay (JASCO).

See Table 4.4 for a summary of when 2008 and 2009 SSV sound radii were implemented during the 2009 survey and Tables 4.1–4.3 for the distances to each of the sound radii.

Goals of Measurement Programs

The goals of the sound level measurement programs were first to verify and refine the sizes of marine mammal exclusion safety zones that are defined by *rms* sound levels near the shallow hazards survey airgun sources. The verification measurements were a requirement of SIO's Incidental Harassment Authorization (IHA). The IHA permitted limited Level B harassment, or disturbance of behavioral patterns, of marine mammals. Safety zones for marine mammals were defined based on the distance from the sound source where sound levels reached 190 dB *rms* re 1 μPa (root-mean-square pressure level in decibel referenced to 1 microPascal) for pinnipeds (seals, sea lions and walruses) and 180 dB *rms* re 1 μPa for cetaceans (whales and dolphins). In addition, an aggregation of 12 or more mysticete whales was not to receive in excess of 160 dB *rms* re 1 μPa.

Second, the IHA stipulated the reporting of distances to broadband sound levels between 190 and 120 dB re 1 μPa in 10 dB increments. In this Chapter, distances are presented to sound levels that are required by the IHA and that reflect the received levels from each source. These distances are presented with two significant figures. The distances to these levels can be dependent on direction relative to the airgun array tow direction, so the measurements had to determine if directional components were associated with the airgun array configurations.

A third goal of the sound level measurement programs was to quantify sound levels as a function of distance from the sub-bottom profiler and due to vessel noise from the *R/V Mt Mitchell* itself.

While the exclusion zone sizes were defined solely upon the distances to *rms* thresholds as discussed above, recent literature has suggested that peak level and sound exposure level (SEL) may be more relevant acoustic metrics upon which to define these zones (Southall et al., 2007). In addition to fulfilling the reporting requirements of the IHA, the final goal was to include an analysis to compute peak level threshold distances and M-weighted cumulative SEL for all seismic pulses received from single seismic survey lines at fixed locations to the sides of the lines. This is to provide information relevant for decisions about possible future implementation of peak level and SEL-based marine mammal safety criteria.

Methods

Equipment

Calibrated Ocean Bottom Hydrophone (OBH) recording systems were deployed and retrieved from the *R/V Mt Mitchell* for the measurement program. The OBHs incorporated Reson reference hydrophones that were calibrated using a G.R.A.S. Pistonphone calibrator. Two hydrophone models with different sensitivities were used: TC4043 (nominal sensitivity -201 dB re 1 V/μPa), and TC4032 (nominal sensitivity -166 dB re 1 V/μPa). The calibration sensitivities of the individual hydrophones calculated with the recorded Pistonphone calibration signal were used for all analysis rather than nominal values stated here. The use of hydrophones with different sensitivities allowed accurate capture of the wide range of sound pressure variation experienced as the sources operated over a range of distances, from more than 20 km (12 mi) to less than 200

m (0.12 mi) from the measurement locations. Digital recordings were obtained with calibrated Sound Devices hard-drive recorders, model 722, 24-bit audio, set to a sampling rate of 48 kHz.

Figure 1. An OBH system being deployed.

Experimental Configuration

Two underwater acoustic measurement programs were carried out. Initial results of these programs were published in field reports within 5 days of each measurement to provide timely verification data that were used to adjust the size of marine mammal exclusion zones around seismic and shallow hazards surveys. Table 1 lists the field studies and presents the specific acoustic sources measured during each program. Figure 2 shows a map of the two study areas, survey lines, and OBH locations.

Table 1. Measurement Programs conducted in Aug 2009.

Shallow Hazards Site	*Sources*	*Measurement Date*
Honeyguide	*40 in^3 airgun array in 40, 20, and 10 in^3 configurations, sub-bottom profiler, and R/V Mt Mitchell*	*1 Aug, 2009*
Burger	*40 in^3 airgun array in 40 and 10 in^3 configurations, sub-bottom profiler, and R/V Mt Mitchell*	*16 Aug, 2009*

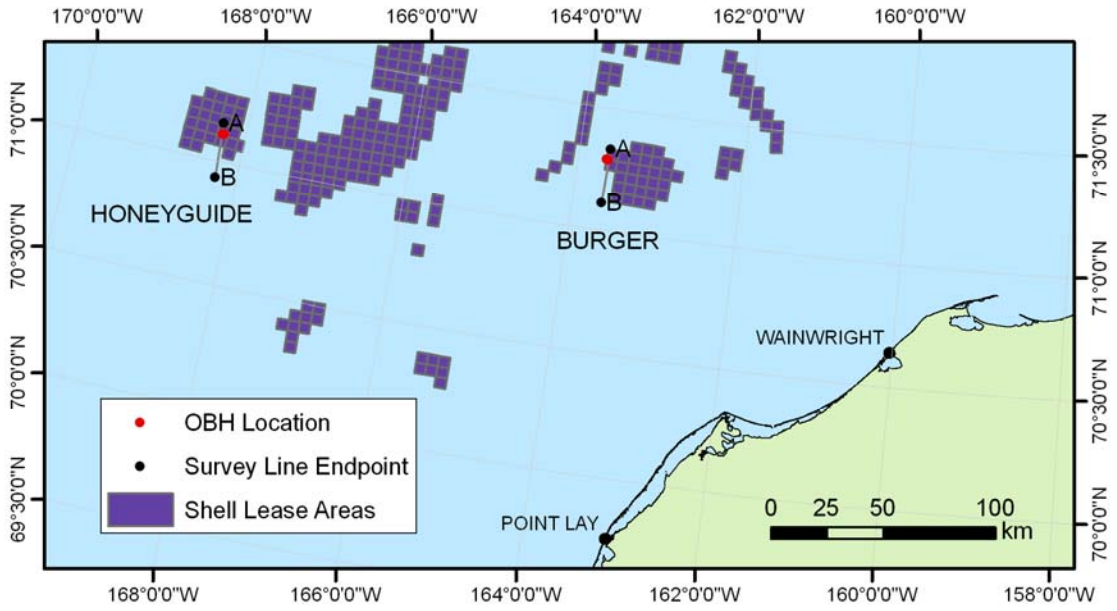

Figure 2. Map of the two study areas with Shell lease areas, showing the deployment locations of the OBH recorders (overlapping red dots) and survey lines (grey).

Shell contracted Fugro Geo Services Inc. to conduct shallow hazards surveys at several prospects in the Chukchi Sea in 2009. The surveys were performed to characterize shallow sub-sea geological structures which could be hazards for future drilling programs. Fugro contracted the *R/V Mt Mitchell* as the survey vessel for this work (see Appendix B for vessel picture and specifications). The shallow hazards geophysical sound sources included three configurations of airguns and a single frequency (3.5 kHz) sub-bottom profiler. Airgun configurations consisted of a single 10 in^3 airgun, a two by 10 in^3 sub-array configuration with guns rigidly mounted 0.6 m (2.0 ft) apart (20 in^3 configuration), and a 40 in^3 configuration using two two-airgun sub-arrays with one positioned 1 m (3.3 ft) in front of the other. The airgun systems were deployed 47 m (150 ft) aft of the *R/V Mt Mitchell* and towed at a depth of 2 m (6.6 ft). During the turns between survey lines, only a single 10 in^3 airgun, referred to as the mitigation gun, was used. Figure 3 shows the positioning of the four airguns from which the three specific configurations were obtained. Figure 4 shows a photograph of all four airguns suspended from their float system prior to deployment. The pole-mounted sub-bottom profiler was deployed from the port side of the vessel at a depth of 4 meters (13 ft). Figure 5 shows the acoustic source transducer head prior to its deployment.

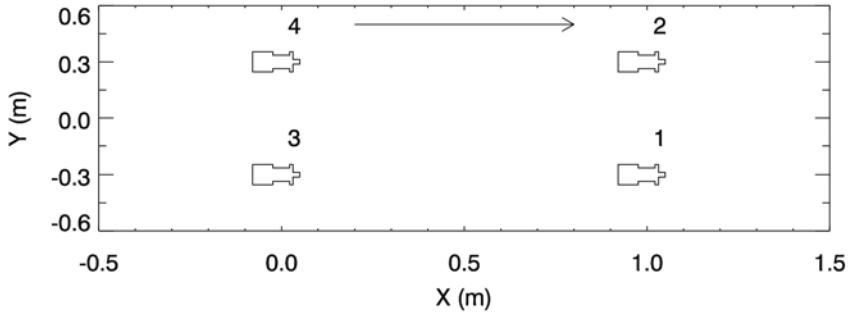

Figure 3. Plan view layout of the Fugro 40 in^3 airgun array. Gun numbers are annotated above the airgun symbols. All four guns were 10 in^3. Tow direction is indicated by the arrow. Multiply by 3.3 to convert m to ft.

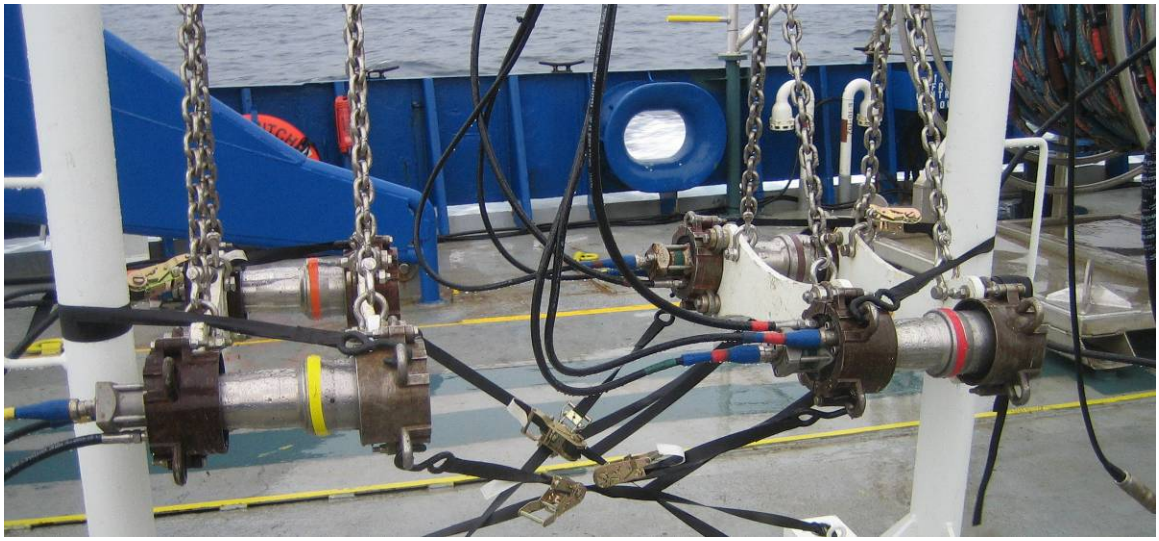

Figure 4. Airgun systems prior to deployment.

Figure 5. The Geopulse 3.5 kHz sub-bottom profiler mounted on a swinging pole on the port side of the *R/V Mt Mitchell*.

Honeyguide Site

Two OBH systems were deployed from the *R/V Mt Mitchell* in 48 m (160 ft) water depth inside the Honeyguide prospect survey area. The measurements were performed as the vessel sailed a single 25 km (16 mi) north-south survey line. The OBHs were aligned perpendicular to the survey line at respectively 200 and 1000 m (0.12 and 0.62 mi) distance off the line as shown in the diagram of Figure 6 (not drawn to scale). See Figure 2 for a map of the study area, survey line and OBH locations.

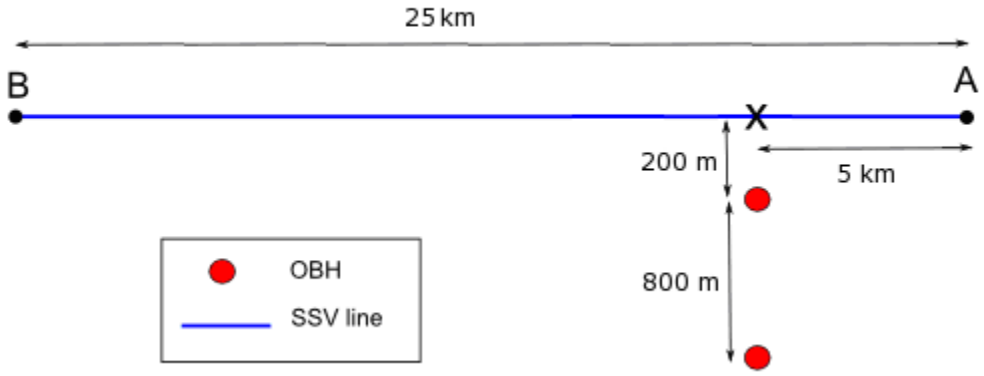

Figure 6. Planned SSV OBH recorder locations relative to the Honeyguide survey track. The point marked by an X is the nominal CPA (closest point of approach) of the vessel to the OBHs. Multiply by 0.62 to convert km to miles.

The OBH systems were deployed 1 Aug 2009 at 13:13 (OBH1) and 13:27 (OBH2) Alaska Daylight Time (AKDT). The coordinates for the actual deployment sites, as well as the navigational coordinates for the SSV line provided to the *R/V Mt Mitchell*, are listed in Table 2.

Table 2. Locations of OBH stations and SSV line segments for the Honeyguide site.

	Geographic	
Point	*Latitude*	*Longitude*
OBH1	*71° 06.705'N*	*168° 16.358'W*
OBH2	*71° 06.723'N*	*168° 15.046'W*
A	*71° 09.375'N*	*168° 17.194'W*
B	*70° 55.945'N*	*168° 14.963'W*
X (CPA)	*71° 06.690'N*	*168° 16.743'W*

The vessel transited from point A to B (ref. Figure 6) at a speed of 3.8 kts, and the airguns fired (alternating between the 10, 20, and 40 in^3 configurations) every 15 m (49 ft). Because of the 3 alternating configurations, the effective shot spacing for each configuration was then 45 m (148 ft). Airgun #1 was fired alone for the 1 × 10 in^3 test (ref. Figure 3). The front sub-array with airguns #1 and #2 were used for the 2 × 10 in^3 configuration, and all four airguns were used for the largest (40 in^3) configuration.

The Geopulse 3.5 kHz sub-bottom profiler was mounted on a pole off the port side of the vessel and operated at 4 m (13 ft) depth when deployed in the vertical position. Measurements were made as the vessel transited from point B to point A (ref. Figure 6) at a speed of 4.7 kts. The pulse time interval was 0.5 s. Table 3 shows the start and end times for the two SSV line runs.

Table 3. Summary of SSV line run start and end times for the *R/V Mt Mitchell* at the Honeyguide site.

Source Run	*Start date/time*	*End date/time*
40, 20, and 10 in^3 Airgun Arrays	*1 Aug 2009 16:12*	*1 Aug 2009 19:54*
3.5 kHz sub-bottom profiler and vessel noise	*1 Aug 2009 20:42*	*1 Aug 2009 23:42*

After completion of the sound measurements, the OBH systems were retrieved onboard the *R/V Mt Mitchell* and the acoustic data were downloaded for analysis.

Burger Site

Two OBH systems were deployed from the *R/V Mt Mitchell* in 41 m (130 ft) water depth near the Burger prospect survey area. The measurements were performed as the vessel sailed a single 25 km (16 mi) north-south survey line. The OBHs were aligned perpendicular to the survey line at respectively 200 and 1000 m (0.12 and 0.62 mi) distance off the line as shown in the diagram of Figure 7 (not drawn to scale). See Figure 2 for a map of the study area, survey line and OBH locations.

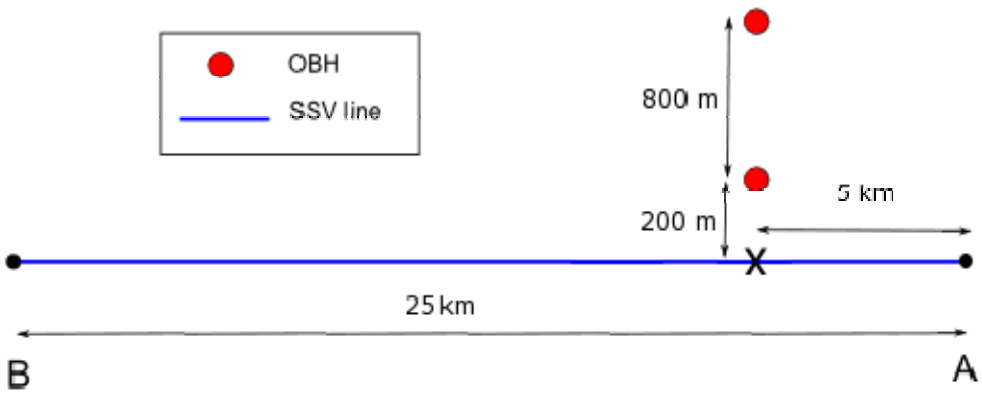

Figure 7. Planned SSV OBH recorder locations relative to the Burger survey track. The point marked by an X is the nominal CPA (closest point of approach) of the vessel to the OBHs. Multiply by 0.62 to convert km to miles.

The OBH systems were deployed on 16 Aug 2009 at 10:52 (OBH1) and 11:20 (OBH2) AKDT. The coordinates noted at the actual deployment sites, as well as the navigational coordinates for the SSV line provided to the *R/V Mt Mitchell*, are listed in Table 4.

Table 4. Locations of OBH stations and SSV line segments for the Burger site.

	Geographic	
Point	*Latitude*	*Longitude*
OBH1	*71° 17.439'N*	*163° 38.115'W*
OBH2	*71° 17.470'N*	*163° 39.436'W*
A	*71° 20.145'N*	*163° 37.598'W*
B	*71° 06.697'N*	*163° 38.540'W*
X (CPA)	*71° 17.436'N*	*163° 37.790'W*

The vessel transited from point A to B (ref. Figure 7) at a speed of 3.5 kts, and all four airguns in the 40 in^3 airgun array fired every 15 m (49 ft).

The single 10 in^3 airgun and the Geopulse 3.5 kHz sub-bottom profiler were tested together on the final transit from point B back to point A at sailing speed 3.5 kts. For this run the sub-bottom profiler was mounted on a pole off the port side of the vessel and operated at 4 m (13 ft) depth with a pulse time interval of 0.15 s while the airgun fired on a 15 m (49 ft) distance interval. The airguns were swapped periodically during the 10 in^3 test to prevent gun wear.

Table 5. Summary of SSV line run start and end times for the *R/V Mt Mitchell* at the Burger site.

Source Run	*Start date/time*	*End date/time*
40 in^3 Airgun Array and vessel noise	*16 Aug 2009 12:50*	*16 Aug 2009 16:30*
10 in^3 mitigation gun and 3.5 kHz sub-bottom profiler	*16 Aug 2009 16:46*	*16 Aug 2009 20:27*

After completion of the sound measurements, the OBH systems were retrieved onboard the *R/V Mt Mitchell* and the acoustic data were downloaded for analysis.

Noise Metrics

Impulsive Noise

Underwater noise is measured in decibels (dB) relative to a fixed reference pressure of 1 µPa. However, the loudness of impulsive noise (e.g., from airguns) is not, in general, proportional to the instantaneous acoustic pressure. Several different sound level metrics are commonly used to evaluate the loudness of impulsive noise. The sound level metrics used in this report are peak sound pressure level (SPL_{Pk}), *rms* sound pressure level (SPL), and sound exposure level (SEL).

Peak sound pressure level is the maximum instantaneous sound pressure level attained by an impulse, *p(t)*:

$$SPL_{Pk} = 20\log_{10}(\max(|p(t)|)) \qquad \text{Equation 1}$$

The *rms* sound pressure level is the root-mean-square pressure level over a time window, T, containing the impulse:

$$SPL = 20\log_{10}\left(\sqrt{\frac{1}{T}\int_{T} p^2(t)dt}\right) \qquad \text{Equation 2}$$

The sound exposure level is the time integral of the square pressure over a fixed time window long enough to include all parts of the signal:

$$SEL = 10\log_{10}\left(\int_{T} p^2(t)dt\right) \qquad \text{Equation 3}$$

Band Pressure Levels

A convenient way of expressing the frequency content of a broadband signal is in terms of 1/3-octave band pressure levels. In 1/3-octave band analysis, sound is band-pass filtered into several adjacent frequency bins, and the mean-square pressure level in each bin is computed. The resultant 1/3-octave band levels give the frequency distribution of sound energy within the signal. The acoustics community has adopted standard 1/3-octave frequencies in order to facilitate comparisons between studies; the center frequencies of these standard pass-bands are given by the following formula:

$$f_c = 10^{i/10} \quad i = 1,2,3\ldots \qquad \text{Equation 4}$$

Note that the bandwidth of a single 1/3-octave band is ~23% of its band center frequency. 1/3-octave band analysis may be applied to both continuous noise and impulsive noise.

Data Analysis Approach

Per-shot Seismic Pulse Levels

The recorded acoustic data from the airgun array and impulsive shallow hazards survey sources were analyzed in a consistent way to compute peak pressure (SPL_{Pk}), *rms* pressure (SPL), and sound exposure level (SEL) levels versus distance from the sources. The data processing steps were as follows:

1. Apply hydrophone sensitivity, analogue circuit frequency response, and digital conversion gain to digital recording units to convert to micropascals (μPa).
2. Determine start times of impulsive pressure signals in digital recordings by using an automatic power-threshold detector.
3. Determine the maximum sound pressure level for each pulse in dB re 1 μPa using Equation 1.
4. Compute cumulative square pressure functions over the duration of each pulse.
5. Determine the interval over which the cumulative square pressure for each received pulse increases from 5% to 95% of the total.
6. For each pulse, compute the standard 90% *rms* level by dividing the cumulative square pressure over the 5% to 95% interval by the number of samples in this period, and taking the square root (Equation 2).

Peak, 90% *rms* sound pressure levels (SPL), and SEL for each impulsive source shot were computed for each OBH system and these three metrics were plotted against the corresponding source-receiver ranges.

The empirical functions used to fit the measured received levels to range had the form:

$RL = SL - n \log R - \alpha R$, or Equation 5

$RL = SL - n \log R$ Equation 6

where RL is the received level in decibels, SL is the source level[2] at 1 m reference distance in dB, R is the source-receiver range in m, n is the geometric spreading loss coefficient, and α is the absorptive loss coefficient. The form of the equation where absorptive losses were significant was that of Equation 5. If no significant absorptive losses were present, an equation of the form 6 was fit to the data. The computed best-fit (least squares regression) functions are shown in the figures. The best-fit function is plotted as the solid line. For the purpose of obtaining conservative estimates of ranges to various sound levels, we applied offsets to the best-fit functions so they would exceed 90% of the measured data points.

[2] This value actually corresponds to the extrapolated level at the reference distance of 1 m from the source. There are other similar approaches to obtain the source level, such as back-propagating the closest distance measurement by 20 log (R), which is referred to as spherical spreading back-propagation. We caution that both of these approaches have limited accuracy. To get the best estimates of source levels, narrow frequency bands should be back-propagated with computer acoustic propagation models. That has not been performed for this report.

Vessel Sound Levels

The acoustic data recorded during the track line traversal for the *R/V Mt Mitchell* were analyzed to compute 1-second average SPLs (using Equation 2 with T=1 sec) as a function of horizontal range from the OBH system. An empirical transmission loss curve of the form of Equation 5 or 6 was fit to the data by least-square regression of the coefficients A and B to obtain estimates of distances at which broadband vessel noise levels reached values between 160 dB re 1 µPa and 100 dB re 1 µPa. The fits to the various datasets were performed only on the first few kilometers of data to limit the interference of ambient noise levels at lower SPLs.

Southall et al. Criteria

Southall et al. (2007) proposed new criteria for assessing auditory injury, defined as onset of permanent threshold shift (PTS), and behavioral disturbance to marine mammals caused by underwater sound. Southall et al. proposed the evaluation of peak pressure and SEL metrics against defined thresholds.

Peak Pressure

The auditory injury criterion peak level thresholds are based on flat weighted peak levels. The thresholds are 230 dB re 1 µPa for cetaceans and 218 dB re 1 µPa for pinnipeds. Empirical functions of the form Equation 5 or 6 were fit to the measured peak levels versus range to extrapolate the peak levels to the thresholds.

Cumulative SEL Levels

The M-weighted SEL metric considers the total energy received from multiple pulses and also accounts for frequency-dependent hearing sensitivity of different species groups. The auditory injury criterion SEL threshold is 198 dB re 1 µPa^2-s (M-weighted) for cetaceans and 186 dB re 1 µPa^2-s (M-weighted) for pinnipeds under water.

The SEL metric proposed by Southall et al. involves summing the single pulse SEL's for multiple pulses. They acknowledge that this approach is very conservative because it does not make any allowance for the recovery of hearing between pulse exposures. Their proposed cumulative SEL metric (flat weighted) is defined as follows:

$$\mathrm{SEL} = 10\log_{10}\left\{\frac{\sum_{n=1}^{N}\int_0^T p_n^2(t)dt}{p_{ref}^2}\right\},$$

where N is the number of pulse exposures, T is the length of the single pulse time integration window and p_{ref} = 1 µPa in water. In the present study the cumulative SEL levels (both flat-weighted and M-weighted levels were considered) were computed for the sum of all shots in a single seismic line. We computed these levels from data from both OBHs at both prospects. It is important to note that if these levels were to be used for assessing impact then one would assume the exposed animals remained stationary throughout the exposure (while the airguns operated along the entire survey line). It is more likely that an animal would move away from the survey line as the seismic vessel approached, resulting in lower SEL. It is considered unlikely that an

animal would swim parallel to a seismic survey at close distance receiving maximum possible SEL.

M-weighting

Marine Mammal Hearing

Marine mammal hearing sensitivity varies with frequency. Audiograms represent the threshold of hearing as a function of frequency. Audiograms for marine mammals are characterized by relatively lower sensitivity (higher threshold values) at very low and very high frequencies. The specific frequencies of highest sensitivity and the frequencies at which sensitivity falls off are dependent on species. Audiograms have been measured for several species of pinnipeds, and for a limited number of odontocetes. No direct measurements of audiograms for mysticetes have been made to date.

The potential for seismic survey noise to impact marine species is partly dependent on how well the species can hear the sounds produced (Austin and Laurinolli, 2007). Noises are less likely to disturb animals if they are at frequencies that the animal cannot hear well. An exception to this is when the noise pressure is so high that it can cause physical injury, whether temporary or permanent. For non-injurious sound levels, frequency weighting curves based on audiograms may be applied to adjust the importance of sound levels at particular frequencies in a manner reflective of the receiver's sensitivity to those frequencies (Nedwell et al. 1998).

M-weighting Filters

A NMFS-sponsored Noise Criteria Committee has proposed standard frequency weighting curves — referred to as M-weighting filters — for use with marine mammal species (Gentry et al. 2004). M-weighting filters are band-pass filter networks that are designed to reduce the importance of inaudible or less-audible frequencies for five broad classes of marine mammals:

1. Low frequency cetaceans (LFC),
2. Mid-frequency cetaceans (MFC),
3. High-frequency cetaceans (HFC),
4. Pinnipeds in water (PINN), and
5. Pinnipeds in air.

The amount of discount applied by M-weighting filters for less-audible frequencies is not as great as would be indicated by the corresponding audiograms for these groups of species. The rationale for applying a smaller discount than would be suggested by the audiogram is in part based on a characteristic of human hearing. Perceived equal loudness curves for humans have smaller slopes outside the most sensitive hearing frequency range as sound levels increase. In other words, equal loudness curves are flatter for loud sounds than for quiet sounds. As a result, frequency weighting filters such as M-weighting for loud sounds should be flatter than filters designed for quiet sounds. This is the reason that C-weighting curves for humans, used for assessing very loud sounds such as blasts, are flatter than A-weighting curves used for quiet to mid-level sounds. Additionally, out-of-band frequencies, though less audible, can still cause

physical injury (either temporary or permanent) if pressure levels are very high. The M-weighting filters therefore are designed for use for primarily high sound level impacts such as temporary or permanent hearing threshold shifts. The use of M-weighting should therefore be considered conservative (in the sense of overestimating the potential for impact) when applied to lower level impacts such as onset of behavioral change impacts. Figure 8 shows the decibel frequency response of the four standard underwater M-weighting filters.

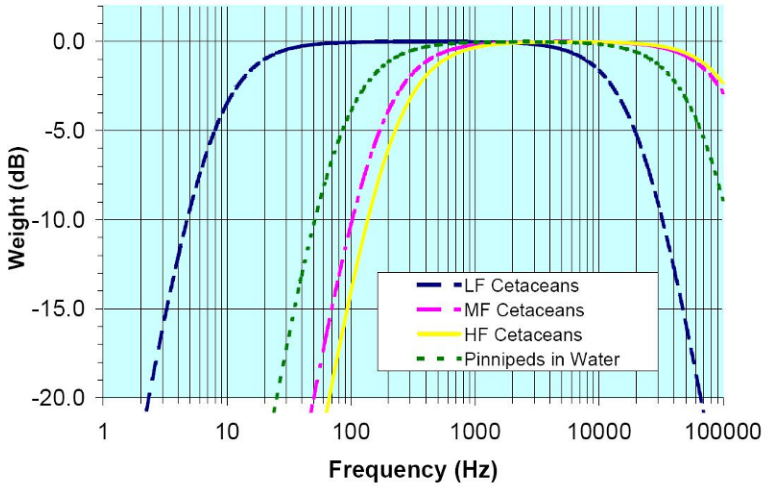

Figure 8. M-weighting curves for four species groups.

These filters have unity gain (0 dB) through the pass band and high and low frequency roll off at approximately –12 dB per octave. The amplitude response of the M-weighting filters is defined in the frequency domain by the following function:

$$G(f) = -20\log_{10}\left[\left(1+\frac{f_{lo}^{2}}{f^{2}}\right)\left(1+\frac{f^{2}}{f_{hi}^{2}}\right)\right] \qquad \text{Equation 7}$$

The roll off and pass band of these filters are controlled by the two parameters f_{lo} and f_{hi}; the parameter values that are used for the four different standard M-weighing curves are given in Table 6.

Table 6. Low frequency and high frequency cutoff parameters for standard marine mammal M-weighting curves.

M-weighting filter	f_{lo} *(Hz)*	f_{hi} *(Hz)*
Low frequency cetaceans (LFC)	*7*	*22000*
Mid-frequency cetaceans (MFC)	*150*	*160000*
High-frequency cetaceans (HFC)	*200*	*180000*
Pinnipeds underwater (PINN)	*75*	*75000*

M-weighting filters were applied directly to the measured seismic survey data using a Fourier approach. The M-weighting filters applicable to marine mammal species commonly encountered in the Alaskan Chukchi Seas are as follows:

1. LFC: Bowhead whales (*Balaena mysticetus*) and other mysticetes.

2. MFC: Beluga whales (*Delphinapterus leucas*), Killer Whales (*Orcinus orca*) and other mid-frequency odontocetes.
3. HFC: Harbour porpoise (*Phocoena phocoena*) and other high-frequency odontocetes.
4. PINN: Spotted seals (*Phoca largha*), ringed seals (*Phoca hispida*), ribbon seals (*Phoca fasciata*), bearded seals (*Erignathus barbatus*), and Pacific walruses (*Odobenus rosmarus*).

Results

Honeyguide Site

Airgun Array Measurements

SPL vs. Range

Ranges from the airgun array to the OBH recording positions were computed for the times corresponding to each shot using the navigation logs supplied by the *R/V Mt Mitchell* upon completion of the survey. For plots at ranges 2 km (1.2 mi) and greater, measurements from the more sensitive TC4032 hydrophones are shown. At shorter ranges, measurements are from the less-sensitive TC4043 hydrophones.

Figure 9, Figure 10, and Figure 11 present the peak, 90% *rms* and per-pulse SEL levels versus range respectively for the 10, 20, and 40 in^3 total volume airgun configurations. The best-fit and 90^{th} percentile trend lines, and their respective equations, are also shown in the figures. None of the three airgun configurations are characterized by a strong directional component; all configurations had similar sound emission levels in the broadside and endfire directions. The spread in received level at long ranges is likely due to variations in propagation characteristics and the decrease in signal-to-ambient-noise ratio.

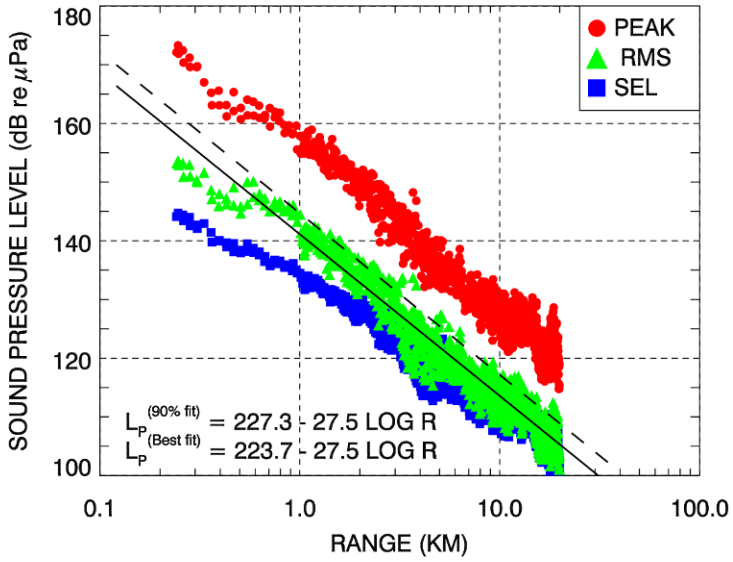

Figure 9. Peak, *rms* and per-shot SEL levels versus range from the single 10 in^3 airgun at the Honeyguide site. Solid line is least squares best fit of Equation 6 to *rms* values. Dashed line represents best fit line increased by 3.6 dB to exceed 90% of all *rms* values (90^{th} percentile fit).

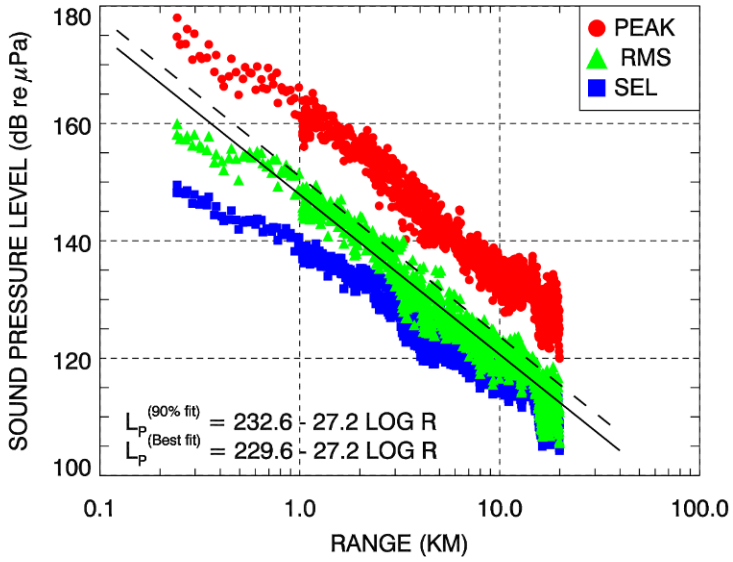

Figure 10. Peak, *rms* and per-shot SEL levels versus range from the 20 in^3 array configuration at the Honeyguide site. Solid line is least squares best fit of Equation 6 to *rms* values. Dashed line represents best fit line increased by 3.0 dB to exceed 90% of all *rms* values (90th percentile fit).

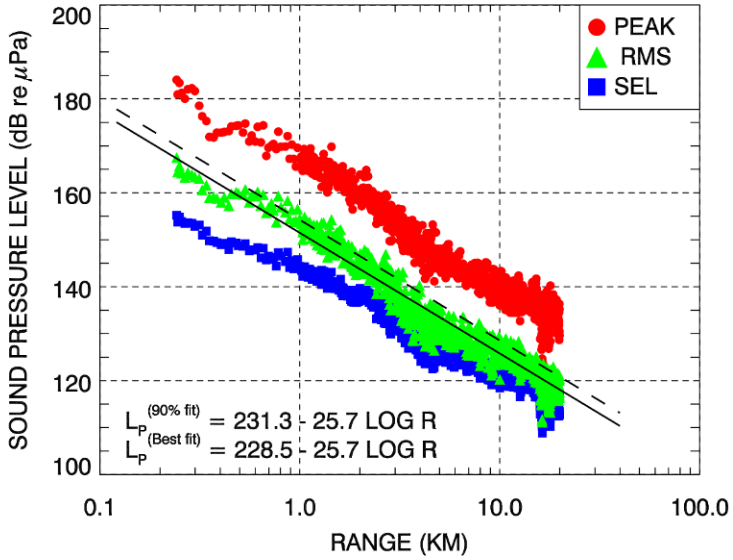

Figure 11. Peak, *rms* and per-shot SEL levels versus range from the 40 in^3 array configuration at the Honeyguide site. Solid line is least squares best fit of Equation 6 to *rms* values. Dashed line represents best fit line increased by 2.8 dB to exceed 90% of all *rms* values (90th percentile fit).

Ranges to Sound Levels

The nominal ranges to the decibel levels 190, 180, 170, 160, and 120 dB re 1 µPa (*rms*) were computed using the best and 90th percentile equation fits presented in Figure 9, Figure 10, and Figure 11. These distances are listed in Table 7, Table 8, and Table 9.

Table 7. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the single 10 in^3 airgun configuration at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
190	*17**	*23**
180	*39**	*52**
170	*89**	*120**
160	*210**	*280*
120	*5900*	*7900*

*Extrapolated from minimum measurement range of 240 m (0.15 mi).

Table 8. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the 20 in^3 array configuration at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
190	*28**	*37**
180	*66**	*86**
170	*150**	*200**
160	*360*	*460*
120	*11000*	*14000*

*Extrapolated from minimum measurement range of 240 m (0.15 mi).

Table 9. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the 40 in^3 array configuration at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
190	*32**	*41**
180	*78**	*99**
170	*190**	*240*
160	*470*	*600*
120	*17000*	*22000‡*

*Extrapolated from minimum measurement range of 240 m (0.15 mi).
‡Extrapolated from maximum measurement range of 20000 m (1.2 mi).

Southall et al. Criteria

Peak Pressure

Equations of the form Equation 6 were fit to the peak levels in Figures 9 to 11. The equations and distances to the proposed peak levels are given in the table below.

Table 10. Least squares best fit of Equation 6 to peak values (ref. Figures 9 to 11) as well as distances to the Southall et al. proposed peak level threshold criteria. All distances are extrapolated from the minimum measurement range.

Array Configuration	*Equation Type*	*Equation*	*Distance to 230 dB re 1 µPa*	*Distance to 218 dB re 1 µPa*
10 in^3	*Best fit*	$L_{Pk} = 242.6 - 28.6 \log r$	*3 m*	*7 m*
	90th percentile	$L_{Pk} = 245.9 - 28.6 \log r$	*4 m*	*9 m*
20 in^3	*Best fit*	$L_{Pk} = 245.1 - 27.6 \log r$	*4 m*	*10 m*
	90th percentile	$L_{Pk} = 248.4 - 27.6 \log r$	*5 m*	*13 m*
40 in^3	*Best fit*	$L_{Pk} = 245.3 - 26.4 \log r$	*4 m*	*11 m*
	90th percentile	$L_{Pk} = 248.3 - 26.4 \log r$	*5 m*	*14 m*

Cumulative M-weighted SEL

The cumulative SEL metric was calculated for one full seismic survey line at OBHs 1 and 2. SEL values were taken from the test track (ref. Figure 6). Various types of M-weighting were applied to the SEL values before summing to provide M-weighted cumulative SEL. The plots below show the flat and M-weighted cumulative SEL curves as they evolve with the progression of the survey line, as well as the flat-weighted pre shot SEL values for comparison. Each plot is specific to an array volume and an OBH; in aggregate they provide an indication of the cumulative SEL at different fixed distances from a seismic survey line. Figure 18 is a diagram showing the relative locations of the receivers to the shot points.

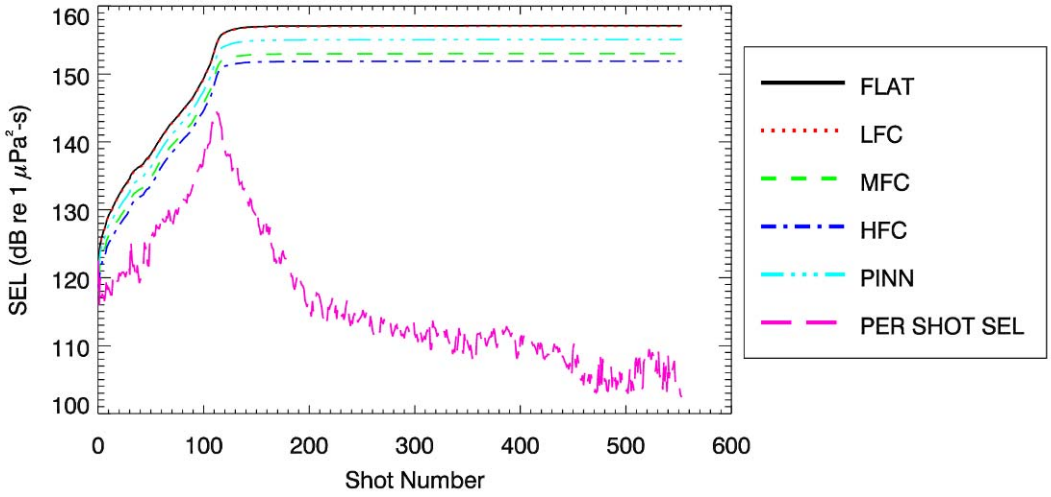

Figure 12. Flat and M-weighted cumulative SEL with flat-weighed per shot SEL from the single 10 in^3 airgun recorded on OBH 1, deployed 240 m (0.15 mi) off the Honeyguide survey line.

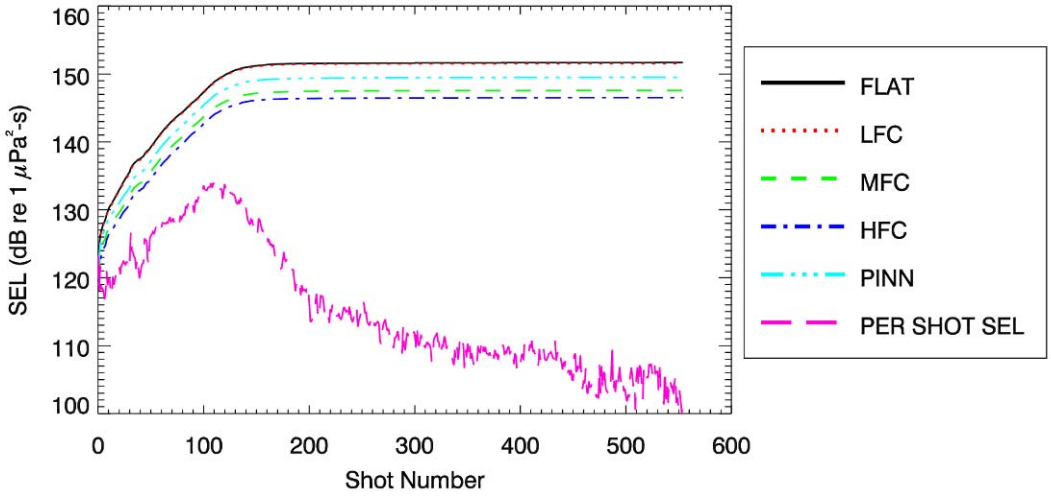

Figure 13. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the single 10 in^3 airgun recorded on OBH 2, deployed 1030 m (0.64 mi) off the Honeyguide survey line.

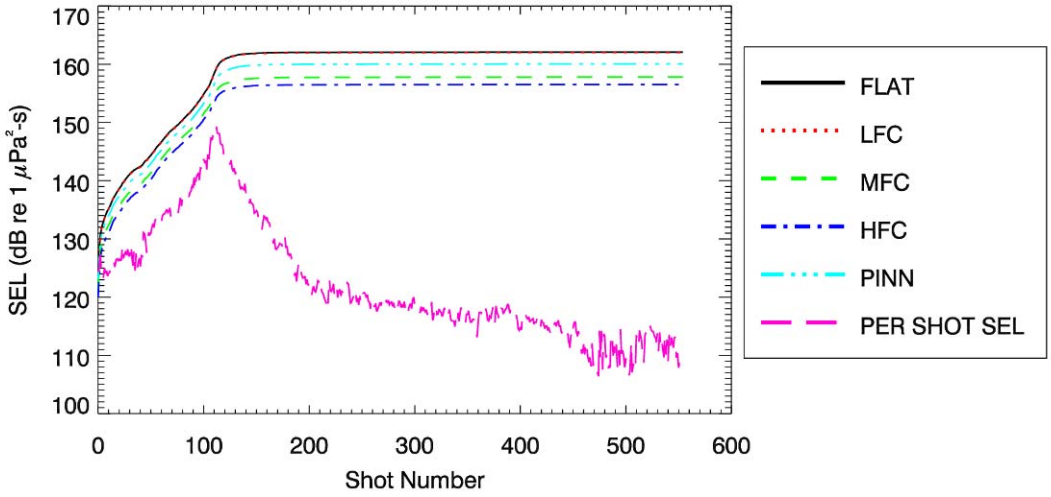

Figure 14. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the 20 in^3 array configuration recorded on OBH 1, deployed 240 m (0.15 mi) off the Honeyguide survey line.

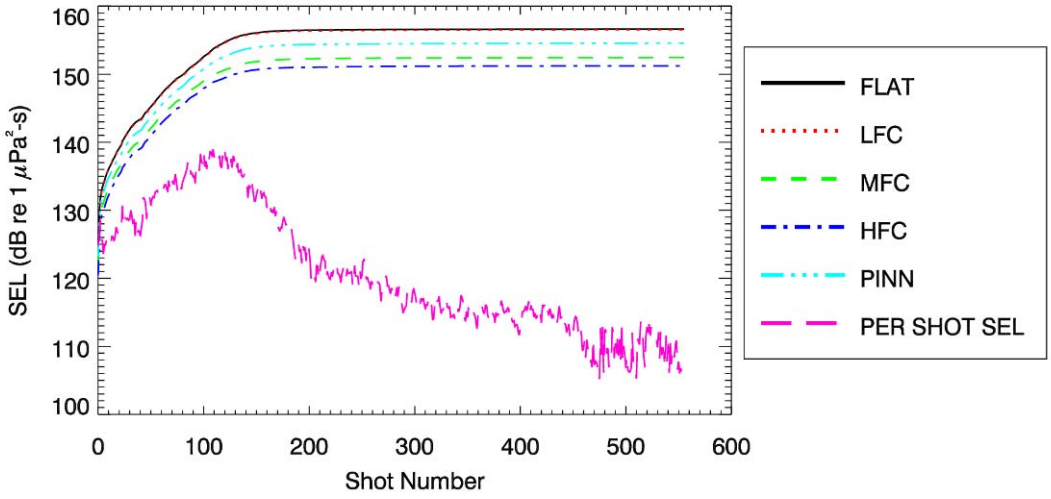

Figure 15. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the 20 in^3 array configuration recorded on OBH 2, deployed 1030 m (0.64 mi) off the Honeyguide survey line.

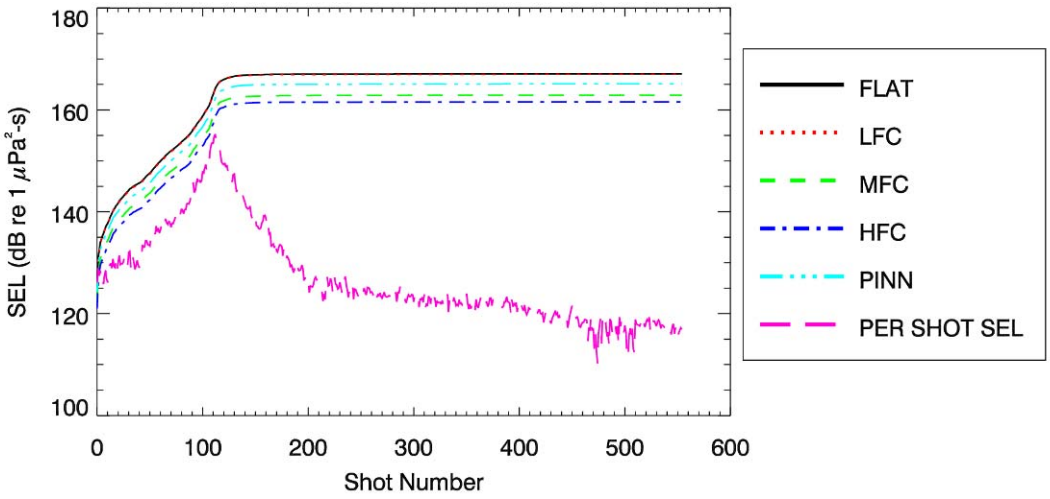

Figure 16. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the 40 in^3 array configuration recorded on OBH 1, deployed 240 m (0.15 mi) off the Honeyguide survey line.

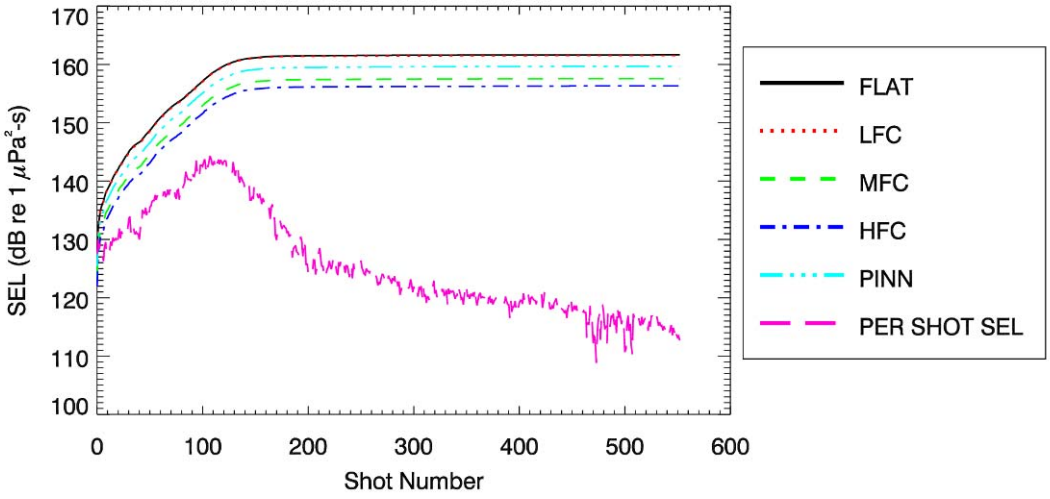

Figure 17. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the 40 in^3 array configuration recorded on OBH 2, deployed 1030 m (0.64 mi) off the Honeyguide survey line.

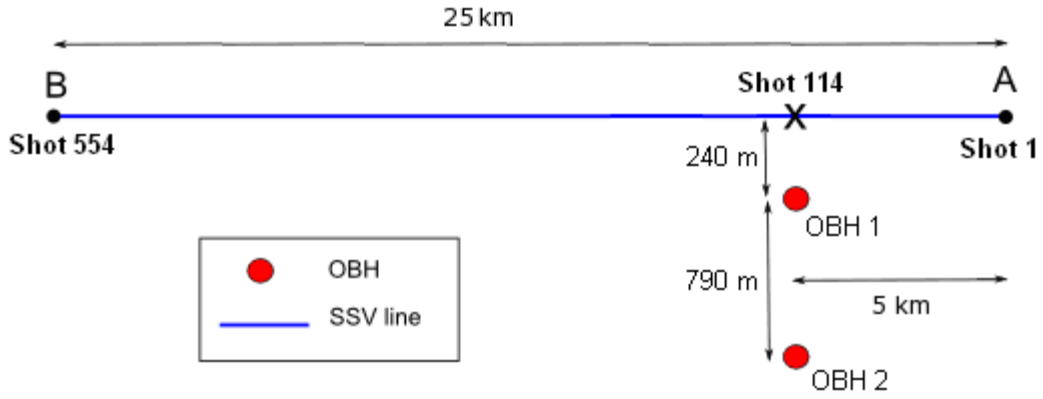

Figure 18. Diagram of the actual seismic survey line with shot points and deployed OBH locations used in the calculation of cumulative SEL at the Honeyguide site. Multiply by 0.62 to convert km to miles.

Table 11 provides the maximum cumulative SEL for each receiver, and Figure 19, Figure 20, and Figure 21 show these maxima as a function of distance off the survey line for the single 10 in^3 airgun, 20 in^3 array configuration, and the 40 in^3 array configuration respectively.

Table 11. Maximum cumulative SEL for each airgun array configuration and OBH off the seismic survey line at the Honeyguide site.

Array Volume (in^3)	*Distance off seismic survey line*	*Cumulative SEL (dB re 1 $\mu Pa^2 s$)*				
		Flat-weighted	*Low Frequency Cetaceans*	*Mid-Frequency Cetaceans*	*High Frequency Cetaceans*	*Pinnipeds underwater*
10	*240 m*	*157.1*	*157.0*	*153.0*	*151.9*	*155.1*
	1030 m	*151.7*	*151.6*	*147.6*	*146.5*	*149.5*
20	*240 m*	*162.1*	*162.0*	*157.8*	*156.5*	*160.1*
	1030 m	*156.6*	*156.5*	*152.5*	*151.2*	*154.6*
40	*240 m*	*167.1*	*167.0*	*162.9*	*161.6*	*165.1*
	1030 m	*161.6*	*161.5*	*157.6*	*156.3*	*159.7*

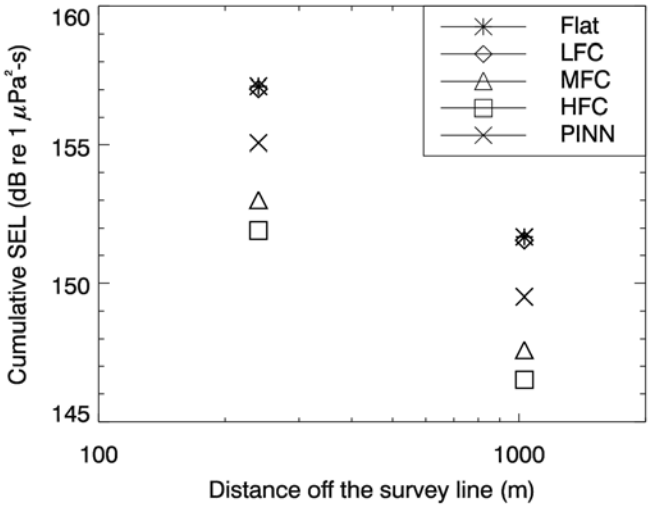

Figure 19. Cumulative SEL as a function of perpendicular distance off the survey line for the single 10 in^3 airgun for the Honeyguide site. Multiply by 0.62 to convert km to miles.

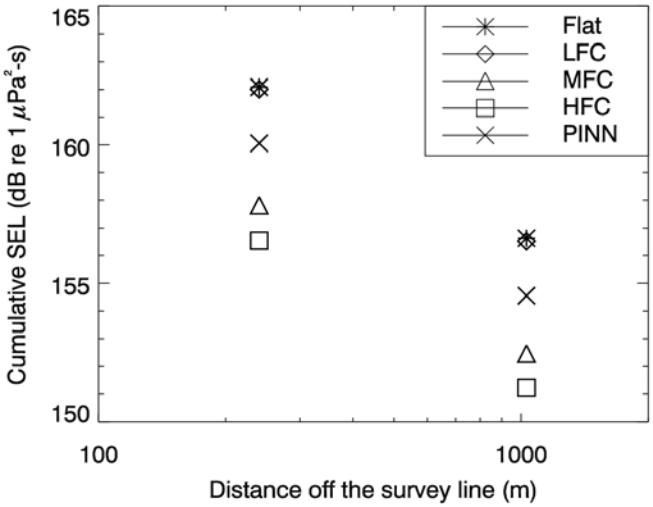

Figure 20. Cumulative SEL as a function of perpendicular distance off the survey line for the 20 in^3 array configuration for the Honeyguide site. Multiply by 0.62 to convert km to miles.

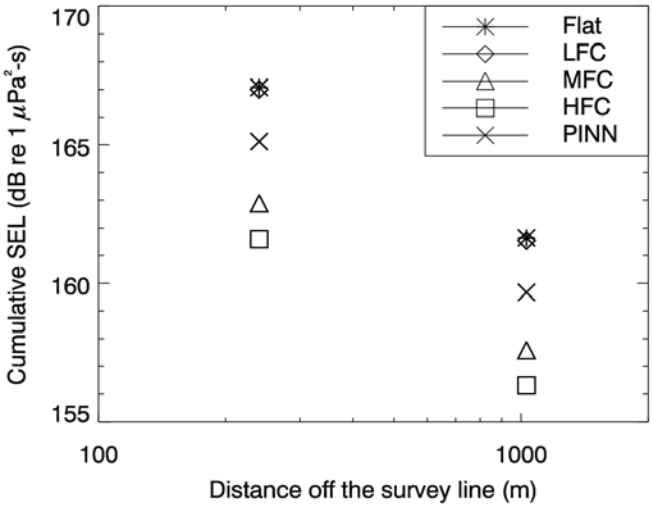

Figure 21. Cumulative SEL as a function of perpendicular distance off the survey line for the 40 in^3 array configuration for the Honeyguide site. Multiply by 0.62 to convert km to miles.

SEL values were taken from shots corresponding to the appropriate array volume as the array was rotated through the 10, 20, and 40 in^3 configurations. This resulted in the effective spatial shot density per configuration to be three times less at the Honeyguide site (shot spacing per configuration was 45 m or 148 ft) than at the Burger site (shot spacing per configuration was 15 m or 49 ft). In order to compare the maximum cumulative SEL values to those at the Burger site, a compensating factor corresponding to the difference in spatial shot density was added to the cumulative SEL values from the Honeyguide site, namely, $10\times\log_{10}3$ (4.8 dB). This approach is valid since the per-shot SEL was sampled at a high enough spatial resolution to capture the peak in SEL at CPA (ref. Figures 12 to 17). The following table provides the maximum cumulative SEL for each airgun array configuration and OBH off the seismic survey line with the added compensating factor for comparison to the levels at the Burger site.

Table 12. Maximum cumulative SEL for each airgun array configuration and OBH off the seismic survey line with the added compensating factor for comparison to the levels at the Burger site. The compensating factor is $10\times\text{Log}_{10}3$ (4.8 dB) since the spatial shot density at the Burger times was three times that of the Honeyguide site.

Array Volume (in^3)	*Distance off seismic survey line*	*Cumulative SEL (dB re 1 μPa^2s)*				
		Flat-weighted	*Low Frequency Cetaceans*	*Mid-Frequency Cetaceans*	*High Frequency Cetaceans*	*Pinnipeds underwater*
10	*240 m*	*161.9*	*161.8*	*157.8*	*156.7*	*159.9*
	1030 m	*156.5*	*156.4*	*152.4*	*151.3*	*154.3*
20	*240 m*	*166.9*	*166.8*	*162.6*	*161.3*	*164.9*
	1030 m	*161.4*	*161.3*	*157.3*	*156.0*	*159.4*
40	*240 m*	*171.9*	*171.8*	*167.7*	*166.4*	*169.9*
	1030 m	*166.4*	*166.3*	*162.4*	*161.1*	*164.5*

The maximum cumulative SEL did not reach the thresholds proposed by Southall et al. (2007) for any of the three array configurations at the closest measured range. The distance to the injury criteria, if calculated using an equation of the form of Equation 6, would be less than 1 m (3.3 ft) for all M-weighting filters and array configurations, including the 4.8 dB compensating factor.

Sub-bottom Profiler (3.5 kHz)

SPL vs. Range

Figure 22 presents the peak, 90% *rms* and per-pulse SEL levels versus range for the 3.5 kHz sub-bottom profiler as well as the best-fit and 90th percentile trend lines and the equations thereof. A 1 kHz high pass filter was applied to the sub-bottom profiler pressure data prior to SPL calculations to isolate the profiler signal from lower frequency vessel sounds.

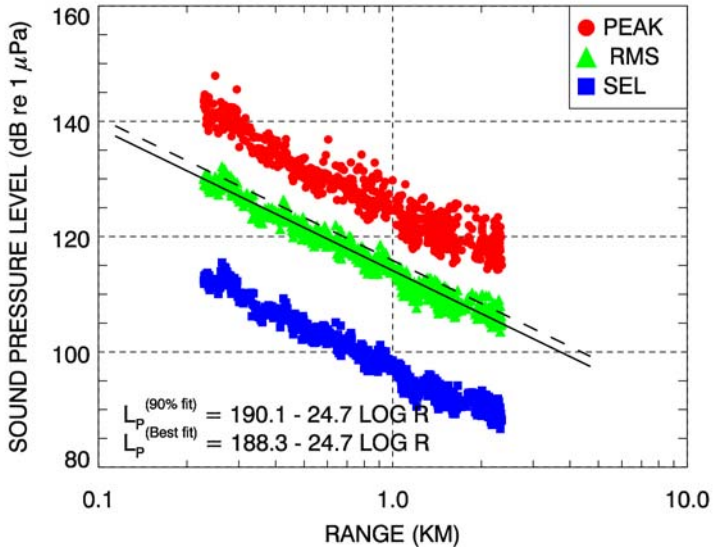

Figure 22. Peak, *rms* and per-shot SEL levels versus range for the sub-bottom profiler (3.5 kHz) at the Honeyguide site. The solid line is the least squares best fit of Equation 6 to the *rms* values. The dashed line represents the best fit line increased by 1.8 dB to exceed 90% of all *rms* values.

Ranges to Sound Levels

The nominal ranges to the decibel levels 160, 150, 140, 130, 120 and 110 dB re 1 µPa (*rms*) were computed using the best and 90th percentile equation fits presented in Figure 22. These ranges are listed in Table 13.

Table 13. Sound level distances for 160, 150, 140, 130, 120 and 110 dB re 1 μPa (*rms*) for the sub-bottom profiler (3.5 kHz) at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
160	*14**	*16**
150	*35**	*42**
140	*90**	*110**
130	*230**	*270*
120	*580*	*680*
110	*1500*	*1700*

*Extrapolated from minimum measurement range of 240 m (0.15 mi).

Vessel Measurements

SPL vs. Range

Figure 23 presents the *rms* levels versus range for the *R/V Mt Mitchell* vessel noise alone, as well as the best-fit and 90th percentile trend lines and the equations thereof.

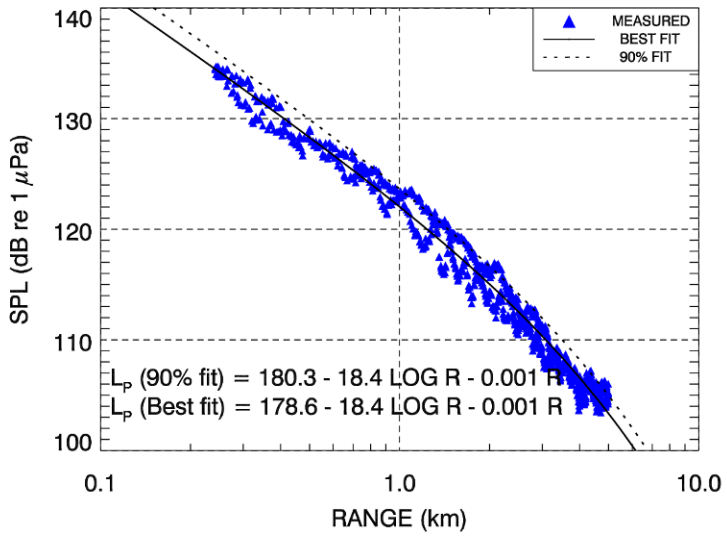

Figure 23. Sound pressure level (*rms*) versus range from the *R/V Mt Mitchell* sailing at 3.8 kts at the Honeyguide site. The solid line is the least squares best fit of Equation 5 to the *rms* values. The dashed line is the best fit increased by 1.7 dB to exceed 90% of all the *rms* values.

Ranges to Sound Levels

The distances to the sound levels of 160, 150, 140, 130, 120, 110 and 100 dB re 1 μPa (*rms*) are listed in Table 14. Note that the sound levels in the table for the vessel measurements have been shifted to a lower range compared to those of the louder impulsive sources.

Table 14. Sound level distances for 140-100 dB re 1 μPa (*rms*) for the *R/V Mt Mitchell* sailing at 3.8 kts at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
160	*10**	*13**
150	*36**	*44**
140	*120**	*150**
130	*410*	*490*
120	*1200*	*1500*
110	*3100*	*3500*
100	*6100‡*	*6700‡*

*Extrapolated from minimum measurement range of 240 m (0.15 mi).
‡Extrapolated from maximum measurement range of 5000 m (3.1 mi).

Burger Site

Airgun Array Measurements

SPL vs. Range

Ranges from the airgun array to the OBH recording positions were computed for the times corresponding to each shot using the navigation logs supplied by the *R/V Mt Mitchell* upon completion of the survey. For plots at ranges 2 km (1.2 mi) and greater, measurements from the more sensitive TC4032 hydrophones are shown. At shorter ranges, measurements are from the less-sensitive TC4043 hydrophones.

Figure 24 and Figure 25 present the peak, 90% *rms* and per-pulse SEL levels versus range respectively for the 10 and 40 in^3 total volume airgun configurations. The best-fit and 90^{th} percentile trend lines, and their respective equations, are also shown in the figures. None of the airgun configurations are characterized by a strong directional component; all configurations had similar sound emission levels in the broadside and endfire directions.

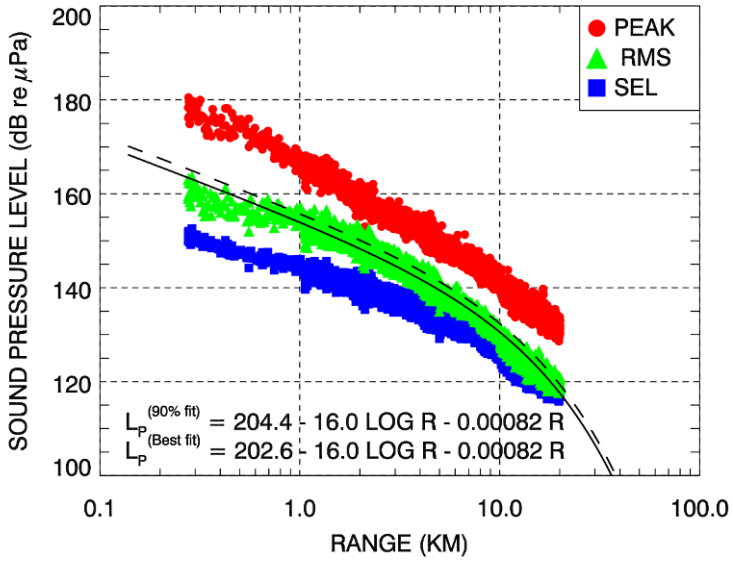

Figure 24. Peak, *rms* and per-shot SEL levels versus range from the single 10 in^3 airgun at the Burger site. Solid line is least squares best fit of Equation 5 to *rms* values. Dashed line represents best fit line increased by 1.8 dB to exceed 90% of all *rms* values (90^{th} percentile fit).

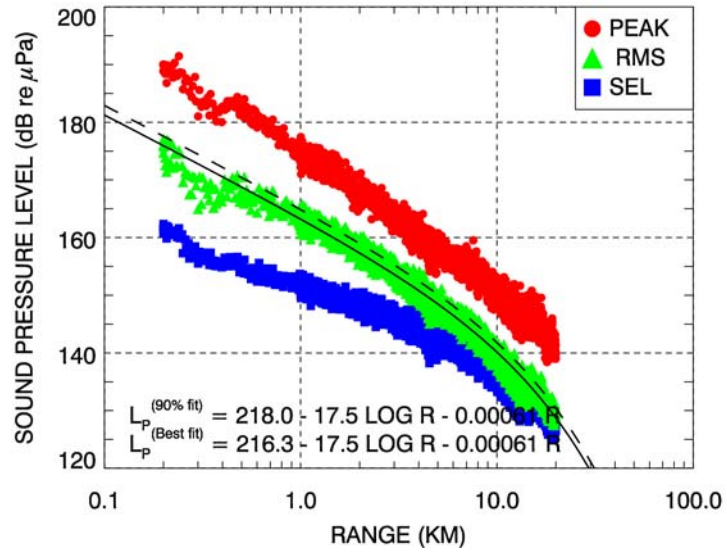

Figure 25. Peak, *rms* and per-shot SEL levels versus range from the 40 in^3 array configuration at the Burger site. Solid line is least squares best fit of Equation 5 to *rms* values. Dashed line represents best fit line increased by 1.7 dB to exceed 90% of all *rms* values (90^{th} percentile fit).

Ranges to Sound Levels

The nominal ranges to the decibel levels 190, 180, 170, 160, and 120 dB re 1 µPa (*rms*) were computed using the best and 90^{th} percentile equation fits presented in Figure 24 and Figure 25. These ranges are listed in Table 15 and Table 16.

Table 15. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the single 10 in^3 airgun configuration at the Burger site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
190	*6**	*8**
180	*26**	*34**
170	*110**	*140**
160	*440*	*570*
120	*18000*	*19000*

*Extrapolated from minimum measurement range of 275 m (0.17 mi).

Table 16. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the 40 in^3 array configuration at the Burger site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
190	*32**	*39**
180	*120**	*150**
170	*430*	*530*
160	*1500*	*1800*
120	*29000‡*	*31000‡*

*Extrapolated from minimum measurement range of 200 m (0.12 mi).
‡Extrapolated from maximum measurement range of 20000 m (12 mi).

Southall et al. Criteria

Peak Pressure

Equations of the form Equation 5 were fit to the peak levels in Figure 24 and Figure 25. The equations and distances to the proposed peak levels are given in the table below.

Table 17. Least squares best fit of Equation 5 to peak values (ref. Figure 24 and Figure 25) as well as distances to the Southall et al. proposed peak level criteria. All distances are extrapolated from the minimum measurement range.

Array Configuration	*Equation Type*	*Equation*	*Distance to 230 dB re 1 μPa*	*Distance to 218 dB re 1 μPa*
10 in^3	*Best fit*	$L_{Pk} = 233.2 - 22.1\log r - 0.00037r$	*1 m*	*5 m*
	90th percentile	$L_{Pk} = 234.9 - 22.1\log r - 0.00037r$	*2 m*	*6 m*
40 in^3	*Best fit*	$L_{Pk} = 240.2 - 21.8\log r - 0.00027r$	*3 m*	*11 m*
	90th percentile	$L_{Pk} = 242.1 - 21.8\log r - 0.00027r$	*4 m*	*13 m*

Cumulative M-weighted SEL

The cumulative SEL metric was calculated for one full seismic survey line at OBHs 1 and 2. SEL values were taken from the test track (ref. Figure 7). Various types of M-weighting were also applied to the SEL values before summing to provide M-weighted cumulative SEL. The plots below show the flat and M-weighted cumulative SEL curves as they evolve with the

progression of the survey line, as well as the flat-weighted pre shot SEL values for comparison. Each plot is specific to an array volume and an OBH; in aggregate they provide an indication of the cumulative SEL at different fixed distances from a seismic survey line. Figure 30 and Figure 31 are diagrams showing the relative locations of the receivers to the shot points for the single 10 in^3 airgun and 40 in^3 array configuration tests respectively.

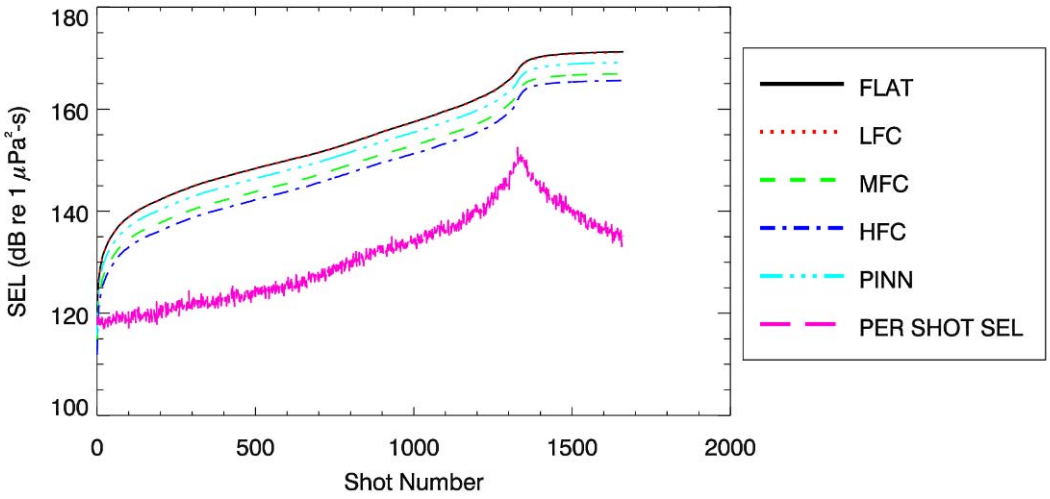

Figure 26. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the single 10 in^3 airgun recorded on OBH 1 at the Burger site. CPA for this pass was 275 m (0.17 mi).

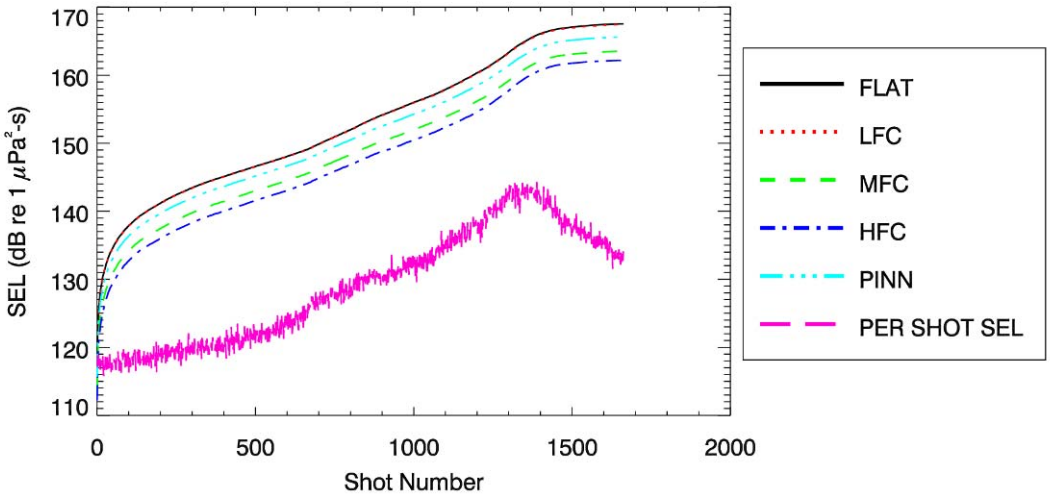

Figure 27. Flat and M-weighted cumulative SEL with flat-weighed per shot SEL from the single 10 in^3 airgun recorded on OBH 2 at the Burger site. CPA for this pass was 1070 m (0.66 mi).

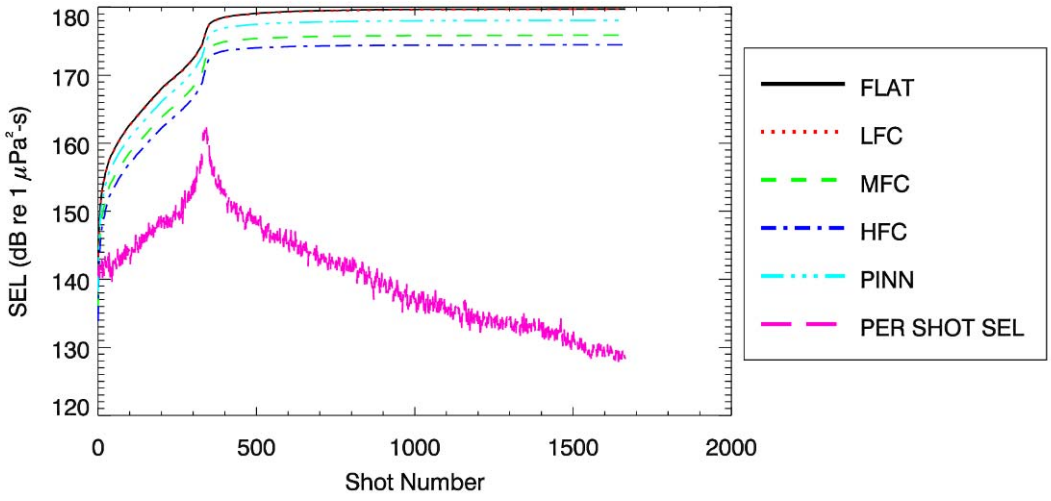

Figure 28. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the 40 in^3 array configuration recorded on OBH 1 at the Burger site. CPA for this pass was 200 m (0.12 mi).

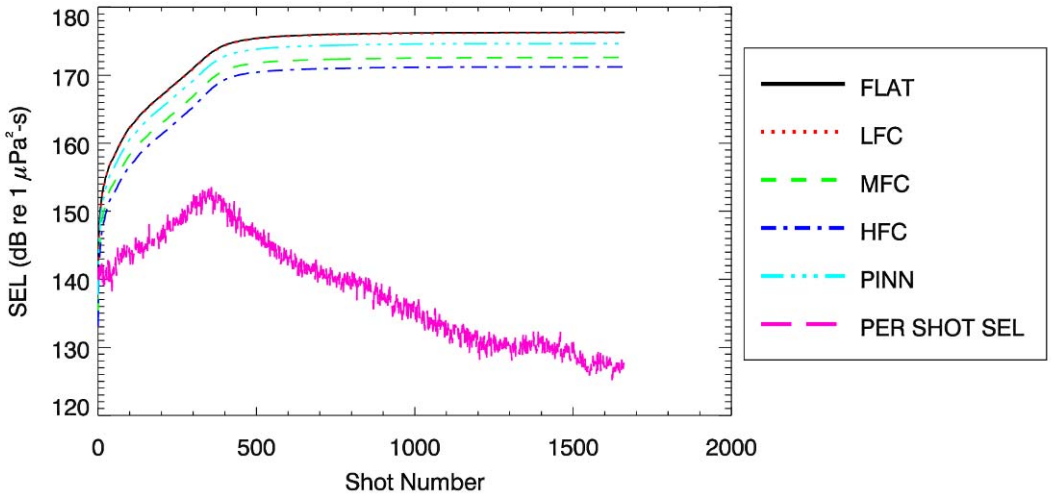

Figure 29. Flat and M-weighted cumulative SEL with flat-weighted per shot SEL from the 40 in^3 array configuration recorded on OBH 2 at the Burger site. CPA was 990 m (0.62 mi).

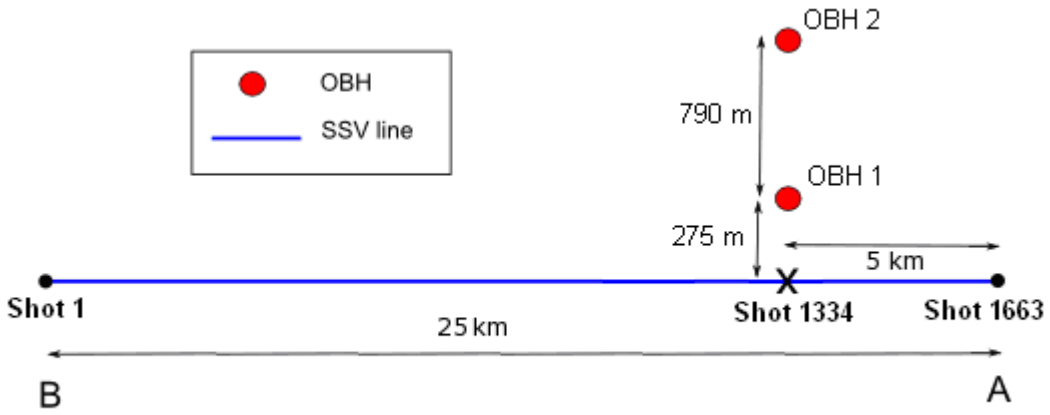

Figure 30. Diagram of the actual seismic survey line with shot points and deployed OBH locations used in the calculation of cumulative SEL at the Burger site for the single 10 in^3 airgun. Multiply by 0.62 to convert km to miles.

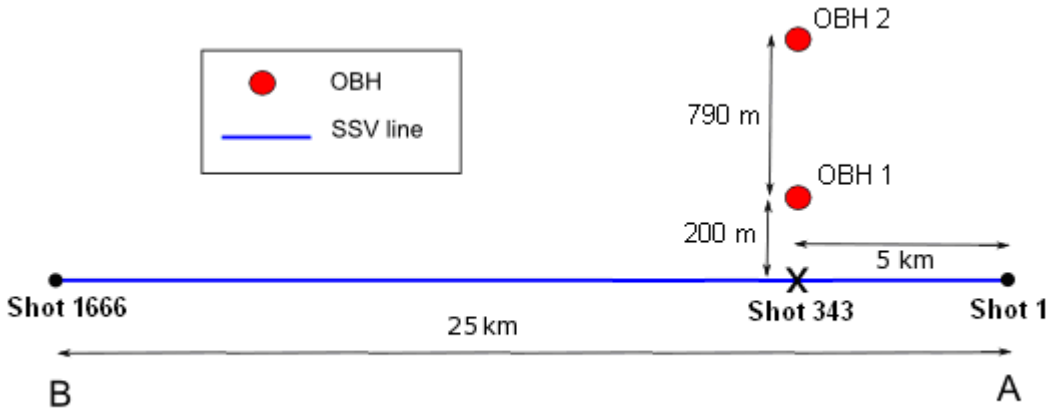

Figure 31. Diagram of the actual seismic survey line with shot points and deployed OBH locations used in the calculation of cumulative SEL at the Burger site for the 40 in^3 array configuration. Multiply by 0.62 to convert km to miles.

Table 18 provides the maximum cumulative SEL for each receiver, and Figure 32 and Figure 33 show these maxima as a function of distance off the survey line for the single 10 in^3 airgun and the 40 in^3 array configuration respectively.

Table 18. Maximum cumulative SEL for each airgun array configuration and OBH off the seismic survey line at the Burger site.

Array Volume (in^3)	*Distance off seismic survey line*	*Cumulative SEL (dB re 1 $\mu Pa^2 s$)*				
		Flat-weighted	*Low Frequency Cetaceans*	*Mid-Frequency Cetaceans*	*High Frequency Cetaceans*	*Pinnipeds underwater*
10	*275 m*	*171.2*	*171.1*	*167.0*	*165.6*	*169.2*
	1070 m	*167.6*	*167.5*	*163.5*	*162.2*	*165.6*
40	*200 m*	*179.7*	*179.7*	*175.9*	*174.5*	*178.1*
	990 m	*176.3*	*176.2*	*172.6*	*171.2*	*174.7*

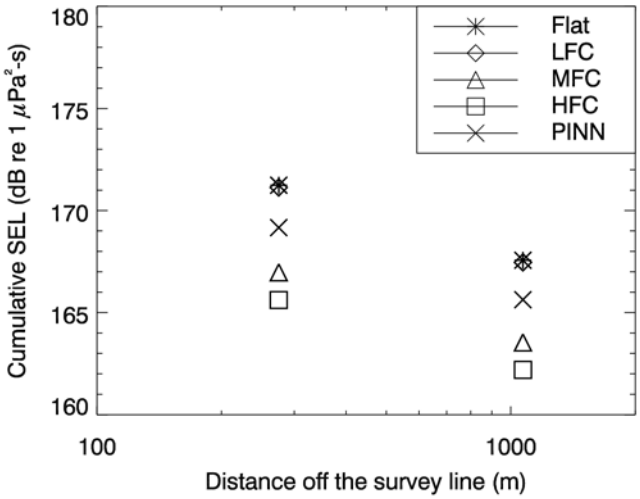

Figure 32. Cumulative SEL as a function of perpendicular distance off the survey line for the single 10 in^3 airgun at the Burger site. Multiply by 0.62 to convert km to miles.

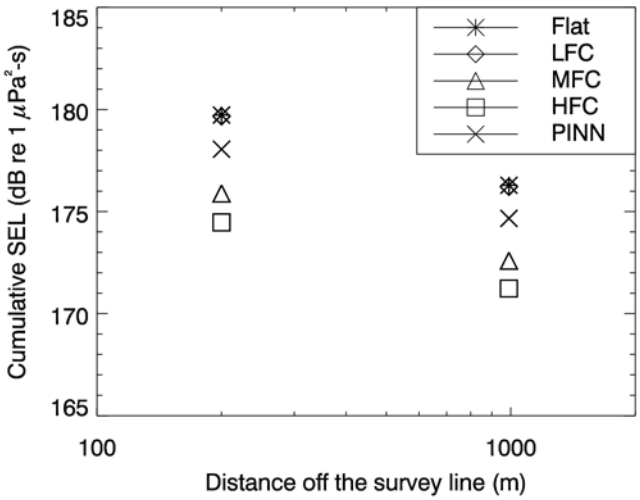

Figure 33. Cumulative SEL as a function of perpendicular distance off the survey line for the 40 in^3 array configuration at the Burger site. Multiply by 0.62 to convert km to miles.

The maximum cumulative SEL did not reach the thresholds proposed by Southall et al. (2007) for either of the two array configurations at the closest measured ranges. The distance to the injury criteria, if calculated using an equation of the form Equation 6, would be less than 1 m (3.3 ft) for all M-weighting filters and array configurations.

Sub-bottom Profiler (3.5 kHz)

SPL vs. Range

Figure 34 presents the peak, 90% *rms* and per-pulse SEL levels versus range for the 3.5 kHz sub-bottom profiler as well as the best-fit and 90th percentile trend lines and the equations thereof. A 1 kHz high pass filter was applied to the sub-bottom profiler pressure data prior to SPL calculations to isolate the profiler signal from lower frequency vessel sounds.

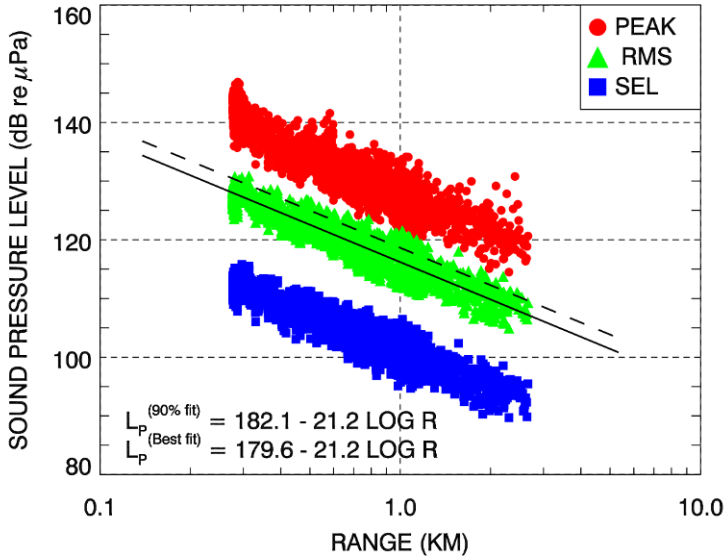

Figure 34. Peak, *rms* and per-shot SEL levels versus range for the sub-bottom profiler (3.5 kHz) at the Burger site. The solid line is the least squares best fit of Equation 6 to the *rms* values. The dashed line represents the best fit line increased by 2.4 dB to exceed 90% of all *rms* values.

Ranges to Sound Levels

The nominal ranges to the decibel levels 160, 150, 140, 130,120 and 110 dB re 1 µPa (*rms*) were computed using the best and 90th percentile equation fits presented in Figure 34. These ranges are listed in Table 19.

Table 19. Sound level distances for 160, 150, 140, 130, 120 and 110 dB re 1 μPa (*rms*) for the sub-bottom profiler (3.5 kHz) at the Burger site.

90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*
160	*8**	*11**
150	*25**	*33**
140	*75**	*98**
130	*220**	*290*
120	*660*	*860*
110	*2000*	*2600*

*Extrapolated from minimum measurement range of 275 m (0.17 mi).

Vessel Measurements

SPL vs. Range

Received sound levels from the approach and departure from the OBHs showed different trends, so we have separated those data into two plots. Figure 35 and Figure 36 present the *rms* levels versus range for the *R/V Mt Mitchell* vessel noise alone, as well as the best-fit and 90th percentile trend lines and the equations thereof.

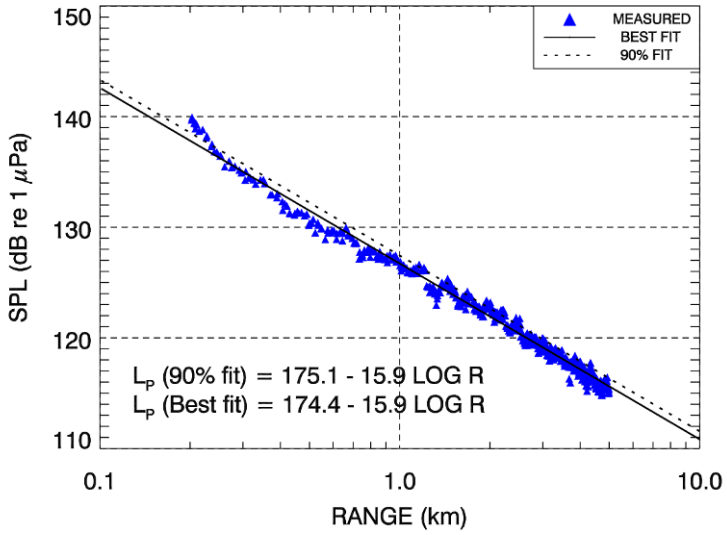

Figure 35. Sound pressure level (*rms*) versus range from the *R/V Mt Mitchell* in the bow aspect while the vessel approached the recorder at 3.5 kts at the Burger site. The solid line is the least squares best fit of Equation 6 to the *rms* values. The dashed line is the best fit increased by 0.7 dB to exceed 90% of all the *rms* values.

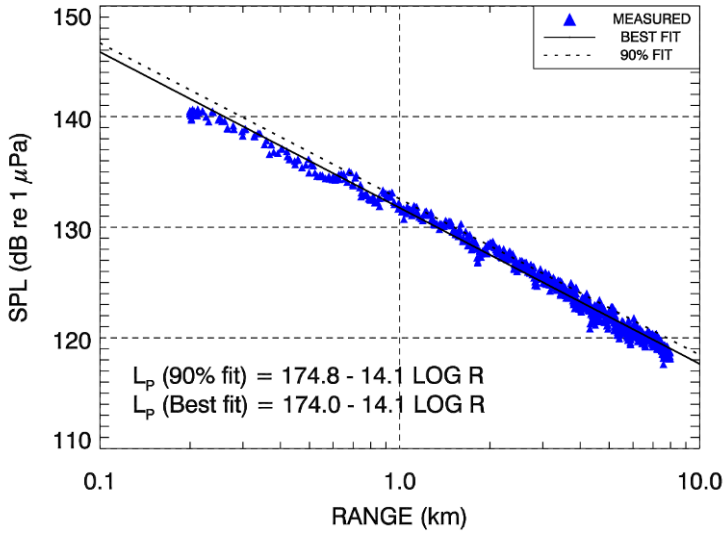

Figure 36. Sound pressure level (*rms*) versus range from the *R/V Mt Mitchell* in the aft direction while the vessel transited away at 3.5 kts at the Burger site. The solid line is the least squares best fit of Equation 6 to the *rms* values. The dashed line is the best fit increased by 0.8 dB to exceed 90% of all the *rms* values.

Ranges to Sound Levels

The distances to the sound levels of 160, 150, 140, 130, and 120 dB re 1 μPa (*rms*) are listed in Table 20. Note that the sound levels in the table for the vessel measurements have been shifted to a lower range compared to those of the louder impulsive sources.

Table 20. Sound level distances for 160-120 dB re 1 μPa (*rms*) for the *R/V Mt Mitchell* sailing at 3.5 kts at the Burger site.

	Approach (bow aspect)		*Departure (stern aspect)*	
90% rms SPL (dB re 1 μPa)	*Best fit range (m)*	*90th percentile fit (m)*	*Best fit range (m)*	*90th percentile fit (m)*
160	*8**	*9**	*10**	*11**
150	*34**	*38**	*51**	*58**
140	*150**	*160*	*260*	*300*
130	*620*	*690*	*1300*	*1500*
120	*2600*	*2900*	*6800*	*7800*

*Extrapolated from minimum measurement range of 200 m (0.12 mi).

Discussion

The measurements made at the Honeyguide and Burger sites were carried out in an almost identical manner; the same airgun and sub-bottom profiler systems were used as the sources, and the OBH recorder equipment using the same gain settings were used to capture calibrated sound level measurements. The OBH recording systems were calibrated in the field with the same

pistonphone calibrators before and after each measurement program. Water depths were also similar, approximately 48 m (160 ft) at Honeyguide and 41 m (130 ft) at Burger. The two sites were separated by approximately 165 km (103 mi).

The preliminary field analyses (Warner and Rideout, 2009a and 2009b) showed systematically higher levels at long ranges measured near the Burger prospect for all of the airgun systems and for the vessel. Interestingly, little differences between levels of the 3.5 kHz profiler were observed. The following sections provide a comparison between the measurements near the Honeyguide and Burger sites.

WAVEFORMS

Airgun Measurements

Figure 37 shows two representative waveforms from the single 10 in^3 airgun measured at 280 m (0.17 mi) horizontal range from both sites. The discussion that follows applies to the waveforms in the plot; however, waveforms from different ranges have a similar structure so this discussion also applies to waveforms from other ranges and airgun array volumes. The plot is annotated with four numbers: 1 and 2 are the pulses that arrived from the direct path for the Burger and Honeyguide sites respectively (sound energy that has travelled from the airgun to the OBH directly), and 3 and 4 are the pulses that arrived from the bottom-surface path for the Burger and Honeyguide sites respectively (sound energy that has travelled from the airgun, reflected off the seafloor, reflected off the sea surface, and arrived at the OBH). 1 and 2 were aligned to show the relative time of arrival difference between 3 and 4.

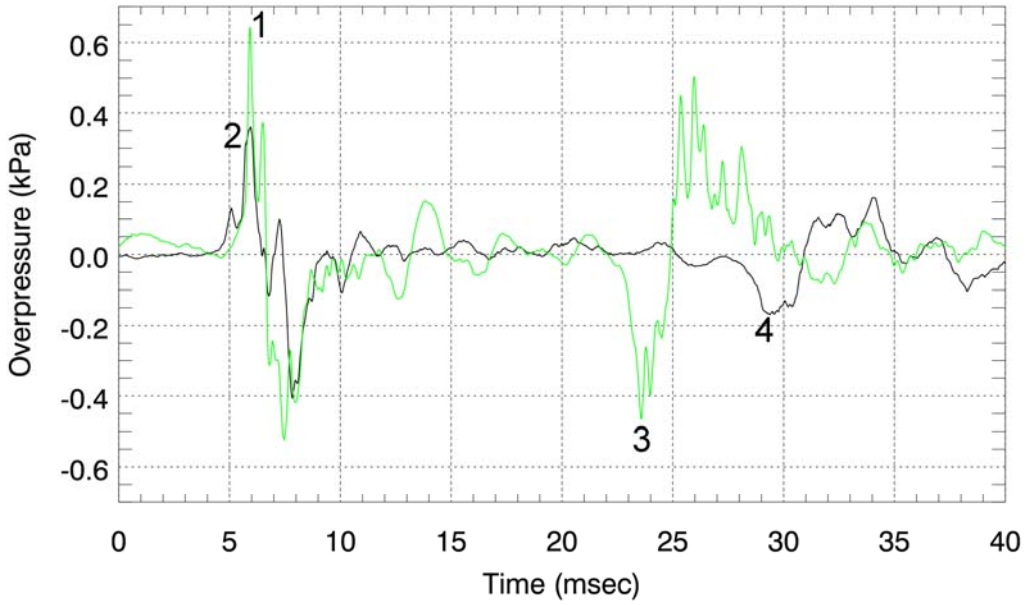

Figure 37. Waveforms from the single 10 in^3 airgun measured at 280 m (0.17 mi) range near the Honeyguide (black) and Burger (green) sites.

The waveforms show 3 arriving about 6 ms before 4. The delay results from the difference in water depth between the two sites. The Burger site is about 41 m (130 ft) deep whereas the Honeyguide site is about 47.5 m (160 ft) deep. The lesser depth at the Burger site results in a shorter path length for the bottom-surface path (see Figure 38 for a diagram). Thus the bottom-surface pulse at the Burger site arrives before that of Honeyguide. The 6 ms difference in arrival time corresponds roughly to the difference in travel path length (as a result of different water depth), with the nominal water sound speed of 1500 m/s.

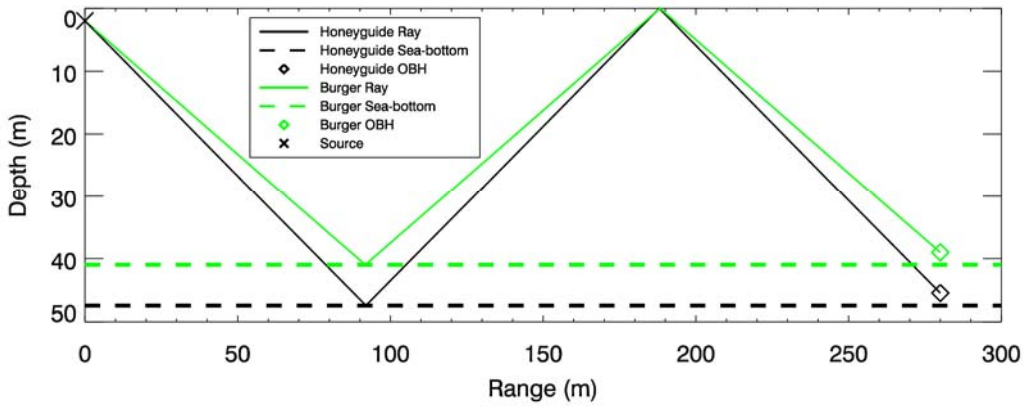

Figure 38. Diagram of the bottom-surface paths for the Honeyguide (black) and Burger (green) sites.

The peak levels from the direct path recorded at the Burger site are significantly larger than those at the Honeyguide site. The direct path (1 and 2) actually includes four slightly different paths: source – receiver, source – sea-bottom – receiver, source – surface – receiver, and source – surface – sea-bottom – receiver. Pulses arriving via these pathways arrive within about 2 ms of each other (ref. Figure 37) because at this range (280 m) the path length difference is relatively small.

The attenuation of the sea-bottom-reflected pulses is dependent on the grazing angle – the angle between the sound ray and sea-bottom. Lower grazing angles increase a reflected pulse's amplitude until a critical angle is reached; at lesser or equal angles, the reflected pulse is not attenuated. At a fixed range, the grazing angle is less at the Burger site because of the shallower water and otherwise identical source-receiver geometry. This suggests that, at least at 280 m range, the critical angle has been reached at the Burger site but not at the Honeyguide site.

The peak level of the bottom-surface pulse (3) is also significantly larger at the Burger site compared to that of the Honeyguide site (4). This results from not only the originally higher peak level of 1, but also from the more reflective bottom at the Burger site as shown by the higher ratio of the bottom-surface to direct path peak levels (1:3 vs. 2:4). This suggests that the seafloor at the Burger site is denser and has a higher sound speed. A higher sound speed reflects more high-frequency energy and prevents energy from leaking into the sub-bottom. The short, sharp peaks of the bottom-surface arrivals at the Burger site indicate that more high frequency energy has remained in the water column than at the Honeyguide site. Evidence that relatively more energy leaked into the sub-bottom at the Honeyguide site is shown as stronger head waves in the section below on Spectrograms.

Sub-bottom Sound Speeds

Figure 39 shows stacked waveforms of the pulses from the 40 in^3 airgun array at the Burger site measured at various ranges. Waveforms from the other array configurations and the Honeyguide site were similar in form and are not presented here for brevity. The vertical axis is time (increasing downwards) and the pressure varies in the horizontal axis direction. The waveforms are plotted along the horizontal axis at the range at which they were measured. The waveforms are aligned in time so that the direct path arrival is at 0.1 seconds. Positive pressures are filled in black and negative pressures are filled in green for display purposes only.

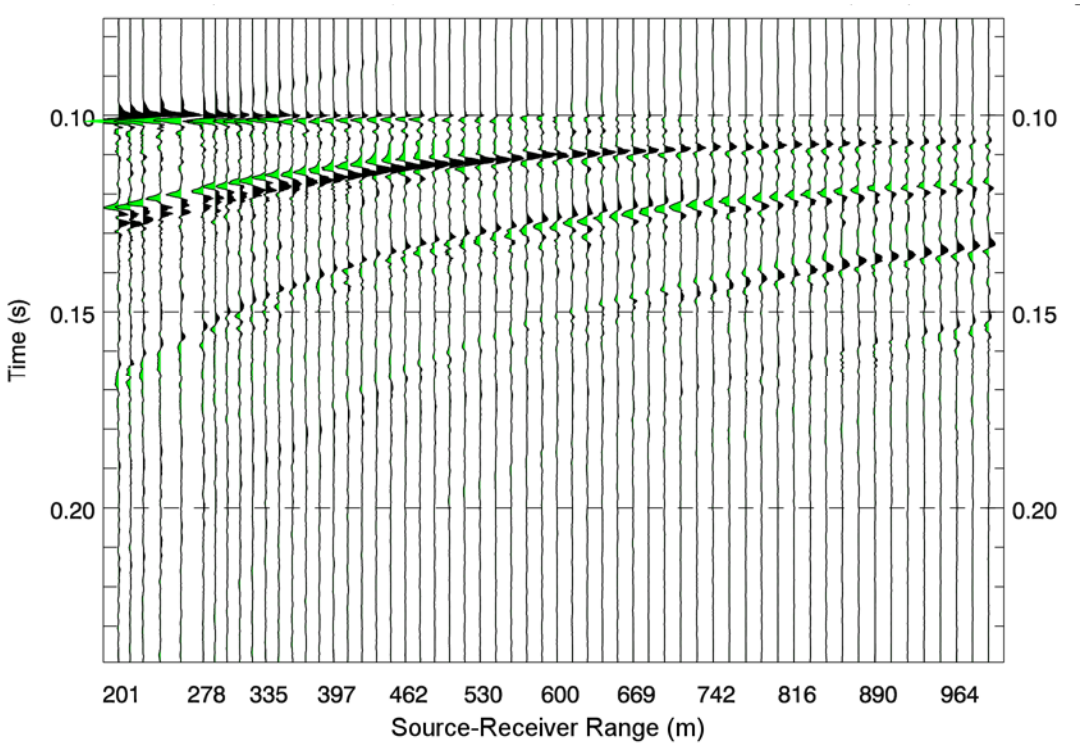

Figure 39. Stacked waveforms aligned at 0.1 seconds from the 40 in^3 airgun array at the Burger site. Waveforms are filled black (positive pressure) and green (negative pressure) for display purposes only.

The plot shows the direct path arrival dominating the signal at close ranges but diminishing to comparatively small amplitudes around about 500 m range. The bottom-surface arrival is present at all ranges plotted, starting at about 0.025 seconds after the direct path arrival (0.125 seconds in the plot) at CPA and decreasing to under 0.01 seconds after the direct path arrival (0.11 seconds in the plot). The time of the bottom-surface arrival decreases with range because the relative path length difference between the direct and bottom-surface paths decreases with range (see Figure 61 below for a diagram).

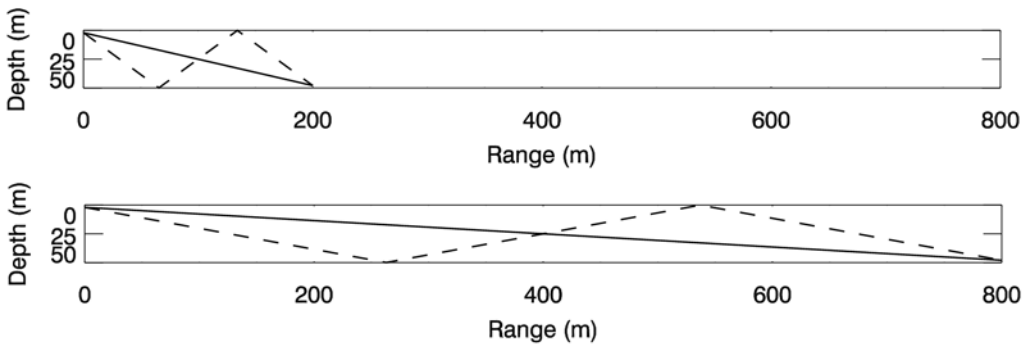

Figure 40. Diagram showing the direct paths (solid lines) and bottom-surface paths (dashed lines) for two receivers at different ranges.

Higher order paths with more bottom-surface reflections (such as the bottom-surface-bottom-surface path, etc.) are also visible in Figure 60 later in time and follow the same characteristic decrease in relative arrival time. There is also a relatively low amplitude headwave arriving before the direct path arrival at around 300 m range and is visible up to about 450 m range. These headwaves, as well as other smaller amplitude signals, are more visible after applying a time-varying energy gain correction to the waveforms. Figure 41 and Figure 42 show stacked waveforms from the Honeyguide and Burger sites respectively, after applying the time-varying energy gain correction.

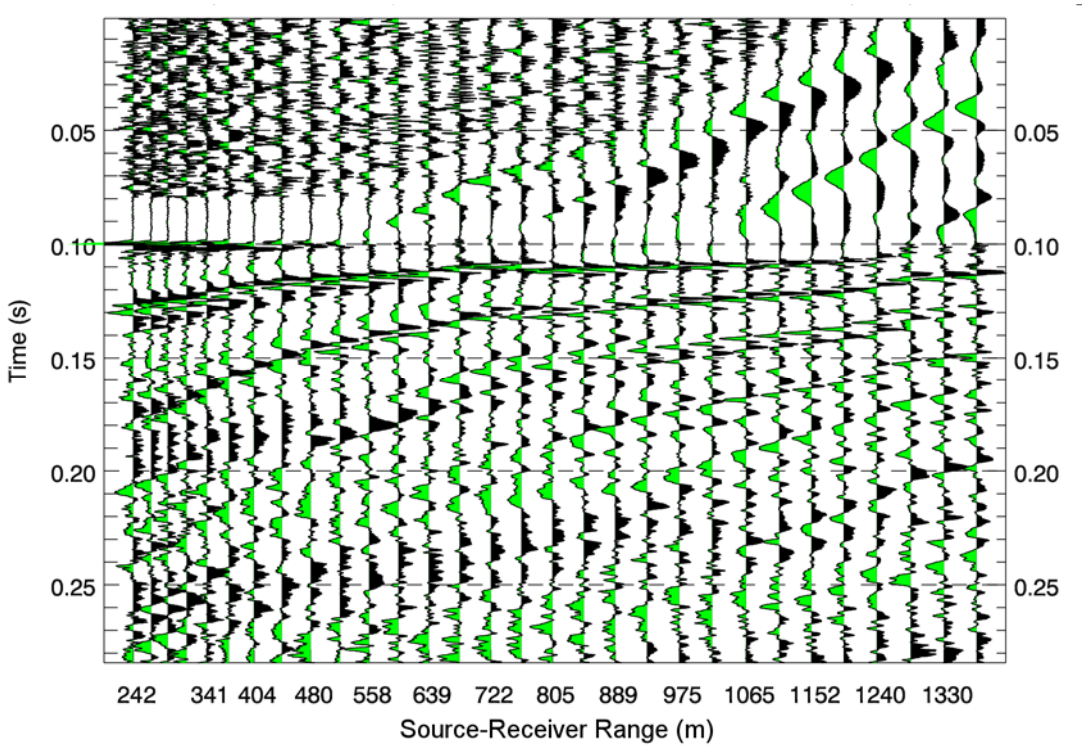

Figure 41. Stacked waveforms aligned at 0.1 seconds from the 40 in^3 airgun array at the Honeyguide site. Waveforms are filled black (positive pressure) and green (negative pressure) for display purposes only. A time-varying energy gain correction has been applied to the waveforms to better display headwaves.

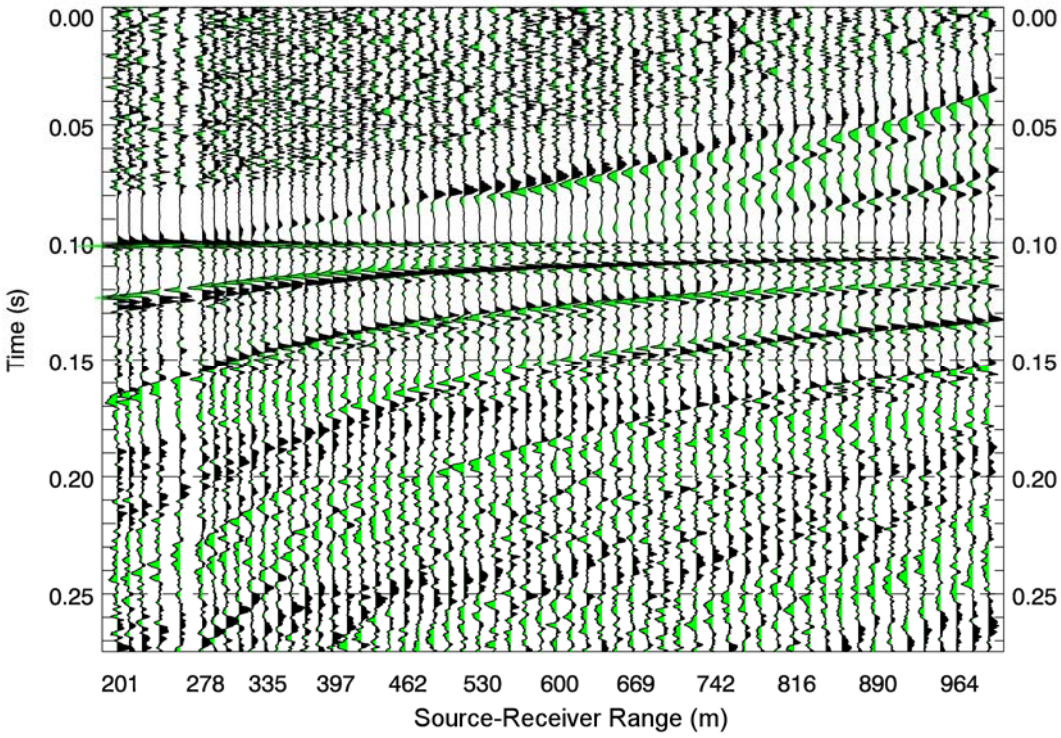

Figure 42. Stacked waveforms aligned at 0.1 seconds from the 40 in^3 airgun array at the Burger site. Waveforms are filled black (positive pressure) and green (negative pressure) for display purposes only. A time-varying energy gain correction has been applied to the waveforms to better display headwaves.

The headwaves travel in a mostly horizontal direction along a sub-bottom layer boundary, can be seen as a straight line inclined relative to the direct path arrival. The first headwave in time corresponds to the shallowest sub-bottom layer that supports headwaves. The speed of sound in these layers can be calculated from the arrival times of the headwaves and the ranges at which they were recorded. The table below presents a few of the first headwave speeds found at both measurement sites with the 40 in^3 airgun array data.

Table 21. Headwave speeds (m/s) at the Honeyguide and Burger sites from the 40 in^3 airgun array data.

Honeyguide	*Burger*
1700 m/s	*1700 m/s*
1900 m/s	*1800 m/s*

Interestingly, the speed of sound of the first headwave-supporting layer is higher at the Honeyguide site than at the Burger site. However, the arrival times of the headwaves indicates that the headwave layer at Honeyguide is deeper in the substrate than at Burger where the high-speed head wave layer is close to or at the seafloor. The lower speed layer overlying the high speed headwave layer at Honeyguide will be less reflective. The near-seafloor high speed head wave layer at the Burger site therefore receives and reflects more energy from each seabed reflection. The greater overall seabed reflectivity at Burger observed in the pulse measurements is attributed to this effect.

Sub-bottom Profiler Measurements

The sub-bottom profiler pulses contained higher frequency energy and were much smaller in amplitude than the airgun pulses. However, the same trend of a more reflective sea-bottom was found at the Burger site than at the Honeyguide site. The plots below show waveforms and spectra from the 3.5 kHz sub-bottom profiler measured at the two sites. The data were band-pass filtered from 2 to 10 kHz to reduce the vessel noise from the recordings. The waveform at the Honeyguide site shows no bottom-surface reflected contribution to the pulse. However, the bottom-surface arrival is clearly observable at the Burger site, arriving about 20 ms after the direct path. This is likely due to the lower speed top seafloor layer at Honeyguide which has much lower reflectivity than at Burger.

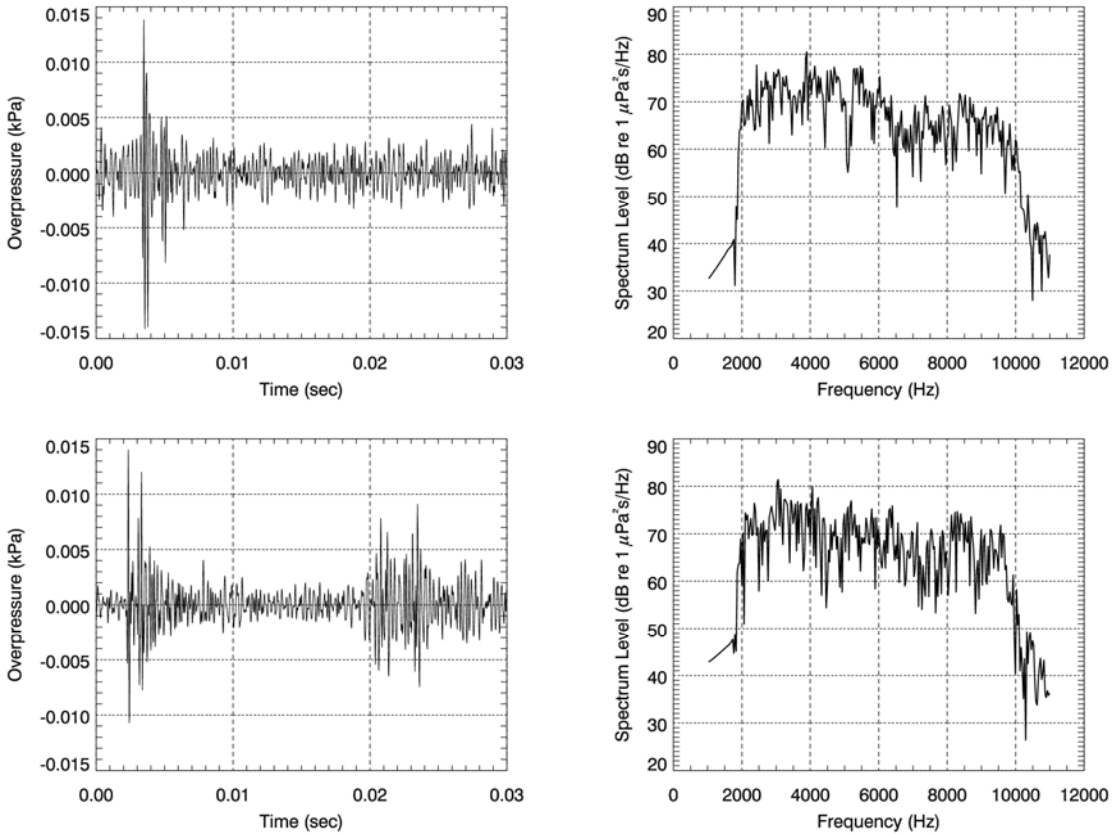

Figure 43. Waveforms and spectra of sub-bottom profiler pulses measured at the Honeyguide (top) and Burger (bottom) sites. The plots are from pulses detected at 240 and 280 m ranges for the Honeyguide and Burger sites respectively. The waveforms were band-pass filtered from 2 to 10 kHz for illustrative purposes.

Despite this difference, ranges to sound levels at the two sites had greater similarity than for the airgun sources. Sub-bottom profiler pulses penetrate the sea-bottom on the order of a few tens of meters and are therefore not reflected from as many sub-bottom layers as an airgun pulse would be. This reduces the effect of the geoacoustic seafloor properties on the profiler pulses as the received pulse does not contain as much energy from reflected pulses. Received levels at the Burger site are around 3 dB greater than those at the Honeyguide site primarily because of the

presence of the bottom-surface reflected pulse. Due to the shallow sea-bottom penetration depth and low sound level of the profiler pulses, the difference in ranges to sound levels is not as large as for the other sources.

SPECTROGRAMS

Airgun pulses at various ranges measured from the 40 in^3 configuration at the two sites are compared below in Figures 44 to 50. The pulses were analyzed to show how their spectral components change with time. Pulses from the single 10 in^3 airgun and 20 in^3 array configuration were smaller in amplitude but had a similar structure to pulses from the 40 in^3 array configuration at their corresponding sites. Pulses from the 10 in^3 and 20 in^3 configurations are not presented here for brevity; the comparison of spectrograms is more representative of the geoacoustic and hydroacoustic properties at the two sites.

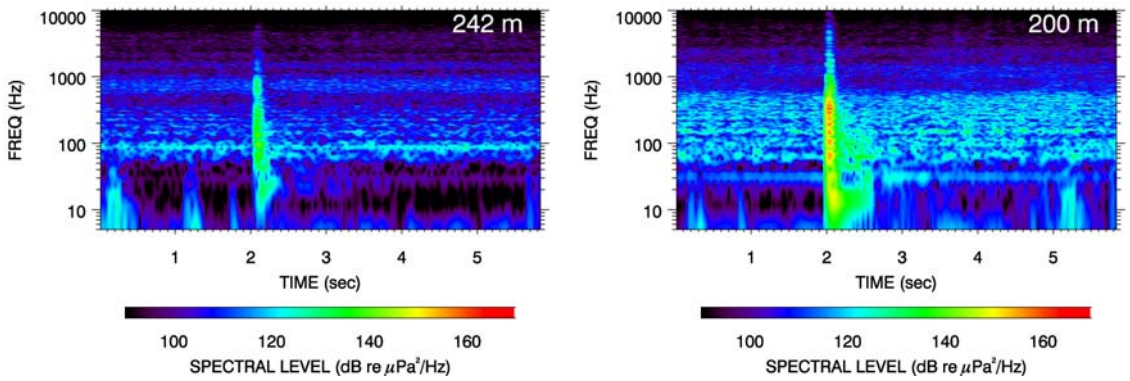

Figure 44. Spectrogram of airgun pulses from the 40 in^3 array configuration recorded at the CPA (actual ranges are annotated in the figures) for the Honeyguide (left) and Burger (right) sites. Multiply by 6.2×10^{-4} to convert m to miles.

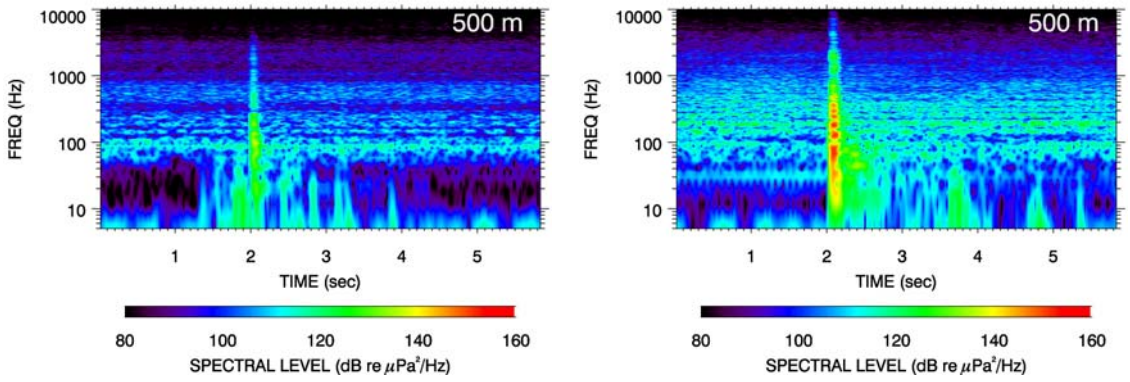

Figure 45. Spectrogram of airgun pulses from the 40 in^3 array configuration recorded at 500 m (0.31 mi) range for the Honeyguide (left) and Burger (right) sites.

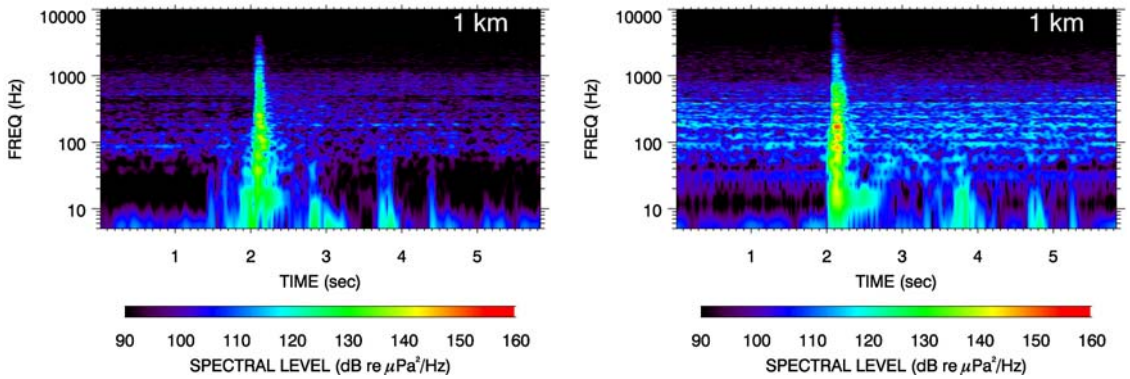

Figure 46. Spectrogram of airgun pulses from the 40 in^3 array configuration recorded at 1 km (0.62 mi) range for the Honeyguide (left) and Burger (right) sites.

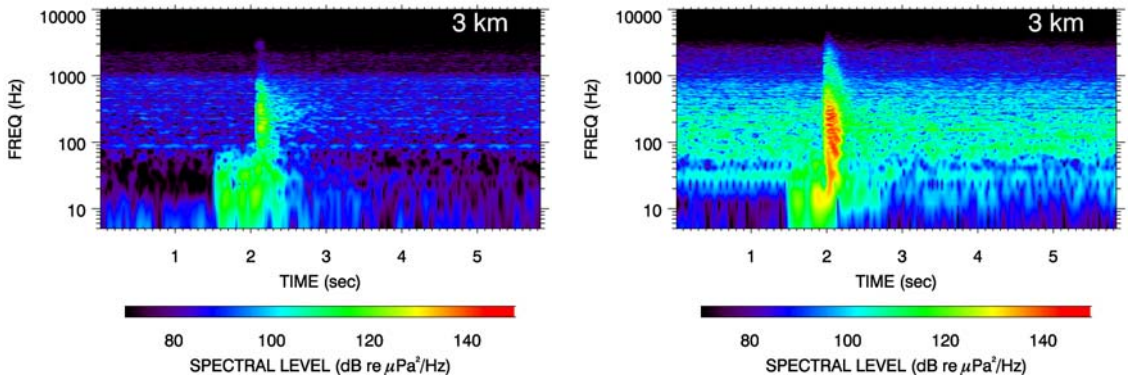

Figure 47. Spectrogram of airgun pulses from the 40 in^3 array configuration recorded at 3 km (1.9 mi) range for the Honeyguide (left) and Burger (right) sites.

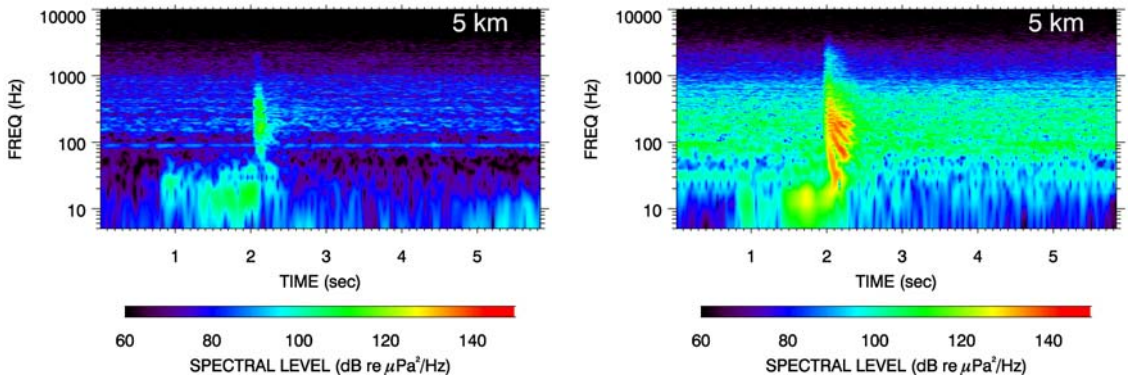

Figure 48. Spectrogram of airgun pulses from the 40 in^3 array configuration recorded at 5 km (3.1 mi) range for the Honeyguide (left) and Burger (right) sites.

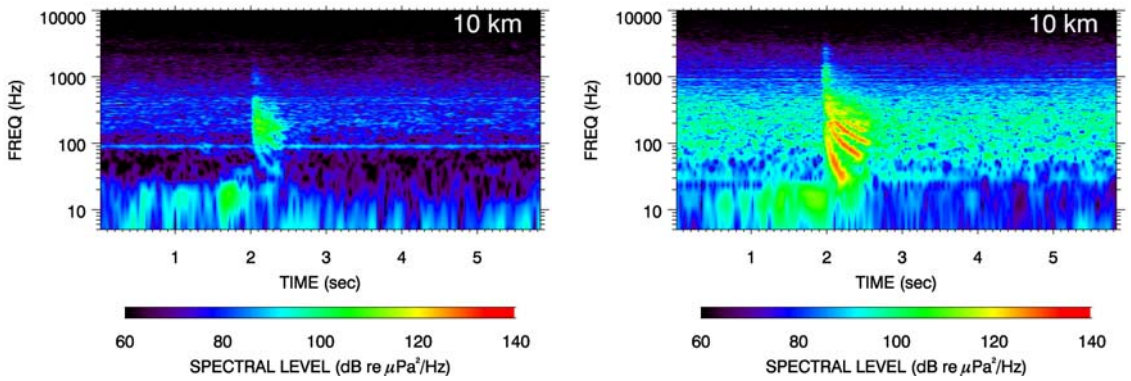

Figure 49. Spectrogram of airgun pulses from the 40 in^3 array configuration recorded at 10 km (6.2 mi) range for the Honeyguide (left) and Burger (right) sites.

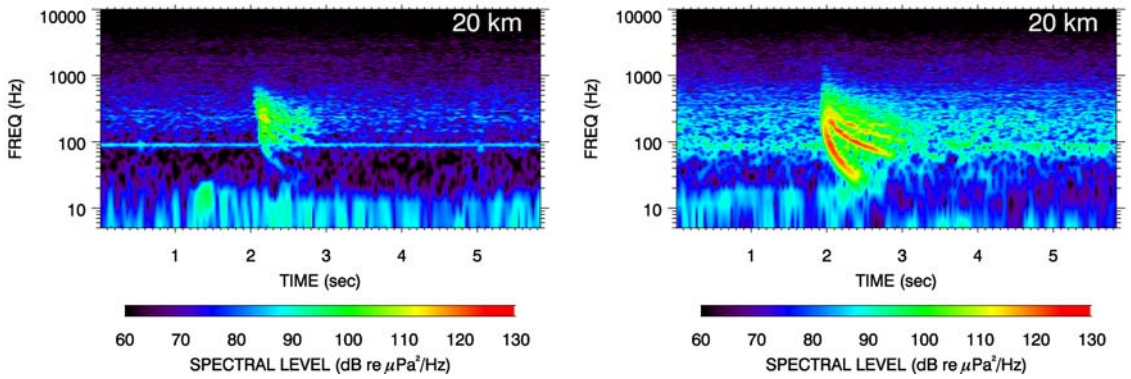

Figure 50. Spectrogram of airgun pulses from the 40 in^3 array configuration recorded at 20 km (12 mi) range for the Honeyguide (left) and Burger (right) sites.

The airgun spectrograms show that most of the pulse energy occurred between 10 Hz and 1000 Hz, with pulse levels being higher at the Burger site than at the Honeyguide site. Spectrograms from ranges around 3 km (1.9 mi) and greater at the Honeyguide site show low frequency energy (between 10 and 50 Hz) travelling through the sub-bottom and arriving up to 1 second before the waterborne energy as head waves. There are head waves at the Burger site from about 3 to 10 km (1.9 to 6.2 mi), but relative to their corresponding waterborne pulse, they contain less energy than the headwaves at the Honeyguide site. This sub-bottom propagation is stronger at the Honeyguide site because the softer bottom allows a higher fraction of energy to be transmitted into the sub-bottom whereas the harder bottom at the Burger site reflects a higher fraction of energy back into the water column.

Modal dispersion starts to become apparent at about 10 km (6.2 mi) range for the Honeyguide site and 5 km (3.1 mi) range for the Burger site, with at least three modes supported. The length of the pulse at these ranges is much larger which is discussed further in the section on RMS Length. The much stronger support for normal mode propagation at the Burger site is consistent with a harder bottom with a higher sound speed top layer. The 90 Hz tone in the background of some of the spectrogram figures was self-noise from the OBH recorder hard disk.

1/3-OCTAVE BAND LEVELS

Figure 51 shows a contour plot of 1/3-octave band pressure levels, versus range and frequency for the 40 in^3 array configuration measured at the Honeyguide (left) and Burger (right)

sites. These contour plots show the spectral distribution of sound energy measured on an OBH recorder, and also show which frequencies dominated sound propagation at the test sites. The general shapes of the contours are similar, with frequencies between 100 and 300 Hz showing the strongest propagation with range; however, the levels at the Burger site are higher than those at the Honeyguide site.

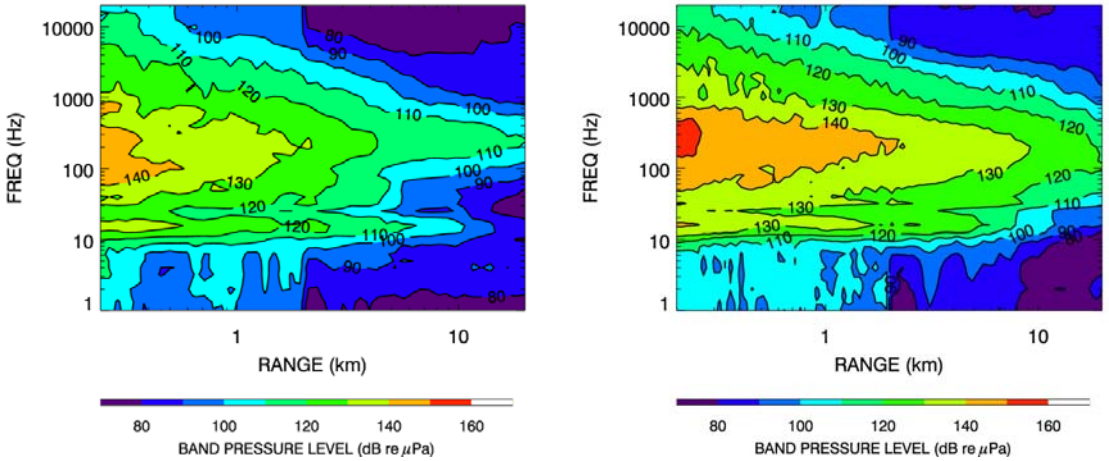

Figure 51. 1/3-octave band pressure levels as a function of range and frequency for the 40 in^3 array configuration measured at the Honeyguide (left) and Burger (right) sites. Multiply by 0.62 to convert km to miles.

RMS LENGTH

Data from the OBHs were analyzed to see how *rms* pulse duration varied with range over the test survey track lines. The automatic power-threshold detector included energy from headwaves and reflected path arrivals, and the *rms* pulse duration was calculated from the resulting time windows (ref. steps 2 and 5 in Per-shot Seismic Pulse Levels for how the pulse duration was calculated). The pulse duration showed much more variability at the Honeyguide site than at the Burger site. This may be due to the lower signal to noise ratio at the Honeyguide site.

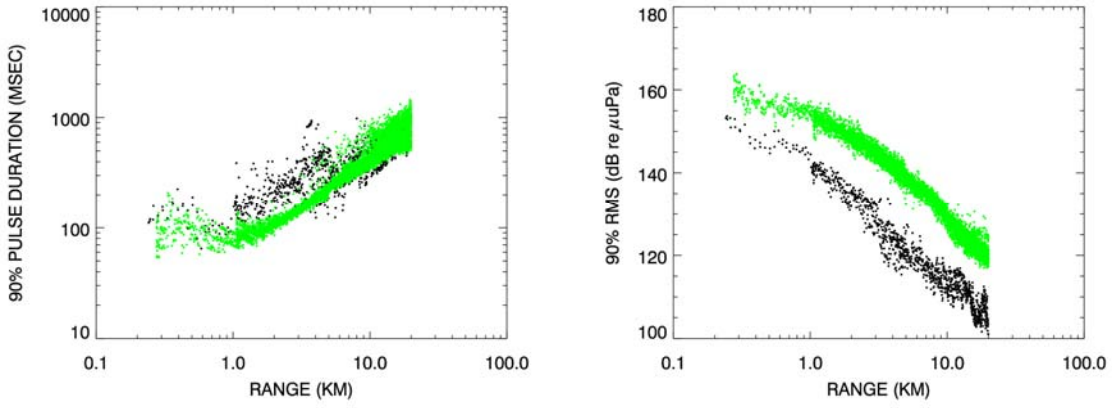

Figure 52. 90% pulse duration and *rms* level as a function of range from the single 10 in^3 airgun at the Honeyguide (black) and Burger (green) sites. Multiply by 0.62 to convert km to miles.

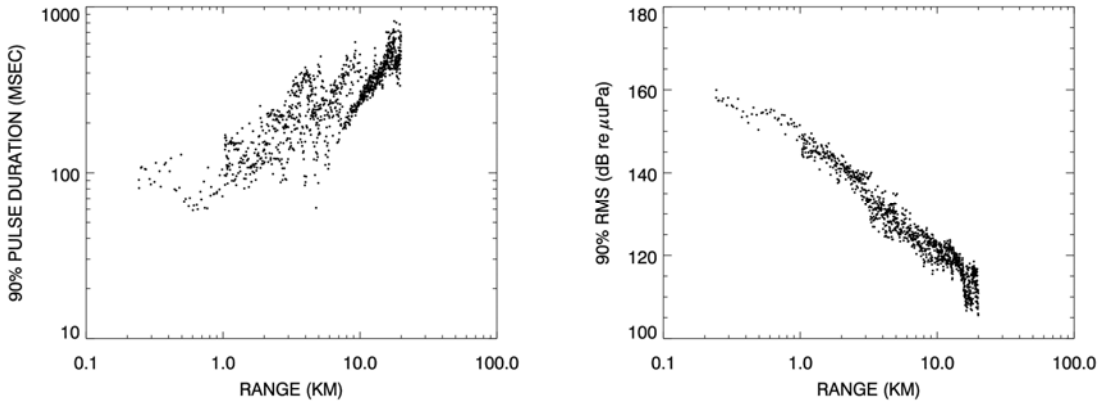

Figure 53. 90% pulse duration and *rms* level as a function of range from the 2 x 10 in^3 array configuration at the Honeyguide site. Multiply by 0.62 to convert km to miles.

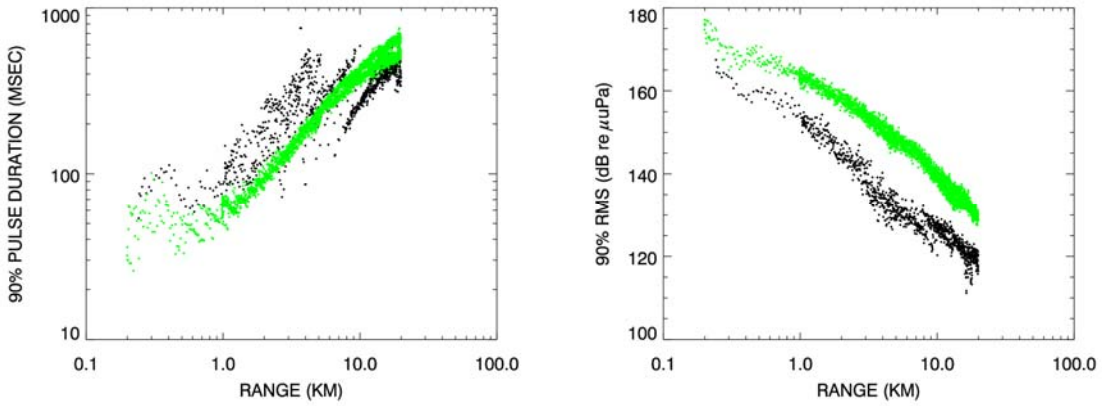

Figure 54. 90% pulse duration and *rms* level as a function of range from the 40 in^3 array configuration at the Honeyguide (black) and Burger (green) sites. Multiply by 0.62 to convert km to miles.

COMPARISON TO PREVIOUS DATA

It may be noted that the sound levels for the array measured during the SSV at the Honeyguide site were smaller than those reported for a similarly sized array at the Crackerjack C site (ref. Figure 59) in 2008 (Laurinolli & Racca, 2008). The shapes of the transmission loss curves fit to the 2008 data differ from the curves fit to the data for the Honeyguide SSV, which indicates that study-site-specific environmental properties caused the difference in received levels. The sound propagation would be affected by differences in the sound speed profile in the water column or in the nature of the interaction of the sound with the seafloor at the two measurement sites.

For geophysical reasons, Shell redesigned the source configuration that was used in the 2009 season. The total volume (40 in^3) remained the same as that used in 2008 by the *M/V Cape Flattery* in the Chukchi Sea but the physical configuration was changed in an effort to more effectively focus the energy. The effect of the redesign was to direct the high frequency components of the source energy more vertically to the seafloor. This can be likened to a focusing

effect where the high frequency energy does not spread as widely as it would in another configuration. Figure 55 below depicts the array configurations considered. In 2008 the *Cape Flattery* utilized the array configuration depicted on the left. In 2009 the *R/V Mt Mitchell* utilized the configuration in the center. All three possible configurations were evaluated prior to deployment and the center configuration was selected for its potential to reduce lateral propagation and provide higher quality data from the array. It is possible that this change in array configuration for the 2009 SSV contributed to the decrease of the Honeyguide propagation distances for the new configuration compared to those recorded in 2008. However, environmental dissimilarities as discussed above are likely the main cause for the decrease since the differences in received level were observed for even a single 10 in^3 airgun.

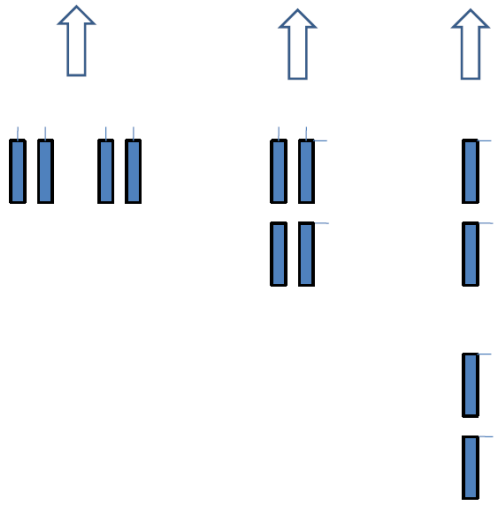

Figure 55. Possible airgun array configurations. Left: configuration from 2008. Center: configuration from 2009.

Tables to compare best fit distances to sound levels calculated from a number of SSV programs over the period 2007 to 2009. Figure 56 plots ranges corresponding to 10 in^3 arrays, Figure 57 plots ranges corresponding to 20 in^3 arrays, and Figure 58 plots ranges corresponding to 40 in^3 arrays. Table 22 presents details of the specific measurement programs and Figure 59 presents the locations of these programs on a map.

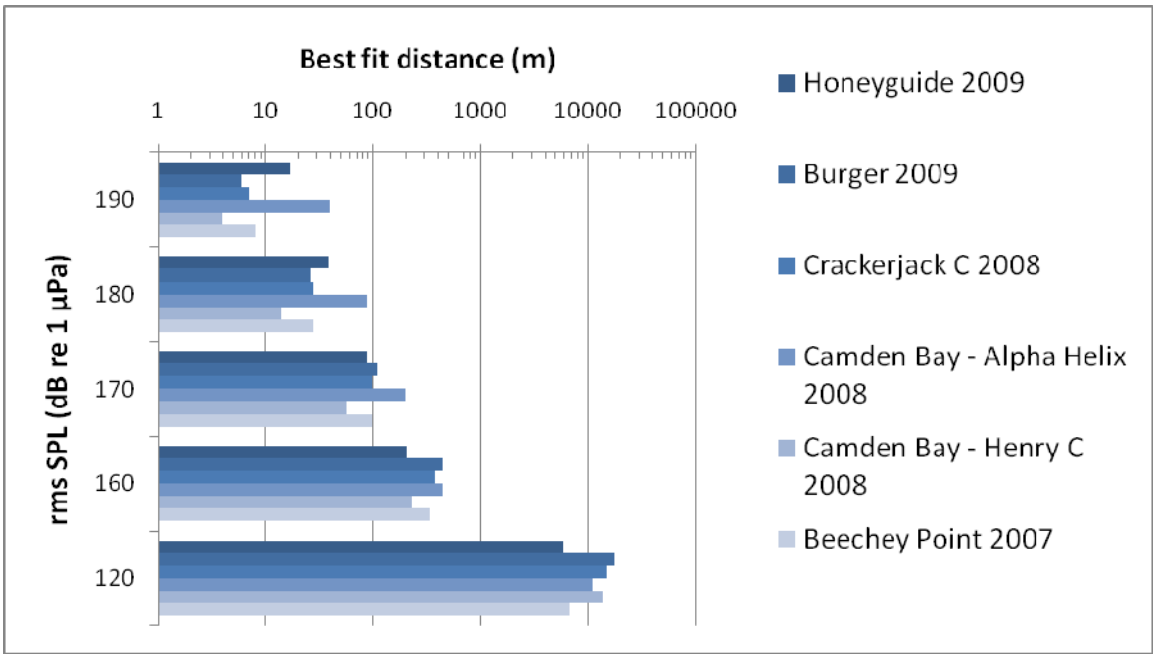

Figure 56. Best fit distances (m) to sound levels (dB re 1 µPa) from various SSV programs with 10 in^3 arrays.

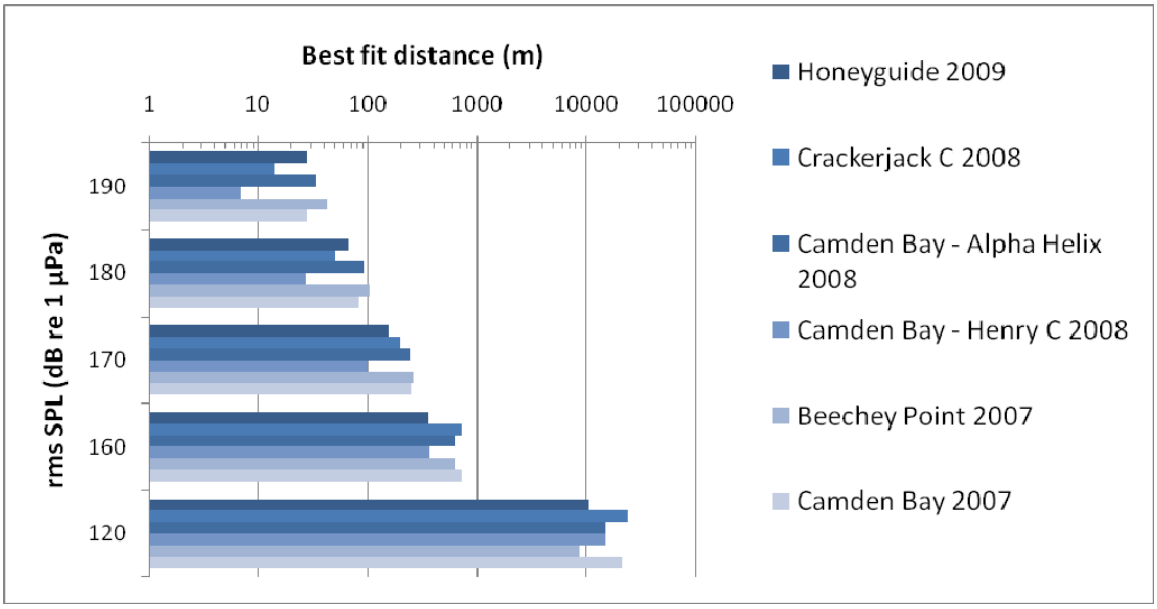

Figure 57. Best fit distances (m) to sound levels (dB re 1 µPa) from various SSV programs with 20 in^3 arrays.

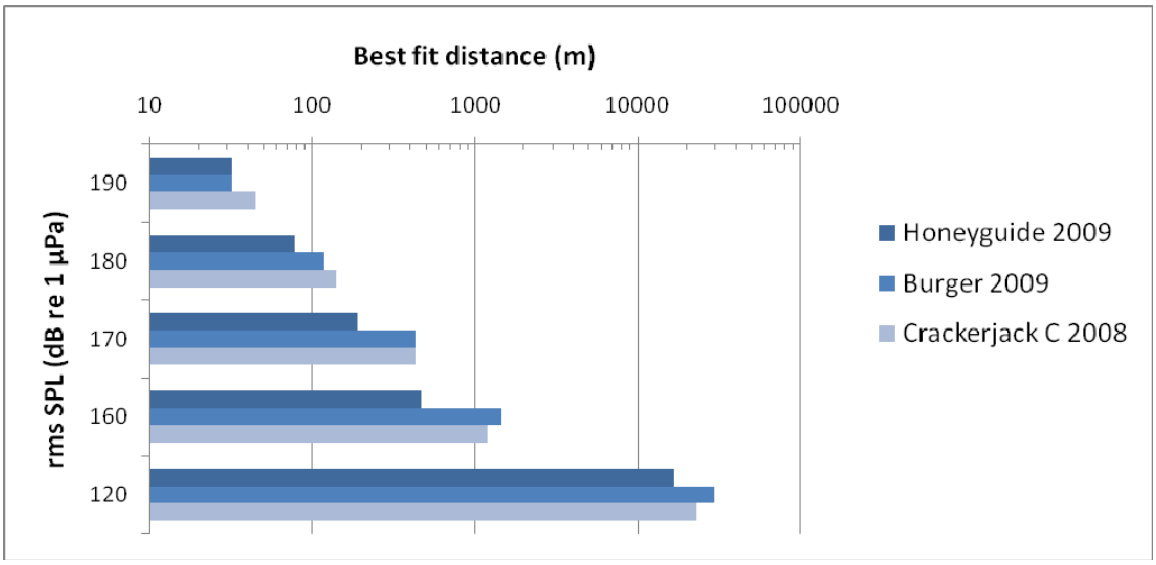

Figure 58. Best fit distances (m) to sound levels (dB re 1 µPa) from various SSV programs with 40 in^3 arrays.

Table 22. Details of the current and previous SSV measurement programs with similar airgun array volumes.

Measurement Program	*Water Depth (m)*	*Latitude*	*Longitude*	*Array Configurations**
Honeyguide 2009	*48 (157 ft)*	*71.1115*	*168.2791*	*40, 20, and 10 in^3*
Burger 2009	*41 (135 ft)*	*71.2906*	*163.6298*	*40 and 10 in^3*
Crackerjack C 2008	*45 (148 ft)*	*71.2065*	*166.2872*	*40, 20, and 10 in^3*
Camden Bay – Alpha Helix 2008	*22 (72 ft)*	*70.2668*	*145.9499*	*20 and 10 in^3*
Camden Bay – Henry C 2008	*33 (108 ft)*	*70.4077*	*146.0413*	*20 and 10 in^3*
Beechey Point 2007	*22 (72 ft)*	*70.7123*	*148.788*	*20 and 10 in^3*
Camden Bay 2007	*35 (115 ft)*	*70.3962*	*146.5721*	*20 and 10 in^3*

*See the Experimental Configuration section for the array configuration used for the 2009 measurement programs. The array configuration used at the Crackerjack C site was four 10 in^3 sleeve guns suspended from floats in a rectangular arrangement at a separation of 61 cm (2 ft) horizontally and 46 cm (1.5 ft) vertically. The arrays used at the Camden Bay and Beechey Point sites consisted of two 10 in^3 airguns horizontally separated by 50 cm (20 in) perpendicular to the tow direction.

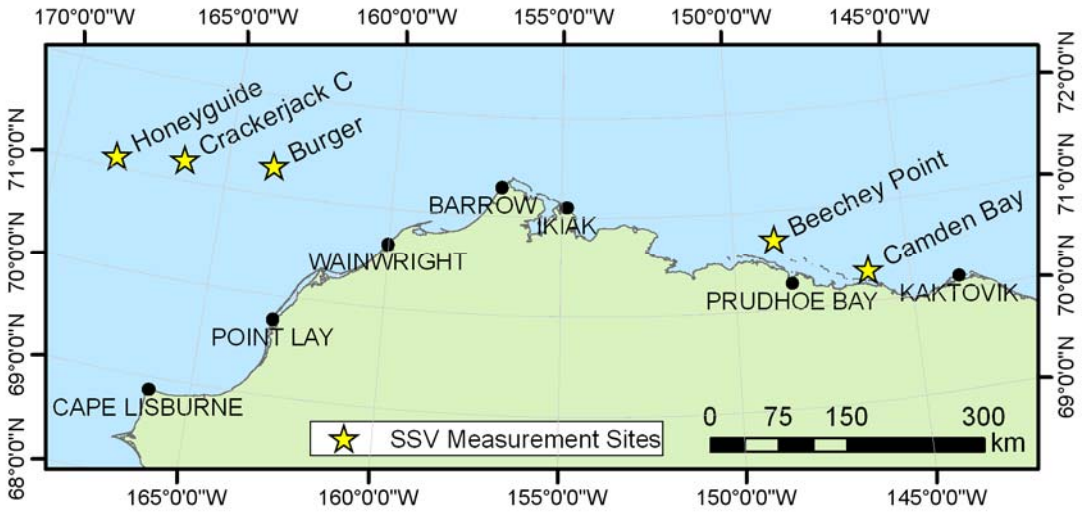

Figure 59. Locations of shallow hazards SSV measurements from 2007 to 2009.

COMPARISON TO SAFETY RADII AS STIPULATED IN THE IHA

The IHA for this project dated 19 Aug 2009, stipulated exclusion and monitoring safety zones for seismic vessel mitigation. The safety radii corresponding to the 160 dB, 180 dB and 190 dB re 1 µPa *rms* thresholds were 1400 m, 160 m, and 50 m (4590, 525, and 164 ft) respectively. The following table compares the stipulated ranges to the measured and extrapolated 90th percentile ranges at both the Honeyguide and Burger sites.

Table 23. Comparison of ranges to thresholds as specified in the IHA and as measured in the field.

Site	*Airgun Array Volume (in^3)*	*Ranges (m) to Threshold Levels (dB re 1 µPa)*					
		190 dB		*180 dB*		*160 dB*	
		IHA	*measured*	*IHA*	*measured*	*IHA*	*measured*
Honeyguide	*10*	*50 m*	*23 m*	*160 m*	*52 m*	*1400 m*	*280 m*
Honeyguide	*20*	*50 m*	*37 m*	*160 m*	*86 m*	*1400 m*	*460 m*
Honeyguide	*40*	*50 m*	*41 m*	*160 m*	*99 m*	*1400 m*	*600 m*
Burger	*10*	*50 m*	*8 m*	*160 m*	*34 m*	*1400 m*	*570 m*
Burger	*40*	*50 m*	*39 m*	*160 m*	*150 m*	*1400 m*	*1800 m*

Ranges to 190 dB *rms* and to 180 dB *rms* as specified in the IHA were greater than measured in the field at both sites. For the 40 in^3 array configuration measured at the Burger site, the 160 dB rms range was greater than the one set in the IHA. This exception aside, the IHA ranges were set conservatively.

Conclusion

The underwater sound measurement program for Shell's 2009 Shallow Hazards Survey provided calibrated high-quality recordings of sounds from an airgun array in three different configurations, a sub-bottom profiler, and the *R/V Mt Mitchell* itself. Sound pressure data were analyzed to determine the distances to sound level thresholds that were required for the setting of exclusion or monitoring zones for marine mammals. The IHA dated 19 Aug 2009 stipulated safety and monitoring ranges for seismic vessel mitigation. These ranges were 50, 160, and 1400 m (164, 525, and 4590 ft) corresponding to SPL *rms* thresholds of 190 dB, 180 dB, and 160 dB re 1 µPa respectively. One requirement of the IHA was that field source verification measurements be undertaken and ranges to thresholds be verified.

Honeyguide

The sound level measurement study at the Honeyguide site in the Chukchi Sea quantified sound levels produced by the three configurations of the 40 in^3 airgun array out to 20 km (12 mi) maximum range. The array pressure data were analyzed to determine the distances to sound level thresholds: 190, 180, 170, 160, and 120 dB re 1 µPa (*rms*). These distances are given in Table 24.

Table 24. Sound level distances for the 10, 20, and 40 in^3 airgun array configurations at the Honeyguide site.

90% rms SPL (dB re 1 µPa)		*190*	*180*	*170*	*160*	*120*
10 in^3 airgun range (m)	*Best fit*	*17**	*39**	*89**	*210**	*5900*
	90th percentile	*23**	*52**	*120**	*280*	*7900*
20 in^3 airgun array range (m)	*Best fit*	*28**	*66**	*150**	*360*	*11000*
	90th percentile	*37**	*86**	*200**	*460*	*14000*
40 in^3 airgun array range (m)	*Best fit*	*32**	*78**	*190**	*470*	*17000*
	90th percentile	*41**	*99**	*240*	*600*	*22000‡*

*Extrapolated from minimum measurement range of 240 m (0.15 mi).
‡Extrapolated from maximum measurement range of 20000 m (1.2 mi).

Measurements of sound levels produced by the sub-bottom profiler and seismic vessel *R/V Mt Mitchell* were made immediately following the airgun array measurements. Ranges to noise levels are presented in Table 13 and Table 14 for the sub-bottom profiler and *R/V Mt Mitchell* respectively. The 90th percentile range to the 120 dB re 1 µPa (*rms*) sound level for the *R/V Mt Mitchell* was 1500 m (0.93 mi).

Burger

The sound level measurement study at the Burger site in the Chukchi Sea quantified sound levels produced by two configurations of the 40 in^3 airgun array out to 20 km (12 mi) maximum range. The array pressure data were analyzed to determine the distances to sound levels: 190, 180, 170, 160, and 120 dB re 1 µPa (*rms*). These distances are given in Table 25.

Table 25. Sound level distances for the 10 and 40 in^3 airgun array configurations at the Burger site.

90% rms SPL (dB re 1 µPa)		*190*	*180*	*170*	*160*	*120*
10 in^3 airgun range (m)	*Best fit*	*6**	*26**	*110**	*440*	*18000*
	90th percentile	*8**	*34**	*140**	*570*	*19000*
40 in^3 airgun array range (m)	*Best fit*	*32***	*120***	*430*	*1500*	*29000‡*
	90th percentile	*39***	*150***	*530*	*1800*	*31000‡*

*Extrapolated from minimum measurement range of 275 m (0.17 mi).
**Extrapolated from minimum measurement range of 200 m (0.12 mi).
‡Extrapolated from maximum measurement range of 20000 m (1.2 mi).

Measurements of sound levels produced by the sub-bottom profiler and seismic vessel *R/V Mt Mitchell* were made during the airgun array measurements. Ranges to noise levels are presented in Table 19 and Table 20 for the sub-bottom profiler and *R/V Mt Mitchell* respectively. The 90th percentile range to the 120 dB re 1 µPa (*rms*) sound level for the *R/V Mt Mitchell* was 7800 m (4.8 mi). This range was calculated from measurements taken behind the *R/V Mt Mitchell*.

A comparison of the measured and extrapolated ranges to thresholds for the airgun arrays to the ranges stipulated in the IHA shows that the IHA was somewhat precautionary in most instances. For all arrays at both sites, the ranges specified in the IHA were larger than the ranges measured in the field, with one exception: the 160 dB range of the 40 in^3 array configuration measured at Burger (1800 m) was longer than the corresponding range specified in the IHA (1400 m).

Additional analyses of airgun shot data are presented in this report as waveforms, spectrograms, 1/3-octave band levels, and *rms* pulse durations. A comparison to data from previous underwater sound measurement programs is also given. These analyses show that the higher received levels from airguns at the Burger site are due primarily to the site-specific geoacoustic properties of the sea-bottom. The important characteristic appears to be a high speed layer at or very close to the seafloor at Burger.

A further analysis of the airgun array data was performed to compute M-weighted cumulative SEL. This metric was recently proposed as an alternative to the *rms* metric that has been applied in the past for the marine mammal take estimates (Southall et al., 2007). M-weighted cumulative SEL was computed at the nominal OBH positions 200 and 1000 m (0.12 and 0.62 mi) off the seismic survey lines. The levels corresponding to those distances are shown in Table 11 for the Honeyguide site and Table 18 for the Burger site. None of the array configurations produced maximum cumulative SEL levels that reached the injury criteria thresholds proposed by Southall et al. (2007) at the receiver sites. Extrapolations of the maximum cumulative SEL injury thresholds to shorter ranges gave distances less than 1 m (3.3 ft) for all airgun array configurations, sites, and M-weighting filters. Peak level injury threshold distances were also calculated and found to be less than the distance based on the *rms* metric. Those distances are presented in Table 10 for the Honeyguide site and Table 17 for the Burger site. In conclusion, the SPL *rms* criteria set in the IHA are more conservative than the Southall et al. 2007 criteria.

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4. MONITORING, MITIGATION, AND DATA ANALYSIS METHODS [1]

This chapter describes the marine mammal monitoring and mitigation measures implemented for Shell's shallow hazard and site clearance survey in the Chukchi Sea during the 2009 open-water season. The required measures were detailed in the IHAs and LoA (Appendices A and B) issued to Shell by NMFS and USFWS, respectively. It also describes the methods used to categorize and analyze the monitoring data collected by observers and reported in the following chapter.

Monitoring Tasks

The main purposes of the vessel-based monitoring program were to ensure that the provisions of the IHA and LoA issued to Shell were satisfied, effects on marine mammals and subsistence use were minimized, and residual effects on animals were documented. Tasks specific to monitoring are listed below (also see Appendices A and B):

- use of dedicated Marine Mammal Observers (MMOs) aboard the seismic source vessel, R/V *Mt. Mitchell*, to visually monitor the occurrence and behavior of marine mammals near the airguns when the airguns are operating and during a sample of the times when they are not;
- record (insofar as possible) the effects of the airgun operations and the resulting sounds on marine mammals;
- use the visual monitoring data as a basis for implementing the required mitigation measures;
- estimate the number of marine mammals potentially exposed to airgun sounds at specified levels.

Safety and Potential Disturbance Radii

Under current NMFS guidelines (e.g., NMFS 2000), "safety radii" for marine mammals around airgun arrays are customarily defined as the distances within which received pulsed sound levels are ≥180 dB re 1 µPa (rms) for cetaceans and ≥190 dB re 1 µPa (rms) for pinnipeds. The ≥180 dB and ≥190 dB (rms) guidelines were also employed by the USFWS for the species under its jurisdiction (Pacific walrus and polar bear, respectively) in the LoA issued to Shell. These safety criteria are based on an assumption that seismic pulses at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels *might* have some such effects. Marine mammals exposed to pulsed sound levels ≥160 dB (rms) are assumed by NMFS to be potentially subject to behavioral disturbance. The following section provides summaries of the measured safety radii and how they were implemented by MMOs during 2009 survey operations described in this report.

Safety radii from Shell's 2008 *Cape Flattery* Sound Source Verification (SSV) in conjunction with shallow hazard and site clearance survey work at the Crackerjack prospect area (Table 4.1), which used a similar airgun array, were implemented for mitigation purposes at the beginning of the 2009 *Mt. Mitchell* survey until results of the 2009 SSV measurements were available. Shell conducted multiple SSVs in 2009 to facilitate the implementation of site specific safety radii in all of its 2009 survey locations. The first 2009 SSV was conducted at the Honeyguide prospect area on 1 Aug (Table 4.2). The second 2009 SSV occurred on 16 Aug at the Burger prospect area (Table 4.3). Dates of seismic operations and the corresponding safety radii that were implemented during survey operations are summarized in Table 4.4. Prospect area locations are shown in Fig. 2.1.

[1] By D. S. Ireland, R. Rodrigues, and C. M. Reiser (LGL).

TABLE 4.1. Final radii for measurements of the ≥190, 180, 170, 160, 150, 140, 130, and 120 dB (rms) distances (in km) for sound pulses from the 40–in^3 array and the 10–in^3 mitigation airgun deployed from R/V *Cape Flattery* at the Crackerjack prospect area, Alaskan Chukchi Sea, 2008.

Received Sound Level (dB rms)	Final Radii [a]	
	4-airgun array (40 in^3)	1 airgun (10 in^3)
≥190	0.050	0.008
≥180	0.160	0.032
≥170	0.490	0.120
≥160	1.400	0.440
≥150	3.700	1.500
≥140	8.200	4.200
≥130	15.100	9.300
≥120	24.000	16.000

[a] Hannay and Warner (2009)

These radii were finalized following 2008 field operations, thus, no "Preliminary Radii" are shown as in Tables 4.2 and 4.3.

TABLE 4.2. Comparison of measurements of the ≥190, 180, 170, 160, 150, 140, 130, and 120 dB (rms) distances (in km) for sound pulses from the 40–in^3 array and the 10–in^3 mitigation airgun deployed from M/V *Mt. Mitchell* at the Honeyguide prospect area, Alaskan Chukchi Sea, 2009.

Received Sound Level (dB rms)	4-airgun array (40 in^3)		1 airgun (10 in^3)	
	Preliminary Radii [a]	Final Radii [b]	Preliminary Radii [a]	Final Radii [b]
≥190	0.033	0.041	0.017	0.023
≥180	0.083	0.099	0.040	0.052
≥170	0.213	0.244	0.098	0.120
≥160	0.546	0.597	0.237	0.278
≥150	-	1.470	-	0.642
≥140	-	3.590	-	1.480
≥130	-	8.810	-	3.420
≥120	23.500	21.600	8.140	7.890

[a] Warner and Rideout (2009a)

[b] Warner et al. (2009)

TABLE 4.3. Comparison of measurements of the ≥190, 180, 170, 160, 150, 140, 130, and 120 dB (rms) distances (in km) for sound pulses from the 40–in^3 array and the 10–in^3 mitigation airgun deployed from M/V *Mt. Mitchell* at the Burger prospect area, Alaskan Chukchi Sea, 2009.

Received Sound Level (dB rms)	4-airgun array (40 in^3)		1 airgun (10 in^3)	
	Preliminary Radii [a]	Final Radii [b]	Preliminary Radii [a]	Final Radii [b]
≥190	0.036	0.039	0.008	0.008
≥180	0.138	0.146	0.034	0.034
≥170	0.517	0.527	0.141	0.141
≥160	1.785	1.770	0.569	0.569
≥150	-	5.060	-	2.030
≥140	-	11.300	-	5.610
≥130	-	20.400	-	11.600
≥120	30.800	31.300	19.400	19.400

[a] Warner and Rideout (2009b)

[b] Warner et al. (2009)

TABLE 4.4. Dates, Prospect area, and safety radii used aboard the *Mt. Mitchell* during seismic operations in the Alaskan Chukchi Sea, 2009.

Date	**Prospect Area**	**Safety Radii Used[a]**
1 Aug	Honeyguide	2008 Crackerjack SSV
7 - 8 Aug	Burger	2009 Honeyguide SSV
10 Aug	Ulu	2009 Honeyguide SSV
11 - 12 Aug	Ulu	2008 Crackerjack SSV
13 - 14 Aug	Burger	2008 Crackerjack SSV
16 Aug	Burger	2008 Crackerjack SSV
21 - 27 Aug	Burger	2009 Burger SSV
7 - 8 Sep	Burger	2009 Burger SSV
10 - 11 Sep	Burger	2009 Burger SSV
12 - 14 Sep	Honeyguide	2009 Honeyguide SSV
15 - 16 Sep	Burger	2009 Burger SSV
26 - 28 Sep	Burger	2009 Burger SSV
30 Sep	Caramel	2008 Crackerjack SSV
1 - 2 Oct	Snickers	2008 Crackerjack SSV

[a] Safety Radii Used: Values of safety radii are shown in Tables 4.1 - 4.3

The measured sound radii from the two *Mt. Mitchell* SSVs in 2009 were similar to the 2008 radii from the *Cape Flattery* SSV at Crackerjack (Tables 4.1–4.3). More extensive analysis of the 2009 field measurements was completed after the field season, as described in Chapter 3 of this report. Those analyses resulted in some refinements of the various 2009 radii (Tables 4.2 and 4.3). The refined values were not available for use by the MMOs in the field. However, the refined estimates were used during processing of the monitoring data presented in Chapter 5 and to estimate the numbers of marine mammals exposed to various sound levels.

Mitigation Measures as Implemented

Through pre-season meetings with coastal communities and stakeholders, the location and timing of *Mt. Mitchell* survey activities, especially in relation to subsistence uses of marine mammals, was determined. These discussions were some of the most significant mitigation measures implemented in 2009. The primary mitigation measures that were implemented during survey operations included ramp up, power down, and shut down of the airguns. In addition, numerous marine mammal sightings, particularly Pacific walrus sightings, were mitigated through the use of course alteration and reduction of vessel speed. These mitigation measures are standard procedures during seismic cruises and are described in detail in Appendix F. Mitigation also included those measures specifically identified in the IHA and LoA (Appendices A and B) as indicated below.

Standard Mitigation Measures

Standard mitigation measures implemented during the study included the following:

1. Safety radii implemented for the seismic activities were determined based on the preliminary results of field measurements of sound sources reported by JASCO (Warner and Rideout 2009a.b; Chapter 3; Tables 4.1–4.3).
2. Power-down or shut-down procedures were implemented when a marine mammal was sighted within or approaching the applicable safety radius while the airguns were operating.
3. A change in vessel course and/or speed alteration, when practicable, was implemented if a marine mammal was detected outside the safety radius and, based on its position and motion relative to the ship track, was judged likely to enter the safety radius.
4. A ramp-up procedure was implemented whenever operation of the airguns was initiated if >10 min had elapsed since shut down or power down of the full array airguns.
5. In order for seismic operations to start up, the entirety of the largest applicable safety radius to be monitored by MMOs on the vessel must have been visible and clear of marine mammals for at least 30 min.

The specific procedures applied during power downs, shut downs, and ramp ups are described in Appendix F. Briefly, a ***power down*** involved reducing the number of operating airguns from the four-airgun array to a single "mitigation" airgun, when a marine mammal was observed approaching or was first detected already within the full array safety radius. Power down also occurred when the *Mt Mitchell* was between seismic survey lines (e.g., turns) to reduce the amount of sound energy introduced into the water. A ***shut down*** involved suspending operation of all airguns. A shut down was implemented if a marine mammal was sighted within or approaching the mitigation gun safety radius either after the full array had been powered down or upon initial observation. A ***ramp up*** involved a gradual increase in the number of airguns operating (from no airguns firing) and was usually accomplished by addition of one or two airguns to the operating array once every five minutes. In this report, when a ramp up was initiated while the mitigation airgun had been firing it is referred to as a ***power up***. A ramp up, also called a "cold-start," could not be initiated during times when the full safety radius was not visible to MMOs for 30 minutes if the mitigation gun had not been firing. A power up could be initiated during times when the full safety radii were not visible if the mitigation gun had been firing within 10 minutes prior to the power up.

Special Mitigation Measures as Required by NMFS

In addition to the standard safety radii based on the ≥190 and ≥180 dB (rms) distances for pinnipeds and cetaceans, respectively, NMFS (in the IHA) required Shell to monitor the ≥160 dB radius for aggregations of 12 or more non-migratory bowhead or gray whales during all seismic activities. To survey the ≥160 dB zone for aggregations of whales, MMOs searched the area using "Big Eye"

binoculars from the *Mt. Mitchell's* flying bridge in addition to the standard visual monitoring methods conducted from the bridge, which are described in detail in the section below.

Visual Monitoring Methods

Visual monitoring methods were designed to meet the requirements specified in the IHA and LoA (see above and Appendices A and B). The primary purposes of MMOs were as follows: ***(1)*** Conduct monitoring and implement mitigation measures to avoid or minimize exposure of cetaceans and walruses to airgun sounds with received levels ≥180 dB re µPa (rms), or of other pinnipeds and polar bears to ≥190 dB (rms). ***(2)*** Conduct monitoring and implement mitigation measures to avoid or minimize exposure of groups of 12 or more bowhead or gray whales to airgun sounds with received levels ≥160 dB. ***(3)*** Document numbers of marine mammals present, any reactions of marine mammals to seismic activities, and whether there was any possible effect on accessibility of marine mammals to subsistence hunters in Alaska. Results of vessel-based monitoring effort are presented in Chapters 5.

The visual monitoring methods that were implemented during Shell's 2009 shallow hazard and site clearance survey were similar to those used during various previous seismic cruises conducted under IHAs since 2003. The standard visual observation methods are described below and in Appendix F.

In summary, at least one MMO onboard the *Mt. Mitchell* vessel maintained a visual watch for marine mammals during all daylight hours while airguns were in use. Observers focused their search effort forward and to the sides of the vessel but also searched aft of the vessel occasionally. Watches were conducted with the unaided eye, Fujinon 7×50 reticle binoculars, Zeiss 20×60 image stabilized binoculars, and Fujinon 25×150 "Big-Eye" binoculars. MMOs requested seismic operators to power down or shut down the airguns if marine mammals were sighted within or about to enter applicable safety radii.

Data Analysis

Categorization of Data

Observer effort and marine mammal sightings were divided into several analysis categories related to environmental conditions and vessel activity. The categories were similar to those used during various other recent seismic studies conducted under IHAs in this region (e.g., Ireland et al. 2009, Funk et al. 2008, Ireland et al. 2007a,b, Patterson et al. 2007). These categories are defined briefly below, with a more detailed description provided in Appendix F.

Data were categorized by the geographic region and time period in which they were collected for reporting in Chapter 5. Only sightings and effort from vessel activities north of Point Hope (68.34 °N) were included in the Chukchi Sea Study Area (Fig. 2.1). Vessel activity occurred from late Jul into the second week of Oct, and the data were categorized into separate seasonal periods. Data collected in Jul and Aug were categorized together and separated from data collected in Sep and Oct.

In order to present meaningful and comparable data, especially for purposes of considering the potential effects of seismic activity on the distribution and behavior of marine mammals, effort and sightings data were categorized by sighting conditions, operational conditions, and other vessel proximity. These data categorization definitions were intended to exclude periods of observation effort when conditions would have made it unlikely to detect marine mammals that were at the surface. If such data were to be included in analyses, important metrics like sightings rates and densities would be biased downward. Therefore, effort and sightings occurring under the following conditions were excluded from many summaries and analyses appearing in Chapter 5:

- periods 3 min to 1 h for pinnipeds and polar bears, or 2 h for cetaceans, after the airguns were turned off (post-seismic period);
- periods when ship speed was <3.7 km/h (2 kt);
- periods when one or more vessels were operating within 5 km (3.1 mi) for cetaceans and 1 km (0.6 mi) for pinnipeds in the forward 180° of the survey vessel;
- periods with seriously impaired visibility including:
  - all nighttime observations;
  - visibility distance <3.5 km (2.2 mi);
  - Beaufort wind force (Bf) >5 (Bf >2 for Minke whales, belugas, and porpoises; See Appendix G for Beaufort wind force definitions);
  - >60º of severe glare in the forward 180° of the vessel.

Data were categorized as "seismic", "non-seismic", or "post-seismic" to allow comparison of sightings during these different operational states. Seismic data included those collected from the *Mt. Mitchell* while the airguns were operating. "Post-seismic" periods were from 3 min to 1 h (pinnipeds and polar bears) or 3 min to 2 h (cetaceans) after cessation of seismic activity and were excluded from analyses as noted above. The 3 minutes after airguns stopped was included in the seismic category because any marine mammals sighted within that time would have likely been present in very nearly the same location when seismic survey activity had been occurring given the relatively slow vessel speed during operations (~7.4 km/h, or 4 kt, average). The 1 and 2 h post-seismic periods correspond to the time required for a source vessel to transit to an area in which the received sound level would not have been likely to have much (if any) effect on the distributions of marine mammals, or for animals to return to the area where operations had been occurring. "Non-seismic" data included all data before the airguns were activated and after the respective post-seismic periods were complete.

This categorization system was designed primarily to distinguish potential differences in behavior and distribution of marine mammals with and without seismic surveys. The rate of recovery toward "normal" during the post-seismic period is uncertain. Marine mammal responses to seismic sound likely diminish with time after the cessation of seismic activity. The end of the post-seismic period was defined as a time long enough after cessation of airgun activity to ensure that any carry-over effects of exposure to sounds from the airguns would have waned to zero or near-zero. The reasoning behind these categories was explained in MacLean and Koski (2005) and Smultea et al. (2004) and is discussed in Appendix F.

Line Transect Estimation of Densities

Marine mammal sightings during the seismic and non-seismic periods were used to calculate separate sighting rates (# / 1000 km) and densities (# / 1000 km^2) of marine mammals near the *Mt. Mitchell* during those periods. Density calculations were based on line-transect principles (Buckland et al. 2001). Several correction factors for animals not detected at greater distances from the vessels, $f(0)$, were calculated from data collected during 2006–2008 surveys in the same areas of the Chukchi Sea. Correction factors for animals near the vessel but underwater and therefore unavailable for detection by observers, $g(0)$, were taken from related studies as summarized by Koski et al. (1998) and Barlow (1999). This was necessary because of the inability to assess trackline sighting probability, $g(0)$, during a project of this type. Further details on the line transect methodology used during the survey are provided in Appendix F.

Densities estimated from non-seismic observations have been used (below) to estimate the numbers of animals that presumably would have been present in the absence of seismic activities. Densities during non-seismic periods have been used to estimate the numbers of animals present near the seismic operation and

exposed to various sound levels. The difference between the two estimates could be taken as an estimate of the number of animals that moved in response to the operating seismic vessel, or that changed their behavior sufficiently to affect their detectability by visual observers.

Estimating Numbers Potentially Affected

For purposes of the IHA, NMFS assumes that any marine mammal that might have been exposed to airgun pulses with received sound levels ≥160 dB re 1 µPa (rms) may have been appreciably disturbed and therefore "taken." When calculating the number of mammals potentially affected, we used the appropriate measured ≥160 dB radii (Tables 4.1–4.3).

In addition to the number of animals actually observed within the ≥160 dB rms zone during seismic activities, two calculations were made to estimate the numbers of marine mammals that may have been potentially exposed to sound levels ≥160, ≥170, ≥180, and ≥190 dB re 1 µPa (rms):

1. Estimates of the number of *individual* mammals exposed (one or more times), and
2. Estimates of the average numbers of potential *exposures per individual*.

The first calculation involved multiplying the area assumed to be ensonified to the specified level by the estimated marine mammal densities based on MMO observations during non-seismic periods. The second calculated the average number of times a given area of water within the seismic survey area was ensonified to the specified level. Thus, animals that remained in areas of water ensonified on more than one occasion, due to overlapping or adjacent tracklines, may have been exposed on multiple occasions.

This approach was originally developed to estimate numbers of seals potentially affected by seismic surveys in the Alaskan Beaufort Sea conducted under IHAs (Harris et al. 2001). The method has recently been used in estimating numbers of seals and cetaceans potentially affected by other seismic surveys conducted under IHAs (e.g., Ireland et al. 2009, Funk et al. 2008, Ireland et al. 2007a,b, Patterson et al. 2007).

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5. VESSEL-BASED MARINE MAMMAL MONITORING RESULTS[1]

Monitoring Effort and Marine Mammal Encounter Results

This section summarizes the visual observer effort and marine mammal sightings from the *Mt. Mitchell* during Shell's 2009 shallow hazard and site clearance survey in the Alaskan Chukchi Sea. The survey period began when the *Mt. Mitchell* entered the Chukchi Sea study area on 30 Jul 2009 (AKDT) and ended when the *Mt. Mitchell* departed the Chukchi Sea study area on 9 Oct 2009.

The *Mt. Mitchell* traveled along a total of 12,260 km (7618 mi) of trackline in the Chukchi Sea Study Area (Fig. 2.1). Airgun operations occurred along 2477 km (1520 mi) of that trackline. The four-airgun array was either ramping up or operating at full array volume (40 in^3) along 1781 km (1107 mi) of trackline. The single mitigation gun (10 in^3) operated along 696 km (432 mi), including turns for line changes and a single power down for a marine mammal sighting. The airguns did not operate along the remaining 9783 km (6079 mi) of trackline in the Chukchi Sea.

MMOs were on watch for a total of 10,241 km (6363 mi; 1177 hr). Over 99% of this visual observation effort was conducted from the *Mt. Mitchell's* bridge (eye height 10.8 m or 11.8 yd). MMOs observed from the *Mt. Mitchell's* flying bridge (eye height 13.2 m or 14.4 yd) for 48 km (30 mi; 5 hr) to clear marine mammal exclusion zones prior to airgun operations. MMOs remained on watch during all nighttime operations when airguns were active, which totaled 565 km (351 mi; 93 hr) of the total 2477 km (1520 mi; 413 hr) of active-airgun trackline). Of the visual observation effort, 1786 km (1110 mi; 200 hr) occurred during darkness.

MMOs observed a total of 190 groups of marine mammals (266 individuals) from the *Mt. Mitchell* during Chukchi Sea survey operations. Seven of the 266 individuals were carcasses, and they consisted of one unidentified mysticete whale, three unidentified pinnipeds, two unidentified seals, and a Pacific walrus. NMFS Stranding Reports were submitted for all carcasses ((Appendix L). Detailed marine mammal sightings data are available in Appendix Table J.1 and Appendix K.

To allow for meaningful comparisons of monitoring results, only the MMO effort (5502 km or 3419 mi for cetaceans; 5632 km or 3500 mi for pinnipeds) and sightings (203 individuals in 140 groups) data that met the analysis criteria are presented below. See Chapter 4, *Data Analysis,* and Appendix E for analysis criteria and a detailed discussion of the empirical rationale behind these criteria. The exceptions to applying analysis criteria are in "*Mitigation Measures Implemented*" and "*Estimated Number of Marine Mammals Present and Potentially Affected*" where all observation effort and sightings are considered.

Other Vessels

The *Mt. Mitchell* did not have a dedicated support vessel and rarely operated within 5 km (3.1 mi) of other vessels during survey operations. Proximity to other vessels may have influenced the number and behavior of marine mammals sighted from the *Mt. Mitchell*, however, the extent of this potential influence was unlikely to have been significant. Vessels not participating in the survey transited well away from survey activities, and MMOs observed no instances of harassment or disturbance to marine mammals due to the presence of other vessels.

Visual Survey Effort

In contrast to the large differences between cetacean and pinniped monitoring effort reported from larger seismic surveys in 2007 and 2008 (Funk et al. 2008, Ireland et al. 2009), there was little difference

[1] By Craig M. Reiser, Danielle M. Savarese, Beth Haley, and Joseph Beland

between cetacean (5502 km or 3419 mi) and pinniped effort (5632 km or 3500 mi) during project operations aboard the *Mt. Mitchell*. Given that cetacean and pinniped effort differed by less than three percent during the current shallow hazard and site clearance survey, only cetacean effort is discussed in this section describing survey effort. Detailed visual observation effort data for cetaceans and pinnipeds are found in Appendix Tables J.2 and J.3

Effort by Seasonal Period

Over 65% of the total MMO visual survey effort was conducted during Jul-Aug compared to the Sep-Oct period (Fig. 5.1). Less visual effort met the analysis criteria during the Sep-Oct period due to growing darkness and higher sea conditions. Additionally, the *Mt. Mitchell* spent several weeks transiting outside the Chukchi Sea study area during Sep-Oct, and effort data from those transit periods are not presented in this chapter. Many of the monitoring results presented in the following sections were divided into these two seasonal periods given the biological significance of seasonality and differences in environmental conditions between these periods.

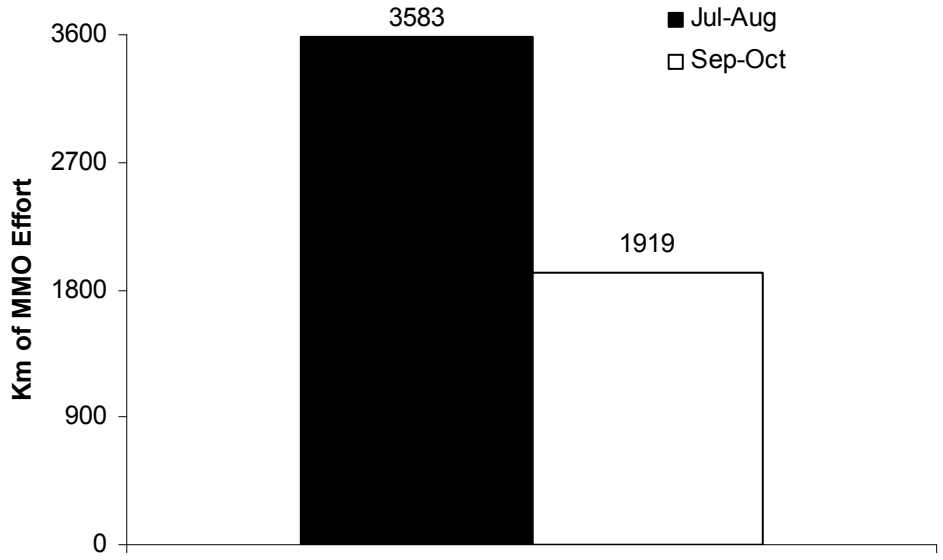

FIGURE 5.1. Marine mammal observer effort (km) by seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Effort by Beaufort Wind Force

A greater proportion of visual survey effort from the *Mt. Mitchell* occurred during periods of Bf 3–5 in Jul-Aug compared to Sep-Oct (Fig. 5.2). Nearly 84% of the visual effort was conducted during periods when the Bf was ≤ 4 for both seasons combined.

Effort by Seismic State

Nearly 75% of the MMO visual observation effort from the *Mt. Mitchell* occurred during non-seismic operations during the combined Jul-Aug and the Sep-Oct periods (Fig. 5.3). The difference in visual survey effort between seismic and non-seismic periods reflected the fact that 80% of the survey trackline did not involve the use of active airguns.

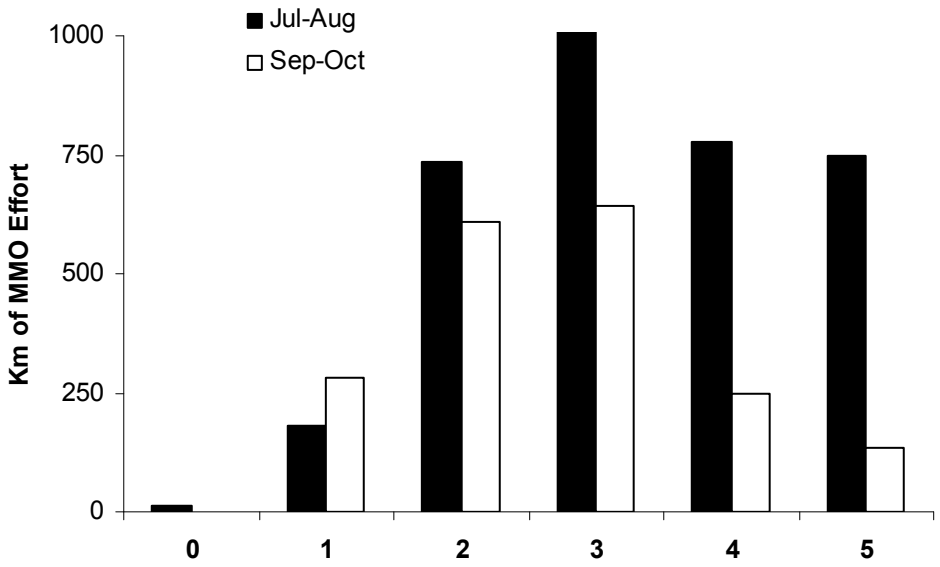

FIGURE 5.2. Marine mammal observer effort (km) by Beaufort wind force and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

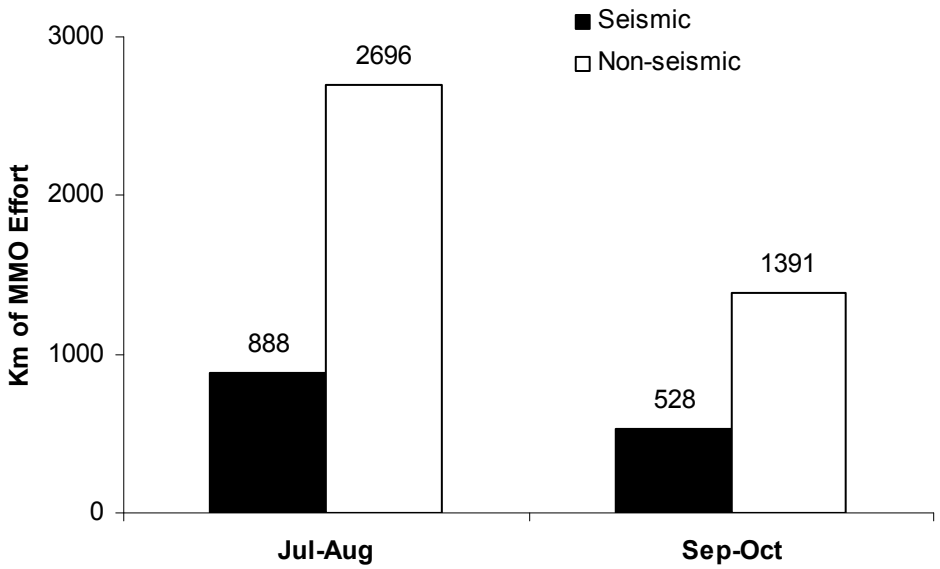

FIGURE 5.3. Marine mammal observer effort (km) by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Effort by number of MMOs

Visual observation effort from the *Mt. Mitchell* with two MMOs on watch was more than five times greater than observation effort with only one MMO on watch (Fig. 5.4). The predominance of two-observer effort was a result of the *Mt. Mitchell* being staffed with five MMOs throughout the survey. Growing darkness in Sep-Oct allowed observers to maximize periods when at least two MMOs were on watch.

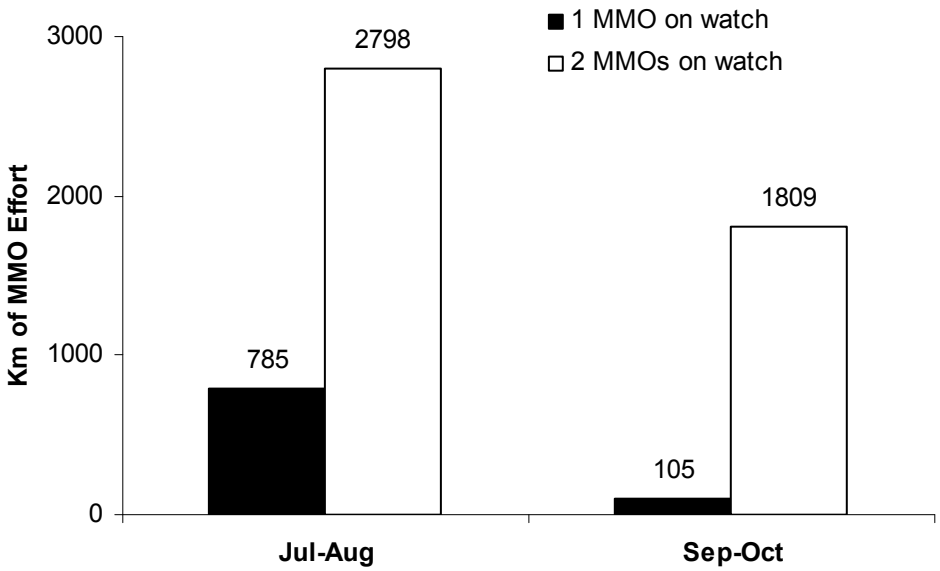

FIGURE 5.4. Marine mammal observer effort (km) by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Cetacean Sightings

MMOs observed 18 cetaceans in 12 groups from the *Mt. Mitchell* during 2009 shallow hazard and site clearance survey activities in the Chukchi Sea (Table 5.1). All but a single cetacean sighting were recorded during the Jul-Aug period. The most commonly identified cetacean species was gray whale (*Eschrichtius robustus*) although many cetaceans could not be identified to species because they were observed at large distances (e.g., >2 km or >1.2 mi). Many of the unidentified mysticete whales were suspected to be gray whales.

A single sighting of two bowhead whales (*Balaena mysticetus*) was confirmed by MMOs on 20 Aug in a nearshore area shortly after completing a crew change in Wainwright. There were no other sightings of endangered cetacean species in the Chukchi Sea during the shallow hazard and site clearance survey in 2009. There were three sightings (ten individuals) of harbor porpoises (*Phocoena phocoena*) recorded during the survey (Appendix Table J.1), but conditions at the time of the sightings did not meet the data analysis criteria.

TABLE 5.1. Number of sightings (number of individuals) of cetaceans observed from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Species	Jul - Aug	Sep - Oct	*Total*
Cetaceans			
Bowhead Whale	1 (2)	0	***1 (2)***
Gray Whale	2 (2)	0	***2 (2)***
Unidentified Mysticete Whale	8 (13)	1 (1)	***9 (14)***
Total Cetaceans	***11 (17)***	***1 (1)***	***12 (18)***

Cetacean Sightings by Seismic State

All 12 cetacean sightings (18 individuals) were recorded during non-seismic periods when airguns were inactive (Fig. 5.5; Appendix Table J.4). Only one cetacean sighting was recorded in the offshore prospect area. All of the remaining 11 cetacean sightings were recorded when the vessel was transiting nearshore areas adjacent to Wainwright for crew changes.

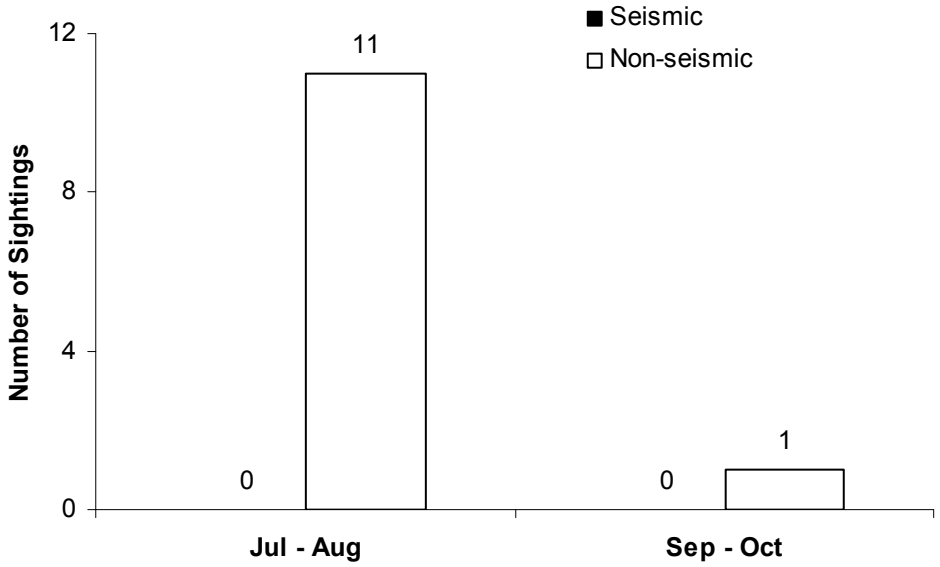

FIGURE 5.5. Number of cetacean sightings by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Cetacean Sighting Rates

Cetacean sighting rates from the *Mt. Mitchell* were higher during non-seismic compared to seismic periods during both the Jul-Aug and Sep-Oct periods (Fig. 5.6). The difference was marginally significant for Jul–Aug ($X^2 = 3.62$, $df = 1$, $p = 0.057$), but not significant for Sep–Oct ($X^2 = 0.38$, $df = 1$, $p = 0.538$). Non-seismic cetacean sighting rates in Jul–Aug were higher than in Sep–Oct, but this difference was not significant ($X^2 = 3.53$, $df = 1$, $p = 0.060$). As discussed above, all but a single cetacean

sighting were recorded when the vessel was transiting nearshore areas adjacent to Wainwright for crew changes.

No clear trend or significant difference in cetacean sighting rates by the number of MMOs on watch (one versus two MMOs) was evident during Jul-Aug ($X^2 = 1.34$, $df = 1$, $p = 0.246$; Fig. 5.7). Only 105 km (65 mi) of one-MMO effort were recorded during Sep-Oct, and effort was too low to allow for statistical comparisons of cetacean sighting rates by number of observers for this period.

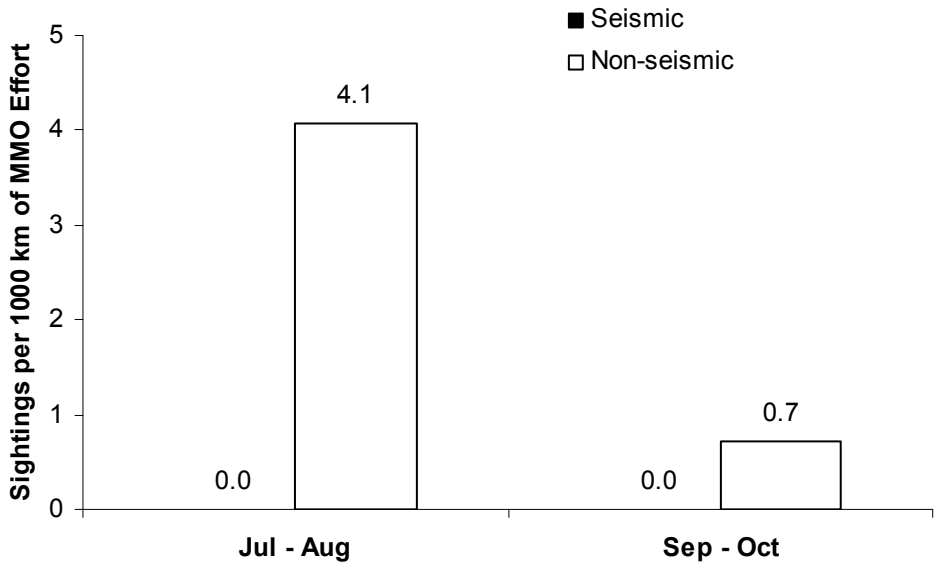

FIGURE 5.6. Cetacean sighting rates by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

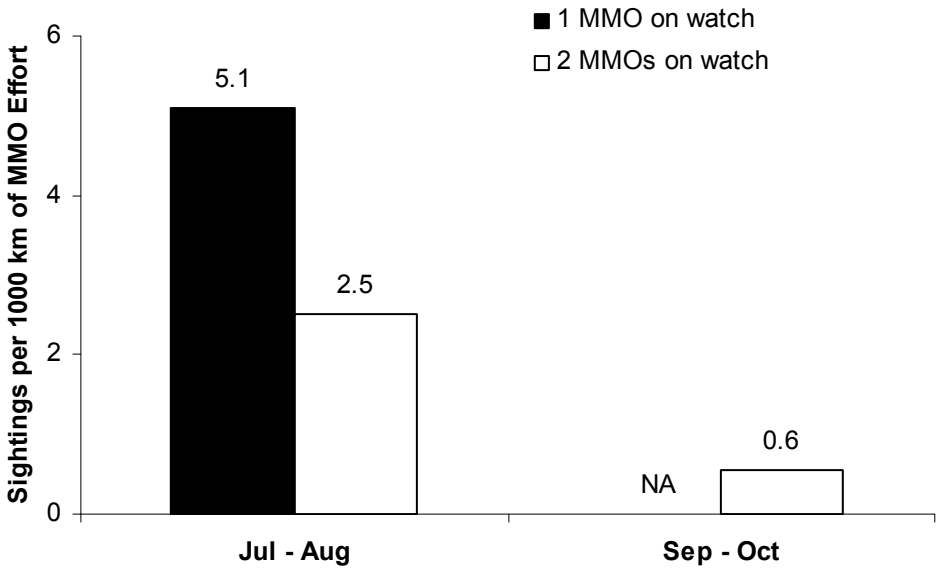

FIGURE 5.7. Cetacean sighting rates by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Note the one-MMO watch effort for Sep-Oct was too low to allow for a meaningful comparison.

Seal Sightings

MMOs observed 71 seals in 69 groups from the *Mt Mitchell* during 2009 shallow hazard and site clearance survey activities in the Chukchi Sea (Table 5.2). Nearly 75% of seals were observed during the Jul-Aug period. The most commonly identified seal species was ringed seal (*Phoca hispida*) followed by bearded seal (*Erignathus barbatus*). There were two spotted seals (*Phoca largha*) recorded during the survey (Appendix Table J.1), but conditions at the time of the sightings did not meet the data analysis criteria.

TABLE 5.2. Number of sightings (number of individuals) of seals observed from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Species	Jul - Aug	Sep - Oct	*Total*
Seals			
Bearded Seal	12 (12)	0	***12 (12)***
Ringed Seal	15 (17)	12 (12)	***27 (29)***
Unidentified Seal	19 (19)	6 (6)	***25 (25)***
Unidentified Pinniped	5 (5)	0	***5 (5)***
Total Seals	***51 (53)***	***18 (18)***	***69 (71)***

Seal Sightings by Seismic State

Over 82% of seal sightings were recorded during non-seismic periods, most of which occurred during Jul-Aug (Fig. 5.8; Appendix Table J.5). This result may have been due in part to the greater amount of effort during non-seismic compared to seismic periods.

Seal Sighting Rates

Seal sighting rates from the *Mt. Mitchell* were higher during non-seismic compared to seismic operations in both seasonal periods, but the differences were not significant ($X^2 = 1.39$, $df = 1$, $p = 0.238$ for Jul–Aug vs. for $X^2 = 0.99$, $df = 1$, $p = 0.320$ for Sep–Oct; Fig. 5.9).

Seal sighting rates were higher when two MMOs were on watch compared to one throughout the survey period. No significant difference in sighting rates based on the number of MMOs on watch was evident during Jul–Aug ($X^2 = 1.95$, $df = 1$, $p = 0.163$; Fig. 5.10). Only 105 km (65 mi) of one-MMO effort were recorded during Sep-Oct, and effort was too low to allow for statistical comparisons of seal sighting rates by number of observers for this period.

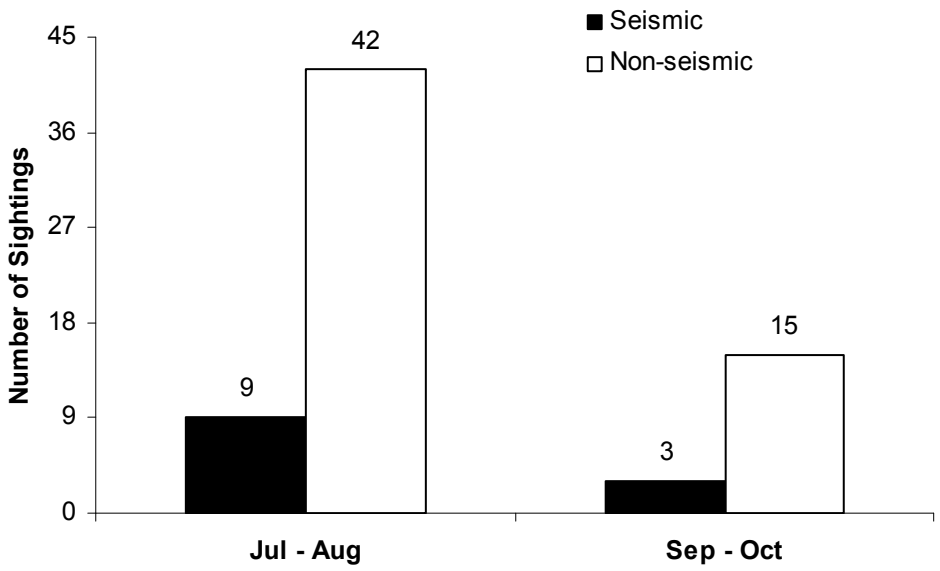

FIGURE 5.8. Number of seal sightings by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

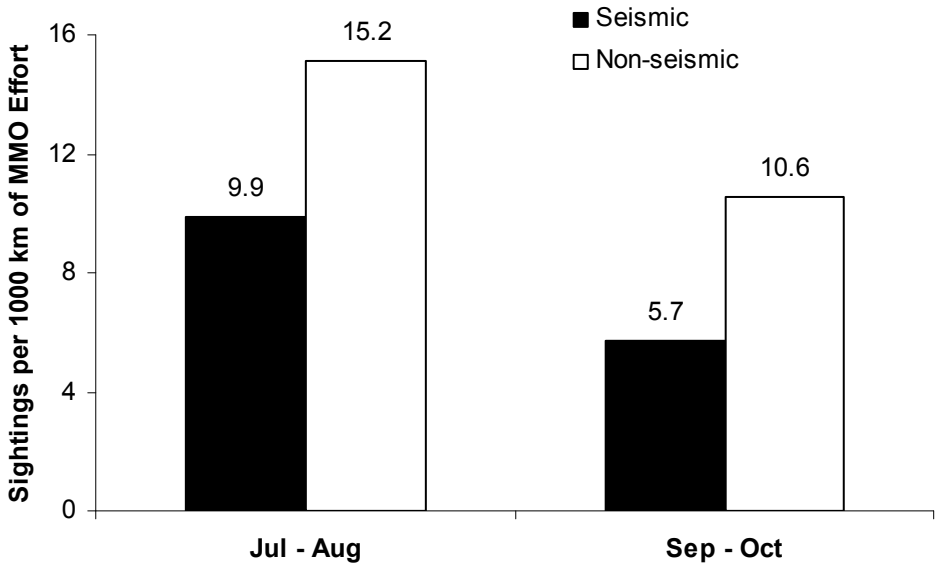

FIGURE 5.9. Seal sighting rates by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

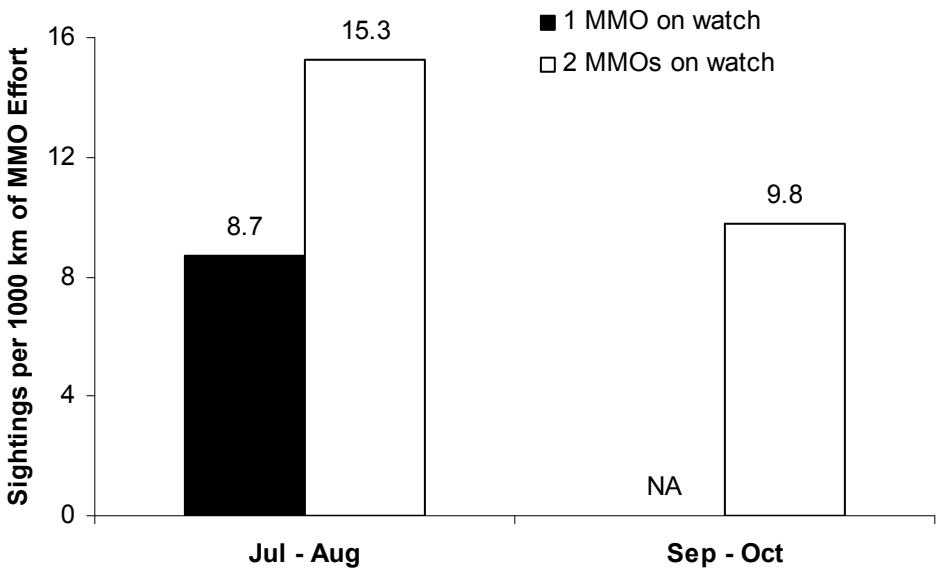

FIGURE 5.10. Seal sighting rates by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Note the one MMO watch effort for Sep–Oct was too low to allow for a meaningful comparison.

Pacific Walrus Sightings

MMOs observed 114 Pacific walruses (*Odobenus rosmarus divergens*) in 59 groups from the *Mt. Mitchell* during 2009 shallow hazard and site clearance survey activities in the Chukchi Sea (Table 5.3). Approximately 90% of Pacific walruses were observed during the Jul-Aug period; shortly thereafter large numbers of walruses were observed at terrestrial haul out sites near Icy Cape on the northwest Alaskan coast (NMML data available online at:

http://www.afsc.noaa.gov/NMML/cetacean/bwasp/flights_COMIDA.php).

TABLE 5.3. Number of sightings (number of individuals) of Pacific walruses observed from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Species	Jul - Aug	Sep - Oct	*Total*
Pacific Walruses	53 (104)	6 (10)	***59 (114)***

Pacific Walrus Sightings by Seismic State

Similar to cetaceans and seals, over 81% of Pacific walrus sightings were recorded during non-seismic periods (Fig. 5.11; Appendix Table J.6). This result was likely due to the greater amount of survey effort during non-seismic compared to seismic periods.

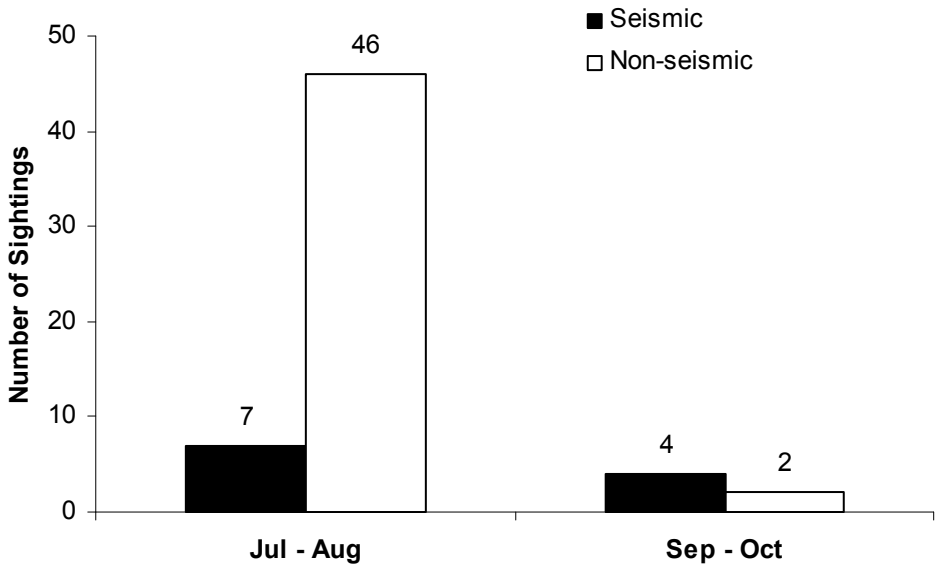

FIGURE 5.11. Number of Pacific walrus sightings by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Pacific Walrus Sighting Rates

There was no clear trend in Pacific walrus sighting rates between seismic and non-seismic periods from the *Mt. Mitchell* (Fig. 5.12). Pacific walrus sighting rates in Jul-Aug were over twice as high during non-seismic compared to seismic periods, and this difference was marginally significant ($X^2 = 3.81$, $df = 1$, $p = 0.051$). In contrast, sighting rates were significantly higher during seismic compared to non-seismic periods in Sep-Oct ($X^2 = 4.76$, $df = 1$, $p = 0.029$). These conflicting results could have been a function of the patchy distribution of Pacific walruses as opposed to a relationship to seismic activity states.

The Pacific walrus sighting rate was slightly higher when one MMO was on watch compared to two, but this difference was not significant during Jul-Aug ($X^2 = 0.66$, $df = 1$, $p = 0.415$) (Fig. 5.13). Only 105 km (65 mi) of one-MMO effort were recorded during Sep-Oct, and effort was too low to allow for statistical comparisons of Pacific walrus sighting rates by number of observers for this period.

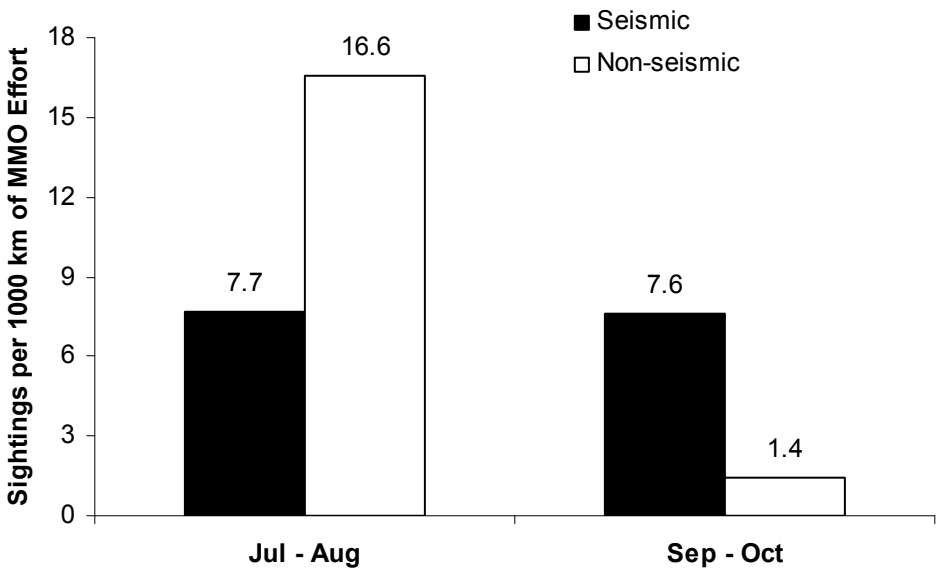

FIGURE 5.12. Pacific walrus sighting rates by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

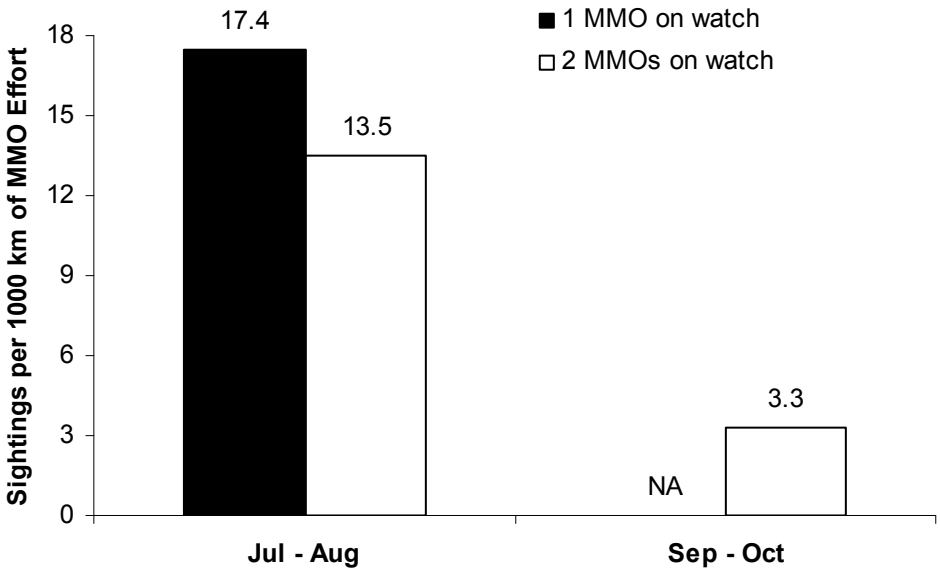

FIGURE 5.13. Pacific walrus sighting rates by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Note the one MMO watch effort for Sep–Oct was too low to allow for a meaningful comparison.

Distribution and Behavior of Marine Mammals

Marine mammal behaviors and reactions were difficult to observe because individuals and/or groups of animals typically spent most of their time below the water surface and could not be observed for extended periods. Additionally, the MMOs primary duty is mitigation rather than collecting behavioral data. The data collected during visual observations provided limited information about behavioral responses of marine mammals to the 2009 Chukchi Sea shallow hazard and site clearance survey. The relevant data collected from the *Mt. Mitchell* included estimated closest observed points of approach (CPA), movement relative to the vessel, and behavior and reaction of animals at the time of the initial detections. We present seismic and non-seismic data from the *Mt. Mitchell* and make statistical comparisons of results between the two activity states when possible. Only one of 12 cetacean sightings, however, was recorded in the offshore survey area where seismic activities occurred, precluding our ability to make statistical comparisons for cetacean behavior and distribution.

Cetaceans

Cetacean Closest Observed Point of Approach

The mean CPA for cetaceans observed in the Chukchi Sea from the *Mt. Mitchell* was greater than 2 km (1.2 mi; Table 5.4). Cetaceans were observed as close as 347 m (379 yd) from the vessel, and the greatest cetacean CPA was nearly 4 km (2.5 mi).

TABLE 5.4. Cetacean CPA to MMOs aboard the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Seismic Status	Mean CPA[a] (m)	s.d.	Range (m)	*n*
Seismic	--	--	--	--
Non-seismic	2089	1238	347-3918	12
Overall Mean	***2089***	***1238***	***347-3918***	***12***

[a] CPA = Marine mammal's closest point of approach to the observer station.

Cetacean Movement

Most movement of cetaceans during non-seismic periods was recorded as either "neutral" or "unknown" relative to vessel (Table 5.5). Neutral movement indicated the animal(s) were swimming neither towards nor away from the vessel. A single cetacean was observed swimming away from the *Mt. Mitchell*.

TABLE 5.5. Cetacean movement with respect to the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

	Movement Relative to Vessel			
Seismic Status	**Swim Away**	**Neutral**	**Unknown**	**Totals**
Seismic	--	--	--	--
Non-seismic	1	5	6	***12***
***Mt Mitchell* Total**	***1***	***5***	***6***	***12***

Cetacean Initial Behavior

The large distances at which most cetaceans were initially detected from the *Mt. Mitchell* made it more difficult to observe specific behaviors compared to pinnipeds. "Blow" was recorded as the initial behavior for two thirds of cetacean sightings, and the remaining third were noted as "swim" (Table 5.6).

TABLE 5.6. Cetacean initial behaviors recorded from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

	Initial Behavior		
Seismic Status	**Blow**	**Swim**	**Totals**
Seismic	--	--	**--**
Non-seismic	8	4	***12***
Total	***8***	***4***	***12***

Cetacean Reaction Behavior

None of the cetaceans observed from the *Mt. Mitchell* demonstrated a detectable reaction to the vessel. MMOs looked for reactions to the vessel that included, "increase speed," "decrease speed," "change direction," "splash," etc. The large distances at which most cetaceans were observed made any potential reaction to the vessel difficult to distinguish.

Seals

Seal Closest Observed Point of Approach to Airguns

Seal CPA to the airgun array was greater during seismic than non-seismic periods, however, this difference was not significant (Wilcoxon test: W = 379.5, $p = 0.558$; Table 5.7). The closest a seal was observed to the active airgun array was 94 m (103 yd). This occurred at the Burger prospect, and the distance was well outside the 190 dB (rms) exclusion zone of 39 m (43 yd) for that prospect area.

TABLE 5.7. Seal CPA to the airgun array by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Seismic Status	**Mean CPA[a] (m)**	**s.d.**	**Range (m)**	***n***
Seismic	445	335	94-1283	12
Non-seismic	410	396	89-2742	57
Overall Mean	***416***	***384***	***89-2742***	***69***

[a] CPA = Marine mammal's closest point of approach to the airgun array, regardless of airgun status.

Seal Movement

Seal movement patterns relative to the *Mt. Mitchell* were similar during seismic compared to non-seismic periods (Fig. 5.14). The majority of seals demonstrated "neutral" movement relative to the vessel, i.e., they swam neither towards nor away from the vessel (Fig. 5.14). Smaller numbers of seals "swam away," or "swam towards" the vessel, and the movement pattern could not be determined for about 20% of seal sightings.

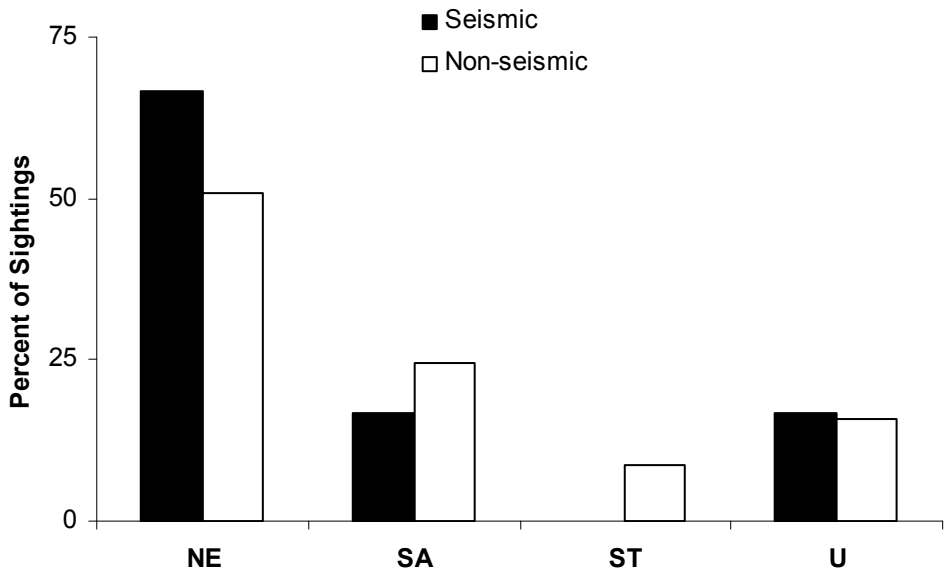

FIGURE 5.14. Seal movement relative to the vessel by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Movement codes: NE = Neutral, SA = Swim Away, ST = Swim Towards, U = Unknown

Seal Initial Behavior

The most common seal initial behavior was "swim," which was recorded in nearly 75% of seal sightings during both seismic and non-seismic periods (Fig. 5.15). "Look" was the next most common seal behavior. Other seal initial behaviors observed less frequently included, "dive," "surface active," "sink," and "unknown." The proportions of different behaviors were similar between seismic and non-seismic periods (Fig. 5.15).

Seal Reaction Behavior

Over 50% of seals observed from the *Mt. Mitchell* demonstrated no detectable reaction to the vessel (Fig. 5.16). The most commonly observed reaction by seals to the *Mt. Mitchell* was to "look" at the vessel, followed by "change direction" of travel. Seals were more likely to change their direction of travel during seismic compared to non-seismic periods (Fig. 5.16). The remaining two reaction behaviors, "increase speed" and "splash," were each observed twice during non-seismic periods.

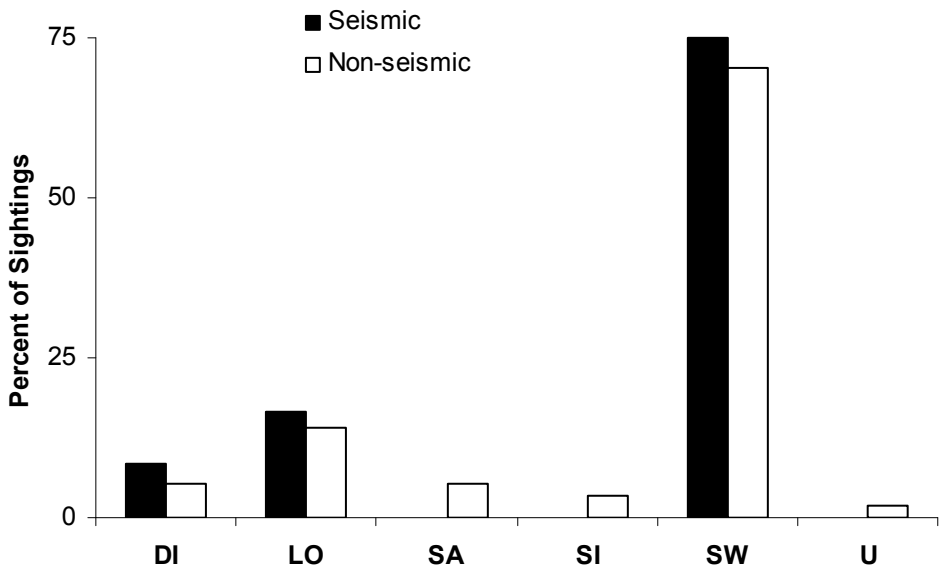

FIGURE 5.15. Seal initial behavior by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Behavior codes: DI = Dive, LO = Look (but not specifically at vessel), SA = Surface Active, SI = Sink, SW = Swim, U = Unknown

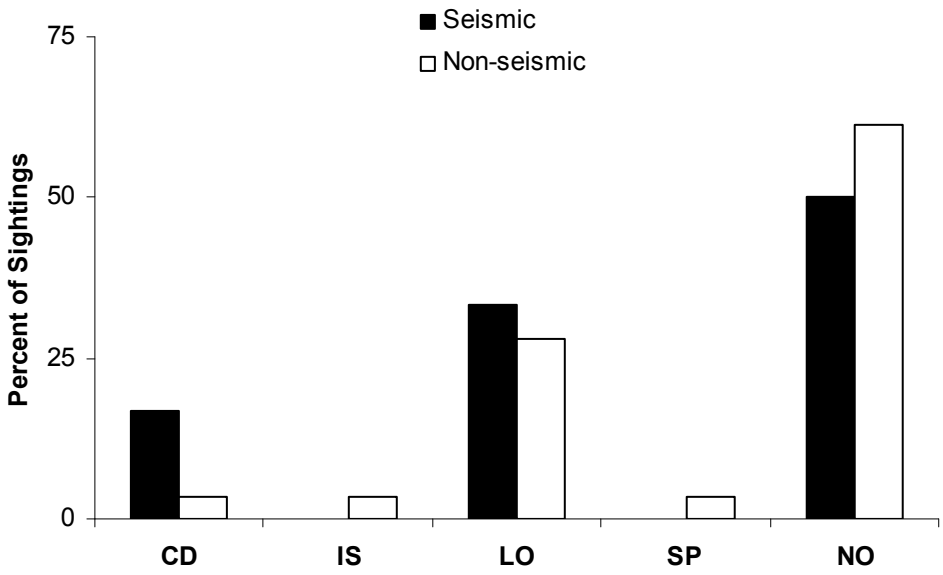

FIGURE 5.16. Seal reaction behavior by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Reaction behavior codes: CD = Change Direction, IS = Increase Speed, LO = Look at Vessel, SP = Splash, NO = No Reaction

Pacific Walruses

Pacific Walrus Closest Observed Point of Approach to Airguns

Pacific walrus mean CPA to the airgun array was greater during non-seismic than seismic periods, however, this difference was not significant (Wilcoxon test: W = 186, $p = 0.131$; Table 5.8). The closest a walrus was observed from the active airgun array was 78 m (85 yd). This occurred at the Burger prospect where the 180 dB (rms) exclusion zone was 146 m (160 yd) and resulted in a shut down of the airgun array.

TABLE 5.8. Pacific walrus CPA to the airgun array by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Seismic Status	Mean CPA[a] (m)	s.d.	Range (m)	*n*
Seismic	470	484	78-1678	11
Non-seismic	651	443	130-1717	48
Overall Mean	***623***	***448***	***78-1717***	***59***

[a] CPA = Marine mammal's closest point of approach to the airgun array, regardless of airgun status.

Pacific Walrus Movement

Pacific walrus movement patterns relative to the *Mt. Mitchell* were similar during seismic compared to non-seismic periods (Fig. 5.17). Approximately one half of walruses demonstrated "neutral" movement relative to the vessel, i.e., they swam neither towards nor away from the vessel (Fig. 5.17). Smaller numbers of walruses "swam away," or "swam towards" the vessel. "No" movement was recorded for two Pacific walrus sightings, and movement pattern could not be determined for about 15% of walrus sightings.

Pacific Walrus Initial Behavior

The most common Pacific walrus initial behavior was "swim," which was recorded for 50% and 75% of walrus sightings during seismic and non-seismic periods, respectively (Fig. 5.18). "Dive" was the next most common behavior followed by "look," and both of these behaviors were recorded more frequently during seismic compared to non-seismic periods (Fig. 5.18). Other walrus initial behaviors observed less frequently included, "log," and "surface active." "Log" means to rest motionless at the water surface, and "surface active" behavior involves, splashing, rolling, etc., often social in nature.

Pacific Walrus Reaction Behavior

Over 70% of Pacific walruses observed from the *Mt. Mitchell* demonstrated no detectable reaction to the vessel regardless of seismic activity state (Fig. 5.19). The most commonly observed reaction by walruses to the *Mt Mitchell* was to "look" at the vessel, followed by "splash," which was recorded more frequently when the airgun array was active.

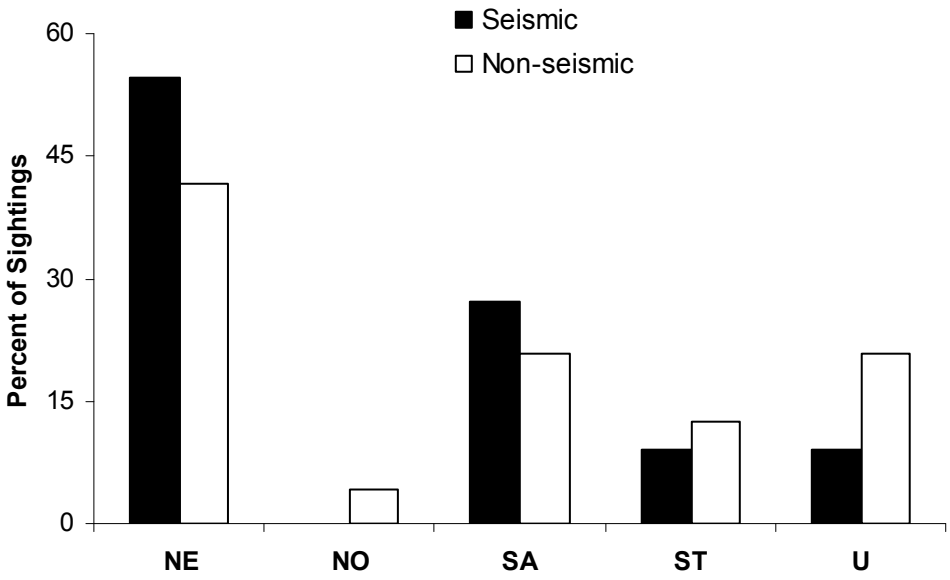

FIGURE 5.17. Pacific walrus movement relative to the vessel by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Movement codes: NE = Neutral, NO = None, SA = Swim Away, ST = Swim Towards, U = Unknown

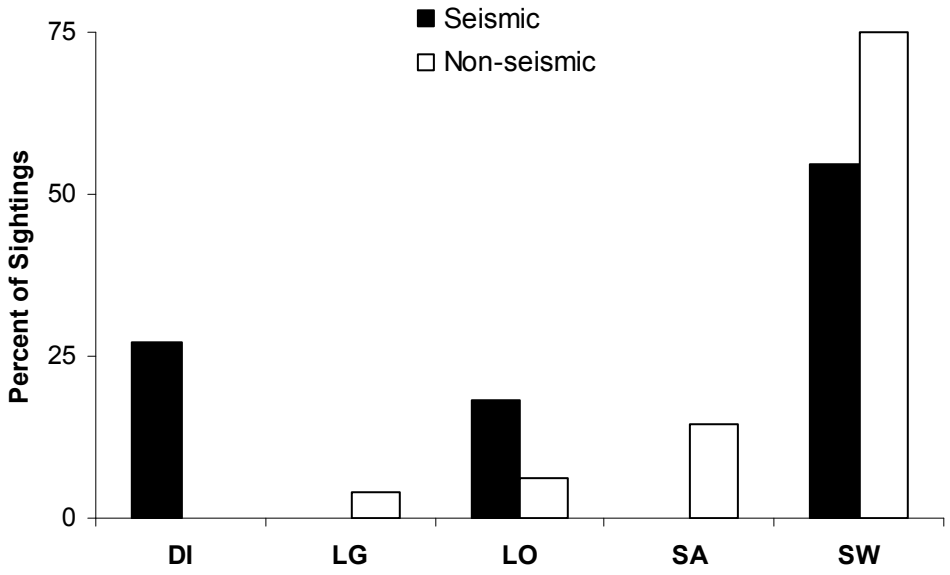

FIGURE 5.18. Pacific walrus initial behavior by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Behavior codes: DI = Dive, LG = Log, LO = Look (but not specifically at vessel), SA = Surface Active, SW = Swim

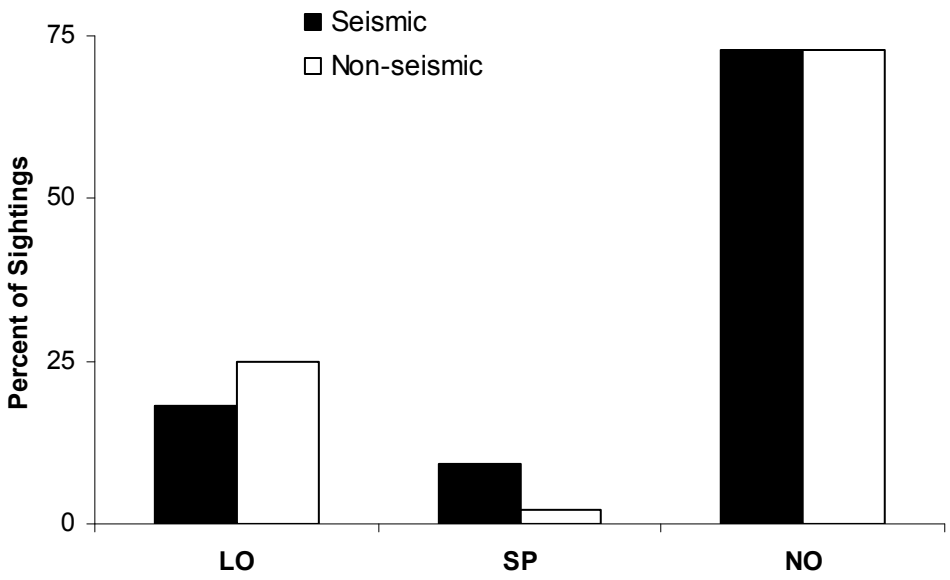

FIGURE 5.19. Pacific walrus reaction behavior by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Reaction behavior codes: LO = Look at Vessel, SP = Splash, NO = No Reaction

Mitigation Measures Implemented

Shell began the 2009 shallow hazard and site clearance survey operating under its 2008 NMFS IHA and a renewed USFWS LoA. The 2009 IHA was issued on 19 Aug 2009. Safety radii from the 2008 *Cape Flattery* shallow hazard and site clearance survey at the Crackerjack prospect area were implemented at the beginning of the 2009 *Mt. Mitchell* survey. Shell conducted a sound source verification (SSV) at the Honeyguide prospect area on 1 Aug 2009. Honeyguide safety radii were implemented at the Burger prospect area between 7 and 11 Aug 2009 before Shell opted to re-implement the more conservative 2008 Crackerjack radii until 19 Aug. Shell conducted a second SSV in 2009 at the Burger prospect area on 16 Aug, and these radii were implemented at that location on 19 Aug. Dates and safety radii that were implemented throughout 2009 survey operations are summarized in Table 4.4. Prospect area locations are shown in Fig. 2.1. Safety radii values are summarized in Tables 4.1–4.3.

One power down and two shut downs of the airgun array were requested by *Mt. Mitchell* MMOs due to Pacific walruses that were sighted approaching or within the ≥180 dB (rms) safety radius of the active array during the Chukchi Sea survey (Tables 5.9 and 5.10)). There were no power downs of the airguns for cetaceans, seals, or polar bears during the 2009 survey.

The single power down of airguns was implemented on 13 Sep when a Pacific walrus was observed approaching ≥180 dB (rms) safety radius of 146 m (160 yd) for the full array at the Burger prospect area (Table 5.9). The walrus was initially detected 322 m (352 yd) from the active airgun array, which was powered down immediately as a precautionary measure. The walrus's CPA to the single mitigation gun was 78 m (85 yd), which was well outside the ≥180 dB (rms) safety radius of 34 m (37 yd) for the mitigation gun. In addition to the power down, this sighting event was further mitigated by altering the vessel's course to starboard to increase the distance between the walrus and the then active mitigation gun. The walrus reacted to the vessel by looking at it before diving.

The first shut down of airguns was implemented on 24 Aug when a Pacific walrus was initially observed 130 m (142 yd) from the active airgun array, which was inside the 146 m (160 yd) safety radius at the Burger prospect area (Table 5.10). The walrus was heading toward the vessel and MMOs requested an immediate shut down of the airguns, which were firing at full-array volume when the walrus was sighted. In addition to the shutdown of airguns, the vessel altered its course to starboard to increase the distance between the ship and the walrus. The animal showed no detectable reaction to the vessel.

The second shut down of airguns occurred on 7 Sep when a Pacific walrus was first detected 102 m (112 yd) from the active airgun array, which was inside the 146 m (160 yd) safety radius for the full array at the Burger prospect area (Table 5.10). Only two of four airguns in the array were firing at the time of the sighting. Both airguns were shut down rather than powered down as a conservative measure. It was still possible, however, that the walrus was exposed to sound levels ≥180 dB (rms) prior to the shut down since the measured safety distance for the two guns was only slightly smaller than that of the four gun array at another prospect area (Honeyguide, see Chapter 3). The walrus reacted to the vessel by looking at it before diving.

TABLE 5.9. The single power down for a Pacific walrus observed near the *Mt. Mitchell's* ≥180-dB (rms) safety radius at the Honeyguide prospect (99 m; 108 yd) during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. There were no other power downs during this survey.

Sighting ID	Species	Group Size	Date	Water Depth (m)	Reaction to Vessel[a]	Distance (m) to airguns at first detection	CPA (m) to airguns[b]
207	Pacific Walrus	1	13-Sep	51	LO	322	87

[a] Reaction Code: LO = Look at Vessel

[b] CPA to airguns = Closest Point of Approach to the airgun array

TABLE 5.10. The two shut downs for Pacific walruses observed inside the *Mt. Mitchell's* ≥180-dB (rms) safety radius at the Burger prospect (146 m; 160 yd) during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. There were no other shut downs during this survey.

Sighting ID	Species	Group Size	Date	Water Depth (m)	Reaction to Vessel[a]	Distance (m) to airguns at first detection	CPA (m) to airguns[b]
118	Pacific Walrus	1	24-Aug	46	NO	130	78
196	Pacific Walrus	1	7-Sep	46	LO	102	102

[a] Reaction Codes: LO = Look at Vessel; NO = No Reaction

[b] CPA to airguns = Closest Point of Approach to the airgun array

Estimated Number of Marine Mammals Present and Potentially Affected

Meaningful estimates of "take by harassment" were difficult to obtain for several reasons: ***(1)*** The relationship between numbers of marine mammals that are observed and the number actually present is uncertain. ***(2)*** The most appropriate criteria for "take by harassment" are uncertain and presumed to vary among different species, individuals within species, and situations. ***(3)*** The distance to which a received sound level reaches a specific criterion such as 190 dB, 180 dB, 170 dB, or 160 dB re 1 µPa (rms) is variable. The received sound level depends on water depth, sound-source depth, water-mass and bottom conditions, and—for directional sources—aspect (Chapter 3; see also Greene 1997, Greene et al. 1998; Burgess and Greene 1999; Caldwell and Dragoset 2000; Tolstoy et al. 2004a,b). ***(4)*** 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 even further reduced for animals that are on ice.

Two methods were used to estimate the number of marine mammals exposed to seismic sound levels strong enough that they might have caused a disturbance or other potential impacts. The procedures included ***(A)*** minimum estimates based on the direct observations of marine mammals by MMOs, and ***(B)*** estimates based on pinniped and cetacean densities obtained during this study. The actual number of individuals exposed to, and potentially impacted by, strong seismic survey sounds likely was between the minimum and maximum estimates provided in the following sections. Further details about the methods and limitations of these estimates are provided below in the respective sections. This section includes all MMO sightings data, not only those that meet the analysis criteria described in Chapter 4.

Disturbance and Safety Criteria

Tables 4.1–4.3 summarize estimated received sound levels at various distances from the *Mt. Mitchell's* four-airgun array. USFWS required the received sound levels of ≥180 dB and ≥190 dB re 1 µPa (rms) as mitigation criteria for Pacific walruses and polar bears, respectively, in 2009. The application of the ≥180 dB (rms) criterion for Pacific walruses for the third consecutive year was a more conservative approach to walrus mitigation than the use of the ≥190 dB (rms) exclusion zone that was applied in 2006.

Estimates from Direct Observations

The number of animals actually sighted by observers within the various sound threshold distances during seismic activity provided a minimum estimate of the number potentially affected by seismic sounds. Some animals probably moved away before coming within visual range of MMOs, and it was unlikely that MMOs were able to detect all of the marine mammals near the vessel trackline. During daylight, animals are missed if they are below the surface when the ship is nearby. Some other mammals, even if they surface near the vessel, are missed because of limited visibility (e.g. fog), glare, or other factors limiting sightability. Visibility and high sea conditions are often significant limiting factors. Furthermore, marine mammals could not be seen effectively during periods of darkness, which occurred for increasing numbers of hours per day beginning in the second half of Aug. Nighttime observations were not required except prior to and during nighttime power ups and if a power down had been implemented during daytime, however, MMOs stayed on watch throughout the night in 2009 to monitor survey operations.

Animals may also have avoided the area near the *Mt. Mitchell* while the airguns were firing (see Richardson et al. 1995, 1999; Stone 2003; Gordon et al. 2004; Smultea et al. 2004). Within the assumed ≥160–170 dB (rms) radii around the source (i.e., ~0.24–1.77 km; ~0.15–1.10 mi), and perhaps farther away in the case of the more sensitive species and individuals, the distribution and behavior of pinnipeds

and cetaceans may have been altered as a result of the seismic survey. Changes in distribution and behavior could result from reactions to the airguns, or to the *Mt. Mitchell* itself. The extent to which the distribution and behavior of pinnipeds might be affected by the airguns is uncertain, given variable previous results (Harris et al. 2001; Moulton and Lawson 2002; Miller et al. 2005, Reiser et al. 2009). It was not possible to determine if cetaceans beyond the distance at which they were detectable by MMOs exhibited avoidance behavior.

Cetaceans Potentially Exposed to Sounds ≥180 dB re 1 µPa (rms)

No cetaceans were observed from the *Mt. Mitchell* while the airguns were active during the 2009 Chukchi Sea shallow hazard and site clearance survey. Therefore, zero cetaceans were exposed to received sound levels of ≥180 dB (rms) based on the direct observations of MMOs (Table 5.11). It is unlikely that MMOs failed to detect cetaceans within the *Mt. Mitchell's* ≥180 dB (rms) safety zone given the small size of the measured radii which ranged from 99 to 160 m (108 to 175 yd).

Seals Potentially Exposed to Sounds ≥190 dB re 1 µPa (rms)

Seventeen seals (17 individuals) were recorded from the *Mt. Mitchell* while airguns were active during the 2009 Chukchi Sea shallow hazard and site clearance survey. Fourteen seals were sighted while the full airgun array was operating and three were observed while the mitigation airgun was firing. None of these seals, however, were observed within or approaching the *Mt. Mitchell's* ≥190 dB (rms) safety zone. Therefore, zero seals were exposed to received sound levels ≥190 dB (rms) based on direct observations by MMOs (Table 5.11).

Pacific Walruses Potentially Exposed to Sounds ≥180 dB re 1 µPa (rms)

Seventeen Pacific walruses (17 individuals) were recorded from the *Mt. Mitchell* while airguns were active during the 2009 Chukchi Sea shallow hazard and site clearance survey. Eleven of these walruses were sighted while the full airgun array was operating and six were observed while the mitigation airgun was firing. Two of these walruses were observed within and one was observed approaching the *Mt. Mitchell's* ≥180 dB (rms) safety zone, and MMOs initiated two shut downs and one power down of the airgun array, respectively, as a result of these sightings (Tables 5.9 and 5.10). It is likely that the two Pacific walruses observed within the ≥180 dB (rms) safety zone were exposed to received sound levels ≥180 dB (rms) for a period of time prior to implementation of mitigation measures (Table 5.11).

TABLE 5.11. Number of individual marine mammals observed within specific safety radii and potentially exposed to the respective sound levels during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Number of Individuals and Exposure Level in dB re 1µPa (rms)		
Cetaceans ≥180	**Seals ≥190**	**Pacific Walruses ≥180**
0	0	2

Estimates Extrapolated from Density

The numbers of marine mammals visually detected by MMOs likely underestimated the actual numbers that were present for reasons described above. To correct for animals that may have been present but not sighted by observers, the sightings recorded during seismic and non-seismic periods along with detectability corrections $f(0)$ and $g(0)$ were used to calculate separate densities of marine mammals present in the project area. These "corrected" densities of marine mammals multiplied by the area of water ensonified (exposed to seismic sounds) were used to estimate the number of *individual* marine mammals exposed to sound levels ≥160, 170, 180, and 190 dB (rms). The average number of *exposures* per individual marine mammal was calculated based on the overlap in ensonified areas around nearby seismic lines considering that an animal remaining in the area would have been exposed repeatedly to the passing seismic source. Marine mammal densities and ensonified areas were calculated independently for Jul-Aug and Sep-Oct to account for seasonal changes in the distribution of marine mammals.

Marine mammal densities were based on data collected from the *Mt. Mitchell* during the 2009 Chukchi Sea shallow hazard and site clearance survey. The density data for the Chukchi Sea survey, including corrections for sightability biases, are summarized in Table 5.12, and the ensonified areas are presented in Table 5.13. The methodology used to estimate the areas exposed to received levels ≥160, 170, 180 and 190 dB (rms) was described in Chapter 4, *Data Analysis*, and in more detail in Appendix E.

The following exposure estimates based on density assume that all mammals present were well below the surface where they were exposed to received sound levels at various distances as predicted in Chapter 3 and summarized in Tables 4.1–4.3. Some pinnipeds and cetaceans in the water might remain close to the surface, where sound levels would be reduced by pressure-release effects (Greene and Richardson 1988). Also, some pinnipeds and cetaceans may have moved away from the path of the *Mt. Mitchell* because of an avoidance behavior in response to the approaching vessel and its airguns. The estimated number of exposures based on data collected during non-seismic periods in Tables 5.14–5.16 represented the number of animals that would have been exposed to various received sound levels had they not shown any localized avoidance of the airguns or the ship itself, and therefore likely overestimate actual numbers of animals exposed to those sound levels. The estimates based on densities observed during seismic periods are likely closer to the true numbers of animals that were exposed to the various received sound levels.

TABLE 5.12. Densities of marine mammals in the Alaskan Chukchi Sea by seismic state during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. 95% confidence intervals are in parentheses. Densities are corrected for *f*(0) and *g*(0) biases.

	No. individuals / 1000 km^2			
	Jul-Aug		Sep-Oct	
Species	Seismic	Non-seismic	Seismic	Non-seismic
Cetaceans				
Bowhead whale	0	0.317 (0.055 - 1.847)	0	0
Gray whale	0	0.317 (0.055 - 1.847)	0	0
Unidentified mysticete whale	0	2.064 (0.417 - 10.214)	0	0.334 (0.075 - 1.496)
Total cetacean density	**0**	**2.699 (0.712 - 10.23)**	**0**	**0.334 (0.075 - 1.496)**
Seals				
Bearded seal	5.016 (1.245 - 20.205)	4.958 (1.434 - 17.146)	0	0
Ringed seal	6.688 (1.53 - 29.237)	7.161 (2.911 - 17.618)	5.788 (1.259 - 26.613)	10.747 (1.532 - 75.389)
Unidentified pinniped	0.814 (0.117 - 5.646)	1.072 (0.278 - 4.14)	0	0
Unidentified seal	1.672 (0.334 - 8.365)	9.916 (2.924 - 33.628)	2.894 (0.379 - 22.066)	5.373 (1.248 - 23.137)
Total seal density	**14.19 (5.441 - 37.009)**	**23.107 (11.534 - 46.291)**	**8.681 (2.297 - 32.813)**	**16.12 (3.509 - 74.052)**
Pacific walrus	**6.508 (2.107 - 20.108)**	**25.731 (6.994 - 94.662)**	**9.856 (2.881 - 33.715)**	**1.569 (0.49 - 5.024)**

TABLE 5.13. Estimated areas (km^2) ensonified to various sound levels during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Maximum area ensonified is shown with overlapping areas counted multiple times; total area ensonified is shown with overlapping areas counted only once.

	Level of ensonification in dB re1µPa (rms)				
Area (km^2)	**120**	**160**	**170**	**180**	**190**
Jul-Aug					
Including Overlap Area	404,314	4347	1111	302	86
Excluding Overlap Area	11,542	680	397	217	76
Sep-Oct					
Including Overlap Area	394,573	3631	913	251	73
Excluding Overlap Area	13,499	778	407	188	64
2009 Survey Totals					
Including Overlap Area	798,887	7978	2024	553	158
Excluding Overlap Area*	14,909	1129	679	377	138

* 2009 Survey Totals Exluding Overlap are less than the sum of seasonal period non-overlap areas because many of the same areas were ensonified during both periods.

Cetaceans

Table 5.14 summarizes the estimated numbers of cetaceans that might have been exposed to received sounds at various levels during the 2009 Chukchi Sea shallow hazard and site clearance survey. The density data are shown in Table 5.12, and the ensonified areas are presented in Table 5.13.

(A) ≥160 dB (rms): We estimated that two individual cetaceans would each have been exposed ~five to six times to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the survey if all cetaceans showed no avoidance of active airguns or vessels (Table 5.14). Based on the proportion of identified species and available densities, both of these animals would have been unidentified mysticete whales, most of which were suspected to be gray whales.

(*B) ≥170 dB (rms*): Some odontocete species may be disturbed only if exposed to received levels of airgun sounds ≥170 dB re 1 µPa (rms). Overall, there would have been ~one individual cetacean exposed to seismic sounds ≥170 dB (rms) approximately three times (Table 5.14).

(C) ≥180 dB (rms): If there was no avoidance of airgun noise by cetaceans, we estimated that there would have been less than one individual cetacean exposed one time to seismic sounds ≥180 dB (rms) (Table 5.14). However, most cetaceans probably moved away before being exposed to received levels ≥180 dB (rms). As noted earlier, no cetacean sightings were reported from the *Mt. Mitchell* during seismic operations.

Seals

Table 5.15 summarizes the estimated numbers of seals potentially exposed to various received sound levels during the 2009 Chukchi Sea shallow hazard and site clearance survey. Exposure estimates were based on the ensonified areas (Table 5.13) and non-seismic seal densities observed during the survey (Table 5.12). Seal sighting rates from the *Mt. Mitchell* were lower during seismic operations compared to non-seismic periods (Fig. 5.9). Seals were not expected to display much avoidance of the survey operations (Harris et al. 2001) but some localized avoidance appears to have occurred based on the lower seismic compared to non-seismic densities. Localized avoidance of seismic surveys by seals has been reported in the Alaskan Chukchi Sea (Reiser et al. 2009).

TABLE 5.14. Estimated numbers of individual cetaceans exposed to received sound levels ≥160, 170, 180, and 190 dB (rms) and average number of exposures per individual during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Estimates were based on "corrected" non-seismic and seismic densities.

Seasonal Period and Exposure level in dB re 1µPa (rms)	Non-seismic Densities		Seismic Densities	
	Individuals	Exposures per Individual	Individuals	Exposures per Individual
Jul-Aug				
≥160	2	6	0	NA
≥170	1	3	0	NA
≥180	1*	1	0	NA
≥190	1*	1	0	NA
Sep-Oct				
≥160	1*	5	0	NA
≥170	1*	2	0	NA
≥180	1*	1	0	NA
≥190	1*	1	0	NA
Survey Totals				
≥160	2	5 to 6	0	NA
≥170	1	2 to 3	0	NA
≥180	1*	1	0	NA
≥190	1*	1	0	NA

"1*" indicates number of individuals was decimal value between 0 and 1
"0" individuals indicates >500 km (>311 mi) of effort within the density bin but no sightings

(A) ≥160 dB (rms): We estimated that ~28 individual seals would have been exposed ~five to six times each to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the survey, assuming no avoidance of the ≥160 dB (rms) zone (Table 5.15). Based on the available non-seismic densities and proportion of identified species during Jul-Aug, eight of the animals would have been ringed seals, six would have been bearded seals, and the remaining 14 would have been unidentified.

(*B) ≥170 dB (rms):* Some seals may be disturbed only if exposed to received levels ≥170 dB re 1 µPa (rms). Overall, there would have been ~16 individual seals each exposed ~two to three times to seismic sounds ≥170 dB (rms) (Table 5.15).

(C) ≥180 dB (rms): We estimated that ~seven individual seals were each exposed once to sounds ≥180 dB (rms) assuming no avoidance of the seismic survey activities (Table 5.15).

(*D) ≥190 dB (rms):* Based on densities calculated from sighting rates during non-seismic periods, we estimated that there would have been three individual seals exposed once each to received levels ≥190 dB (rms) if there was no seal avoidance (Table 5.15). This estimate was higher than the number of seals exposed to received levels ≥190 (rms) based on direct observations (n = 0; Table 5.11). Some pinnipeds within the ≥190 dB (rms) radius presumably were missed during times when MMOs were on watch. Even during times when MMOs were on watch, some seals at the surface could have been missed due to brief surface times, poor visibility, rough seas, and other factors. Because of this, density-based estimates

of exposures and exposed individuals are higher than those based on direct observation. The actual number of seals exposed to received sound levels ≥190 dB (rms) was probably lower than the estimate calculated from non-seismic densities, but greater than that from direct observations.

TABLE 5.15. Estimated numbers of individual seals exposed to received sound levels ≥160, 170, 180, and 190 dB (rms) and average number of exposures per individual during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Estimates were based on "corrected" non-seismic and seismic densities.

Seasonal Period and Exposure level in dB re 1µPa (rms)	Non-seismic Densities		Seismic Densities	
	Individuals	Exposures per Individual	Individuals	Exposures per Individual
Jul-Aug				
≥160	16	6	10	6
≥170	9	3	6	3
≥180	4	1	3	1
≥190	1	1	1	1
Sep-Oct				
≥160	13	5	7	5
≥170	7	2	4	2
≥180	3	1	2	1
≥190	1	1	1*	1
Survey Totals				
≥160	28	5 to 6	16	5 to 6
≥170	16	2 to 3	9	2 to 3
≥180	7	1	5	1
≥190	3	1	2	1

"1*" indicates number of individuals was decimal value between 0 and 1

Pacific Walruses

Table 5.16 summarizes the estimated numbers of Pacific walruses potentially exposed to received sounds of various levels during the 2009 Chukchi Sea shallow hazard and site clearance survey. Exposure estimates were based on the ensonified areas (Table 5.13) and walrus densities observed during the survey (Table 5.12). Pacific walrus densities were lower during seismic compared to non-seismic periods in Jul–Aug, however, the opposite was observed in Sep–Oct (Table. 5.12). In order to provide a maximum exposure estimate for walruses in 2009, The following totals are based on non-seismic densities for Jul–Aug and seismic densities for Sep–Oct.

(A) ≥160 dB (rms): We estimated that ~26 individual Pacific walruses would have been exposed ~five to six times each to airgun pulses with received levels ≥160 dB re 1 µPa (rms) during the survey, assuming no avoidance of the ≥160 dB (rms) zone (Table 5.16). The majority of these individuals would have been exposed during Jul–Aug when Pacific walrus densities were higher compared to Sep–Oct (Table 5.12).

(*B) ≥170 dB (rms):* Some Pacific walruses may be disturbed only if exposed to received levels ≥170 dB re 1 µPa (rms). Overall, there would have been ~14 individual walruses each exposed ~two to three times to seismic sounds ≥170 dB (rms; Table 5.16).

(C) ≥180 dB (rms): We estimated that ~eight individual walruses were each exposed once to sounds ≥180 dB (rms) assuming no avoidance of the seismic survey activities (Table 5.16).

(*D) ≥190 dB (rms):* Based on densities calculated from sighting rates during non-seismic periods in Jul–Aug and seismic densities in Sep–Oct, we estimated that there would have been ~three individual walruses exposed once each to received levels ≥190 dB (rms) if there was no avoidance (Table 5.16). This estimate was higher than the number of Pacific walruses exposed to received levels ≥190 (rms) based on direct observations (n = 0; Table 5.11). The actual number of walruses exposed to received sound levels ≥190 dB (rms) was probably lower than the estimate calculated from non-seismic densities, but greater than that from direct observations.

TABLE 5.16. Estimated numbers of individual Pacific walruses exposed to received sound levels ≥160, 170, 180, and 190 dB (rms) and average number of exposures per individual during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Estimates were based on "corrected" non-seismic and seismic densities.

Seasonal Period and Exposure level in dB re 1µPa (rms)	Non-seismic Densities		Seismic Densities	
	Individuals	Exposures per Individual	Individuals	Exposures per Individual
Jul-Aug				
≥160	18	6	4	6
≥170	10	3	3	3
≥180	6	1	1	1
≥190	2	1	1*	1
Sep-Oct				
≥160	1	5	8	5
≥170	1*	2	4	2
≥180	1*	1	2	1
≥190	1*	1	1*	1
Survey Totals				
≥160	19	5 to 6	12	5 to 6
≥170	11	2 to 3	7	2 to 3
≥180	6	1	3	1
≥190	2	1	1	1

"1*" indicates number of individuals was decimal value between 0 and 1

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APPENDICES TO:

MARINE MAMMAL MONITORING AND MITIGATION DURING OPEN WATER SHALLOW HAZARDS AND SITE CLEARANCE SURVEYS BY SHELL OFFSHORE INC. IN THE ALASKAN CHUKCHI SEA, JULY–OCTOBER 2009: 90-DAY REPORT

Edited by

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and

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LGL Report P1112–1

January 2010

APPENDIX A: NATIONAL MARINE FISHERIES SERVICE IHAs

08/21/2008 THU 13:03 FAX 907 334 5322 MMS RESOURCE EVALUATION ☑002/002

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Alaska Outer Continental Shelf Region
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823

AUG 21 2008

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Ms. Susan Childs
Shell Offshore Inc.
3601 C Street, Suite 1334
Anchorage, AK 99503

RE: New Mitigation Measure on G&G Permit 08-03

Dear Ms. Childs:

The Minerals Management Service (MMS) is requiring the following new mitigation measure on MMS OCS G&G Permit 08-03 to eliminate or reduce the probability of a "take" of minke whales in the Chukchi Sea:

Immediately shutdown/power down the seismic airgun array whenever any minke whales or unidentified large cetaceans are observed within or approaching close to the 160 dB isopleth. Follow the procedures as described in the G&G permit mitigation measures.

This mitigation is necessary because the issue of "take" of this MMPA species was not addressed in the 2008 IHA issued by NMFS. This mitigation becomes effective immediately and will remain in effect until Shell receives authorization for incidental harassment of minke whales or until expiration of the permit.

Sincerely,

Rance Wall
Regional Supervisor
Resource Evaluation

TAKE PRIDE IN AMERICA

DEPARTMENT OF COMMERCE

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

NATIONAL MARINE FISHERIES SERVICE

Incidental Harassment Authorization

Shell Offshore, Inc. and WesternGeco, Inc.(SOI/WG) are hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C. 1371 (a)(5)(D)) and 50 CFR 216.107, to take by Level B harassment only, small numbers of marine mammals incidental to conducting a marine seismic survey program in the Chukchi and Beaufort seas in Arctic Ocean waters under the jurisdiction of the United States, contingent upon the following conditions:

1. This Authorization is valid from August 20, 2008, through August 19, 2009, or until a new Incidental Harassment Authorization is issued to SOI/WG, whichever is earlier.

2. This Authorization is valid only for activities (including support vessels and aircraft) associated with the *M/V Gilavar* conducting deep 3D seismic surveys in the Chukchi and Beaufort seas, and the *M/V Henry Christoffersen* and the *M/VAlpha Helix* (or comparable vessels) conducting shallow-hazard seismic survey programs , in the Beaufort and Chukchi seas respectively, as described in SOI/WG's October 16, 2007, IHA application.

3 (a) The species authorized for incidental harassment takings are : bowhead whales *(Balaena mysticetus),* gray whales *(Eschrichtius robustus),* humpback whales *(Megaptera novaeangliae),* fin whales *(Balaenoptera physalus),* beluga whales *(Delphinapterus leucas),* killer whales *(Orcinus orca),* harbor porpoise *(Phocoena phocoena),* ringed seals *(Phoca hispida),* spotted seals *(Phoca largha),* and bearded seals *(Erignathus barbatus).*

(b) The authorization for taking by harassment is limited to vessel and aircraft noise and to the following acoustic sources (or sources with comparable frequency and intensity) without an amendment to this Authorization:

(i) On the *M/V Gilavar.*

(A) A Bolt-seismic airgun array of 3147 in3 composed of 3 identically tuned 1049-in3 Bolt-gun sub-arrays operating at an air pressure of 2,000 psi;

(B) a subbottom profiler (1 - 12.0 kHz);

(C) a boomer/sparker/ airgun (400-800 Hz);

(D) a hi-resolution multi-channel seismic system (20-300 Hz);

(E) a multi-beam bathymetric sonar (200-500 kHz) ; and
(F) a side-scan sonar system.

(ii) On the *M/V Henry Christoffersen* and *M/V Alpha Helix:*

(A) a dual frequency subbottom profiler, Datasonics CAP6000 Chirp II (2-7kHz or 8-23kHz)
(B) a medium penetration Subbottom profiler, Datasonics SPR-1200 Bubble Pulser (400 Hz);
(C) a hi-resolution multi-channel seismic system consisting of 2 subarrays of 2-10 in^3 (2X10) airgun array (0-150 Hz);
(D) a multi-beam bathymetric sonar, Seabat 8101 (240 kHz); and
(E) a side-scan sonar system, Datasonics SIS-1500 (190kHz - 210 kHz)

(c) The taking of any marine mammal in a manner prohibited under this Authorization must be reported within 24 hours of the taking to the Alaska Regional Administrator (907-586-7221) or his designee in Anchorage (907-271-5006), National Marine Fisheries Service (NN1FS) and the Chief of the Permits, Conservation and Education Division ,. Office of Protected Resources, NMFS, at (301) 713-2289, ext 110, or his designee (301-713-2289 ext 128).

4. The Holder of this Authorization is required to cooperate with the National Marine Fisheries Service and any other Federal, state or local agency with authority to monitor the impacts of the activity on marine animals . The Holder must notify the Chief of the Permits, Conservation and Education Division, Office of Protected Resources at least 48 hours prior to the start of collecting seismic data (unless constrained by the date of issuance of this Authorization in which case notification shall be made as soon as possible), whenever moving between the Chukchi Sea and the Beaufort Sea, and whenever not conducting seismic for more than 48 hours.

5 . Prohibitions

(a) The taking, by incidental harassment only, is limited to the species listed under condition 3(a) above. The taking by Level A harassment (i.e., serious injury that is likely to lead to mortality) or death of these species or the taking by behavioral harassment, injury or death of any other species of marine mammal is prohibited and may result in the modification, suspension or revocation of this Authorization.

(b) The taking of any marine mammal is prohibited whenever the required seismic and support vessel marine mammal observers (HMOs), required by conditions 7(a)(i) and 7(b), are not onboard in conformance with these conditions, or the coastal or offshore aerial, and/or the coastal passive acoustic monitoring programs described in conditions 7(c) and 8 have not been

fully implemented as required by this Authorization.

(c) The taking of any marine mammals by seismic sounds when the seismic vessel is within 15 miles of another operating seismic vessel.

6. Mitigation.

(a) General Mitigation: The Holder of this Authorization is required to:

(i) (A) Avoid concentrations or groups of whales by all vessels and aircraft under the direction of SOI/WG. Operators of support vessels and aircraft should, at all times, conduct their activities at the maximum distance possible from such concentrations of whales. Except as provided in condition 6(a)(Il), under no circumstances, other than an emergency, should aircraft operate at an altitude lower than 1,000 feet when within 500 lateral yards of groups of whales. Helicopters may not hover or circle above such areas or within 500 lateral yards of such areas; and (B) When weather conditions do not allow a 1,000-ft flying altitude, such as during severe storms or when cloud cover is low, aircraft may be operated below the 1,000-ft altitude stipulated above. However, when aircraft are operated at altitudes below 1,000 feet because of weather conditions, the operator must avoid known whale concentration areas and should take precautions to avoid flying directly over or within 500 yards of groups of whales.

(ii) Take every precaution to avoid harassment of whale concentrations when a vessel is operated near these animals. Vessels should reduce speed when within 300 yards of whales and those vessels capable of steering around such groups should do so. Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group, especially bowhead whale cow/calf pairs.

(iii) Avoid multiple changes in direction and speed when within 300 yards of whales. In addition, operators should check the waters immediately adjacent to a vessel to ensure that no whales will be injured when the vessel's propellers (or screws) are engaged.

(iv) Not operate support vessels (including small boats) at a speed that would make collisions with whales likely.

(v) When weather conditions require, such as when visibility drops, vessels should adjust speed accordingly to avoid the likelihood of injury to whales.

(vi) (A) To avoid having an unmitigable adverse impact on the availability of marine mammal species or stocks for taking for subsistence uses, the following measures must be fully implemented:

(I) Plan all vessel and aircraft routes to minimize any potential conflict with subsistence whaling and sealing activities , particularly the fall bowhead whale subsistence

harvest by the villages of Nuiqsuk, Kaktovik and Barrow. All vessels shall avoid areas of active or anticipated whaling activity.

(II) (*1*) During the fall bowhead whaling season, aircraft shall not operate below 1500 ft 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 other emergency situations.

(*2*) Aircraft engaged in marine mammal monitoring shall not operate below 1500 ft in areas of active whaling (such areas to be identified though communications with the Com-Centers).

(III) All geophysical activity in the Beaufort Sea and eastern Chukchi seas shall be restricted from conducting seismic survey and related work as 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 fall bowhead whale hunt in Kaktovik and Nuiqsut. From August 10 to August 25, the Holder of this Authorization shall communicate and collaborate with the Alaska Eskimo Whaling Commission on any planned vessel movement in and around Kaktovik and Cross Island to avoid impacts to the whale hunt.

(2) Nuiqsut: (a) Point Storkersen (-148 deg. 42 min. W) to Thetis Island (-150 deg. 10.2 min. W): (i) Inside the barrier islands, no geophysical activity prior to August 5; geophysical activity allowed from August 5 until completion of operations. Geophysical activity allowed in this area after August 25 shall include a source array of no more than 12 airguns, a source layout no greater than 8 in x 6 in, and a single source volume of no greater than 880 cubic inches. (ii) Outside the barrier islands, no geophysical activity from August 25 to the close of fall towhead whale hunting in Nuiqsut; geophysical activity allowed at all other times; (b) Canning River (-146 deg. 4 min. W) to Point Storkersen (-148 deg. 42 min. W): No geophysical activity from August 25 to the close of the bowhead whale subsistence hunting in Nuiqsut.

(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 fall bowhead whale hunting in Barrow.

(4) Chukchi Sea: (a) Geophysical activities may not commence prior to July 20, 2008, but in any case geophysical exploration activities shall not be conducted within 60 miles from the Chukchi Sea coast at any point.

(b) Geophysical activity may occur beginning July 20th, and shall end on September l0th. Geophysical activity may resume in the Chukchi Sea following the close of the fall 2008 towhead whale subsistence hunt in Barrow, Wainwright, Pt. Lay and Pt Hope, unless an earlier start date is specifically authorized by the Whaling Captains' Associations of Barrow, Wainwright, Pt. Lay, and Pt. Hope, and the AEWC.

(c) For purposes of this Authorization, fall bowhead whale subsistence hunting in the Chukchi Sea is considered to be occurring if the following conditions are met: (i) the villages of Wainwright, Pt. Hope and Pt Lay have remaining village quotas for 2008; and (ii) traditional bowhead whale subsistence hunting activity is anticipated or ongoing.

(*5*) Beginning with spring ice break-up and until fall freeze-up, all vessels transiting east of Bullet Point, to the Canadian border should remain at least 5 miles offshore during transit along the coast.

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(*6*) Seismic and support vessel transits in the Chukchi Sea spring lead system must not occur prior to July 1, 2009, and should remain a minimum of 30 miles offshore during transit during the year.

(IV) For the purposes of reducing or eliminating conflicts between subsistence whaling activities and the seismic activity, the Holder of this Authorization, in cooperation with Holders of related Authorizations, will establish and operate at least five Communication Centers (Com-Centers) to be staffed by Inupiat operators. The Com-Centers will be operated 24 hours/day during the 2008 fall subsistence bowhead whale hunt.

(V) Upon notification by Com-Center operator of an at-sea emergency, the Holder of this Authorization shall provide such assistance as necessary to prevent the loss of life.

(VI) Upon request for emergency assistance made by a subsistence whale hunting organization, or by a member of such an organization in order to prevent the loss of a whale, the Holder of this Authorization shall assist towing of a whale taken in a traditional subsistence whale hunt.

(Vll)(*a*) Post-Season Review: Following the end of the fall 2008 bowhead whale subsistence hunt and prior to the 2009 Pre-season Introduction Meetings , the Holder of this Authorization and other Industry Participants will host a joint meeting with all whaling captains of the Villages of Nuiqsut, Kaktovik and Barrow, the Inupiat Communicator (s) and with the Chairman and Executive Director of the AEWC at a mutually agreed upon place on the North Slope to review the results of the 2008 fall season (unless it is agreed by all designated individuals or their representatives that such a meeting should be held at a different location, should be postponed , or is not necessary).

(*b*) Following completion of Chukchi Sea geophysical activities, and prior to the 2009 Pre-Season Introduction Meetings, the Holder of this Authorization and other Chukchi Sea Industry Participants will host a meeting in each of the villages of: Wainwright, Point Lay, Point Hope, and Barrow (or a joint meeting of the whaling captain from all these villages if the whaling captains agree to a joint meeting) to review the results of operations and to discuss any concerns residents of those villages might have regarding the operations.

(b) Seismic Vessel Mitgation: The Holder of this Authorization is required to:

(i) Reduce the volume of the airgun array during vessel turns while running seismic lines to one airgun or to a reduced number of airguns (unless seismic data collection will continue during line turns).

(ii) Whenever a marine mammal is detected outside the exclusion zone radius, and based on its position and motion relative to the ship track is likely to enter the safety radius, calculate and implement an alternative ship speed or track.

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(iii) Exclusion and Monitoring-Safety Zones:

(A) Establish and monitor with trained MMOs, a preliminary exclusion zone for cetaceans surrounding the seismic airgun array on the *M/V Gilavar* where the received level would be 180 dB re I µPa rms . For purposes of the field verification test, described in condition 7(d), this radius is estimated to be 1.3 mi (2.1 km) from the seismic source.

(B) Establish and monitor with trained MMOs a preliminary exclusion zone for pinnipeds surrounding the seismic airgun array on the *M/V Gilavar* where the received level would be 190 dB re 1 µPa rms. For purposes of the field verification test described in condition 7(d), this radius is estimated to be 0 .5 mi (0.86 km) from the seismic source.

(C) Establish and monitor with trained MMOs a preliminary exclusion zone for cetaceans and pinnipeds surrounding the high-resolution seismic airgun arrays on the *M/V Henry Christoffersen* and *M/V Alpha Helix* where the received level would be preliminarily determined to be 180 dB and 190 dB re I µPa rms, respectively.

(D) Immediately upon completion of data analysis of the field verification measurements required under condition 7(d) below, establish and monitor the new 180-dB and 190-dB marine mammal exclusion zones.

(E) Cetacean Monitor (Safety) Zones:

(I) Whenever the support "chase" vessel monitoring program described in condition 7(b) below detects an aggregation of 12 or more non-migratory mysticete whales within an acoustically verified 160-dB rms zone ahead of, or perpendicular to, the seismic vessel track, the Holder of this Authorization must: (a) Immediately shutdown the seismic airgun array and/or other acoustic sources to ensure that sound pressure levels (SPLs) at the shortest distance to the aggregation do not exceed 160 dB rms (the mitigation airgun may continue to operate provided its 160-dB SPL does not reach the aggregation); and (b) Not proceed with ramping up the seismic airgun array until the lead MMO on board the support "chase" vessel(s) or survey aircraft confirm that no mysticete whale aggregations have been detected within the seismic vessel's 160-dB zone based upon ship course, direction and distance from last sighting and the last aggregation sighting appropriate safety zones;

(II) Whenever the aerial monitoring program described in conditions 7(c) below detects 4 bowhead whale cow/calf pairs within an acoustically-verified 120-dB monitoring zone, the Holder of this Authorization must: (a) Immediately shutdown the seismic airgun array and/or other acoustic sources, and (b) not proceed with ramping up the seismic airgun array until two consecutive aerial surveys confirm that there are no more than 3 bowhead cow/calf pairs within the area to be seismically surveyed within the next 24 hours.

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(iv) Power-down/Shut-down.

(A) Immediately power-down the seismic airgun array and/or other acoustic sources, whenever any cetaceans are sighted approaching close to or within the area delineated by the 180-dB (re 1 μPa_{rms}), or pinnipeds are sighted approaching close to or within the area delineated by the 190-dB re 1 .Pa rms isopleth as established under condition 6(b)(iii) for the authorized seismic airgun array- If the power-down operation cannot reduce the received sound pressure level at the cetacean or pinniped to 180 dB or 190 dB, whichever is appropriate, the Holder of this Authorization must immediately shut-down the seismic airgun array and/or other acoustic sources.

(B) Not proceed with ramping up the seismic airgun array unless the marine mammal exclusion zones described in condition 6(b)(iii)(A), W), and (C) are visible and no marine mammals are detected within the appropriate safety zones ; or until 15 minutes (for small odontocetes, pinnipeds) or a minimum of 30 minutes (for mysticetes/large odontocetes) after there has been no further visual detection of the animal(s) within the safety zone and the trained MMO on duty is confident that no marine mammals remain within the appropriate safety zone.

(C) Emergency shut-down. In the unanticipated event that an injured or dead marine mammal is sighted within an area where the Holder of this Authorization deployed and utilized seismic airguns within the past 24 hours, immediately shutdown the seismic airgun array.

(I) In the event that the marine mammal has been determined to have been deceased for at least 72 hours, as certified by the lead MMO onboard the seismic vessel, and no other marine mammals have been reported injured or dead during that same 72 hour period, the airgun array may be restarted (by conducting the necessary ramp-up procedures described in condition 6(b)(v) below) upon completion of a written certification, including supporting documents (e.g., photographs or other evidence to support the certification) by the MMO. Within 24 hours after the event specified herein, the Holder of this Authorization must notify the designated staff person (see III below) by telephone or email of the event and ensure that the written certification and supporting documents are provided to the NWS staff person.

(II) In the event that the marine mammal injury resulted from something other than seismic airgun operations (e. g., gunshot wound, polar bear attack), as certified by the lead MMO onboard the seismic vessel, the airgun array may be restarted (by conducting the necessary ramp-up procedures described in condition 6(b)(v) below) upon completion of a written certification, including supporting documents (e.g., photographs or other evidence to support the certification) by the MMO. Within 24 hours after the event specified herein, the Holder of this Authorization must notify the designated staff person (see III below) by telephone or email of the event and ensure that the written certification and supporting documents are provided to the NMFS staff person.

(III) In the event the animal has not been dead for a period greater than 72 hours or the cause of the injury or death cannot be immediately determined by the lead MMO, the Holder shall immediately report the incident to either the NWS staff person designated by the Director, Office of Protected Resources (Ken Hollingshead, Office of Protected Resources,

NMFS, 301-713-2289 ext 128 or Ken.Hollingshead@noaa.gov) or to the staff person(s) designated by the Alaska Regional Administrator (Brad Smith or James Wilder, Alaska Regional Office, NMFS, 907-271-5006 or Brad.Smith@noaa.gov or James.Wilder@noaagov).

(1) The seismic airgun array shall not be restarted until NMFS is able to review the circumstances of the take, make determinations as to whether modifications to the activities are appropriate and necessary, and has notified the Holder that activities may be resumed.

(2) NMFS approval to resume operations may be given by the Director, Office of Protected Resources, NMFS, or his designee or by the Alaska Regional Administrator, NMFS, or his designee. NMFS approval may be provided in writing via a letter or an email or via the telephone.

(v) Ramp-up

(A) Prior to commencing ramp-up described in condition 6 (b)(v)(C), conduct a 30-minute period of marine mammal observations by at least one trained MMO W at the commencement of seismic operations and (2) at any time electrical power to the airgun array is discontinued for a period of 10 minutes or more and the MMO watch has been suspended;

(B) If the complete safety radii are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime, do not commence ramp-up unless the seismic source has maintained a sound pressure level at the source of at least 180 dB re 1 μPa rms during the interruption of seismic survey operations.

(C) If no marine mammals are observed while undertaking mitigation conditions 6(v)(A) and (B), ramp-up airgun arrays no greater than approximately 6 dB per 5-minute period starting with the smallest airgun in the array and then adding additional guns in sequence, until the full array is firing: (1) At the commencement of seismic operations, and (2), anytime after the airgun array has been powered down for more than 10 minutes;

7. Monitoring.

(a) Vessel Monitoring:

(i) Seismic Vessel: The Holder of this Authorization must designate biologicallytrai ned, on-site individuals (MMOs) to be onboard the *M/V Gilavar*, *M/V Henry Christoffersen,* and *M/V Alpha Helix* (or similar source vessel) and designated support vessels conducting marine mammal observations or surveys, approved in advance by National Marine Fisheries Service (one may be an Inupiat), to conduct the visual monitoring programs required under this Authorization and to record the effects of seismic surveys and the resulting noise on marine mammals. The minimum number of observers required for the source vessels are:

9

(A) Between August 16 and September 15, 2008 , there must be at least 4 MMOs onboard each source vessel at any one time during all seismic operations;

(B) Between September 16 and the end of the 2008 survey, there must be at least 3 MMOs onboard each source vessel at any time during all seismic operations.

(C) Between July 20, 2009 and August 19, 2009, there must be at least 5 MMOs onboard each source vessel at any one time during all seismic operations.

(ii) To the extent possible , MMOs should be on duty for 4 consecutive hours or . less, although more than one 4-hour shift per day is acceptable.

(iii) Monitoring is to be conducted by the MMOs described in condition 7(a)(i) above, onboard each active seismic vessel and support vessel , to (A) ensure that no marine mammals enter the appropriate safety zone whenever the seismic array is on, and/or `B) to record marine mammal activity as described in condition 7(a)(vi) below, at least two MMOs must be on watch during ramp ups and the 30 minutes prior to full ramp ups , and for as large a fraction of the other operating hours as possible . At all other times, at least one MMO must be on active watch whenever the seismic airgun array is operating during all daytime airgun operations, during any nighttime power-ups of the airguns and at night , whenever daytime monitoring resulted in one or more power-down situations due to marine mammal presence.

(iv) At all times, the crew must be instructed to keep watch for marine mammals. If any are sighted, the bridge watch-stander must immediately notify the MMO on-watch. If a marine mammal is within, or closely approaching, its designated safety zone, the airgun array must be immediately powered down.

(v) Observations by the MMOs described in condition 7(a)(i) above on marine mammal presence and activity will begin a minimum of 30 minutes prior to the estimated time that the seismic source is to be turned on and/or ramped-up.

(vi) Monitoring will consist of recording : (i) the species, group size, age/size/sex categories (if determinable), the general behavioral activity, heading (if consistent), bearing and distance from seismic vessel, sighting cue, behavioral pace , and apparent reaction of all marine mammals seen near the seismic vessel and/or its airgun array (e.g., none, avoidance, approach, paralleling, etc) and; (ii) the time, location, heading, speed, and activity of the vessel (shooting or not), along with sea state, visibility, cloud cover and sun glare at (1) any time a marine mammal is sighted, (2) at the start and end of each watch, and (3) during a watch (whenever there is a change in one or more variable); and, (iii) the identification of all vessels that are visible within 5 km of the seismic vessel whenever a marine mammal is sighted , and the time observed, bearing, distance, heading , speed and activity of the other vessel(s).

(vii) All MMOs and Inupiat observers must be provided with and use appropriate

night-vision devices, Big Eyes, and reticulated and/or laser range finding binoculars, in order to detect marine mammals within the Exclusion Zone.

(b) Chase Boat Monitoring:

(i) At least one "chase boat "and/or support vessel will assist in monitoring safety and monitoring zones during active seismic survey operations in the Chukchi and Beaufort Seas. The chase boat and support vessel will have at least two MMOs onboard to collect marine mammal observations.

(ii) During all active seismic survey activity, the chase boat will conduct marine mammal surveys no less than every 48 hours or 3 times per 7 days, and at all other times except during re-supply operations, of the 160-dB area to be seismically surveyed over the next 24 hours. MMOs will search for aggregations of bowhead and gray whale feeding utilizing a survey design approved by the National Marine Fisheries Service.

(iii) The MMOs on the chase boat will immediately contact the seismic survey ship if marine mammals are sited within the 180/190-dB safety zone or aggregations of 12 or more non-migratory bowhead whales or gray whales are sited within the surveyed 160-dB zone.

(iv) MMOs onboard chase boats will be limited to 4 hrs in length and 12 hrs total in a 24 hr period.

(c) Aerial Surveys: Beaufort Sea

(i) In accordance with the survey design descnibed in Shell's 2008 Beaufort Sea monitoring plan, the Holder of this Authorization must conduct aerial surveys of the seismic area and nearby waters (A) biweekly through August 31, 2008, and (B) daily, weather permitting, from September 1, 2008, until 3 days after the conclusion of the seismic program.

(ii) Using standard aerial survey procedures for marine mammal surveys, monitoring is to be conducted by 2 primary MMOs and a third MMO for part-time observations and data logging.

(iii) Aerial monitoring will consist of noting the marine mammal species, number, age/size/sex class (if determinable), general activity, heading (if consistent), swimming speed category (if traveling), sighting cue, ice conditions, and inclinometer reading.

(iv) As proposed by SOI, after September 1, 2008, the aerial survey will look for migratory cow/calf pairs during normal survey activity. If the biological observers onboard the aircraft see 4 or more migratory bowhead whale cow/calf pairs within the surveyed portion of the 120-dB isopleth from the seismic survey vessel, the lead MMO or his/her designee will immediately contact the MMO on watch onboard the seismic vessel of the observation. The

location, bearing and approximate speed of the migratory bowhead whales will be recorded.

(d) Field Source Verification Using a bottom founded hydrophone system, the Holder of this Authorization is required to conduct sound source verification tests for all seismic sources and vessels and also for all support vessels not previously measured and at a minimum report the following results within 5 days of completing the test:

(i)(A) the empirical distances from the airgun array and other acoustic sources utilized during the pendency of this authorization to broadband received levels of 190, 180, 160, and 120 dB(rms) re 1 microPa, and

(i)(B) the radiated sounds vs. distance from the seismic vessels supporting the survey.

(ii) Measurements are to be made at the beginning of the survey for locations not previously modeled in the Chukchi Sea and Beaufort Sea in water depths shallower than 200 m (656 ft) and water depths greater than 200 m (656 ft).

8. Additional Monitoring

(a) The Holder of the Authorization, in cooperation with other oil company participants must conduct all monitoring described in the *"Marine Mammal Monitoring and Mitigation Plan for Seismic Exploration in the Alaskan Chukchi and Beaufort Seas, 2008."* Research will include establishment of:(i) an acoustic program to measure sounds produced by seismic vessels (required under condition 7(d); (ii) an aerial monitoring and reconnaissance of marine mammals available for subsistence harvest along the Chukchi Sea coast; (iii) deployment, and later analysis of data from , bottom-founded autonomous acoustic recorder arrays along the coast of the Chukchi Sea to record ambient sound levels, vocalizations of marine mammals, and received levels of seismic operations should they be detectable and, (iv) an acoustic study of bowhead deflections in the Beaufort Sea.

9. Reporting.

(a) Field Source Verification and the distances to the various radii are to be reported to the National Marine Fisheries Service within 5 days of completing the measurements. In addition to reporting the radii of specific regulatory concern, distances to other sound isopleths down to 120 dB rms (if measurable) will be reported in increments of 10 dB.

(b) Seismic Vessel Monitoring Program: A draft report will be submitted to the Director, Office of Protected Resources, National Marine Fisheries Service within 90 days after the end of Shell 's seismic survey program in the Arctic Ocean . The report will describe in detail (i) the

operations that were conducted, (ii) the results of the acoustical measurements to verify the safety radii, (iii) the methods, results, and interpretation pertaining to all monitoring tasks; (iv) the results of the 2008 shipboard marine mammal monitoring;; (v), a summary of the dates and locations of seismic operations, including summaries of power downs, shut downs, and ramp up delays; (vi) marine mammal si tins (species, numbers, dates, times and locations; age/size/gender, environmental correlates, activities, associated seismic survey activities), (vii) estimates of the amount and nature of potential take (exposure) of marine mammals (by species) by harassment or in other ways to industry sounds; (viii) an analysis of the effects of seismic operations (e.g., on sighting rates, sighting distances, behaviors, movement patterns of marine mammals); (ix) provide an analysis of factors influencing detectability of marine mammals; and (x) provide summaries on communications with hunters and potential effects on subsistence uses.

(c) The draft report will be subject to review and comment by the National Marine Fisheries Service. Any recommendations made by the National Marine Fisheries Service must be addressed in the final report prior to acceptance by the National Marine Fisheries Service. The draft report will be considered the final report for this activity under this Authorization if the National Marine Fisheries Service has not provided comments and recommendations within 90 days of receipt of the draft report.

(d) A draft comprehensive report describing the acoustic, vessel-based, and aerial monitoring programs will be prepared and submitted within 240 days of the date of this Authorization. The comprehensive report will describe the methods, results, conclusions and limitations of each of the individual data sets in detail. The report will also integrate (to the extent possible) the studies into a broad based assessment of all industry activities and their impacts on marine mammals in the Arctic Ocean during 2008.

(e) The draft comprehensive report will be reviewed by participants at the 2009 Open Water Scientific Meeting to be held in Anchorage AK in the spring of 2009. The draft comprehensive report will be accepted by the National Marine Fisheries Service as the final comprehensive report upon incorporation of recommendations by the workshop participants.

10. Activities related to the monitoring described in this Authorization do not require a separate scientific research permit issued under section 104 of the Marine Mammal Protection Act.

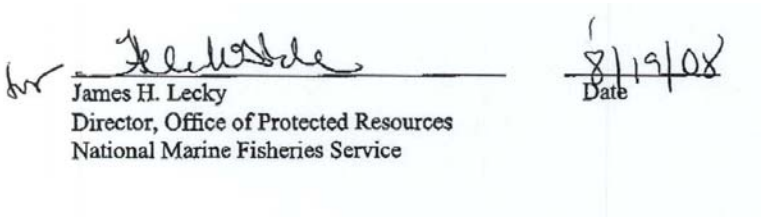
11. The Plan of Cooperation and that portion of the Conflict Avoidance Agreement outlining the steps that will be taken to cooperate and communicate with the native communities to ensure the availability of marine mammals for subsistence uses, must be implemented.

12. This Authorization may be modified, suspended or withdrawn if the Holder fails to

abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals, or an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

13. A copy of this Authorization must be in the possession of each seismic vessel operator taking marine mammals under the authority of this Incidental Harassment Authorization.

14. The Holder of this Authorization is required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to NMFS' Biological Opinion.



James H. Lecky
Director, Office of Protected Resources
National Marine Fisheries Service

8/19/08
Date

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

AUG 27 2008

Ms. Susan Childs
Manager, Regulatory Affairs Coordinator,
Alaska
Shell Exploration and Production Company
3601 C Street, Suite 1334
Anchorage, AK 99503

Dear Ms. Childs:

On August 19, 2008, the National Marine Fisheries Service (NMFS) issued an Incidental Harassment Authorization (IHA) to Shell Offshore Inc. (SOI), under the authority of Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C. 1361 *et seq.*). This IHA is for SOI's taking by harassment, of marine mammals during seismic and shallow hazard surveys in the Chukchi and Beaufort Seas off Alaska, during the open water periods between August 19, 2008, through August 18, 2009. By e-mails on August 20 and 22, 2008, respectively, SOI requested that condition 3(a) be revised to include Level B harassment taking for minke whales (*Balaenoptera acutorostrata*) and ribbon seals (*Histriophoca fasciata*). These species were requested originally in SOI's October 16, 2007, IHA application.

NMFS has reviewed SOI's request and agrees that the addition of minke whales and ribbon seals to the list of marine mammal species authorized by the IHA to be taken by Level B harassment is warranted. Although not explicitly analyzed in SOI's IHA application, NMFS believes that, based on available information, these two species have been seen on occasion in the northern Chukchi Sea where SOI plans to conduct seismic operations, and therefore, could potentially be exposed to seismic sounds. As a result, NMFS has reconsidered its take authorization to SOI, and has determined that taking by Level B harassment should be authorized. NMFS believes that these takings (by Level B harassment) would be limited to a very few animals, and thus, would be small relative to its stock or population size; would have a negligible impact on these two marine mammal stocks; and would not have an unmitigable adverse impact on their availability for taking for subsistence uses (minke whales are not hunted and the mean estimate of ribbon seals taken annually by subsistence hunters is 193, all in the southern Chukchi Sea). Therefore, NMFS has determined that condition 3(a) can be amended.

Accordingly, Condition 3(a) is amended to read as follows.

Condition 3 (a). The species authorized for incidental harassment takings are: bowhead whales (*Balaena mysticetus*), gray whales (*Eschrichtius robustus*), humpback whales (*Megaptera novaeangliae*), fin whales (*Balaenoptera physalus*), minke whales (*Balaenoptera acutorostrata*),

beluga whales (*Delphinapterus leucas*), killer whales (*Orcinus orca*), harbor porpoise (*Phocoena phocoena*), ringed seals (*Phoca hispida*), ribbon seals (*Histriophoca fasciata*), spotted seals (*Phoca largha*), and bearded seals (*Erignathus barbatus*).

A copy of this modification letter must be attached to the IHA and must be in the possession of the operator of each vessel, aircraft, and marine mammal monitors operating under the authority of this Authorization.

If you have any questions concerning the IHA or its requirements, please contact Ken Hollingshead, NMFS, Office of Protected Resources, at (301) 713-2289, ext. 128.

Sincerely,

James H. Lecky
Director
Office of Protected Resources

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

Ms. Susan Childs
Manager, Regulatory Affairs Coordinator,
Alaska
Shell Exploration and Production Company
3601 C Street, Suite 1334
Anchorage, AK 99503

AUG 19 2009

Dear Ms. Childs:

Enclosed is an Incidental Harassment Authorization (IHA) issued to Shell Offshore, Inc. and Shell Gulf of Mexico Inc., a legal entity of Shell Exploration and Production Company, pursuant to Section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C. 1361 *et seq.*), to take, by Level B harassment only, marine mammals incidental to conducting an open-water marine survey program in the Chukchi Sea, Alaska, during 2009-2010. Shell is required to comply with the conditions contained in the IHA. In addition, Shell must cooperate with any Federal, state, or local agency monitoring the impacts of your activities, and submit a draft report to the National Marine Fisheries Service's (NMFS) Office of Protected Resources, within 90 days after completion of the work authorized herein. Along with other mitigation measures to be incorporated, the IHA requires monitoring for the presence and behavior of marine mammals.

NMFS provided you with copies of the comment letters submitted during the 30-day public comment period on your MMPA application and NMFS' proposed IHA notice. Many of the comments were specific to the application itself. NMFS recommends that Shell consider these comments when submitting future MMPA authorization applications.

If you have any questions concerning the IHA or its requirements, please contact Candace Nachman, Office of Protected Resources, NMFS, at (301) 713-2289 ext. 156.

Sincerely,

James H. Lecky, Director
Office of Protected Resources

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

Incidental Harassment Authorization

Shell Offshore Inc. and Shell Gulf of Mexico Inc. (Shell), 3601 C Street, Suite 1314, Anchorage, Alaska, 99503, are hereby authorized under section 101(a)(5)(D) of the Marine Mammal Protection Act (16 U.S.C. 1371(a)(5)(D)) and 50 CFR 216.107 to take, by Level B harassment only, small numbers of marine mammals incidental to conducting an open-water marine survey program in the Chukchi Sea in Arctic Ocean waters under the jurisdiction of the United States, contingent upon the following conditions:

1. This Authorization is valid from August 19, 2009, through August 18, 2010.

2. This Authorization is valid only for activities (including support vessels and aircraft) associated with the *R/V Mt. Mitchell* (or equivalent vessel) site clearance and shallow hazards surveys in the Minerals Management Service's Lease Sale 193 located in the Chukchi Sea. The specific areas where Shell's shallow hazard and site clearance surveys would occur are located approximately 113 km (70 mi) off the Alaska coast, generally west from the village of Wainwright in the Chukchi Sea.

3. (a). The species authorized for incidental harassment takings are: beluga whales (*Delphinapterus leucas*); killer whales (*Orcinus orca*); harbor porpoise (*Phocoena phocoena*); bowhead whales (*Balaena mysticetus*); gray whales (*Eschrichtius robustus*); minke whales (*Balaenoptera acutorostrata*); fin whales (*Balaenoptera physalus*); humpback whales (*Megaptera novaeangliae*); bearded seals (*Erignathus barbatus*); spotted seals (*Phoca largha*); ringed seals (*Phoca hispida*); and ribbon seals (*Histriophoca fasciata*).

(b). The authorization for taking by harassment is limited to vessel noise and to the following acoustic sources (or sources with comparable frequency and intensity) without an amendment to this Authorization:

(i). Dual frequency subbottom profiler (2-7 kHz or 8-23 kHz);
(ii). Single beam Echo Sounder (33-210 kHz);
(iii). Multi-beam Echo Sounder (200 kHz);
(iv). High resolution multi-channel 2D system, consisting of 40 in^3 (4 x 10) airgun array (0-150 Hz);
(v). Shallow subbottom profiler (1-12 kHz); and
(vi). Medium penetration subbottom profiler (400-800 Hz).

(c). The taking of any marine mammal in a manner prohibited under this Authorization must be reported within 24 hours of the taking to the Alaska Regional Administrator (907-586-7221) or his designee in Anchorage (907-271-3023), National

Marine Fisheries Service (NMFS) and the Chief of the Permits, Conservation and Education Division, Office of Protected Resources, NMFS, at (301) 713-2289, ext. 110, or his designee (301-713-2289 ext. 156).

4. The holder of this Authorization is required to cooperate with NMFS and any other Federal, state or local agency with authority to monitor the impacts of the activity on marine animals. The holder must notify the Chief of the Permits, Conservation and Education Division, Office of Protected Resources, at least 48 hours prior to the start of collecting seismic data (unless constrained by the date of issuance of this Authorization in which case notification shall be made as soon as possible).

5. Prohibitions

(a). The taking, by incidental harassment only, is limited to the species listed under condition 3(a) above. The taking by Level A harassment, injury or death of these species or the taking by harassment, injury or death of any other species of marine mammal is prohibited and may result in the modification, suspension, or revocation of this Authorization.

(b). The taking of any marine mammal is prohibited whenever the required source vessel marine mammal observers (MMOs), required by condition 7(a)(i), are not onboard in conformance with condition 7(a)(i) of this Authorization or the passive acoustic monitoring program described in condition 8 is not fully implemented.

(c.) The taking of any marine mammals by seismic sounds when the seismic vessel is within 15 miles of another operating seismic vessel, which is being used for a separate operation, is prohibited.

6. Mitigation

(a.) General Mitigation: The holder of this Authorization is required to:

(i). Avoid concentrations or groups of whales by all vessels under the direction of Shell. Operators of support vessels should, at all times, conduct their activities at the maximum distance possible from such concentrations of whales.

(ii). Reduce vessel speed when within 300 yards of whales and those vessels capable of steering around such groups should do so. Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group.

(iii). Avoid multiple changes in direction and speed when within 300 yards of whales. In addition, operators should check the waters immediately adjacent to a vessel to ensure that no whales will be injured when the vessel's propellers (or screws) are engaged.

(iv). Not operate support vessels (including small boats), to the extent that they are being used, at a speed that would make collisions with whales likely.

(v). When weather conditions require, such as when visibility drops, adjust vessel speed accordingly to avoid the likelihood of injury to whales.

(vi). Fully implement the following measures, consistent with the 2009 Conflict Avoidance Agreement, in order to avoid having an unmitigable adverse impact on the availability of marine mammal species or stocks for taking for subsistence uses:

(A). For the purposes of reducing or eliminating conflicts between subsistence whaling activities and Shell's survey program, the holder of this Authorization will participate with other operators in the Communication Center (Com-Center) Program that is currently operating in the Chukchi Sea by Inupiat operators. The Com-Centers will be operated 24 hours/day during the 2009 fall subsistence bowhead whale hunt.

(B). Plan all vessel routes to minimize any potential conflict with subsistence whaling and sealing activities. All vessels shall avoid areas of active or anticipated whaling activity.

(C). All geophysical activity in the Chukchi Sea shall be restricted from conducting seismic survey and related work as set forth below:

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

(II). Geophysical activity shall not be conducted within 60 miles of any point on the Chukchi Sea coast.

(D). Upon notification by a Com-Center operator of an at-sea emergency, the holder of this Authorization shall provide such assistance as necessary to prevent the loss of life, if conditions allow the holder of this Authorization to safely do so.

(E). Upon request for emergency assistance made by a subsistence whale hunting organization, or by a member of such an organization, in order to prevent the loss of a whale, the holder of this Authorization shall assist towing of a whale taken in a traditional subsistence whale hunt, if conditions allow the holder of this Authorization to safely do so.

(F). Post-season Review: Following completion of 2009 Chukchi Sea geophysical activities, and prior to the 2010 Pre-Season Introduction Meetings, the Holder of this Authorization and other Chukchi Sea Industry Participants, if requested by the Alaska Eskimo Whaling Commission (AEWC) or the Whaling Captain's Association of each village, will host a meeting in each of the following villages: Wainwright, Point Lay, Point Hope, and Barrow (or a joint meeting of the whaling captains from all these villages if the whaling captains agree to a joint meeting) to review the results of the 2009 operations and to discuss any concerns residents of those villages might have regarding the operations. The meetings will include the MMOs/Inupiat Communicators stationed on the Authorization holder's vessels in the

Chukchi Sea. The Chairman and Executive Director of the AEWC will be invited to attend the meeting(s).

(b). Seismic Vessel Mitigation: The holder of this Authorization is required to:

(i). Reduce the volume of the airgun array during vessel turns while running seismic lines to one airgun or to a reduced number of airguns (unless seismic data collection will continue during line turns).

(ii). Whenever a marine mammal is detected outside the exclusion zone radius and based on its position and motion relative to the ship track is likely to enter the safety radius, calculate and implement an alternative ship speed or track or de-energize the airgun array, as described in condition 6(b)(iv)(A) below.

(iii). Exclusion and Monitoring-Safety Zones:

(A). Establish and monitor with trained MMOs a preliminary exclusion zone for cetaceans surrounding the airgun array on the source vessel where the received level would be 180 dB re 1 μPa rms. For purposes of the field verification test, described in condition 7(b), this radius is estimated to be 160 m (525 ft) from the seismic source.

(B). Establish and monitor with trained observers a preliminary exclusion zone for pinnipeds surrounding the airgun array on the source vessel where the received level would be 190 dB re 1 μPa rms. For purposes of the field verification test described in condition 7(b), this radius is estimated to be 50 m (164 ft) from the seismic source.

(C). Whenever the vessel monitoring program described in condition 7(a) below detects an aggregation of 12 or more mysticete whales within an acoustically verified 160-dB rms zone ahead of, or perpendicular to, the seismic vessel track, the holder of this Authorization must: (I) shutdown the seismic airgun array and/or other acoustic sources; and (II) not proceed with powering up the airgun array until the lead MMO on-board confirms that no mysticete whale aggregations are likely to occur within the 160-dB zone based upon ship course, direction and distance from last sighting and the last aggregation sighting appropriate safety zones. For purposes of the field verification test described in condition 7(b), this radius is estimated to be 1,400 m (0.87 mi) from the seismic source.

(D). Immediately upon completion of data analysis of the field verification measurements required under condition 7(b) below, establish and monitor the new 160-dB, 180-dB, and 190-dB marine mammal exclusion zones.

(iv). Power-down/Shutdown:

(A). Immediately power-down the seismic airgun array and/or other acoustic sources, whenever any cetaceans are sighted approaching close to or within the area delineated by the 180 dB re 1 μPa (rms), or pinnipeds are sighted approaching close to or within the area delineated by the 190 dB re 1 μPa (rms) isopleth as established under condition 6(b)(iii) for the authorized seismic airgun array. If the power-down operation cannot reduce the received sound pressure level at the cetacean or pinniped to 180 dB or 190 dB, whichever is appropriate, the holder of this Authorization must immediately shutdown the seismic airgun array and/or other acoustic sources.

(B). Not proceed with powering up the seismic airgun array unless the marine mammal exclusion zones described in conditions 6(b)(iii)(A), (B), and (C) are visible and no marine mammals are detected within the appropriate safety zones; or until 15 minutes (for small odontocetes, pinnipeds) or a minimum of 30 minutes (for mysticetes) after there has been no further visual detection of the animal(s) within the safety zone and the trained MMOs on duty are confident that no marine mammals remain within the appropriate safety zone.

(C). In the unanticipated event that an injured or dead marine mammal is sighted within an area where the holder of this Authorization deployed and utilized seismic airguns within the past 24 hours, immediately shutdown the seismic airgun array and notify the Marine Mammal Stranding Network (telephone: 1-800-853-1964).

(I). In the event that the marine mammal has been determined to have been deceased for at least 72 hours, as certified by the lead MMO onboard the source vessel, and no other marine mammals have been reported injured or dead during that same 72 hour period, the airgun array may be restarted (by conducting the necessary ramp-up procedures described in condition 6(b)(v) below) upon completion of a written certification, including supporting documents (e.g., photographs or other evidence to support the certification) by the MMO. Within 24 hours after the event specified herein, the holder of this Authorization must notify the designated staff person (see III below) by telephone or email of the event and ensure that the written certification and supporting documents are provided to the NMFS staff person.

(II). In the event that the marine mammal injury resulted from something other than seismic airgun operations (e.g., gunshot wound, polar bear attack), as certified by the lead MMO onboard the seismic vessel, the airgun array may be restarted (by conducting the necessary ramp-up procedures described in condition 6(b)(v) below) upon completion of a written certification, including supporting documents (e.g., photographs or other evidence to support the certification) by the MMO. Within 24 hours after the event specified herein, the holder of this Authorization must notify the designated staff person (see III below) by telephone or email of the event and ensure that the written certification and supporting documents are provided to the NMFS staff person.

(III). In the event the animal has not been dead for a period greater than 72 hours or the cause of the injury or death cannot be immediately

determined by the lead MMO, the holder shall immediately report the incident to either the NMFS staff person designated by the Director, Office of Protected Resources (Candace Nachman, Office of Protected Resources, NMFS, 301-713-2289 ext. 156 or Candace.Nachman@noaa.gov) or to the staff person designated by the Alaska Regional Administrator (Brad Smith, Alaska Regional Office, NMFS, 907-271-3023 or Brad.Smith@noaa.gov).

(*1*) The seismic airgun array shall not be restarted until NMFS is able to review the circumstances of the take, make determinations as to whether modifications to the activities are appropriate and necessary, and has notified the holder that activities may be resumed.

(*2*) NMFS approval to resume operations may be given by the Director, Office of Protected Resources, NMFS, or his designee or by the Alaska Regional Administrator, NMFS, or his designee. NMFS approval may be provided in writing via a letter or an email or via the telephone.

(v). Ramp-up:

(A). Conduct a 30-minute period of marine mammal observations by at least two trained MMOs prior to commencing ramp-up described in condition 6(b)(v)(C): (I) at the commencement of seismic operations and (II) at any time electrical power to the airgun array has been discontinued for a period of 10 minutes or more and the MMO watch has been suspended;

(B). Not commence ramp-up if the complete safety radii are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime and not commence ramp-up at night unless the seismic source has maintained a sound source pressure level at the source of at least 180 dB re 1 μPa rms during the interruption of seismic survey operations. If a sound source of at least 180 dB re 1 μPa rms has been maintained during the interruption of seismic operations, then the 30 minute pre-ramp-up visual survey is waived; and

(C). Ramp-up the airgun arrays at no greater than 6 dB per 5-minute period starting with the smallest airgun in the array and then adding additional guns in sequence until the full array is firing, if no marine mammals are observed while undertaking conditions 6(v)(A) and (B): (I) at the commencement of seismic operations and (II) anytime after the airgun array has been powered down for more than 10 minutes.

7. Monitoring:

(a). Vessel Monitoring:

(i). The holder of this Authorization must designate biologically-trained, on-site individuals (MMOs) to be onboard the source vessel approved in advance by NMFS, to conduct the visual monitoring programs required under this Authorization and to record the effects of seismic surveys and the resulting noise on marine mammals.

There must be at least five (5) MMOs onboard the source vessel at any one time during all seismic operations.

(ii). To the extent possible, MMOs should be on duty for four (4) consecutive hours or less, although more than one four-hour shift per day is acceptable. MMOs will not work more than three (3) shifts in a 24-hour period (i.e., 12 hours total per day).

(iii). Monitoring is to be conducted by the MMOs described in condition 7(a)(i) above, onboard the active seismic vessel, to (A) ensure that no marine mammals enter the appropriate safety zone whenever the seismic acoustic sources are on, and (B) to record marine mammal activity as described in condition 7(a)(vi) below, at least two observers must be on watch during ramp ups and the 30 minutes prior to full ramp ups, and for as large a fraction of the other operating hours as possible. At all other times, at least one observer must be on active watch whenever the seismic acoustic sources is operating during all daytime airgun operations, during any nighttime power-ups of the airguns and at night, whenever daytime monitoring resulted in one or more power-down situations due to marine mammal presence.

(iv). At all times, the crew must be instructed to keep watch for marine mammals. If any are sighted, the bridge watch-stander must immediately notify the MMO(s) on-watch. If a marine mammal is within or closely approaching its designated exclusion (safety) zone, the seismic acoustic sources must be immediately powered down or shutdown (in accordance with condition 6(b)(iv)(A) above).

(v). Observations by the MMOs described in condition 7(a)(i) above on marine mammal presence and activity will begin a minimum of 30 minutes prior to the estimated time that the seismic source is to be turned on and/or ramped-up.

(vi). Monitoring will consist of recording: (A) the species, group size, age/size/sex categories (if determinable), the general behavioral activity, heading (if consistent), bearing and distance from seismic vessel, sighting cue, behavioral pace, and apparent reaction of all marine mammals seen near the seismic vessel and/or its airgun array (e.g., none, avoidance, approach, paralleling, etc); (B) the time, location, heading, speed, and activity of the vessel (shooting or not), along with sea state, visibility, cloud cover and sun glare at (I) any time a marine mammal is sighted, (II) at the start and end of each watch, and (III) during a watch (whenever there is a change in one or more variable); and, (C) the identification of all vessels that are visible within 5 km of the seismic vessel whenever a marine mammal is sighted, and the time observed, bearing, distance, heading, speed and activity of the other vessel(s).

(vii). All MMOs must be provided with and use appropriate night-vision devices, Big Eyes, and reticulated and/or laser range finding binoculars in order to detect marine mammals within the Exclusion Zone.

(b). Field Source Verification: Using a hydrophone system, the holder of this Authorization is required to conduct sound source verification tests for all seismic sources and source vessel not previously measured and, at a minimum, report the following results within 5 days of completing the test:

(i). The empirical distances from the airgun array and other acoustic sources utilized during the effectiveness of this Authorization to broadband received levels of 190, 180, 160, and 120 dB re 1 μPa (rms), and the radiated sounds vs. distance from the source vessel.

(ii). Measurements are to be made at the beginning of the survey for locations not previously modeled in the Chukchi Sea.

8. Research: The holder of the Authorization, in cooperation with other oil company participants, must conduct all monitoring described in the "*Marine Mammal Monitoring and Mitigation Plan for Site Clearance and Shallow Hazards Data Acquisition in the Alaskan Chukchi Sea, 2009*." Research will include establishment of: (i). an acoustic program to measure sounds produced by the source vessel (required under condition 7(b) above); and (ii) deployment, and later analysis of data from, bottom-founded autonomous acoustic recorder arrays along the coast of the Chukchi Sea to record ambient sound levels, vocalizations of marine mammals, and received levels of seismic operations should they be detectable.

9. Reporting:

(a). Field Source Verification and the distances to the various isopleths are to be reported to NMFS within five (5) days of completing the measurements. In addition to reporting the radii of specific regulatory concern, distances to other sound isopleths down to 120 dB rms (if measurable) will be reported in increments of 10 dB.

(b). Seismic Vessel Monitoring Program: A draft report will be submitted to the Director, Office of Protected Resources, NMFS, within 90 days after the end of Shell's 2009 survey program in the Chukchi Sea. The report will describe in detail: (i) the operations that were conducted; (ii) the results of the acoustical measurements to verify the safety radii; (iii) the methods, results, and interpretation pertaining to all monitoring tasks; (iv) the results of the 2009 shipboard marine mammal monitoring; (v) a summary of the dates and locations of seismic operations, including summaries of power-downs, shutdowns, and ramp-up delays; (vi) marine mammal sightings (species, numbers, dates, times and locations; age/size/gender, environmental correlates, activities, associated seismic survey activities); (vii) estimates of the amount and nature of potential take (exposure) of marine mammals (by species) by harassment or in other ways to industry sounds; (viii) an analysis of the effects of seismic operations (e.g., on sighting rates, sighting distances, behaviors, movement patterns of marine mammals); (ix) an analysis of factors influencing detectability of marine mammals; and (x) summaries on communications with hunters and potential effects on subsistence uses.

(c). The draft report will be subject to review and comment by NMFS. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS. The draft report will be considered the final report for this activity under this Authorization if NMFS has not provided comments and recommendations within 90 days of receipt of the draft report.

(d). A draft comprehensive report describing the acoustic and vessel-based monitoring programs will be prepared and submitted within 240 days of the date of this Authorization. The comprehensive report will describe the methods, results, conclusions and limitations of each of the individual data sets in detail. The report will also integrate (to the extent possible) the studies into a broad based assessment of all industry activities and their impacts on marine mammals in the Arctic Ocean during 2009.

(e). The draft comprehensive report will be subject to review and comment by NMFS, the AEWC, and the North Slope Borough Department of Wildlife Management. The draft comprehensive report will be accepted by NMFS as the final comprehensive report upon incorporation of comments and recommendations.

10. Activities related to the monitoring described in this Authorization do not require a separate scientific research permit issued under section 104 of the Marine Mammal Protection Act.

11. The Plan of Cooperation and that portion of any Conflict Avoidance Agreement outlining the steps that will be taken to cooperate and communicate with the native communities to ensure the availability of marine mammals for subsistence uses, must be implemented.

12. This Authorization may be modified, suspended or withdrawn if the holder fails to abide by the conditions prescribed herein or if the authorized taking is having more than a negligible impact on the species or stock of affected marine mammals, or if there is an unmitigable adverse impact on the availability of such species or stocks for subsistence uses.

13. A copy of this Authorization must be in the possession of each seismic vessel operator taking marine mammals under the authority of this Incidental Harassment Authorization.

14. Shell is required to comply with the Terms and Conditions of the Incidental Take Statement corresponding to NMFS' Biological Opinion.

AUG 19 2009

James H. Lecky
Director, Office of Protected Resources
National Marine Fisheries Service

Date

APPENDIX B: U.S. FISH AND WILDLIFE SERVICE LoA

JUL-20-2009 MON 04:16 PM FAX NO. P. 02

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:

AFES/MMM

JUL 16 2009

Ms. Susan Childs
Shell Exploration & Production Company
3601 C Street, Suite 1334
Anchorage, Alaska 99503

Dear Ms. Childs:

This responds to your March 26, 2009, request for Letters of Authorization (LOA) for the incidental take of polar bears and pacific walrus and intentional take of polar bears in relation to the Shell Gulf of Mexico, Inc. (Shell) 2009 Chukchi Sea Marine Surveys Program Activities.

Enclosed is a LOA (09-01-CS) that would allow Shell to take small numbers of polar bears and Pacific walrus incidental to oil and gas industry exploration activities identified in your LOA request. Shell plans to conduct site clearance and shallow hazards surveys and scientific data device deployments during 2009 within the Minerals Management Service (MMS) Lease Sale 193 area.

If any changes develop in your project during the 2009 open-water season, such as activities or location, the Marine Mammals Management Office (MMM) must be notified prior to the planned operation. This will allow us to evaluate the activity and, if appropriate, amend the LOA.

This letter, through a separate authorization, also grants Shell authority to take polar bears by harassment (deterrence activities) for the protection of both human life and polar bears while conducting activities in polar bear habitat. This authorization allows only the harassment or deterrence of polar bears and does not authorize lethal take of a polar bear. This authorization is issued specifically to Shell employees who are responsible for ensuring that trained and qualified personnel are assigned the task to harass (deter) polar bears. All polar bear harassment events are to be reported to our MMM within 24 hours. Observation forms can be sent by fax or electronic mail to our office. This authorization is effective from the date of issuance to November 30, 2009. Intentional take is authorized under sections 101(a)(4)(A), 109(h), and 112(c) of the Marine Mammal Protection Act (MMPA). A final report of all encounters and hazing events is due 60 days from the expiration of this authorization (by January 31, 2010).

TAKE PRIDE IN AMERICA

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:

AFES/MMM

JUL 16 2009

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If any changes develop in your project during the 2009 open-water season, such as activities or location, the Marine Mammals Management Office (MMM) must be notified prior to the planned operation. This will allow us to evaluate the activity and, if appropriate, amend the LOA.

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In addition to protection measures for marine mammals described in the Shell polar bear interaction plan (Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska, April 2008, with addendums), the U.S. Fish and Wildlife Service (Service) believes that Shell personnel can limit human/polar bear interactions by being observant of approaching animals, such as through the use of marine mammal observers, and breaking off interactions, if practicable, thereby allowing the animals to continue their travel. Service biologists are available for consultation if questions or concerns arise regarding polar bears during the project period at the phone numbers listed below and noted in your interaction plan.

Any situations where the application of deterrents involves a safety risk to personnel should be avoided. If a polar bear interaction escalates into a life threatening situation, Section 101(c) of the MMPA allows, without specific authorization, the take (including lethal take) of a polar bear if such taking is imminently necessary in self-defense or to save the life of a person in immediate danger, and such taking is reported to the U.S. Fish and Wildlife Service, Marine Mammal Management Office within 24 hours.

Furthermore, in accordance with Section 7 of the Endangered Species Act of 1973, as amended (ESA), issuance of this LOA also fulfills the requirements for Tier 2 Consultation of the Programmatic Biological Opinion for the activities described herein. In the "Programmatic Biological Opinion for Polar Bears (*Ursus maritimus*) on Chukchi Sea Incidental Take Regulations" (June 2008; Tier 1 BO), the Service determined that the take anticipated as a result of the issuance of the Incidental Take Regulations is not likely to result in jeopardy to the polar bear, in accordance with Section 7 of the ESA. In order for the Tier 2 BO to be consistent with the "no jeopardy" conclusion of the Tier 1 BO and for an ESA incidental take statement (ITS) to be issued, the following need to occur: (1) the proposed activity must provide the required information, as described in §18.118 of the Regulations; (2) the LOA includes all mitigation measures that the MMM believes appropriate for the specific activity and location, as described in §18.118 of the Regulations; and (3) the MMM must determine that the incidental take for the specific activity will be consistent with the negligible impact finding for the total take allowed under the Incidental Take Regulations.

A reasonable and prudent measure and implementing terms and conditions were included for the MMM in the Tier 1 BO and have been incorporated into the LOA process. Issuance of this ITS with the LOA completes ESA requirements for authorization of incidental take of the polar bear. Compliance with the terms and conditions of this LOA ensures that the LOA holder is also in compliance with the ESA.

This authorization is issued in accordance with our regulations listed at 73 FR 33212, dated June 11, 2008. Should you have any further questions contact Mr. Craig Perham of our Marine Mammals Management Office, at (907) 786-3800 or 786-3810.

Sincerely,

Rosa Meehan, Ph.D.
Chief, Marine Mammals Management

Enclosure

cc: Mr. Rance Wall, MMS
Fairbanks Fish and Wildlife Field Office (FFWFO)
USFWS Office of Law Enforcement (OLE)

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:

AFES/MMM

ISSUED: July 7, 2009
EXPIRES: November 30, 2009

LETTER OF AUTHORIZATION
(09-01-CS)

Shell Gulf of Mexico, Inc. (Shell) is hereby authorized to take, by Level B Harassment only, small numbers of polar bears and Pacific walruses incidental to activities occurring during the 2009 Chukchi Sea Marine Surveys Program Activities. Shell plans to conduct site clearance and shallow hazards surveys and scientific data device deployments during 2009 within the Minerals Management Service (MMS) Lease Sale 193 area. A detailed description of the authorized activity is provided in Addendum 2009-03, *2009 Marine Surveys Program Activities - Chukchi Sea* (Attachment A), dated March 26, 2009. Addendum 2009-03 is a supplement to the U.S. Fish and Wildlife Service (Service) - approved *Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska; April 2008.* The 2009 Marine Mammal Monitoring and Mitigation Plan is attached to Addendum 2009-03, as Attachment B.

The LOA is valid from the date of issuance to November 30, 2009. This authorization and the required conditions below include contractors of Shell performing Shell-approved work under the scope of operations to be conducted. Authorization is subject to the following conditions:

1. Shell Operations Managers, or their designates, must be fully aware, understand, and capable of implementing the conditions of this authorization.

2. The species authorized for takings, by Level B Harassment only, are: Pacific walrus (*Odobenus rosmarus divergens*), and polar bear (*Ursus maritimus*). The taking of any walrus or polar bear in a manner prohibited under this authorization must be reported within 24 hours of the taking to the Service Incidental Take Coordinator in Anchorage Alaska (907-786-3800), or their designee.

3. This Authorization is valid only for activities (including support vessels and aircraft) described in Shell's March 26, 2009 application. Changes in the siting, timing, scope or nature of project activities will require prior review and approval.

4. The holder of this Authorization is required to cooperate with the Service and any other Federal, state or local agency monitoring the impacts of the activity on walruses and polar bears.

5. At the discretion of the Service, the operator will allow the Service to place an observer on site (vessels and aircraft) to monitor the impacts of the activity on Pacific walruses and polar bears.

6. The following documents are hereby approved, and all provisions unless specifically noted are incorporated into this authorization by reference:

(a) *Marine Mammal Monitoring and Mitigation Plan for Site Clearance and Shallow Hazards and Marine Survey Data Acquisition in the Alaskan Chukchi and Beaufort Seas, 2009*, October 2007. Received by the Service March 26, 2009.
(b) *Polar Bear Interaction Plan* (Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska, April 2008).
(c) *2009 Plan of Cooperation, Beaufort and Chukchi Sea, Alaska*

7. If any changes develop in your project during the 2008 open-water season, such as activities or location, notify the Marine Mammals Management Office prior to the planned operation.

8. The holder must notify the Service Incidental Take Coordinator at least 24 hours prior to the start of collecting seismic data.

9. Prohibitions:

(a) The taking, by incidental Level B harassment only, is limited to the species listed under condition 4 above. The taking by Level A harassment, serious injury, or death of these species is prohibited and may result in the modification, suspension or revocation of this Authorization.
(b) The taking of any walrus or polar bear whenever the required marine mammal mitigation and monitoring measures have not been fully implemented as required by this Authorization, is prohibited.
(c) Intentional take of walruses or polar bears is prohibited and may result in the modification, suspension or revocation of this Authorization.
(d) Any take that fails to comply with 50 CFR part 18 subpart I or the terms and conditions of this Letter of Authorization is prohibited and may result in the modification, suspension or revocation of this Authorization.

10. Polar bear and walrus monitoring and mitigation must be conducted in accordance with 50 CFR Section 18.118, where Shell must comply with the following monitoring, mitigation, and reporting requirements:

(a) *General Mitigation*:
The holder of this Authorization is required to:
(i) Avoid concentrations or groups of walruses and polar bears hauled out onto land or ice by all vessels under the direction of Shell. Operators of support vessels should, at all time, conduct their activities at the maximum distance possible from known or observed concentrations of animals. Under no circumstances, other than an emergency, should vessels operate within 800 meters (1/2 mile) of walruses or polar bears observed on land or ice;
(ii) Take every precaution to avoid harassment of walruses or polar bears in water when a vessel is operated near these animals. Maintain an 800 meter (1/2 mile) exclusion zone, when practicable. Vessels must reduce speed when walruses or polar bears are observed in water and vessels capable of steering around these animals must do so. Vessels may not be operated in such a way as to separate members of a group of walruses or polar bears from other members of the group. Vessels should avoid multiple changes in direction and speed when walruses or polar bears are present;
(iii) Operate in full compliance with the terms identified in the approved documents identified in Condition 6;
(iv) Restriction of walrus or polar bear movements, by any means, in sea or on land, is prohibited. Exclusion zones will be enforced until animals have left the area.

(b) *Seismic Vessel Mitigation:*
The holder of this Authorization is required to:
(i) Reduce the volume of the airgun array during vessel turns while running seismic lines;
(ii) To the extent practical, whenever a marine mammal is detected outside the exclusion zone radius, and based on its position and motion relative to the ship track is likely to enter the safety radius, an alternative ship speed and/or track will be calculated and implemented;
(iii) Exclusion and Monitoring-Safety Zones:

(A) Establish and monitor with trained observers an exclusion zone (safety radius) for walruses surrounding the seismic airgun array where the received level would be 180 dB.

(B) Establish and monitor with trained observers an exclusion zone (safety radius) for polar bears surrounding the seismic airgun array where the received level would be 190 dB.

(iv) Power-down/Shut-down Procedures:

(A) Immediately shut-down the airgun array, whenever any walruses are sighted approaching close to or within the area delineated by the established safety radii for pinnipeds of 180 dB isopleth, or polar bears are sighted approaching close to or within the area delineated by the 190 dB isopleth.

(B) During seismic operations, if a bear or a walrus is sighted within the Shell-established exclusion zone, operations will power down/shut-down until the animal moves out of the exclusion zone or established safety radii.

(C) Do not proceed with ramping up the airgun array unless the safety zones are visible and no walruses and polar bears are detected within the appropriate safety zones;

or until 15 minutes after there has been no further visual detection of the animal(s) within the safety zone and the trained marine mammal observer on duty is confident that no walruses and polar bears remain within the appropriate safety zone, provided the entire safety zone was visible for at least 30 minutes.

(D) Emergency shut-down. If observations are made or credible reports are received that one or more walruses and polar bears are within the area of the survey are in an injured or mortal state, or are indicating acute distress due to noise, the airgun array will be immediately shut down and the Service Incidental Take Coordinator contacted. The airgun array will not be restarted until review and approval has been given by either the Service Incidental Take Coordinator or their designee.

(v) Ramp-up Procedures:

(A) Prior to commencing ramp-up, the safety radius for polar bears and walruses has to be visible and observed by a marine mammal observer if: a complete shut-down has occurred; or at any time electrical power to the airgun array is discontinued for a period of 10 minutes or more; and the marine mammal observer watch has been suspended.

(B) If the safety radii are not completely visible for at least 30 minutes prior to ramp-up in either daylight or nighttime, ramp up can commence following established procedures.

(C) If the complete 180 dB safety range is visible and no walruses and polar bears are observed while undertaking pre-ramp-up monitoring; as described in (B), ramp-up airgun arrays slowly over a period of at least 15 minutes starting with one airgun in the array and then adding additional guns in sequence, until the full array is firing: (1) At the commencement of data collection operations; and (2), anytime after the airgun array has been powered down for more than 10 minutes.

(vi) Poor Visibility Conditions:

(A) During any nighttime operations, if the entire 180–dB safety radius is visible using vessel lights and/or night vision devices, then start of a ramp-up procedure after a complete shutdown of the airgun array may occur following a 30–minute period of observation without sighting marine mammals in the safety zone.

(B) If during foggy conditions or darkness, the full 180–dB safety zone is not visible, the airguns cannot commence a ramp-up procedure from a full shutdown.

(C) If one or more airguns have been operational before nightfall or before the onset of foggy conditions, they can remain operational throughout the night or foggy conditions. In this case, ramp-up procedures can be initiated, even though the entire safety radius may not be visible, on the assumption that marine mammals will be alerted by the sounds from the single airgun and have moved away.

11. Monitoring.

(a) *Seismic Vessel Monitoring*:

(i) The holder of this Authorization must have biologically-trained, marine mammal observers (MMOs) onboard the seismic source vessels;

(ii) MMOs will monitor to:

(A) Ensure that no walruses and polar bears enter the appropriate safety zones

established under condition 10(b)(iii), whenever the seismic array is on.

(B) Record marine mammal activity as described in condition 12 below. An observer must be on watch during ramp ups and the 30 minutes prior to full ramp ups, and for as large a fraction of the other operating hours as possible. At all other times, one observer must be on active watch whenever the seismic airgun array is operating during all daytime airgun operations, during any nighttime power-ups of the airguns and at night, whenever that day's monitoring resulted in one or more power-downs due to marine mammal presence.

(iii) The vessel crews also must be instructed to keep watch for walruses and polar bears at all times. If any are sighted, the bridge watch-stander must immediately notify the MMO on-watch;

(iv) Observations by the MMOs on marine mammal presence and activity will begin a minimum of 30 minutes prior to the estimated time that the seismic source is to be turned on and/or ramped-up;

(v) For each walrus or polar bear sighting, MMOs will record the following:

(A) Species, group size, age/size/sex categories (if determinable), behavioral activity, heading (if consistent), bearing and distance from seismic vessel, sighting cue, and apparent reaction of animals seen near the seismic vessel and/or its airgun array.

(B) Time, location, heading, speed, and activity of the vessel, along with sea state, ice cover, visibility, cloud cover and sun glare at: (1) any time a marine mammal is sighted; (2) at the start and end of each watch; and (3) during a watch (whenever there is a change in one or more variable.)

(C) The identification of all vessels that are visible within 5 km of the seismic vessel whenever a marine mammal is sighted, and the time observed, bearing, distance, heading, speed and activity of the other vessel(s).

(vi) All MMOs must be provided with and use appropriate night-vision devices, Big Eyes, and reticulated and/or laser range finding binoculars;

(vii) The operator of the seismic vessel must maintain a log of activity noting the date and time of all changes in seismic activity (e.g., ramp up, power down, shut down, changes in the number of active airguns or the volume of airgun arrays) and any corresponding changes in monitoring radii.

(b) *Non-seismic Vessel Monitoring:*

(i) A designated crew member on a non-seismic vessel will immediately contact the seismic survey ship if walruses and polar bears are sighted within the 800 meter exclusion zone of the source vessels;

(ii) For each walrus or polar bear sighting, a designated crew member will either record or communicate to the source vessel MMO the following:

(A) Species, group size, age/size/sex categories (if determinable), behavioral activity, heading (if consistent), bearing and distance from vessel, sighting cue, and apparent reaction of animals seen near the vessel.

(B) Time, location, heading, speed, and activity of the vessel, along with sea state, visibility, cloud cover and sun glare at any time a walrus or polar bear is sighted.

(C) The identification of all vessels that are visible within 5 km of the vessel

whenever a marine mammal is sighted, and the time observed, bearing, distance, heading, speed and activity of the other vessel(s).

12. Reporting:

(a) *Marine mammal observer training manual and data collection protocols*. Prior to the initiation of seismic operations, the operator must provide the Service with:
(i) A description and documentation of the MMO training program;
(ii) a copy of the MMO field manual and/or operating procedures; and,
(iii) a key to MMO data codes, including definitions and descriptions of all data fields.

(b) *Sound source verification report*. The results of field source verification and the distances to the various sound radii are to be reported to the Service within 5 days of completing the measurements.

(c) *Weekly summary of walrus and polar bear sightings*. The operator must tabulate and report all walrus and polar bear sightings recorded by the MMOs from all project vessels to the Service on a weekly basis. For each walrus or polar bear sighting include:
(i) a unique sighting identification number;
(ii) species, group size, age/size/sex categories, and substrate (on ice, in water, both);
(iii) date, time and location (for pre-lease seismic surveys, specific location information may be withheld until the results of the next lease sale are announced);
(iv) environmental conditions including: water depth (meters), sea state (Beaufort scale), visibility 1 (#km), visibility 2 (light/dark), visibility 3 (glare: none, little, moderate, severe), ice condition 1 (estimated percentage ice cover in vicinity of sighting), ice condition 2 (estimated distance (km) to pack ice);
(v) estimated range (meters) at first sighting, estimated range (meters) at closest approach;
(vi) the behavior of animals sighted (if determinable);
(vii) whether animals appeared to react to the presence of the ship (yes, no), if yes, describe the reaction of the animal(s);
(viii) vessel activity at time of sighting including: vessel name; vessel speed (knots); seismic activity code; action taken by operator in response to sighting? (yes, no) If yes, specify (e.g., powerdown, shutdown); and,
(ix) any MMO comments or notes

(d) *Notification of incident report*. The operator must report:
(A) any incidental lethal take or injury of a polar bear or walrus; and,
(B) observations of walruses or polar bears within the prescribed safety zones (180/190 dB radii around seismic arrays, or 0.5 mile marine buffer areas) to the Service within 24 hours. Reports should include all information specified under 10(c) as well as a full written description of the encounter and any actions taken by the operator.

(e) *Post season seismic monitoring report*: A draft report will be submitted to the Service within 90 days after the end of the seismic survey program in the Chukchi Sea.

The report will describe in detail:
(i) the operations that were conducted;
(ii) the results of the acoustical measurements to verify the safety radii;
(iii) the methods, results, and interpretation pertaining to all monitoring tasks;
(iv) the results of the 2008 shipboard marine mammal monitoring;
(v) a summary of the dates and locations of seismic operations, including summaries of power downs, shut downs, and ramp up delays;
(vi) marine mammal sightings (species, numbers, dates, times and locations; age/size/gender, environmental correlates, activities, associated seismic survey activities);
(vii) estimates of the amount and nature of potential take (exposure) of walruses and polar bears (by species) by harassment or in other ways to industry sounds;
(viii) an analysis of the effects of seismic operations (e.g., on sighting rates, sighting distances, behaviors, movement patterns of walruses and polar bears);
(ix) provide an analysis of factors influencing detectability of walruses and polar bears; and,
(x) provide summaries on communications with hunters and potential effects on subsistence uses

The draft report will be subject to review and comment by the Service. Any recommendations made by the Service must be addressed in the final report prior to acceptance by the Service. The draft report will be considered the final report for this activity under this Authorization if the Service has not provided comments and recommendations within 90 days of receipt of the draft report.

13. Activities related to the monitoring described in this Authorization do not require a separate scientific research permit issued under section 104 of the Marine Mammal Protection Act.

14. A copy of this Authorization and the Service-approved Polar Bear Interaction Plan must be in the possession of the operator of all vessels and aircraft engaging in the activity operating under the authority of this Letter of Authorization.

16. Per the "Programmatic Biological Opinion for the Chukchi Sea Incidental Take Regulations for Polar Bear (June 2008)", your request also triggers the second of the two-tiered programmatic process. In order for incidental take of the polar bear to be exempted from the prohibitions of the ESA, the LOA also serves as an "Incidental Take Statement" (ITS), required under section 7 of the Endangered Species Act of 1973 (ESA). Issuance of the LOA/ITS fulfills

the requirements for Tier 2 Consultation of the Programmatic Biological Opinion for the activities described in this letter.

Signed

JUL 16 2009

Date

United States Department of the Interior

FISH AND WILDLIFE SERVICE
1011 E. Tudor Road
Anchorage, Alaska 99503-6199

IN REPLY REFER TO:

AFES/MMM

U.S. Fish and Wildlife Service

AUTHORIZATION TO TAKE, BY HARASSMENT, POLAR BEARS

ISSUED: July 7, 2009
EXPIRES: November 30, 2009

Under Sections 101 (a)(4)(A), 109(h), and 112(c) of the Marine Mammal Protection Act of 1972, as amended, Shell Gulf of Mexico, Inc. (Shell) is authorized to take, by harassment, polar bears during exploration activities in association with the 2009 Chukchi Sea Marine Surveys Program Activities. Shell plans to conduct site clearance and shallow hazards surveys and scientific data device deployments during 2009 within the Minerals Management Service (MMS) Lease Sale 193 area. A detailed description of the authorized activity is provided in Addendum 2009-03, *2009 Marine Surveys Program Activities - Chukchi Sea* (Attachment A), dated March 26, 2009. Addendum 2009-03 is a supplement to the U.S. Fish and Wildlife Service (Service)-approved *Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska; April 2008.* The 2009 Marine Mammal Monitoring and Mitigation Plan is attached to Addendum 2009-03, as Attachment B.

Section 101(a)(4)(A) states that, "Except as provided in subparagraphs (B) and (C), the provisions of this chapter shall not apply to the use of measures:

(i) by the owner of fishing gear or catch, or an employee or agent of such owner, to deter a marine mammal from damaging the gear or catch;

(ii) by the owner of other private property, or an agent, bailee, or employee of such owner, to deter a marine mammal from damaging private property;

(iii) by any person, to deter a marine mammal from endangering personal safety; or

(iv) by a government employee, to deter a marine mammal from damaging public property, so long as such measures do not result in the death or serious injury of a marine mammal.

Section 109(h)(1) states that "nothing in this title (Conservation and Protection of Marine Mammals) shall prevent a Federal, State, or local government official or employee or a person designated under Section 112(c) from taking, in the course of his or her duties as an official, employee, or designee, a marine mammal in a humane manner (including euthanasia) if such taking is for:

(A) the protection or welfare of the mammal;

(B) the protection of the public health and welfare; or

(C) the non-lethal removal of nuisance animals."

The purpose of authorizing taking by harassment, or deterrence, is to maintain human and bear safety and welfare in polar bear habitat. Authorizing Level B harassment take reduces the likelihood of death or injury of polar bears. This is accomplished by the following objectives:

1. Prevent bears from associating food with humans and facilities;
2. "Train" bears to avoid people;
3. Allow bears to use travel routes (natural and man-made) to move along the coast;
4. Prevent bears from extended use of areas around facilities.

Harassment authorization is subject to the following conditions:

1. The "Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska, April 2008," is approved and all provisions must be complied with unless specifically noted otherwise in this Letter of Authorization. A copy of this polar bear interaction plan must be available on site for all personnel.

2. Shell Operations Managers, or their designates, must be fully aware of, understand, and be capable of implementing the conditions of this authorization.

3. This authorization is valid only for those activities identified in the request for a Letter of Authorization dated March 26, 2009.

4. This authorization is restricted to harassment activities.

5. Authorized individuals are responsible for documenting and reporting to the U.S. Fish and Wildlife Service, Marine Mammals Management Office, (907) 786-3800, all instances involving harassment activities as soon as possible and not later than 24 hours after the occurrence.

6. This authorization is issued specifically to Shell who is responsible for ensuring that **trained and qualified** personnel are assigned the task to harass (deter) polar bears.

7. Activities will not operate nor pass within 1 mile of known polar bear dens, and all observed dens will be reported to the Marine Mammals Management Office, Fish and Wildlife Service immediately. Should occupied dens be identified within one mile of activities, work in the immediate area will cease and Service will be contacted for guidance. The Service will evaluate these instances on a case-by-case basis to determine the appropriate action. Potential responses may range from cessation or modification of work to conducting additional monitoring.

8. Hazing techniques must not cause the injury or death of a bear. Types of hazing techniques may include:

- Bear Monitors
- Air horns
- Electric fences
- Chemical repellents
- Acoustic recordings
- Vehicles
- Projectiles: cracker shells, bean bags, rubber bullets, screamers

9. Prior to conducting a harassment activity, operators must:

- Reduce/eliminate attractants
- Secure site; notify supervisor; move personnel to safety
- Ensure bear has escape route(s)
- Ensure communication with all personnel

10. When conducting a harassment activity, operators must:

- Chose the method that will have the least effect on the bear and increase the intensity of the method or use additional methods only if necessary
- Shout at the bear before using projectile (avoidance conditioning)
- Move bear in proper direction; continue with minimally necessary deterrents to receive desired result

11. After a harassment event has occurred, operators must:

- Monitor bear movement (to ensure no return)
- Notify supervisor and personnel to resume work
- Fill out report to be sent to the Service as required under condition 4 (within 24 hours)

12. This Authorization is valid for the period indicated on this authorization, unless extended or terminated in writing by the U.S. Fish and Wildlife Service, Marine Mammals Management Office.

13. A final report of all encounters and hazing events must be submitted to the U.S. Fish and Wildlife Service, Marine Mammals Management Office within 60 days from the expiration date of this authorization.

Signed: _____

Date: JUL 16 2009

APPENDIX C: CONFLICT AVOIDANCE AGREEMENT

Summary of Comments on 2009 CAA Final for Signature

Page: 13

Sequence number: 1
Author: Susan.Childs
Date: 6/23/2009 4:34:36 PM
Type: Strikeout
the Chukchi Sea jointly will arrange for the funding of Com-Centers in Barrow, Wainwright, Pt. Lay, and Pt. Hope.

Sequence number: 2
Author: Susan.Childs
Date: 6/25/2009 1:47:09 PM
Type: Note
Shell will utilize the most appropriate Communication Center in the Chukchi Sea, Wainwright, in order to effectively communicate vessel transit and presence while working far offshore in the Chukchi Sea given the limited scope of our program in 2009. Shell and ConocoPhillips will cost share this Com Center. We will also have Subsistence Advisors in place in Point Hope, Point Lay, Wainwright and Barrow to help us maintain a non-impactive profile while working far offshore in the Chukchi Sea.

Sequence number: 3
Author: Susan.Childs
Date: 6/25/2009 1:50:31 PM
Type: Strikeout
the Beaufort Sea jointly will arrange for the funding of Com-Centers in Deadhorse and Kaktovik; and

Page: 25

Sequence number: 1
Author: Susan.Childs
Date: 6/23/2009 4:31:01 PM
Type: Strikeout
For purposes of obtaining a sound signature for Industry Participants' sound sources, the Industry Participants shall have initiated a test of both the geophysical equipment and the vessels identified in Attachments II and III to this Agreement, within 72 hours of initiating or having initiated operations in the Beaufort Sea or Chukchi Sea. If more than one sound source will be used on an individual vessel, a cumulative test of all sound sources used on that vessel will be conducted. Industry Participants are not required to conduct sound signature tests of Near Shore Operations Support Vessels.

Sequence number: 2
Author: Susan.Childs
Date: 6/23/2009 4:33:19 PM
Type: Note
While an SSV will be performed for the source vessel in 2009 at the initiation, of operations to support establishment of mitigation safety zones, other vessels not being used as energy sources will not be measured by the above program. As indicated below, Shell and ConocoPhillips are conducting an extensive acoustic assessment program both widely over the Chukchi Sea lease area and intensively in the vicinity of primary lease holds for each company. One goal of this acoustic program is to understand the soundscape of the Chukchi Sea. One aspect of gaining such an understanding is the collection of data on vessel traffic within the system. As such, the acoustic array will be utilized by Shell to collect Sound Source information on each of the vessels that we have in theater. The locations of each recorder will be utilized to identify opportunistic steam by measurements. By recording vessel track, date, and time as each vessel steams over a recorder, it will be possible to recover these non-mitigation setting data upon retrieval of the units at the end of the season. Sound profiles for each vessel will be incorporated into the Comprehensive Report.
The locations of the recorder arrays will also be made available to all vessels traversing the Chukchi Sea with the understanding that, if they conduct a steam by (while documenting vessel track, position, date and time), the data from the recorders will be available to support sound assessment.

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2009 OPEN WATER SEASON
PROGRAMMATIC CONFLICT AVOIDANCE AGREEMENT

BETWEEN

BP EXPLORATION (ALASKA), INC.
CONOCOPHILLIPS ALASKA, INC.
ENI US OPERATING COMPANY, INC.
EXXON MOBIL
PGS ONSHORE
PIONEER NATURAL RESOURCES ALASKA, INC.
SHELL OFFSHORE, INC

AND

THE ALASKA ESKIMO WHALING COMMISSION
THE BARROW WHALING CAPTAINS' ASSOCIATION
THE KAKTOVIK WHALING CAPTAINS' ASSOCIATION
THE NUIQSUT WHALING CAPTAINS' ASSOCIATION
THE PT. HOPE WHALING CAPTAINS' ASSOCIATION
THE PT. LAY WHALING CAPTAINS' ASSOCIATION
THE WAINWRIGHT WHALING CAPTAINS' ASSOCIATION

Final for Signature
June 15, 2009

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TITLE I – GENERAL PROVISIONS

SECTION 101. APPLICATION.

Titles I and II apply to all Participants.

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.

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 whaling crews, in areas where subsistence whaling crews 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 affect the subsistence hunt through effects on migrating bowhead whale behavior;

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

(4) Dispute resolution procedures.

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SECTION 103. DEFINITIONS.

(a) Defined Terms.

For the purposes of this Agreement:

(1) The term "Agreement" means this 2009 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 fixed platform developments located near shore (for example Northstar or Oooguruk).

(3) The term "barge" means a non-powered vessel that is pushed or towed, and the accompanying pushing or towing vessel, that 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.

(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 environment, sea floor, or subsurface, including but not limited to use of air guns, sonar, and other equipment used for seismic exploration or shallow hazard identification.

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

(7) 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.

(8) 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.

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

(10) 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 or transit vessel traffic by or for any Participant.

(11) 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.

(12) 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.

(13) 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.

(14) 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.

(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.

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SECTION 104. TERM, 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 the potential impacts of oil and gas operations and barge and transit vessel traffic on bowhead whales and the Alaskan Eskimo subsistence hunt of bowhead whales, are designed to apply to all activities of each Participant during the 2009 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 2009 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 2009 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 or any other 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 2009 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 2009 bowhead whale subsistence hunting season, the AEWC will provide to all Participants a supplement to this document containing 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.

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 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.

SECTION 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.

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SECTION 108. POST-SEASON REVIEW / PRESEASON INTRODUCTION.

(a) Beaufort Sea Post-Season Joint Meeting.

Following the end of the fall 2009 bowhead whale subsistence hunt and prior to the 2010 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 2009 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 2009 Chukchi Sea Open Water Season and prior to the 2010 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, 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 2009 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 2010 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 2010 Open Water Season Meeting.

(d) Map of Planned Industry Participant Activities.

The Industry Participants, jointly, shall 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 2010 CAA Meeting.

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 vessel owned or operated by such Industry Participant in the Beaufort Sea or Chukchi Sea.

(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 its 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.

(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 2009 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.

SECTION 202. COM-CENTER GENERAL COMMUNICATIONS SCHEME.

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

(1) All vessels (other than barge and transit vessels covered under section 302) 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 coordinates 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 Marine Mammal Observer / Inupiat Communicator shall contact those boats in order to coordinate movement and take necessary avoidance precautions.

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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, 2008-2012.

(b) Set Up and Operation.

(1) Subject to the terms of Section 104(c) of this Agreement, the Industry Participants conducting operations 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, and Pt. Hope.~~

(2) All six 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 2009 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 until the end of the bowhead whale subsistence hunt in:

(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.

(3) 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. 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 whale hunter 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.

(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.

(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 should attempt to contact the industry vessel involved and advise the Industry Participant's Local Representative(s) and the vessel operators of the potential conflict.

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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 2009 fall bowhead subsistence whale hunting season shall be completed no later than August 15, 2009. 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 2009 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, Barrow, 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 equipment on or before August 15, 2009, 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.

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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 Norhtstar Island and will be available by telephone at (907)670-3520 and when Mr. Brott is not available, his alternate, Dan Ferriter, will be stationed at Northstar Island and will be available by telephone at the above number.

(2) ConocoPhillips' Local Representative

Jim Darnell (907) 265-6240
Heather Collins-Ballot (907) 265-6213
Field Rep TBD (Jeff Hastings, Fairweather)

(3) ENI's Local Representative

TBD

(4) Exxon Mobil's Local Representative

TBD

(5) PGS Onshore's Local Representative

CHUCK ROBINSON, Area Manager, will be PGS Onshore, Inc.'s local representative during the Term of this Agreement and will be available by telephone at (907) 569-4049.

(6) Pioneer Natural Resources' (Pioneer) Local Representative

PAT FOLEY will be Pioneer's local representative during the Term of this Agreement and will be stationed in Anchorage and will be available by telephone at (907) 343-2110.

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

BOB ROSENBLADT and PETER LITTLEWOOD 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.

(8) Veritas

TBD

(9) 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 FENTON REXFORD at (907) 640-2042 (Home) or (907) 640-6419 (Work).

(10) 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), and ARCHIE AHKIVIANA at (907) 480-6918 (Home).

(11) 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.

(12) The Village of Wainwright

For purposes of this Agreement, the individuals to contact for the Village of Wainwright will be: ROSSMAN PEETOOK at (907) 763-4774, and WALTER NAYAKIK at (907)763-2915 (Work).

(13) The Village of Pt. Hope

For purposes of this Agreement, the individuals to contact for the Village of Pt. Hope will be: RAY KOONUK, SR. at (907)368-2120 (Home), 368-3117 (Work); 368-2618 (Fax), JACOB LANE, JR. at (907) 368-3812 (Home), (907) 368-2334 (Work), (907) 368-5402 (Fax) .

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(14) 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) 833-6467 (Home), (907) 833-3838

(15) The AEWC

For purposes of this Agreement, the individuals to contact for the AEWC shall be: HARRY BROWER, JR. at (907) 852-0350 (Work) and JANICE MEADOWS 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 (12) twelve boats for subsistence whale hunting during the late summer and fall of 2009.

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

The subsistence whaling crews of the Village of Kaktovik plan to use (8) eight boats for subsistence whale hunting during the late summer and fall of 2009.

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

The subsistence whaling crews of the Village of Barrow plan to use (40) forty boats for subsistence whale hunting during the late summer and fall of 2009.

(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 2009.

(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 (10) ten boats for subsistence whale hunting during the late fall of 2009.

(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 2009.

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 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 or transit 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 or transit vessel name, operator of vessel, charter or owner of vessel, and the project or entity the vessel is transporting materials for.

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

(C) Plans for barge or transit 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 and 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 Barges and Transit Vessels.

(1) All barge and 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.

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(2) Beaufort Sea. Vessels transiting east of Bullet 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.

(d) Vessel Speeds.

Barges 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 Migrating 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) Sound Signature and Marine Mammal Sighting Data.

Industry Participants whose operations are limited exclusively to barge or vessel traffic will submit to the AEWC and NSB DWM sound signature data for each vessel over 5 net tons they are using and all marine mammal sighting data.

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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 May Be Used.

(1) **NONE OF THE INDUSTRY PARTICIPANTS INTENDS TO OPERATE ANY VESSEL OR 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. PRE-SEASON SOUND SIGNATURE TESTS.

(a) Test Required Within 72 Hours of Initiating Operations.

~~For purposes of obtaining a sound signature for Industry Participants' sound sources, the Industry Participants shall have initiated a test of both the geophysical equipment and the vessels identified in Attachments II and III to this Agreement, within 72 hours of initiating or having initiated operations in the Beaufort Sea or Chukchi Sea. If more than one sound source will be used on an individual vessel, a cumulative test of all sound sources used on that vessel will be conducted. Industry Participants are not required to conduct sound signature tests of Near Shore Operations Support Vessels.~~

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

(1) In General. Each 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 provide a minimum of seven days notice of its intent to perform each test to the AEWC.

(2) Beaufort Sea Testing. For 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 sound signature tests conducted on vessels to be used in the Chukchi Sea, the Industry Participant(s) conducting such tests will invite the AEWC and the NSB DWM to observe such tests and transportation will be provided by the appropriate Industry Participant(s).

(4) Subsistence Participants. In order to facilitate the participation of interested Subsistence Participants and the NSB DWM in any sound signature test(s), the Industry Participant(s) will make a good faith effort to provide three weeks notice of its intent to perform each test.

(c) Sound Signature Data to be Made Available.

(1) Within seven (7) days of completing the the sound signature data calculations from the field tests, each Industry Participant and/or its contractor conducting such test(s) will make all data collected during the sound signature test(s) available upon request to the AEWC and the NSB DWM and will provide the AEWC and the NSB DWM the preliminary analysis of that data, as well as any other sound signature data that is available and that the AEWC, the NSB DWM, and the Industry Participant agree is relevant to understanding the potential noise impacts of the proposed operations to migrating bowhead whales or other affected marine mammals.

(2) Once completed the final data analysis will be provided to the AEWC and the NSB DWM upon request.

(3) Any Industry Participant who prepares a model of the sound signature of its vessels and operations, whether before or after the Pre-Season Sound Signature Test, will provide copies of those models and any related analysis to the AEWC and the NSB DWM upon request.

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SECTION 403. MONITORING PLANS.

(a) Monitoring Plan Required.

(1) Each Industry Participant agrees to prepare and implement a noise impact monitoring plan to collect data designed to determine the effects of its oil and gas operations on fall migrating bowhead whales and other affected marine mammals.

(2) The Monitoring Plans shall be designed in cooperation with the AEWC, the NSB DWM, NOAA Fisheries, the U.S. Minerals Management Service, and any other entities or individuals designated by one of these organizations.

(b) Beaufort Sea Monitoring Plans.

In the Beaufort Sea, the monitoring plans shall include an investigation of noise effects on fall migrating bowhead whales as they travel past the noise source, with special attention to changes in calling behavior, deflection from the normal migratory path, where deflection occurs, and the duration of the deflection.

(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.

(d) Use of Prior Information and Peer Review Required.

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

(2) Each monitoring plan shall be subject to peer review by stakeholders at the 2009 Open Water Season Peer Review Meeting, convened by NOAA Fisheries. Draft plans will be submitted to the NSB DWM and AEWC three weeks prior to the Open Water Meeting. Peer review and acceptance of each monitoring plan through this process shall be completed prior to the commencement of each Industry Participants' 2009 operations in the Beaufort Sea or Chukchi Sea.

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

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

(A) make raw data, including datasheets, field notes, and 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 fall of 2009. The results of this workshop will be presented at the 2010 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.

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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 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.

(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.

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(d) Vessels Operating in Proximity of Migrating 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.

(a) Limit on Number of Simultaneous Geophysical Activity Operations.

Only two (2) geophysical activity operations will occur at any one time in either the Beaufort Sea or the Chukchi Sea. The Industry Participants conducting geophysical activity operations agree to coordinate the timing and location of such operations so as to reduce, by the greatest extent reasonably possible, the level of noise energy entering the water from such operations at any given time and at any given location.

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

All geophysical activity in the Beaufort Sea shall be confined as 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.[1] 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 August 5. Geophysical activity is allowed from August 5 until completion of operations[2]

(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.

(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.

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[1] 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.

[2] 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.

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(c) 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) Geophysical activity shall not be conducted within 60 miles of any point on the Chukchi Sea coast.

(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 July 1 and shall be listed in Attachment IV.

(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.

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SECTION 503. DRILLING AND PRODUCTION.

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.

(a) Zero Discharge of Drilling Mud, Cuttings, Ballast Water, and Produced Water.[3]

(1) Beafort Sea. For all drilling operations, whether for exploration, development, or production, in the Beaufort Sea habitat of the bowhead whale, zero volume discharge of drilling mud, cuttings, ballast water, or produced water shall be allowed into the marine environment. All such material shall be disposed of through re-injection or backhaul for onshore disposal.

(2) Chukchi Sea. For all drilling operations, whether for exploration, development, or production, in the Chukchi Sea habitat of the bowhead whale, zero harmful discharge of drilling muds, cuttings, ballast water, or produced water shall be allowed into the marine environment. Any harmful material shall be disposed of through re-injection or backhaul for onshore disposal.

(b) Sampling of Drilling Mud and Cuttings.

For all drilling operations, whether for exploration, development, or production, in the Beaufort Sea or Chukchi Sea habitat of the bowhead whale, the operator shall cooperate with the AEWC and North Slope Borough in the design and implementation of a program to monitor all discharged materials and impacts to migratory resources from any materials that might be discharged into the marine environment.

[3] The intent of this subsection is to apply the same discharge standards that are applicable to Industry Participants that conduct oil and gas operations off Norway. The standard for the Beaufort Sea is to be the same as that applied by Norway in the Barents Sea, and the standard in the Chukchi Sea is to be the same as that applied by Norway in waters south of the Barents Sea. The "harmful" discharges that are prohibited are those classified by Norway as "red" or "yellow" (above certain amounts); discharge of material classified by Norway as "green" is allowed under the zero harmful discharge standard.

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(c) Monitoring of Gray Water, Black Water, and Heated Water.

For all exploratory drilling operations in the Beaufort Sea or Chukchi Sea habitat of the bowhead whale, the operator shall cooperate with the AEWC and North Slope Borough in the design and implementation of a program to monitor the composition or temperature and the fate of all discharged materials and impacts to migratory resources from any materials dumped into the marine environment.

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

No drilling equipment or related vessels 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.

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

No drilling equipment or related vessels 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.

(f) Oil Spill Mitigation.

Unless otherwise agreed with the AEWC, Industry Participants engaged in oil production or in drilling operations in the Beaufort Sea or Chukchi Sea agree to adhere to the AEWC/NSB/Inupiat Community of the Arctic Slope oil spill contingency agreement.

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.

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TITLE VI – 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.

Harry Brower
Chairman, AEWC
Dated: _____

Harry Brower
AEWC Commissioner for Barrow
Dated: _____

Archie Ahkiviana
AEWC Commissioner for Nuiqsut
Dated: _____

Joe Kaleak
AEWC Commissioner for Kaktovik
Dated: _____

Rossman Peetook
AEWC Commissioner for Wainwright
Dated: _____

Ray Koonook
AEWC Commissioner for Pt. Hope
Dated: _____

Julius Rexford
AEWC Commissioner for Pt. Lay.
Dated: _____

Name:
BP Exploration (Alaska) Inc.
Dated: _____

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_____

ENI
Dated: _____

Pete Slaiby, General Manager
Shell Offshore, Inc.
Dated: Jun 24 2009

_____
Name:
ConocoPhillips Alaska
Dated: _____

_____
Name:
Exxon Mobil
Dated: _____

_____
Chuck Robinson
PGS Onshore, Inc.
Dated: _____

_____
Name:
Pioneer Natural Resources Alaska
Dated: _____

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ATTACHMENT I

LOCAL SEARCH AND RESCUE ORGANIZATIONS - CONTACT PERSONS
(IN EMERGENCIES, ALWAYS DIAL 911)

North Slope Borough			
Search and Rescue (Pilots)			
Director Richard Patterson		852-2822 WK	852-2496 Home
Hugh Patkotak		852-2822 WK	852-4844 Home
Barrow Volunteer			
Search and Rescue Station			852-2808 OFS
President	Oliver Leavitt	852-7032 WK	852-7032 Home
Vice-Pres.	Price Brower	852-8633 WK	852-7848 Home
Secretary	Lucille Adams	852-0250 Wk	852-7200 Home
Treasurer	Eli Solomon	852-2808 Wk	852-6261 Home
Coordinator	Arnold Brower, Jr.	852-0290 WK	852-5060 Home
Director	Jimmy Nayakik	852-0200 WK	852-JENS Home
Director	Johnny Adams	852-0250 WK	852-7724 Home
Nuiqsut Volunteer			
Search and Rescue Station		480-6613 (Fire Hall)	
Kaktovik Volunteer			
Search and Rescue Station		640-6212 (Fire Hall)	
President	Lee Kayotuk	640-5893 Wk	640-6213 Home
Vice-Pres.	Tom Gordon	640-	
Secretary	Nathan Gordon	640-6925	
Treasurer	Don Kayotuk	640-2947	
Fire Chief	George T. Tagarook	640-6212 WK	640-6728 Home

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Wainwright Volunteer Search and Rescue

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	John Akpik	Unlisted

Pt. Hope Volunteer Search and Rescue

Coordinator	Andrew Tooyak Jr.	368-2071 Home
Fire Chief	Willard Hunnicutt	368-2774 Wk (Note: Only contact for Pt. Hope)

North Slope Borough Disaster Relief Coordinator

Frederick Brower	852-0284 OFS

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ATTACHMENT II

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.

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ATTACHMENT III

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.

FINAL 06-15-2009

ATTACHMENT IV

SAFE HARBOR

APPENDIX D: DESCRIPTION OF VESSELS AND EQUIPMENT

R/V *Mt. Mitchell*

Fugro Geo Services, Inc. contracted the R/V *Mt. Mitchell* to conduct Shell's 2009 shallow hazards and site clearance survey. The *Mt. Mitchell* was built in Jacksonville, Florida in 1963 and was originally commissioned as a survey ship with NOAA in 1967. The *Mt. Mitchell* currently is owned by Global Seas LLC of Seattle, Washington. It's home port is Ketchikan, Alaska. The overall length of the *Mt. Mitchell* is 70.4 m (231 ft) and its gross tonnage is 1453 metric tons with a mean draft of 3.9 m (13 ft). The total fuel capacity of the *Mt. Mitchell* is 397 m^3 with a fuel consumption rate ranging from 6.6 to 8.8 m^3 per day. The *Mt. Mitchell* is equipped with fresh water making capabilities, and a sludge and waste oil incinerator.

Airgun Description

The sound source used by Shell and its survey contractor, Fugro Geo Services Inc., consisted of a 40-in^3 airgun array towed approximately 47 m (154 ft) aft of the *Mt. Mitchell* at a depth of ~2 m (6 ft) during the shallow hazards and site clearance survey operations. This array was similar to the array used during shallow hazard surveys in the Chukchi Sea in 2008. The *Mt. Mitchell* also towed two streamers, 30 and 300 m (33 and 328 yd) in length with a 24- and 48-channel hydrophone, respectively, to record reflected sound energy. A 10-in^3 airgun was used as a mitigation source during power downs when marine mammals were observed within or about to enter the applicable full-array safety radius and during turns. Air compressors aboard the *Mt. Mitchell* were the source of high pressure air used to operate the airgun array. Seismic pulses were emitted at intervals of 15 m (16 yd; ~8 sec) while the *Mt. Mitchell* traveled at a speed of 3.2 to 4 knots (5.9–7.4 km/h, 3.7–4.6 mi/h). In general, the *Mt. Mitchell* towed this system along a predetermined survey track, although coarse alterations were occasionally made during the field season to avoid obstacles or during repairs to the equipment.

Non-seismic Survey Gear

In addition to the seismic airgun gear described above, the *Mt. Mitchell* was equipped with various survey equipment and gear, including:

- And Echotrac DF3200 bathymetry system with an operating frequency of 200 kHz;
- GeoPulse Pinger sub-bottom profiler with an operating frequency of 3.5 kHz;
- Edgetch Model 4200 side scan sonar with an operating frequency of 100–500 kHz;
- SeaSpy Marine Sensor magnetometer.

APPENDIX E: DETAILS OF MONITORING, MITIGATION, AND ANALYSIS METHODS

This appendix provides details on the standard visual and acoustic monitoring methods and data analysis techniques implemented for this project and previous seismic studies. Five marine mammal observers (MMOs) were aboard the *Mt. Mitchell* throughout the cruise. Three MMOs were biologists experienced in marine mammal identification and observation methods and the other two MMOs were Inupiat with various levels of experience identifying Arctic marine mammals. MMOs generally worked 2-4 hr shifts for up to 12 hrs per day during a 6-week shift before being replaced by other MMOs.

All MMOs participated in extensive safety training and a three-day observer training course designed to familiarize them with the operational and data recording procedures, reporting protocols, and IHA and LoA stipulations. The IHA and LoA stipulations and requirements were also explained to the Operations Manager and Head Airgun Operator(s) aboard the *Mt. Mitchell* during a meeting prior to seismic operations. MMO duties included

- recording environmental and sighting conditions;
- searching for and identifying marine mammals, and recording their numbers, distances from the vessel, and behavior;
- recording possible reactions of marine mammals to the seismic operations; and
- initiating mitigation measures when appropriate.

Visual Monitoring for Marine Mammals

Vessel-based observers monitored marine mammals from the *Mt. Mitchell* during all daytime seismic operations, and during any nighttime power ups of the airgun(s), as specified in the IHAs. Additionally, MMOs stayed on watch throughout all nighttime survey operations as a precautionary measure. Seismic operations were suspended or amended when marine mammals were observed within, or about to enter, designated safety zones described in the IHAs. In general, vessel-based observations for marine mammals were conducted using the following guidelines:

- Observations during daylight hours were conducted in good and poor visibility whenever the airgun(s) were operating, and by two observers when possible, unless precluded by safety considerations.
- MMOs observed during transit periods without airgun operations, at the discretion of the lead MMO, to obtain baseline data on marine mammal distribution and (in the case of less experienced observers) to become more familiar with observation protocols.
- Two MMOs observed for 30 min prior to the planned start of seismic operations after an extended shut down and the entirety of the ≥180 dB radius was required to be visible for those 30 min.
- When the airgun array was powered up at night, two MMOs watched for marine mammals, using night vision devices, for 30 min prior to start up. (Note that there was 24-hour daylight until late August.)
- At least one MMO was on watch during ongoing seismic operations at night.
- Bridge personnel watched for marine mammals during seismic operations. They notified the MMO if marine mammals were observed in or about to enter the safety radii and had not yet been detected by the MMO.
- MMOs also recorded locations and movements of vessels when on watch; information regarding vessels as well as marine mammals was recorded in a database.

From the duty station, MMO(s) systematically scanned the area around the vessel in a sweeping pattern, usually alternating scan sweeps between reticle binoculars (e.g., Fujinon 7 × 50) and the unaided eye during the daytime. Observations were focused forward and to the sides of the vessel in an arc of ~210º, but MMOs also regularly checked for the presence of marine mammals astern of the vessel. Night vision devices were used aboard seismic source vessels during non-daylight hours using a similar sweep search pattern.

The duration of a single visual shift was no longer than 4 hr to minimize observer fatigue. Use of two observers simultaneously was desirable and was scheduled when possible to increase detection of marine mammals near the source vessel. In addition to the dedicated MMOs, bridge personnel were instructed and assisted in detecting marine mammals, implementing mitigation requirements, and collecting data when possible.

While on watch, MMOs kept systematic written records of the vessel's position, activity, and environmental conditions using codes that were entered either onto a datasheet and later transcribed onto database, or entered directly into a database using a hand-held computer. Vessel and environmental data were recorded onto the datasheet every 30 min or whenever conditions changed significantly. Additional data were recorded when marine mammals were observed. For all records, the date and time, vessel position (longitude and latitude), and environmental conditions were recorded. The database was constructed to prevent entry of out-of-range values and codes. Data entries were checked manually by comparing listings of the computerized data with the original handwritten datasheets, both in the field and upon later analyses.

The following information was recorded for each marine mammal sighting: date, time, species, total number of individuals, number of juveniles, bearing relative to vessel's heading, direction of movement relative to the vessel, distance from the vessel, behavior when sighted, whether animal was in the water or hauled out on ice or land, behavioral pace, reaction to the vessel, vessel position, water depth, observer initials, species identification reliability, and the time that mitigation measures were requested (if necessary). On the seismic vessel, distance to marine mammals was measured from the MMO's location on the bridge rather than from the nominal center of the seismic source. The distance of the animal from the airgun array was calculated using a GIS during data error checking and processing at the end of the season. However, for sightings near or within the safety radius in effect at the time, the distance from the marine mammal to the nearest airgun was estimated and recorded for the purposes of implementing power downs or shut downs. The bearing from the vessel to individual or groups of marine mammals was estimated using positions on a clock face, with the bow of the vessel considered to be 12 o'clock and the stern 6 o'clock.

Operational activities that were recorded by MMOs onboard seismic vessels included the number of airguns in use, total volume of the airguns, and the type of vessel/seismic activity. Intra-ship communication between seismic technicians and MMOs was conducted via radio or telephone and used to alert MMOs of any changes in operations, and to request power or shut downs by MMOs. The position of the vessel was logged every 60 sec by the ships navigational system and these data were integrated with the marine mammal database to check for data recording errors. Details regarding the seismic activities (start and stop times, number of guns firing, etc.) was collected from the airgun operators log and also used to error check MMO data.

Marine Mammal Mitigation During Operations

The following mitigation measures were adopted for marine mammal sightings during the proposed seismic program, provided that doing so did not compromise operational safety requirements: ramp ups, power ups, shut downs, power downs, and course alterations.

Ramp Up

A ramp up is a process commonly used by seismic vessels with large airgun arrays that involves a gradual increase in the number of airguns firing from none or one airgun until the full array is active. In this report, a ramp up from no airguns firing is simply called a **ramp up**. However, when a ramp up was initiated while the single "mitigation" airgun had been firing it is referred to as a **power up**. The reason for the different terms, as described further below, is that a ramp up can not be initiated during times when the full safety radii are not visible to MMOs for 30 minutes while a power up can be initiated during times when the full safety radius is not visible because the mitigation gun has been firing.

Daylight Procedure

During daylight hours, a ramp up or power up was required when the full airgun array had not been operating for a period of >10 min. A 30 min watch period performed by at least two MMOs was required prior to a ramp up. The entire ≥180 dB safety radius for the full array must be visible for the entire 30-min pre-ramp up observation period before the ramp-up could commence. However, if the mitigation airgun had been operating during the break in full array activity, then a power up could be initiated at any time provided two MMOs were on active watch during the power up. If the airguns had been shut down or powered down because of the presence of a marine mammal within or near the applicable safety radius, a ramp up or power up could not begin until that safety radius was clear of marine mammals. Following a marine mammal sighting the safety radius was considered clear when the marine mammal was observed to exit safety radius, or if no marine mammals were seen in the safety radii for 15 min (for small odontocetes and pinnipeds) or 30 min (for mysticetes and large odontocetes). If a marine mammal was observed within the applicable safety radius during the 30-min pre-ramp up observation period, the airgun operator was informed and the ramp up was postponed.

Ramp ups of the airgun array began with firing a single airgun. The number of airguns firing was then increased at a rate no greater than an increase of ~6 dB per 5-min period. During a power up the same procedure was applied by increasing the number of operating guns from the single "mitigation" gun to the full array. During a ramp up or power up, the safety zone for the full airgun array was maintained even though fewer airguns were operating.

MMOs informed the airgun operators when ramp up could proceed. If a marine mammal was observed within its applicable safety radius during the 30-min observation period, or during the ramp up, the bridge and airgun operators were informed, as usual, of any necessary mitigation measures (power down, shutdown).

Darkness Procedures

During hours of darkness, ramp up could commence only if the entire ≥180 dB safety radius for the full array was visible to MMOs for 30 min using either the unaided eye or night-vision devices (unlikely with very large safety radii). However, similar to daylight periods with poor visibility conditions, a power up could commence at night even if the full array ≥180 dB radius was not visible.

Power Down

A power down is a reduction in the number of operating airguns (usually from all airguns firing to a single mitigation gun firing). If marine mammals were detected outside the applicable safety radius of

the full airgun array but were likely to enter the safety radius (i.e., if the mammals were moving towards the vessel or if the vessel was moving in the direction of the mammals), and if the vessel's course or speed could not be changed to avoid having the mammals enter the safety radius, the airgun array was powered down to the single mitigation airgun before the mammals were within the full array safety radius. Likewise, if a mammal was first observed already within the full array safety radius, the airguns were immediately powered down. The single airgun continued firing at a source level of at least 180 dB re 1 μPa-m (rms) during the interruption of full array seismic operations. A shut-down (see below) was implemented only if a marine mammal was detected within or about to enter the smaller safety zone around the mitigation airgun. Full airgun activity did not resume (via a power up) until the marine mammal had cleared the safety zone for the full array.

Shut Down

A shut down is the cessation of all airgun activity, including the single mitigation airgun. If a cetacean or pinniped was detected within or about to enter the applicable safety radius of the mitigation gun, the airgun was shut down. After a shut down, the animal must have cleared the safety zone before start up procedures could begin. If the mitigation airgun was shut down for >10 min and no observer was on duty, then at least 30 min of observation by two MMOs was necessary prior to ramp up. MMOs informed the bridge when ramp up of the airgun(s) could proceed.

Vessel Course / Speed Alteration

If a marine mammal was detected outside the applicable safety radius and, based on its position and direction of travel, was likely to enter the safety radius, one mitigation measure was to adjust the ship track and/or speed to avoid close approach to the mammal. If the mammal appeared likely to enter the safety radius, further mitigation actions were taken, i.e., power or shut down of the airgun(s). The vessel speed was reduced for Pacific walrus sightings in the water per 2009 LoA stipulation.

Analyses

Vessel Based Monitoring

This section describes the analyses of the marine mammal sightings and survey effort recorded during this project. It also describes the methods used to calculate densities and estimate the number of marine mammals potentially exposed to airgun sounds associated with Shell's and shallow-hazards surveys.

The sightings and effort data were grouped into three categories to assess potential effects of seismic sounds on marine mammals. The categories were "seismic" (1 or more airguns operating and up to 3 minutes after airguns stopped firing), "post-seismic" (3 min to 1h for pinnipeds and 2 h for cetaceans after the airguns were turned off), and "non-seismic" (periods before seismic started or >1 or >2 h after airguns were turned off for pinnipeds and cetaceans, respectively). Unless specifically stated otherwise, comparison of seismic and non-seismic periods excluded the post seismic period. The justification for the selection of these criteria was based on the size of the array in use and is provided below. These criteria were also used and discussed in previous reports to NMFS (see Haley and Koski 2004; Smultea et al. 2004, 2005; MacLean and Koski 2005; Holst et al. 2005a,b):

- Mammal distribution and behavior during the short period up to 3 min after the last seismic shot are assumed to be similar to those while seismic surveying is ongoing.
- It is likely that any marine mammals near the vessel between 3 min and 30 min after the cessation of seismic activities would have been "recently exposed" (i.e., within the past 30 min)

to sounds from the seismic survey. During at least a part of that period, the distribution and perhaps behavior of the marine mammals may still be influenced by the (previous) sounds.

- For some unknown part of the period from 30 min to 1 or 2 h post-seismic, it is possible that the distribution of the animals near the ship, and perhaps the behavior of some of those animals, would still be at least slightly affected by the (previous) seismic sounds.
- By 1 or 2 h after the cessation of seismic operations, the distribution and behavior of pinnipeds and cetaceans, respectively, would be expected to be indistinguishable from "normal" because of (a) waning of responses to past seismic activity, (b) re-distribution of mobile animals, and (c) movement of the ship and thus the MMOs. Given those considerations, plus the limited observed responses of most marine mammals to seismic surveys (e.g., Stone 2003; Smultea et al. 2004; Haley and Koski 2004; MacLean and Koski 2005; Holst et al. 2005a,b), it is unlikely that the distribution or behavior of marine mammals near the vessel > 1 or 2 h post-seismic would be appreciably different from "normal" even if they had been exposed to seismic sounds earlier. Therefore, we consider animals seen >1 or 2 h after cessation of seismic operations to be unaffected by the (previous) seismic sounds.

As summarized in Chapter 4, marine mammal density was one of the variables examined to assess differences in the distribution of marine mammals relative to the seismic vessel between seismic and non-seismic periods. Densities were calculated using line-transect procedures for vessel-based surveys. To allow for animals missed during daylight, we corrected our visual observations using correction factors calculated with these procedures.

Corrections for Sightability

As is standard for line-transect estimation procedures, corrections for the following two parameters were included in the calculation of densities:

- $g(0)$, a measure of detection bias. This factor allows for the fact that less than 100% of the animals present along a transect line are detected.
- $f(0)$, the reduced probability of detecting an animal with increasing distance from a transect line.

Where species-specific values did not exist, values for similar species were used. The $g(0)$ values for gray whales and bowhead whales were taken from previously calculated values for gray whales and right whales respectively. The $g(0)$ values for pinniped species observed during this study were taken from values calculated previously for pinniped species off California. Other correction factors were extracted from species-specific $g(0)$ tables produced for previous studies.

The $f(0)$ factors used in the analysis were calculated from observations made during this study when enough data were available. The sightings from all vessels involved in this study were combined to achieve the largest sample size possible and to minimize the number of $f(0)$s calculated. Only non-seismic period sightings that were made during good sighting conditions were used for the calculations. These sightings were imported into DISTANCE 4.1 where the $f(0)$ values were calculated separately for each species or species group. The default analysis method was conventional distance sampling with a half-normal model and cosine expansion with no stratification. As very few sightings were of large groups of animals, we simply used the ratio of $f(0)$s between group sizes of 1–16, 17–60 and >60 individuals used in previous studies to estimate the appropriate $f(0)$s for the two larger group categories.

Number of Individuals Exposed

Estimates of the number of individual marine mammals potentially exposed to sound levels ≥160 dB re 1 μPa (rms) were calculated by multiplying the area of water ensonified to that level by the density of marine

mammals estimated by line transect methods. The area of water ensonified was calculated using MapInfo Geographic Information System (GIS) software to create a "buffer" that extended around the vessel's trackline to the predicted ≥160 dB distance. The area of water covered by the buffer was calculated two different ways: 1) "Including Overlap Area" is the area of water ensonified to ≥160 dB where areas exposed on more than one occasion (as a result of crossing tracklines or tracklines that were close enough for their ≥160 dB zones to overlap) were counted repeatedly each time they were exposed; and 2) "Excluding Overlap Area" was the area of water that was exposed to airgun sounds ≥160 dB where areas exposed on more than one occasion were counted only once.

Number of Exposures per Individual

The estimated number of potential exposures per individual is the ratio of the two area calculations described above and represents the average number of times a given area of water was exposed to sound levels ≥160 dB.

APPENDIX F: BEAUFORT WIND FORCE DEFINITIONS

Wind Speed		Beaufort Wind Force	World Meteorological Organization Terms	Wave Height (m)	Description
Knots	m/s				
<1	<0.5	0	Calm	0	Glassy like a mirror
1-3	0.5-1.5	1	Light air	<0.1	Ripples with the appearance of scales but no whitecaps or foam crests
4-6	2.1-3.1	2	Light breeze	0-0.1	Small wavelets, crests have a glassy appearance but do not break (no whitecaps)
7-10	3.6-5.1	3	Gentle breeze	0.1-0.5	Smooth large wavelets, crests begin to break, occasional/scattered whitecaps
11-16	5.7-8.2	4	Moderate breeze	0.5-1.2	Slight; small fairly frequent whitecaps
17-21	8.7-10.8	5	Fresh breeze	1.2-2.4	Moderate waves becoming longer, some spray, frequent moderate whitecaps
22-27	11.3-13.9	6	Strong breeze	2.4-4	Rough, larger waves, longer-formed waves, many large whitecaps
28-33	14.4-17.0	7	Near gale	4-6	Very rough, large waves forming, white foam crests everywhere, spray is present
34-40	17.5-20.6	8	Gale		
41-47	21.1-24.2	9	Strong gale		
48-55	24.7-28.3	10	Storm	6-9	High
56-63	28.8-32.4	11	Violent storm	11-14	Very high

APPENDIX G: BACKGROUND ON MARINE MAMMALS IN THE CHUKCHI SEA

TABLE F-1. The habitat, abundance and conservation status of marine mammals potentially inhabiting the project areas of the Chukchi Sea.

Species	Habitat	Abundance	ESA[1]	IUCN[2]	CITES[3]
Odontocetes					
Beluga whale (*Delphinapterus leucas*)	Offshore, Coastal, Ice edges	50,000[4] 39,257[5]	Not listed	VU	
Narwhal (*Monodon monoceros*)	Offshore, Ice edge	Rare[6]	Not listed	DD	II
Killer whale (*Orcinus orca*)	Widely distributed		Not listed	LR-cd	II
Harbor Porpoise (*Phocoena phocoena*)	Coastal, inland waters, shallow offshore waters	Common (Chukchi) Uncommon (Beaufort)	Not listed	VU	II
Mysticetes Bowhead whale (*Balaena mysticetus*)	Pack ice & coastal	10,545[7]	Endangered	LR-cd	I
Gray whale (*Eschrichtius robustus*) (eastern Pacific population)	Coastal, lagoons	488[8] 17,500[9]	Not listed	LR-cd	I
Minke whale (*Balaenoptera acutorostrata*)	Shelf, coastal	Small numbers	Not listed	LR-cd	I
Fin whale (*Balaenoptera physalus*)	Slope, mostly pelagic	Rare (Chukchi)	Endangered	EN	I
Humpback whale (*Megaptera novaeangliae*)	Shelf, coastal	Rare	Endangered	–	–
Pinnipeds Bearded seal (*Erignathus barbatus*)	Pack ice	300,000-450,000[10] 4863[11]	In review for listing	–	–
Spotted seal (*Phoca largha*)	Pack ice	1000[12]	In review for listing	–	–
Ringed seal (*Pusa hispida*)	Landfast & pack ice	Up to 3.6 million [13] ~208,000-252,000[14] 326,500[15]	In review for listing	–	–
Ribbon seal (*Histriophoca fasciata*)	Offshore, pack ice	90-100,000[16]	In review for listing	–	–

[1] U.S. Endangered Species Act.
[2] IUCN Red List of Threatened Species (2003). Codes for IUCN classifications: CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LR = Lower Risk (-cd = Conservation Dependent; -nt = Near Threatened; -lc = Least Concern); DD = Data Deficient.
[3] Convention on International Trade in Endangered Species of Wild Fauna and Flora (UNEP-WCMC 2004).
[4] Total Western Alaska population, including Beaufort Sea animals that occur there during migration and in winter (Small and DeMaster 1995).
[5] Beaufort Sea population (IWC 2000).
[6] Population in Baffin Bay and the Canadian arctic archipelago is ~60,000 (DFO 2004); very few enter the Beaufort Sea.
[7] Abundance of bowheads surveyed near Barrow, as of 2001 (George et al. 2004); revised to 10,545 by Zeh and Punt (2005).
[8] Southern Chukchi Sea and northern Bering Sea (Clark and Moore 2002).
[9] North Pacific gray whale population (Rugh 2003 *in* Keller and Gerber 2004) ; see also Rugh et al. (2005).
[10] Alaska population (USDI/MMS 1996).

[11] Eastern Chukchi Sea population (NMML, unpublished data).
[12] Alaska Beaufort Sea population (USDI/MMS 1996).
[13] Alaska estimate (Frost et al. 1988 *in* Angliss and Outlaw 2008).
[14] Bering/Chukchi Sea population (Bengston et al. 2005).
[15] Alaskan Beaufort Sea population estimate (Amstrup 1995).
[16] Burns, J.J. 1981a.

APPENDIX H: UNDERWATER SOUND MEASUREMENTS

Part 1: Tables and Figures Referenced from Chapter 3

Vessel Name	R/V Mt Mitchell
Function	Research vessel
Captain	Hazen Denison
# of Engines	2
Power per Engine (HP)	1200
Length (ft)	231
Beam (ft)	42
Draft (ft)	13
Propulsion Type	Two variable pitch, three blade propellers, each 8.5 ft diameter.

A 42AC G.R.A.S. pistonphone calibrator was used to calibrate the Reson TC4043 and TC4032 hydrophones with the Sound Devices Recorders (model 722) immediately before and after each OBH deployment. Couplers specific to the design of the hydrophone models were attached to the calibrator, and the hydrophones were inserted into their corresponding coupler at a fixed distance. The pistonphone calibrator was turned on for approximately one minute during which the recorder captured the 250 Hz tone produced by the calibrator (ref. Figure H.1 for a waveform plot of a calibration signal). The recorded signal was then band-pass filtered around 250 Hz (225 to 275 Hz) to remove any contaminating noise energy (ref. Figure H.2 for a spectrogram of an unfiltered calibration signal showing some environmental noise outside the bandwidth of the calibrator). The SPL was then calculated in digital units (dB re Full Scale) from the filtered waveform. The system gain (the difference between the SPL of the calibration signal, in dB re 1 µPa, and the SPL of the filtered waveform, in dB re FS) was then applied to digital recording data (step 1 in the Per-shot Seismic Pulse Levels Section) to convert the levels to microPascals. The SPL of the calibration signal was measured prior to the field measurement programs. It is dependent on the air cavity volume between the pistonphone calibrator, coupler, and hydrophone. A calibrated Larson Davis sound level meter (model 824) with a 1/2" free field microphone (model 2541) was used to measure the SPL of the calibration signal with the two hydrophone/coupler combinations. The sound level meter was calibrated with a Larson Davis precision acoustic calibrator (model CAL200) at an output level of 114 dB re 20 µPa at 1000 Hz. The CAL200 was calibrated on 15 June 2005 and the 824 Sound Level Meter was calibrated on 28 June 2005, both in accordance with the National Institute of Standards and Technology (NIST) standards.

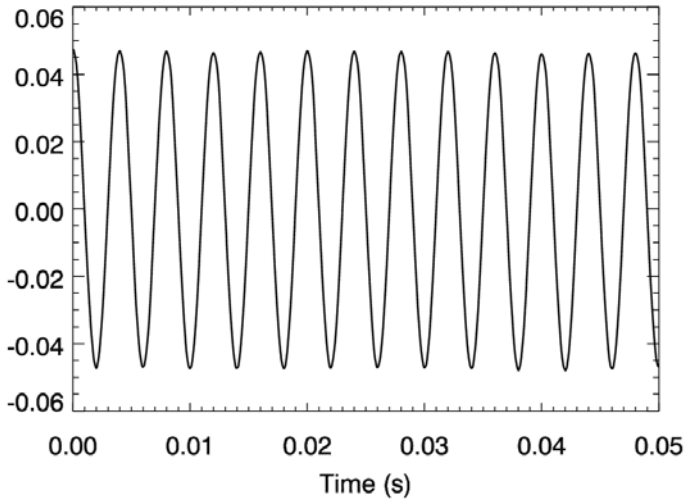

Figure H.1. Waveform (y values are in digital recording units) of an unfiltered calibration signal from a 42AC G.R.A.S. pistonphone calibrator recorded on a Sound Devices Recorder model 722 with a Reson TC4032 hydrophone.

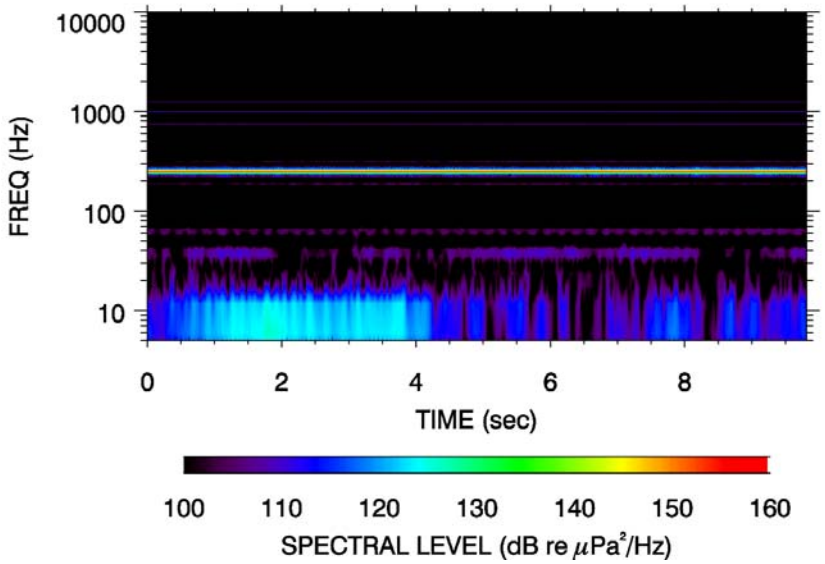

Figure H.2. Spectrogram plot of an unfiltered calibration signal from a 42AC G.R.A.S. pistonphone calibrator recorded on a Sound Devices Recorder model 722 with a Reson TC4032 hydrophone. Low frequency energy below 100 Hz does not originate from the calibrator and likely comes from the surrounding environment. This energy is removed from the calibration signal during the calculation of the SPL in dB re FS.

Part 2: English Units Tables and Figures from Chapter 3

Table H.7E. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the single 10 in^3 airgun configuration at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
190	56*	75*
180	130*	170*
170	290*	390*
160	690*	920
120	19000	26000

*Extrapolated from minimum measurement range of 240 m (787 ft).

Table H.8E. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the 20 in^3 array configuration at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
190	92*	120*
180	220*	280*
170	500*	660*
160	1200	1500
120	36000	46000

*Extrapolated from minimum measurement range of 240 m (787 ft).

Table H.9E. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the 40 in^3 array configuration at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
190	110*	140*
180	260*	330*
170	620*	790
160	1500	2000
120	56000	72000‡

*Extrapolated from minimum measurement range of 240 m (787 ft).
‡Extrapolated from maximum measurement range of 20000 m (787 ft).

Table H.11E. Maximum cumulative SEL for each airgun array configuration and OBH off the seismic survey line at the Honeyguide site.

Array Volume (in^3)	Distance off seismic survey line	Cumulative SEL (dB re 1 μPa^2s)				
		Flat-weighted	Low Frequency Cetaceans	Mid-Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds underwater
10	787 ft	157.1	157.0	153.0	151.9	155.1
	3380 ft	151.7	151.6	147.6	146.5	149.5
20	787 ft	162.1	162.0	157.8	156.5	160.1
	3380 ft	156.6	156.5	152.5	151.2	154.6
40	787 ft	167.1	167.0	162.9	161.6	165.1
	3380 ft	161.6	161.5	157.6	156.3	159.7

Table H.12E. Maximum cumulative SEL for each airgun array configuration and OBH off the seismic survey line with the added compensating factor for comparison to the levels at the Burger site. The compensating factor is $10\times\log_{10}3$ (4.8 dB) since the spatial shot density at the Burger times was three times that of the Honeyguide site.

Array Volume (in^3)	Distance off seismic survey line	Cumulative SEL (dB re 1 μPa^2s)				
		Flat-weighted	Low Frequency Cetaceans	Mid-Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds underwater
10	787 ft	161.9	161.8	157.8	156.7	159.9
	3380 ft	156.5	156.4	152.4	151.3	154.3
20	787 ft	166.9	166.8	162.6	161.3	164.9
	3380 ft	161.4	161.3	157.3	156	159.4
40	787 ft	171.9	171.8	167.7	166.4	169.9
	3380 ft	166.4	166.3	162.4	161.1	164.5

Table H.13E. Sound level distances for 160, 150, 140, 130, 120 and 110 dB re 1 μPa (*rms*) for the sub-bottom profiler (3.5 kHz) at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
160	46*	52*
150	120*	140*
140	300*	360*
130	760*	890
120	1900	2200
110	4900	5600

*Extrapolated from minimum measurement range of 240 m (787 ft).

Table H.14E. Sound level distances for 140-100 dB re 1 μPa (*rms*) for the *R/V Mt Mitchell* sailing at 3.8 kts at the Honeyguide site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
160	33*	43*
150	120*	140*
140	390*	490*
130	1300	1600
120	3900	4900
110	10000	11000
100	20000‡	22000‡

*Extrapolated from minimum measurement range of 240 m (787 ft).
‡Extrapolated from maximum measurement range of 5000 m (16400 ft).

Table H.15E. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the single 10 in^3 airgun configuration at the Burger site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
190	20*	26*
180	85*	110*
170	360*	460*
160	1400	1900
120	59000	62000

*Extrapolated from minimum measurement range of 275 m (902 ft).

Table H.16E. Sound level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) for the 40 in^3 array configuration at the Burger site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
190	110*	130*
180	390*	490*
170	1400	1700
160	4900	5900
120	95000‡	100000‡

*Extrapolated from minimum measurement range of 200 m (656 ft).
‡Extrapolated from maximum measurement range of 20000 m (65600 ft).

Table H.18E. Maximum cumulative SEL for each airgun array configuration and OBH off the seismic survey line at the Burger site.

Array Volume (in^3)	Distance off seismic survey line	Cumulative SEL (dB re 1 μPa^2s)				
		Flat-weighted	Low Frequency Cetaceans	Mid-Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds underwater
10	902 ft	171.2	171.1	167.0	165.6	169.2
	3510 ft	167.6	167.5	163.5	162.2	165.6
40	902 ft	179.7	179.7	175.9	174.5	178.1
	3510 ft	176.3	176.2	172.6	171.2	174.7

Table H.19E. Sound level distances for 160, 150, 140, 130, 120 and 110 dB re 1 μPa (*rms*) for the sub-bottom profiler (3.5 kHz) at the Burger site.

90% rms SPL (dB re 1 μPa)	Best fit range (ft)	90th percentile fit (ft)
160	26*	36*
150	82*	110*
140	250*	320*
130	720*	950
120	2200	2800
110	6600	8500

*Extrapolated from minimum measurement range of 275 m (902 ft).

Table H.20E. Sound level distances for 160-120 dB re 1 μPa (*rms*) for the *R/V Mt Mitchell* sailing at 3.5 kts at the Burger site.

90% rms SPL (dB re 1 μPa)	Approach (bow aspect)		Departure (stern aspect)	
	Best fit range (ft)	90th percentile fit (ft)	Best fit range (ft)	90th percentile fit (ft)
160	26*	30*	33*	36*
150	110*	130*	170*	190*
140	490*	530	850	980
130	2000	2300	4300	4900
120	8500	9500	22000	26000

*Extrapolated from minimum measurement range of 200 m (656 ft).

Table H.23E. Comparison of ranges to thresholds as specified in the IHA and as measured in the field.

Site	Airgun Array Volume (in^3)	Ranges (ft) to Threshold Levels (dB re 1 µPa)					
		190 dB		180 dB		160 dB	
		IHA	measured	IHA	measured	IHA	measured
Honeyguide	10	164 ft	75 ft	525 ft	170 ft	4590 ft	910 ft
Honeyguide	20	164 ft	120 ft	525 ft	280 ft	4590 ft	1500 ft
Honeyguide	40	164 ft	140 ft	525 ft	330 ft	4590 ft	1200 ft
Burger	10	164 ft	26 ft	525 ft	110 ft	4590 ft	1900 ft
Burger	40	164 ft	130 ft	525 ft	480 ft	4590 ft	5800 ft

Table H.24E. Sound level distances for the 10, 20, and 40 in^3 airgun array configurations at the Honeyguide site.

90% rms SPL (dB re 1 µPa)		190	180	170	160	120
10 in^3 airgun range (ft)	Best fit	56*	130*	290*	690*	19000
	90^{th} percentile	75*	170*	390*	920	26000
20 in^3 airgun array range (ft)	Best fit	92*	220*	500*	1200	36000
	90^{th} percentile	120*	280*	660*	1500	46000
40 in^3 airgun array range (ft)	Best fit	110*	260*	620*	1500	56000
	90^{th} percentile	140*	330*	790	2000	72000‡

*Extrapolated from minimum measurement range of 240 m (787 ft).
‡Extrapolated from maximum measurement range of 20000 m (65600 ft).

Table H.25E. Sound level distances for the 10 and 40 in^3 airgun array configurations at the Burger site.

90% rms SPL (dB re 1 µPa)		190	180	170	160	120
10 in^3 airgun range (ft)	Best fit	20*	85*	360*	1400	59000
	90^{th} percentile	26*	110*	460*	1900	62000
40 in^3 airgun array range (ft)	Best fit	110**	390**	1400	4900	95000‡
	90^{th} percentile	130**	490**	1700	5900	100000‡

*Extrapolated from minimum measurement range of 275 m (902 ft).
**Extrapolated from minimum measurement range of 200 m (656 ft).
‡Extrapolated from maximum measurement range of 20000 m (65600 ft).

APPENDIX I: MONITORING, MITIGATION, AND DATA ANALYSIS METHODS

English Units Tables and Figures from Chapter 4

TABLE I.4.1E. Final radii for measurements of the ≥190, 180, 170, 160, 150, 140, 130, and 120 dB (rms) distances (in mi) for sound pulses from the 40–in^3 array and the 10–in^3 mitigation airgun deployed from R/V *Cape Flattery* at the Crackerjack prospect area, Alaskan Chukchi Sea, 2008.

Received Sound Level (dB rms)	Final Radii [a]	
	4-airgun array (40 in^3)	1 airgun (10 in^3)
≥190	0.031	0.005
≥180	0.099	0.020
≥170	0.304	0.075
≥160	0.869	0.273
≥150	2.298	0.932
≥140	5.092	2.608
≥130	9.377	5.775
≥120	14.904	9.936

[a] Hannay and Warner (2009)

These radii were finalized following 2008 field operations, thus, no "Preliminary Radii" are shown as in Tables 4.2 and 4.3.

TABLE I.4.2E. Comparison of measurements of the ≥190, 180, 170, 160, 150, 140, 130, and 120 dB (rms) distances (in mi) for sound pulses from the 40–in^3 array and the 10–in^3 mitigation airgun deployed from M/V *Mt. Mitchell* at the Honeyguide prospect area, Alaskan Chukchi Sea, 2009.

Received Sound Level (dB rms)	4-airgun array (40 in^3)		1 airgun (10 in^3)	
	Preliminary Radii [a]	Final Radii [b]	Preliminary Radii [a]	Final Radii [b]
≥190	0.020	0.025	0.011	0.014
≥180	0.052	0.061	0.025	0.032
≥170	0.132	0.152	0.061	0.075
≥160	0.339	0.371	0.147	0.173
≥150	-	0.913	-	0.399
≥140	-	2.229	-	0.919
≥130	-	5.471	-	2.124
≥120	14.594	13.414	5.055	4.900

[a] Warner and Rideout (2009a)

[b] Warner et al. (2009)

TABLE I.4.3E. Comparison of measurements of the ≥190, 180, 170, 160, 150, 140, 130, and 120 dB (rms) distances (in mi) for sound pulses from the 40–in^3 array and the 10–in^3 mitigation airgun deployed from M/V *Mt. Mitchell* at the Burger prospect area, Alaskan Chukchi Sea, 2009.

Received Sound Level (dB rms)	4-airgun array (40 in^3)		1 airgun (10 in^3)	
	Preliminary Radii [a]	Final Radii [b]	Preliminary Radii [a]	Final Radii [b]
≥190	0.022	0.024	0.005	0.005
≥180	0.086	0.091	0.021	0.021
≥170	0.321	0.327	0.088	0.088
≥160	1.108	1.099	0.353	0.353
≥150	-	3.142	-	1.261
≥140	-	7.017	-	3.484
≥130	-	12.668	-	7.204
≥120	19.127	19.437	12.047	12.047

[a] Warner and Rideout (2009b)

[b] Warner et al. (2009)

APPENDIX J: VESSEL-BASED MARINE MAMMAL MONITORING RESULTS

Part 1: Tables and Figures Referenced from Chapter 5

TABLE J.1. Number of sightings (number of individuals) of all marine mammals from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. All survey sightings are show regardless of whether they met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Species	Jul - Aug	Sep - Oct	*Total*
Cetaceans			
Bowhead Whale	1 (2)	0	***1 (2)***
Gray Whale	3 (3)	0	***3 (3)***
Harbor Porpoise	2 (8)	1 (2)	***3 (10)***
Unidentified Mysticete Whale	10 (15)	2 (2)	***12 (17)***
Unidentified Odontocete Whale	0	1 (1)	***1 (1)***
Total Cetaceans	***16 (28)***	***4 (5)***	***20 (33)***
Seals			
Bearded Seal	17 (17)	0	***17 (17)***
Ringed Seal	20 (22)	18 (18)	***38 (40)***
Spotted Seal	1 (1)	1 (1)	***2 (2)***
Unidentified Seal	25 (25)	8 (8)	***33 (33)***
Unidentified Pinniped	8 (8)	1 (1)	***9 (9)***
Total Seals	***71 (73)***	***28 (28)***	***99 (101)***
Pacific Walruses	63 (120)	8 (12)	***71 (132)***
Grand Total of All Sightings	***150 (221)***	***40 (45)***	***190 (266)***

This table includes one off-watch sighting of a Pacific walrus, two sightings from periods of darkness of unidentified mysticete whales (two individuals), one dead unidentified mysticete whale, three dead unidentified pinnipeds, two dead unidentified seals, and one dead Pacific walrus.

TABLE J.2. Marine mammal observer cetacean effort (in km) from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Effort is categorized by seismic state, seasonal period, and Beaufort wind force, and is that which met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Seasonal Period and Seismic State	Beaufort Wind Force 0	1	2	3	4	5	*Total*
Jul-Aug							
Seismic	5	74	177	390	136	104	***888***
Non-seismic	7	107	556	739	642	644	***2696***
Jul-Aug Total	***12***	***181***	***734***	***1130***	***778***	***748***	***3583***
Sep-Oct							
Seismic	0	150	318	48	12	0	***528***
Non-seismic	0	133	293	594	237	134	***1391***
Sep-Oct Total	***0***	***283***	***610***	***642***	***249***	***134***	***1919***
2009 Seismic Total	***5***	***224***	***495***	***438***	***149***	***104***	***1415***
2009 Non-seismic Total	***7***	***241***	***849***	***1334***	***878***	***778***	***4087***
2009 Survey Total	***12***	***465***	***1344***	***1772***	***1027***	***883***	***5502***

TABLE J.3. Marine mammal observer pinniped effort (in km) from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Effort is categorized by seismic state, seasonal period, and Beaufort wind force, and is that which met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Seasonal Period and Seismic State	Beaufort Wind Force 0	1	2	3	4	5	*Total*
Jul-Aug							
Seismic	5	77	188	401	138	104	***913***
Non-seismic	7	114	570	768	649	662	***2771***
Jul-Aug Total	***12***	***191***	***758***	***1169***	***787***	***767***	***3684***
Sep-Oct							
Seismic	0	150	318	48	12	0	***528***
Non-seismic	0	141	302	594	240	144	***1420***
Sep-Oct Total	***0***	***290***	***620***	***642***	***252***	***144***	***1948***
2009 Seismic Total	***5***	***227***	***506***	***448***	***150***	***104***	***1440***
2009 Non-seismic Total	***7***	***254***	***872***	***1363***	***889***	***806***	***4191***
2009 Survey Total	***12***	***481***	***1378***	***1811***	***1038***	***910***	***5632***

TABLE J.4. Number of cetacean sightings (number of individuals) by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Seasonal Period and Species	Seismic	Non-Seismic	*Total*
Jul-Aug			
Bowhead Whale	0	1 (2)	***1 (2)***
Gray Whale	0	2 (2)	***2 (2)***
Unidentified Mysticete Whale	0	8 (13)	***8 (13)***
Jul-Aug Total Cetaceans	***0***	***11 (17)***	***11 (17)***
Oct-Nov			
Unidentified Mysticete Whale	0	1 (1)	***1 (1)***
Sep-Oct Total Cetaceans	***0***	***1 (1)***	***1 (1)***
2009 Total Cetaceans	***0***	***12 (18)***	***12 (18)***

TABLE J.5. Number of seal sightings (number of individuals) by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Seasonal Period and Species	Seismic	Non-Seismic	*Total*
Jul-Aug			
Bearded Seal	3 (3)	9 (9)	***12 (12)***
Ringed Seal	4 (4)	11 (13)	***15 (17)***
Unidentified Pinniped	1 (1)	4 (4)	***5 (5)***
Unidentified Seal	1 (1)	18 (18)	***19 (19)***
Jul-Aug Total Seals	***9 (9)***	***42 (44)***	***51 (53)***
Oct-Nov			
Ringed Seal	2 (2)	10 (10)	***12 (12)***
Unidentified Seal	1 (1)	5 (5)	***6 (6)***
Sep-Oct Total Seals	***3 (3)***	***15 (15)***	***18 (18)***
2009 Total Seals	***12 (12)***	***57 (59)***	***69 (71)***

TABLE J.5. Number of Pacific walrus sightings (number of individuals) by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Seasonal Period	Seismic	Non-Seismic	*Total*
Jul-Aug	7 (8)	46 (96)	***53 (104)***
Oct-Nov	4 (7)	2 (3)	***6 (10)***
2009 Total Pacific Walruses	***11 (15)***	***48 (99)***	***59 (114)***

Part 2: English Units Tables and Figures from this Appendix and Chapter 5

TABLE J.2E. Marine mammal observer cetacean effort (in mi) from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Effort is categorized by seismic state, seasonal period, and Beaufort wind force, and is that which met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Seasonal Period and Seismic State	Beaufort Wind Force						
	0	1	2	3	4	5	*Total*
Jul-Aug							
Seismic	3	46	110	242	85	65	***551***
Non-seismic	5	67	345	459	399	400	***1674***
Jul-Aug Total	***8***	***113***	***456***	***701***	***483***	***465***	***2225***
Sep-Oct							
Seismic	0	93	197	30	8	0	***328***
Non-seismic	0	83	182	369	147	83	***864***
Sep-Oct Total	***0***	***176***	***379***	***399***	***155***	***83***	***1192***
2009 Seismic Total	***3***	***139***	***308***	***272***	***92***	***65***	***879***
2009 Non-seismic Total	***5***	***149***	***527***	***828***	***546***	***483***	***2538***
2009 Survey Total	***8***	***288***	***835***	***1100***	***638***	***548***	***3417***

TABLE J.3E. Marine mammal observer pinniped effort (in mi) from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Effort is categorized by seismic state, seasonal period, and Beaufort wind force, and is that which met the data-analysis criteria discussed in Chapter 4, *Data Analysis*.

Seasonal Period and Seismic State	Beaufort Wind Force						
	0	1	2	3	4	5	*Total*
Jul-Aug							
Seismic	3	48	117	249	85	65	***567***
Non-seismic	5	71	354	477	403	411	***1721***
Jul-Aug Total	***8***	***119***	***471***	***726***	***488***	***476***	***2288***
Sep-Oct							
Seismic	0	93	197	30	8	0	***328***
Non-seismic	0	87	188	369	149	89	***882***
Sep-Oct Total	***0***	***180***	***385***	***399***	***156***	***89***	***1210***
2009 Seismic Total	***3***	***141***	***314***	***278***	***93***	***65***	***895***
2009 Non-seismic Total	***5***	***158***	***542***	***846***	***552***	***501***	***2603***
2009 Survey Total	***8***	***299***	***856***	***1125***	***645***	***565***	***3497***

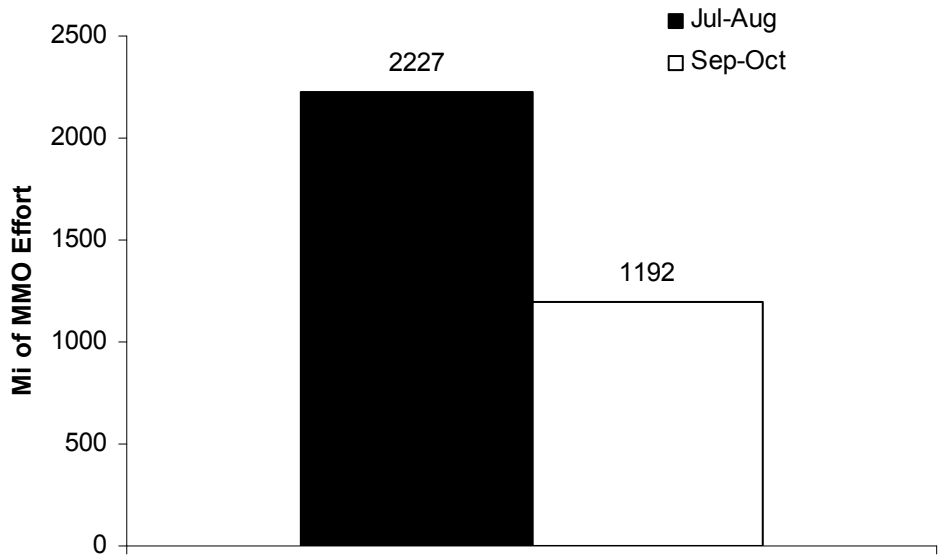

FIGURE J.5.1E. Marine mammal observer effort (mi) by seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

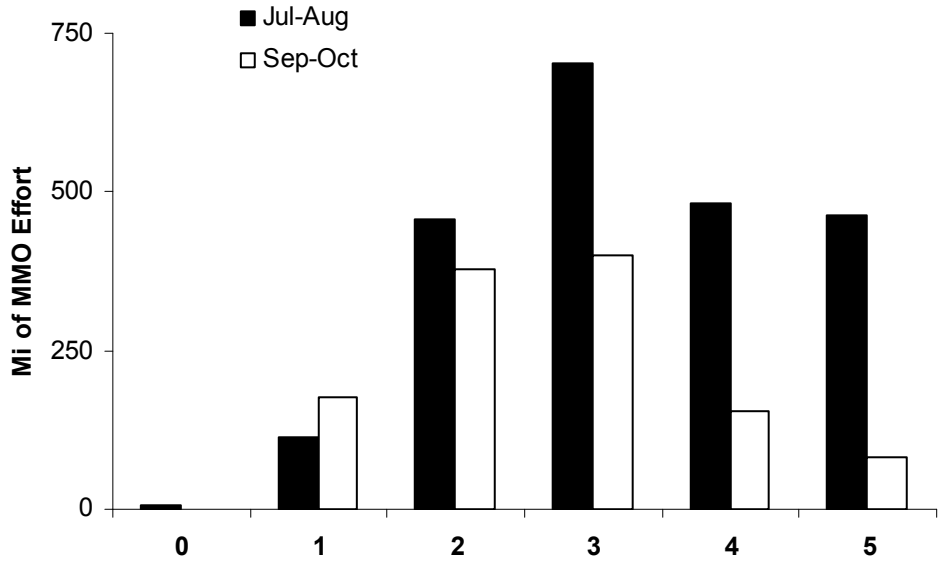

FIGURE J.5.2E. Marine mammal observer effort (mi) by Beaufort wind force and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

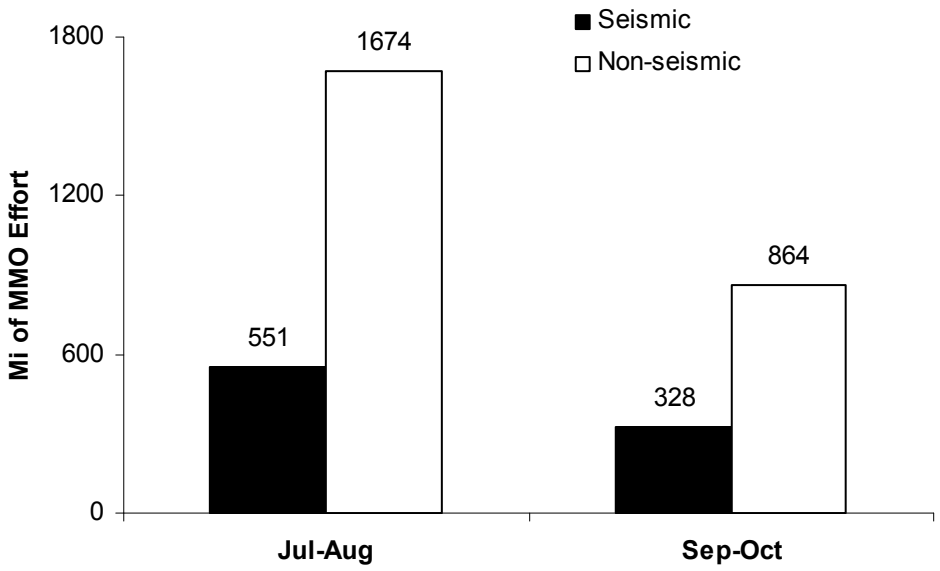

FIGURE J.5.3E. Marine mammal observer effort (mi) by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

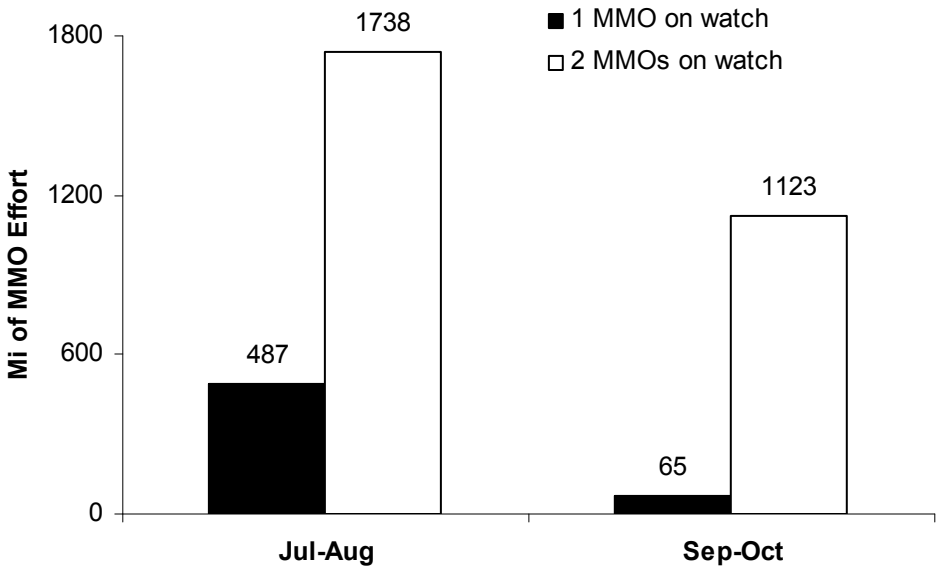

FIGURE J.5.4E. Marine mammal observer effort (mi) by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

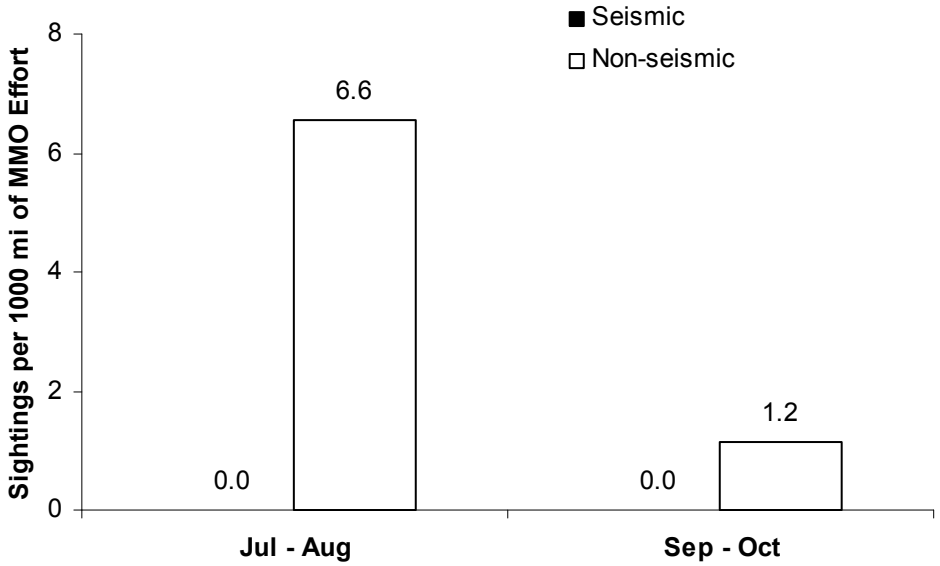

FIGURE J.5.6E. Cetacean sighting rates by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

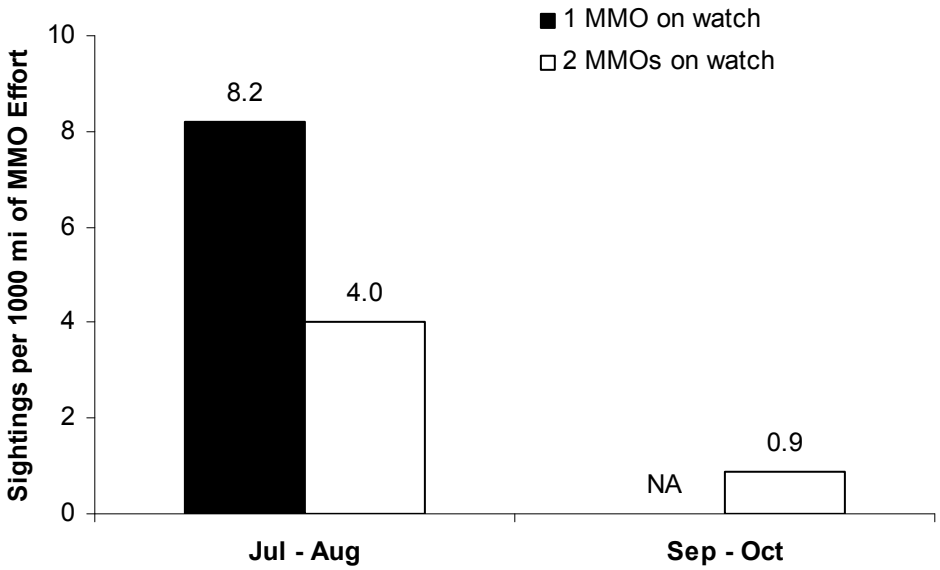

FIGURE J.5.7E. Cetacean sighting rates by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Note the one-MMO watch effort for Sep-Oct was too low to allow for a meaningful comparison.

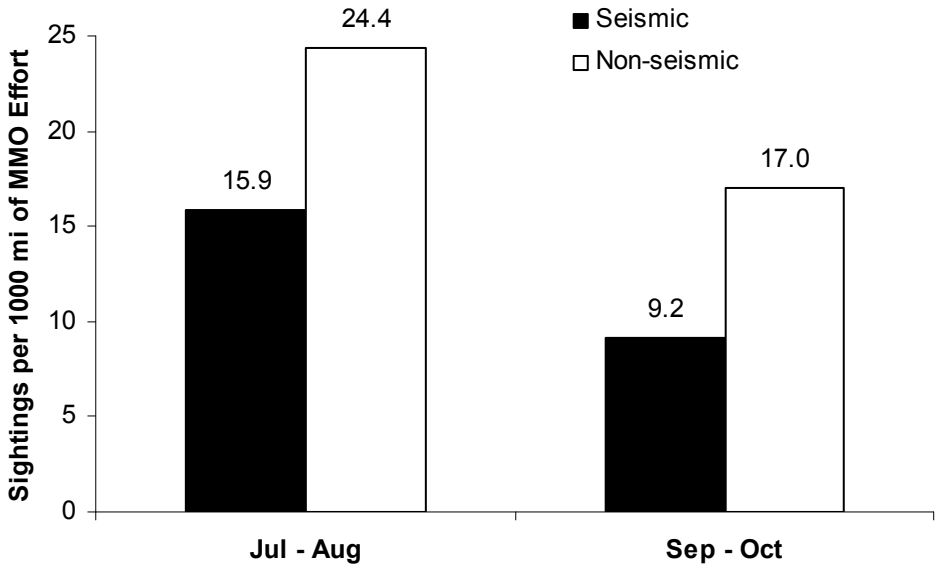

FIGURE J.5.9E. Seal sighting rates by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

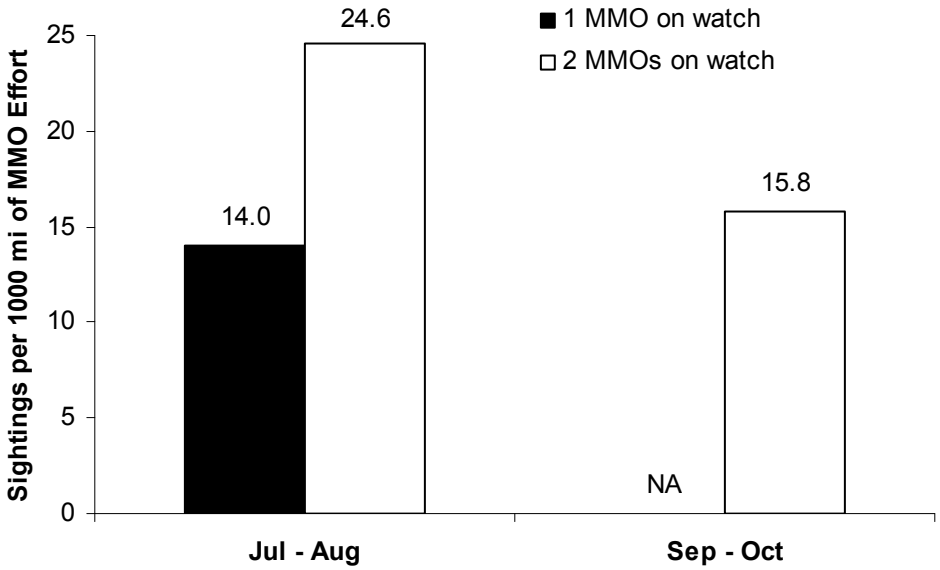

FIGURE J.5.10E. Seal sighting rates by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Note the one MMO watch effort for Sep–Oct was too low to allow for a meaningful comparison.

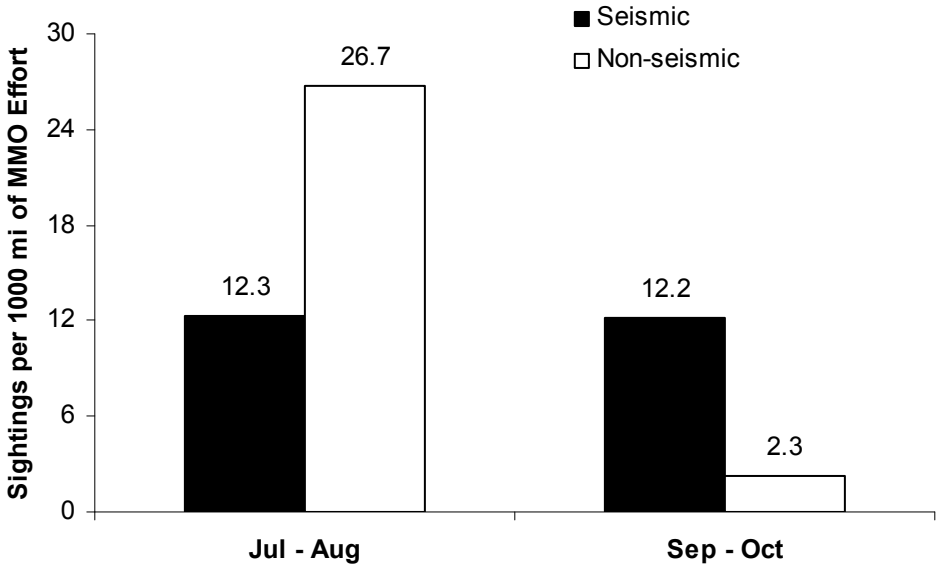

FIGURE J.5.12E. Pacific walrus sighting rates by seismic state and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

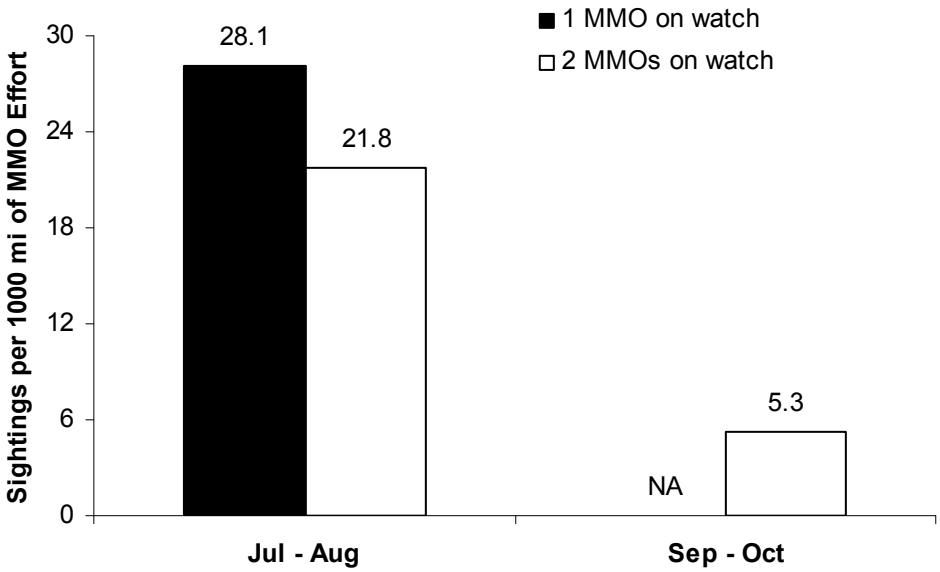

FIGURE J.5.13E. Pacific walrus sighting rates by number of MMOs on watch and seasonal period from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Note the one MMO watch effort for Sep–Oct was too low to allow for a meaningful comparison.

TABLE J.5.4E. Cetacean CPA to MMOs aboard the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Seismic Status	Mean CPA[a] (yd)	s.d.	Range (yd)	*n*
Seismic	--	--	--	--
Non-seismic	2284	1354	379-4285	12
Overall Mean	***2284***	***1354***	***379-4285***	***12***

[a] CPA = Marine mammal's closest point of approach to the observer station.

TABLE J.5.7E. Seal CPA to the airgun array by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Seismic Status	Mean CPA[a] (yd)	s.d.	Range (yd)	*n*
Seismic	486	366	103-1403	12
Non-seismic	448	433	97-2999	57
Overall Mean	***455***	***420***	***97-2999***	***69***

[a] CPA = Marine mammal's closest point of approach to the airgun array, regardless of airgun status.

TABLE J.5.8E. Pacific walrus CPA to the airgun array by seismic state from the *Mt. Mitchell* during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Seismic Status	Mean CPA[a] (yd)	s.d.	Range (yd)	*n*
Seismic	514	529	85-1835	11
Non-seismic	712	485	142-1877	48
Overall Mean	***682***	***490***	***83-1877***	***59***

[a] CPA = Marine mammal's closest point of approach to the airgun array, regardless of airgun status.

TABLE J.5.9E. The single power down for a Pacific walrus observed near the *Mt. Mitchell's* ≥180-dB (rms) safety radius at the Honeyguide prospect (99 m; 108 yd) during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. There were no other power downs during this survey.

Sighting ID	Species	Group Size	Date	Water Depth (yd)	Reaction to Vessel[a]	Distance (yd) to airguns at first detection	CPA (yd) to airguns[b]
207	Pacific Walrus	1	13-Sep	56	LO	352	95

[a] Reaction Code: LO = Look at Vessel

[b] CPA to airguns = Closest Point of Approach to the airgun array

TABLE J.5.10E. The two shut downs for Pacific walruses observed inside the *Mt. Mitchell's* ≥180-dB (rms) safety radius at the Burger prospect (146 m; 160 yd) during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. There were no other shut downs during this survey.

Sighting ID	Species	Group Size	Date	Water Depth (yd)	Reaction to Vessel[a]	Distance (yd) to airguns at first detection	CPA (yd) to airguns[b]
118	Pacific Walrus	1	24-Aug	50	NO	142	85
196	Pacific Walrus	1	7-Sep	50	LO	112	112

[a] Reaction Codes: LO = Look at Vessel; NO = No Reaction

[b] CPA to airguns = Closest Point of Approach to the airgun array

TABLE J.5.12E. Densities of marine mammals in the Alaskan Chukchi Sea by seismic state during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. 95% confidence intervals are in parentheses. Densities are corrected for *f*(0) and *g*(0) biases.

	No. individuals / 1000 mi^2			
	Jul-Aug		Sep-Oct	
Species	Seismic	Non-seismic	Seismic	Non-seismic
Cetaceans				
Bowhead whale	0	0.821 (0.142 - 4.784)	0	0
Gray whale	0	0.821 (0.142 - 4.784)	0	0
Unidentified mysticete whale	0	5.346 (10.080 - 26.454)	0	0.865 (0.194 - 3.875)
Total cetacean density	**0**	**6.990 (1.844 - 26.496)**	**0**	**0.865 (0.194 - 3.875)**
Seals				
Bearded seal	12.991 (3.225 - 52.331)	12.841 (3.714 - 44.408)	0	0
Ringed seal	17.322 (3.963 - 75.723)	18.547 (7.539 - 45.630)	14.991 (3.261 - 68.927)	27.835 (3.968 - 195.257)
Unidentified pinniped	2.108 (0.303 - 14.623)	2.776 (0.720 - 10.723)	0	0
Unidentified seal	4.330 (0.865 - 21.665)	25.682 (7.573 - 87.096)	7.495 (0.982 - 57.151)	13.916 (3.232 - 59.925)
Total seal density	**36.752 (14.092 - 95.853)**	**59.847 (29.873 - 119.893)**	**22.484 (5.949 - 54.985)**	**41.751 (9.088 - 191.794)**
Pacific walrus	**16.856 (5.457 - 52.079)**	**66.643 (18.114 - 245.173)**	**25.527 (7.462 - 87.321)**	**4.064 (1.269 - 13.012)**

TABLE J.5.13E. Estimated areas (mi^2) ensonified to various sound levels during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Maximum area ensonified is shown with overlapping areas counted multiple times; total area ensonified is shown with overlapping areas counted only once.

	Level of ensonification in dB re1µPa (rms)				
Area (mi^2)	**120**	**160**	**170**	**180**	**190**
Jul-Aug					
Including Overlap Area	156,107	1678	429	117	33
Excluding Overlap Area	4457	263	153	84	29
Sep-Oct					
Including Overlap Area	152,346	1402	353	97	28
Excluding Overlap Area	5212	300	157	73	25
2009 Survey Totals					
Including Overlap Area	308,452	3080	781	214	61
Excluding Overlap Area*	5757	436	262	146	53

* 2009 Survey Totals Exluding Overlap are less than the sum of seasonal period non-overlap areas because many of the same areas were ensonified during both periods.

APPENDIX K: ALL VESSEL-BASED MARINE MAMMAL DETECTIONS

Table K.1. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (m) [c]	CPA (m) [d]	Behavior [e]	Bf [f]	Water Depth (m)	Vessel Activity [g]	Airgun Volume (in^3)
34	Gray whale	1	30/07/2009 18:47:47	-167.777	69.6155	150	244	SW	6	48	OT	X
35	Unidentified seal	1	31/07/2009 09:45:08	-164.19	71.1083	506	591	SW	3	44	OT	X
36	Ringed seal	1	31/07/2009 10:22:56	-163.812	71.1457	50	136	SW	2	43	OT	X
37	Ringed seal	2	31/07/2009 10:28:25	-163.757	71.1506	454	539	SW	2	44	OT	X
38	Unid. Mstc. Whale	1	31/07/2009 15:54:12	-162.858	71.2131	3130	3131	SW	1	44	OT	X
39	Unidentified seal	1	31/07/2009 20:27:08	-163.795	71.0471	657	753	SW	2	43	OT	X
40	Unidentified seal	1	31/07/2009 20:27:12	-163.796	71.0471	936	1020	SW	2	43	OT	X
41	Ringed seal	1	31/07/2009 22:16:35	-164.785	71.0375	347	440	SW	2	39	OT	X
42	Unidentified seal	1	31/07/2009 22:20:35	-164.821	71.0369	400	473	SW	2	38	OT	X
43	Unidentified seal	1	31/07/2009 23:03:34	-165.212	71.0369	100	194	SW	2	43	OT	X
44	Ringed seal	1	31/07/2009 23:39:55	-165.544	71.0414	347	360	LG	1	43	OT	X
45	Unidentified seal	1	01/08/2009 04:08:52	-167.664	71.1444	506	602	LO	1	47	OT	X
46	Spotted seal	1	01/08/2009 05:01:11	-167.897	71.1524	150	246	SW	1	48	OT	X
47	Ringed seal	1	01/08/2009 08:25:07	-168.313	71.1893	165	211	SW	2	50	OT	X
48	Unidentified seal	1	01/08/2009 13:58:50	-168.256	71.1257	657	753	LO	2	51	DP	X
49	Unidentified seal	1	01/08/2009 15:19:07	-168.252	71.1678	772	778	LO	2	50	DP	X
50	Bearded seal	1	03/08/2009 07:08:57	-162.814	71.2308	264	339	LO	5	47	OT	X
51	Bearded seal	1	03/08/2009 19:15:12	-163.947	71.5093	75	158	SW	3	43	OT	X
52	Bearded seal	1	04/08/2009 07:38:58	-163.155	71.3424	50	136	SW	1	46	OT	X
53	Pacific walrus	1	04/08/2009 20:54:54	-163.233	71.3125	400	222	SA	2	47	OT	X
54	Unidentified seal	1	04/08/2009 21:13:36	-163.284	71.3151	100	194	SW	2	47	OT	X
55	Unidentified seal	1	04/08/2009 21:15:19	-163.289	71.3153	200	276	LO	2	47	OT	X
56	Unidentified seal	1	04/08/2009 23:58:04	-163.226	71.3232	347	404	SI	2	47	OT	X
57	Pacific walrus	1	07/08/2009 08:35:38	-163.287	71.2959	154	232	SW	2	47	DP	X
58	Unidentified seal	1	09/08/2009 03:17:00	-163.394	71.2999	50	142	DE	4	46	OT	X
59	Bearded seal	1	09/08/2009 15:17:01	-163.034	71.1819	30	119	SA	3	46	OT	X
60	Unidentified seal	1	10/08/2009 00:55:17	-163.297	71.2013	100	196	DI	3	47	OT	X
61	Bearded seal	1	10/08/2009 04:59:04	-163.262	71.1656	165	243	DI	1	46	OT	X
62	Unidentified seal	1	10/08/2009 06:33:59	-163.282	71.1672	150	238	SW	2	46	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (m) [c]	CPA (m) [d]	Behavior [e]	Bf [f]	Water Depth (m)	Vessel Activity [g]	Airgun Volume (in^3)
63	Unidentified pinniped	1	10/08/2009 06:49:21	-163.223	71.1655	150	238	SW	2	46	OT	X
64	Ringed seal	1	10/08/2009 08:56:20	-163.342	71.157	200	262	DI	2	46	OT	X
65	Ringed seal	2	10/08/2009 11:05:40	-163.641	71.0907	506	602	SW	1	46	OT	X
66	Ringed seal	1	10/08/2009 11:14:40	-163.691	71.09	506	539	SW	1	46	OT	X
67	Ringed seal	1	10/08/2009 11:21:47	-163.734	71.0897	936	1029	SW	1	46	OT	X
68	Ringed seal	1	10/08/2009 11:45:01	-163.875	71.0913	572	626	SW	0	44	OT	X
69	Unidentified seal	1	10/08/2009 12:08:00	-164.016	71.0843	200	262	SW	1	43	OT	X
70	Unidentified seal	1	10/08/2009 12:31:45	-164.163	71.0621	236	332	DI	1	44	OT	X
71	Bearded seal	1	10/08/2009 14:40:04	-165.038	71.0682	150	244	SW	2	44	OT	X
72	Unknown	1	11/08/2009 22:54:10	-166.629	71.1664	100	194	SW	3	46	SH	10
73	Harbor porpoise	2	12/08/2009 07:19:32	-166.666	71.1338	347	443	PO	3	46	RU	20
74	Pacific walrus	1	12/08/2009 11:28:15	-166.535	71.1275	1637	98	DE	3	46	LS	40
75	Unidentified seal	1	13/08/2009 10:49:10	-164.175	71.112	772	824	LO	2	44	OT	X
76	Unidentified pinniped	1	13/08/2009 12:46:50	-163.534	71.2401	2649	2742	SW	3	46	OT	X
77	Bearded seal	1	13/08/2009 18:27:35	-163.014	71.2045	412	178	SW	1	47	LS	40
78	Unidentified pinniped	1	13/08/2009 18:56:20	-162.97	71.2125	1190	1283	SW	2	46	RU	20
79	Unidentified seal	1	13/08/2009 19:04:10	-162.991	71.2145	347	300	SW	1	47	SH	40
80	Ringed seal	1	13/08/2009 19:54:30	-163.132	71.2163	936	868	SW	1	47	LS	40
81	Bearded seal	1	16/08/2009 06:00:10	-164.352	71.0523	75	150	LO	2	44	OT	X
82	Ringed seal	1	16/08/2009 08:43:24	-163.393	71.0979	50	126	SW	2	46	OT	X
83	Unidentified seal	1	19/08/2009 17:27:30	-162.267	71.1321	100	178	SW	5	47	OT	X
84	Unidentified pinniped	1	19/08/2009 20:22:11	-162.331	71.1369	350	428	DE	5	47	OT	X
85	Unidentified seal	1	20/08/2009 00:21:16	-161.447	70.9474	150	214	SW	4	47	OT	X
86	Unid. Mstc. Whale	1	20/08/2009 04:36:40	-160.392	70.7564	1190	1260	BL	3	47	OT	X
87	Unid. Mstc. Whale	1	20/08/2009 04:36:40	-160.392	70.7564	657	662	BL	3	47	OT	X
88	Harbor porpoise	6	20/08/2009 08:35:04	-160.215	70.6323	936	994	PO	3	20	IA	X
89	Bearded seal	1	20/08/2009 14:38:25	-160.216	70.6321	213	98	LO	3	19	IA	X
91	Unid. Mstc. Whale	1	20/08/2009 15:58:59	-160.279	70.6553	3918	3995	BL	2	21	OT	X
90	Unid. Mstc. Whale	1	20/08/2009 15:58:59	-160.279	70.6553	936	1006	SW	2	21	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (m) [c]	CPA (m) [d]	Behavior [e]	Bf [f]	Water Depth (m)	Vessel Activity [g]	Airgun Volume (in^3)
92	Pacific walrus	3	20/08/2009 16:07:55	-160.296	70.6661	572	408	SW	2	24	OT	X
93	Pacific walrus	1	20/08/2009 16:15:49	-160.285	70.6743	600	678	SW	2	24	OT	X
94	Bearded seal	1	20/08/2009 16:23:22	-160.274	70.6809	936	1006	SW	2	24	OT	X
95	Pacific walrus	2	20/08/2009 16:29:50	-160.265	70.6863	936	1006	SW	2	24	OT	X
96	Pacific walrus	1	20/08/2009 16:43:51	-160.24	70.6971	936	481	LG	2	24	OT	X
97	Bearded seal	1	20/08/2009 16:50:45	-160.241	70.7024	264	336	SW	2	23	OT	X
98	Pacific walrus	1	20/08/2009 17:17:17	-160.342	70.7267	657	700	SW	2	37	OT	X
99	Pacific walrus	3	20/08/2009 17:34:15	-160.445	70.7437	1637	1678	SW	2	47	OT	X
100	Bowhead whale	2	20/08/2009 17:36:20	-160.458	70.7461	1637	1639	BL	2	48	OT	X
101	Gray whale	1	20/08/2009 17:48:23	-160.533	70.7607	2649	2719	BL	2	44	OT	X
102	Unid. Mstc. Whale	4	20/08/2009 18:12:10	-160.682	70.792	3918	3939	BL	3	47	OT	X
103	Unid. Mstc. Whale	2	20/08/2009 18:34:20	-160.82	70.8252	1637	1707	SW	3	51	OT	X
104	Unid. Mstc. Whale	2	20/08/2009 18:36:53	-160.835	70.8292	2649	2719	BL	3	50	OT	X
105	Gray whale	1	20/08/2009 18:43:50	-160.878	70.8399	657	315	SW	3	52	OT	X
106	Pacific walrus	3	20/08/2009 19:13:52	-161.083	70.8735	213	285	SW	3	49	OT	X
107	Pacific walrus	3	20/08/2009 19:41:17	-161.268	70.9059	1637	1013	SW	3	46	OT	X
108	Unid. Mstc. Whale	1	20/08/2009 20:16:29	-161.498	70.9573	936	960	BL	3	48	OT	X
109	Unidentified pinniped	1	20/08/2009 20:24:25	-161.549	70.9693	50	126	U	3	46	OT	X
110	Unidentified pinniped	1	21/08/2009 14:37:00	-163.585	71.3636	657	727	DE	5	45	ST	40
111	Bearded seal	1	22/08/2009 08:58:25	-163.347	71.3074	412	457	DI	1	46	LS	40
112	Unidentified seal	1	22/08/2009 11:21:02	-163.379	71.3128	506	584	LO	1	47	LS	40
113	Unidentified pinniped	1	22/08/2009 15:04:12	-163.279	71.364	500	471	DE	3	45	LS	40
114	Bearded seal	1	23/08/2009 12:27:15	-163.167	71.323	347	393	SW	1	47	SH	10
115	Unidentified pinniped	1	23/08/2009 17:25:47	-163.374	71.3228	1190	512	SW	1	47	LS	40
116	Pacific walrus	1	23/08/2009 18:43:05	-163.175	71.3186	1637	1678	SW	1	47	LS	40
117	Pacific walrus	1	23/08/2009 22:42:14	-163.549	71.294	936	830	SW	3	45	SH	10
118	Pacific walrus	1	24/08/2009 22:34:00	-163.275	71.2912	50	78	DI	3	46	LS	40
119	Pacific walrus	2	25/08/2009 09:19:20	-163.284	71.3249	506	427	SW	3	46	LS	40
120	Ringed seal	1	25/08/2009 10:27:30	-163.327	71.2848	264	285	SW	2	46	SH	40

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (m) [c]	CPA (m) [d]	Behavior [e]	Bf [f]	Water Depth (m)	Vessel Activity [g]	Airgun Volume (in^3)
121	Unidentified seal	1	25/08/2009 22:58:00	-163.397	71.3527	936	393	SW	3	46	SH	10
122	Pacific walrus	1	27/08/2009 08:03:56	-163.135	71.341	347	312	SW	3	47	SH	10
123	Pacific walrus	1	27/08/2009 10:05:12	-163.457	71.3405	936	842	SW	2	46	LS	40
124	Ringed seal	1	27/08/2009 10:34:29	-163.539	71.3421	264	276	SW	2	45	OT	X
125	Pacific walrus	1	27/08/2009 10:47:30	-163.565	71.342	936	919	SW	2	45	OT	X
126	Pacific walrus	1	27/08/2009 10:51:25	-163.573	71.3418	936	978	SW	2	46	OT	X
127	Pacific walrus	1	27/08/2009 11:16:10	-163.587	71.3292	506	577	SW	1	46	RC	X
128	Pacific walrus	1	27/08/2009 12:05:30	-163.509	71.2977	412	440	SW	1	45	OT	X
129	Pacific walrus	1	27/08/2009 13:31:14	-163.217	71.2916	412	483	SW	3	47	OT	X
130	Pacific walrus	2	27/08/2009 14:12:45	-163.228	71.3	936	1006	SW	2	47	OT	X
131	Pacific walrus	1	27/08/2009 14:38:26	-163.168	71.2949	1637	1717	SW	3	46	OT	X
132	Pacific walrus	2	27/08/2009 16:46:35	-163.495	71.3099	347	367	SW	3	46	OT	X
133	Pacific walrus	2	27/08/2009 17:46:17	-163.285	71.3056	1637	420	SA	3	46	OT	X
134	Pacific walrus	1	27/08/2009 18:28:16	-163.145	71.3	1637	1717	SW	3	47	OT	X
135	Pacific walrus	4	27/08/2009 18:41:56	-163.187	71.299	1637	662	SA	3	47	OT	X
136	Pacific walrus	3	27/08/2009 19:01:05	-163.257	71.3005	1190	584	SW	3	47	OT	X
137	Pacific walrus	7	27/08/2009 19:11:12	-163.293	71.3012	1637	578	LO	2	46	OT	X
138	Ringed seal	1	27/08/2009 19:39:12	-163.381	71.3031	100	178	SW	1	46	OT	X
139	Pacific walrus	2	27/08/2009 19:43:31	-163.396	71.3035	936	700	SW	1	46	OT	X
140	Unidentified seal	1	27/08/2009 20:43:11	-163.486	71.3108	249	311	SW	2	46	OT	X
141	Pacific walrus	2	27/08/2009 20:50:15	-163.459	71.3098	100	180	SW	2	46	OT	X
142	Unidentified seal	1	27/08/2009 21:24:30	-163.326	71.3074	150	202	SA	2	46	OT	X
143	Pacific walrus	5	27/08/2009 21:25:14	-163.323	71.3074	500	445	SW	2	46	OT	X
144	Bearded seal	1	27/08/2009 21:27:40	-163.314	71.3072	50	130	SW	2	46	OT	X
145	Pacific walrus	4	27/08/2009 21:38:10	-163.274	71.3063	800	644	SW	2	47	OT	X
146	Bearded seal	1	27/08/2009 22:08:45	-163.171	71.3037	506	577	SW	1	47	OT	X
147	Unidentified seal	1	27/08/2009 22:17:38	-163.152	71.3073	250	322	SA	1	47	OT	X
148	Pacific walrus	2	27/08/2009 22:22:10	-163.167	71.3084	800	396	SA	1	47	OT	X
149	Pacific walrus	2	28/08/2009 06:36:07	-163.184	71.3126	300	347	SW	2	47	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (m) [c]	CPA (m) [d]	Behavior [e]	Bf [f]	Water Depth (m)	Vessel Activity [g]	Airgun Volume (in^3)
150	Pacific walrus	2	28/08/2009 07:23:20	-163.237	71.3009	506	586	SW	2	47	OT	X
151	Pacific walrus	1	28/08/2009 08:19:30	-163.442	71.3052	347	427	SW	3	46	OT	X
152	Pacific walrus	1	28/08/2009 10:10:50	-163.259	71.307	506	512	SW	2	46	OT	X
153	Pacific walrus	1	28/08/2009 10:29:35	-163.186	71.3054	936	650	SW	2	47	OT	X
154	Pacific walrus	1	28/08/2009 10:56:18	-163.195	71.301	1190	584	SW	3	47	OT	X
155	Bearded seal	1	28/08/2009 12:14:50	-163.492	71.3071	264	326	SW	2	46	OT	X
156	Pacific walrus	2	28/08/2009 13:22:24	-163.335	71.3094	347	376	SW	2	46	OT	X
157	Pacific walrus	2	28/08/2009 14:55:15	-163.323	71.3135	936	420	LO	3	46	OT	X
158	Pacific walrus	1	28/08/2009 15:19:20	-163.416	71.3155	506	584	SW	3	46	OT	X
159	Pacific walrus	3	28/08/2009 15:32:19	-163.457	71.3163	772	577	SW	3	46	OT	X
160	Pacific walrus	1	28/08/2009 17:38:10	-163.179	71.3151	500	465	SA	3	47	OT	X
161	Pacific walrus	1	28/08/2009 18:26:05	-163.278	71.3116	412	472	SW	2	46	OT	X
162	Pacific walrus	1	28/08/2009 21:29:47	-163.156	71.3191	300	371	SA	3	47	OT	X
163	Pacific walrus	2	28/08/2009 21:37:27	-163.183	71.3197	657	483	SA	3	47	OT	X
164	Pacific walrus	2	29/08/2009 14:01:39	-163.409	71.3316	100	180	SW	6	47	OT	X
165	Bearded seal	1	29/08/2009 16:56:29	-163.415	71.337	85	164	SW	6	47	OT	X
166	Ringed seal	1	29/08/2009 17:09:49	-163.464	71.338	50	130	LO	6	46	OT	X
167	Pacific walrus	4	29/08/2009 20:47:08	-163.432	71.3365	200	280	SW	5	47	OT	X
168	Unidentified pinniped	1	29/08/2009 21:08:57	-163.509	71.338	700	780	SW	5	46	OT	X
169	Ringed seal	1	29/08/2009 22:05:10	-163.368	71.3317	80	160	LO	5	47	OT	X
170	Pacific walrus	1	30/08/2009 08:21:21	-163.458	71.3082	350	410	SW	1	46	OT	X
171	Pacific walrus	3	30/08/2009 09:34:55	-163.417	71.3236	350	410	SW	4	47	OT	X
172	Ringed seal	1	30/08/2009 10:41:15	-163.408	71.3208	506	196	SW	2	47	OT	X
173	Pacific walrus	3	30/08/2009 10:59:38	-163.417	71.3364	936	727	SW	2	47	OT	X
174	Unidentified seal	1	30/08/2009 11:52:03	-163.5	71.3391	506	577	SW	2	45	OT	X
175	Unidentified seal	1	30/08/2009 12:08:51	-163.527	71.3216	657	700	LO	2	46	OT	X
176	Pacific walrus	1	30/08/2009 15:16:00	-163.248	71.2451	236	308	LG	5	46	OT	X
177	Pacific walrus	2	30/08/2009 19:48:30	-161.329	70.8646	60	140	SW	7	49	OT	X
178	Pacific walrus	2	30/08/2009 20:06:20	-161.185	70.8448	150	230	SW	7	48	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (m) [c]	CPA (m) [d]	Behavior [e]	Bf [f]	Water Depth (m)	Vessel Activity [g]	Airgun Volume (in^3)
179	Pacific walrus	2	31/08/2009 10:51:20	-160.229	70.6533	936	1016	LO	6	22	OT	X
180	Pacific walrus	3	31/08/2009 11:20:30	-160.308	70.6295	400	478	SW	6	21	OT	X
181	Pacific walrus	1	31/08/2009 11:52:10	-160.401	70.6039	1190	1270	DI	6	22	OT	X
182	Pacific walrus	2	31/08/2009 14:02:35	-160.748	70.5032	1637	1678	SW	4	21	OT	X
183	Unid. Mstc. Whale	1	31/08/2009 14:21:41	-160.793	70.4915	2649	2690	BL	4	20	OT	X
184	Pacific walrus	3	31/08/2009 14:49:15	-160.864	70.4745	1637	1707	SW	4	20	OT	X
185	Pacific walrus	1	02/09/2009 10:57:10	-160.999	70.4537	1637	1695	LO	2	20	OT	X
186	Harbor porpoise	2	02/09/2009 14:08:55	-162.317	70.5443	500	578	PO	3	37	OT	X
187	Unid. Mstc. Whale	1	02/09/2009 19:22:56	-164.853	70.2534	3918	506	DE	3	43	OT	X
193	Unid. Toothed Whale	1	06/09/2009 17:55:30	-165.506	70.0183	10	89	SW	3	42	OT	X
194	Unid. Mstc. Whale	1	06/09/2009 20:07:00	-165.078	70.2547	657	727	BL	3	44	OT	X
195	Unidentified pinniped	3	07/09/2009 11:32:35	-162.979	71.2476	15	93	DI	2	43	SH	10
196	Pacific walrus	1	07/09/2009 11:53:00	-162.983	71.2471	25	102	LO	2	42	RU	20
197	Spotted seal	1	09/09/2009 14:39:31	-159.817	70.8555	200	272	SW	6	43	OT	X
198	Unidentified seal	1	09/09/2009 19:55:00	-160.595	70.6958	40	112	DI	3	43	OT	X
199	Ringed seal	1	10/09/2009 15:23:58	-163.094	71.2344	179	94	LO	1	47	SH	40
200	Ringed seal	1	10/09/2009 15:52:35	-163.098	71.2091	154	206	SW	1	47	SH	10
201	Ringed seal	1	10/09/2009 19:43:30	-163.037	71.1953	179	211	SW	1	46	SH	40
202	Pacific walrus	2	11/09/2009 09:30:00	-163.211	71.1988	347	393	LO	2	46	SH	40
203	Pacific walrus	1	11/09/2009 09:54:08	-163.213	71.1876	195	262	DI	1	46	SH	10
204	Unidentified seal	1	12/09/2009 11:16:00	-167.377	71.1794	377	437	DE	2	47	OT	X
205	Unidentified seal	1	12/09/2009 12:28:30	-167.607	71.1539	154	166	SW	2	48	OT	X
206	Ringed seal	1	13/09/2009 15:28:55	-168.319	71.098	100	174	SW	2	52	SH	40
207	Pacific walrus	1	13/09/2009 22:35:30	-168.313	71.122	250	87	LO	1	51	LS	40
208	Unidentified seal	1	16/09/2009 07:05:43	-162.91	71.1897	30	103	DI	1	44	SH	40
209	Pacific walrus	1	17/09/2009 12:45:57	-167.517	68.3663	25	104	SW	X	43	OT	X
227	Pacific walrus	2	25/09/2009 17:17:49	-168.39	68.6124	50	130	SW	5	52	OT	X
228	Unidentified pinniped	1	27/09/2009 19:45:00	-163.57	71.228	300	310	SW	2	45	RC	X
229	Unidentified seal	1	28/09/2009 10:07:50	-163.491	71.2708	249	329	SW	1	45	LS	40

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (m) [c]	CPA (m) [d]	Behavior [e]	Bf [f]	Water Depth (m)	Vessel Activity [g]	Airgun Volume (in^3)
231	Ringed seal	1	28/09/2009 14:49:25	-163.494	71.2836	300	361	LO	1	45	OT	X
232	Unidentified seal	1	28/09/2009 15:10:30	-163.533	71.2641	412	460	SW	1	45	OT	X
233	Ringed seal	1	28/09/2009 15:23:03	-163.555	71.2528	377	455	SW	1	45	OT	X
234	Ringed seal	1	28/09/2009 15:29:32	-163.568	71.2473	40	112	SI	1	45	OT	X
235	Ringed seal	1	28/09/2009 15:41:05	-163.565	71.2559	454	275	SW	1	44	OT	X
236	Ringed seal	1	28/09/2009 15:54:12	-163.541	71.2683	179	251	SW	1	44	OT	X
237	Unidentified seal	1	28/09/2009 16:38:06	-163.48	71.2893	179	251	SW	1	45	OT	X
238	Unidentified seal	1	28/09/2009 18:03:57	-163.512	71.2813	506	584	SW	1	45	OT	X
239	Ringed seal	1	28/09/2009 18:19:53	-163.48	71.2961	264	295	LO	1	45	OT	X
240	Ringed seal	1	28/09/2009 18:39:35	-163.5	71.2776	264	295	SW	1	45	OT	X
241	Ringed seal	1	28/09/2009 18:43:41	-163.507	71.2736	165	216	LO	1	45	OT	X
242	Ringed seal	1	28/09/2009 18:58:05	-163.535	71.2594	150	214	SW	1	45	OT	X
243	Ringed seal	1	28/09/2009 19:46:08	-163.524	71.2736	20	100	DI	1	45	OT	X
244	Ringed seal	1	28/09/2009 20:40:39	-163.511	71.2702	50	89	SW	1	45	OT	X
245	Unidentified seal	1	29/09/2009 10:35:50	-163.156	71.2498	264	336	LO	2	46	OT	X
246	Unidentified seal	1	29/09/2009 15:58:30	-165.837	71.2746	347	425	SW	1	395	OT	X

[a] Sighting ID = Sequential number given to sighting by MMOs, 1 - 33 and subsequent number gaps were observed during transit (e.g. Bering Sea)

[b] No. = Number of individual marine mammal(s)

[c] Initial Sighting Distance (m) = distance of marine mammal(s) from the MMOs when initially detected

[d] CPA (m) = Closest Point of Approach of the marine mammal(s) to the airgun array

[e] Behavior = Initial behavior observed by MMOs, codes: BL = Blow (cetacean surfacing), DE - Dead, DI = Dive, LG = Log (rest motionless at water surface), LO = Look, PO = Porpoise (repeated swimming and diving near water surface), SA = Surface active (splashing, rolling,etc., often social in nature), SI = Sink (pinnipeds, as opposed to Dive), SW = Swim, U = Unknown

[f] Bf = Beaufort Wind Force, See Appendix F for definitions

g Vessel Activity = Vessel activity at the time of initial detection, codes: DP = Deploying Survey Gear, IA = Idle (at anchor), LS = Survey Line Shooting, OT = Other (e.g., transit), RC = Recovering Survey Gear, RU = Ramp Up / Power Up of Airgun Array, ST = Seismic Testing of Airgun Array

English Units Table

Table K.1E. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (yd) [c]	CPA (yd) [d]	Behavior [e]	Bf [f]	Water Depth (yd)	Vessel Activity [g]	Airgun Volume (in^3)
34	Gray whale	1	30/07/2009 18:47:47	-167.777	69.6155	164	267	SW	6	53	OT	X
35	Unidentified seal	1	31/07/2009 09:45:08	-164.19	71.1083	553	646	SW	3	48	OT	X
36	Ringed seal	1	31/07/2009 10:22:56	-163.812	71.1457	55	149	SW	2	47	OT	X
37	Ringed seal	2	31/07/2009 10:28:25	-163.757	71.1506	497	589	SW	2	49	OT	X
38	Unid. Mstc. Whale	1	31/07/2009 15:54:12	-162.858	71.2131	3423	3424	SW	1	49	OT	X
39	Unidentified seal	1	31/07/2009 20:27:08	-163.795	71.0471	719	823	SW	2	47	OT	X
40	Unidentified seal	1	31/07/2009 20:27:12	-163.796	71.0471	1024	1115	SW	2	47	OT	X
41	Ringed seal	1	31/07/2009 22:16:35	-164.785	71.0375	379	481	SW	2	43	OT	X
42	Unidentified seal	1	31/07/2009 22:20:35	-164.821	71.0369	437	517	SW	2	41	OT	X
43	Unidentified seal	1	31/07/2009 23:03:34	-165.212	71.0369	109	212	SW	2	47	OT	X
44	Ringed seal	1	31/07/2009 23:39:55	-165.544	71.0414	379	394	LG	1	47	OT	X
45	Unidentified seal	1	01/08/2009 04:08:52	-167.664	71.1444	553	658	LO	1	51	OT	X
46	Spotted seal	1	01/08/2009 05:01:11	-167.897	71.1524	164	269	SW	1	52	OT	X
47	Ringed seal	1	01/08/2009 08:25:07	-168.313	71.1893	180	231	SW	2	54	OT	X
48	Unidentified seal	1	01/08/2009 13:58:50	-168.256	71.1257	719	823	LO	2	56	DP	X
49	Unidentified seal	1	01/08/2009 15:19:07	-168.252	71.1678	844	851	LO	2	54	DP	X
50	Bearded seal	1	03/08/2009 07:08:57	-162.814	71.2308	289	371	LO	5	51	OT	X
51	Bearded seal	1	03/08/2009 19:15:12	-163.947	71.5093	82	173	SW	3	47	OT	X
52	Bearded seal	1	04/08/2009 07:38:58	-163.155	71.3424	55	149	SW	1	51	OT	X
53	Pacific walrus	1	04/08/2009 20:54:54	-163.233	71.3125	437	243	SA	2	52	OT	X
54	Unidentified seal	1	04/08/2009 21:13:36	-163.284	71.3151	109	212	SW	2	51	OT	X
55	Unidentified seal	1	04/08/2009 21:15:19	-163.289	71.3153	219	302	LO	2	51	OT	X
56	Unidentified seal	1	04/08/2009 23:58:04	-163.226	71.3232	379	442	SI	2	52	OT	X
57	Pacific walrus	1	07/08/2009 08:35:38	-163.287	71.2959	168	254	SW	2	51	DP	X
58	Unidentified seal	1	09/08/2009 03:17:00	-163.394	71.2999	55	155	DE	4	50	OT	X
59	Bearded seal	1	09/08/2009 15:17:01	-163.034	71.1819	33	130	SA	3	51	OT	X
60	Unidentified seal	1	10/08/2009 00:55:17	-163.297	71.2013	109	214	DI	3	51	OT	X
61	Bearded seal	1	10/08/2009 04:59:04	-163.262	71.1656	180	266	DI	1	51	OT	X
62	Unidentified seal	1	10/08/2009 06:33:59	-163.282	71.1672	164	260	SW	2	51	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (yd) [c]	CPA (yd) [d]	Behavior [e]	Bf [f]	Water Depth (yd)	Vessel Activity [g]	Airgun Volume (in^3)
63	Unidentified pinniped	1	10/08/2009 06:49:21	-163.223	71.1655	164	260	SW	2	51	OT	X
64	Ringed seal	1	10/08/2009 08:56:20	-163.342	71.157	219	287	DI	2	50	OT	X
65	Ringed seal	2	10/08/2009 11:05:40	-163.641	71.0907	553	658	SW	1	50	OT	X
66	Ringed seal	1	10/08/2009 11:14:40	-163.691	71.09	553	589	SW	1	51	OT	X
67	Ringed seal	1	10/08/2009 11:21:47	-163.734	71.0897	1024	1125	SW	1	50	OT	X
68	Ringed seal	1	10/08/2009 11:45:01	-163.875	71.0913	626	685	SW	0	48	OT	X
69	Unidentified seal	1	10/08/2009 12:08:00	-164.016	71.0843	219	287	SW	1	47	OT	X
70	Unidentified seal	1	10/08/2009 12:31:45	-164.163	71.0621	258	363	DI	1	48	OT	X
71	Bearded seal	1	10/08/2009 14:40:04	-165.038	71.0682	164	267	SW	2	48	OT	X
72	Unknown	1	11/08/2009 22:54:10	-166.629	71.1664	109	212	SW	3	51	SH	10
73	Harbor porpoise	2	12/08/2009 07:19:32	-166.666	71.1338	379	484	PO	3	50	RU	20
74	Pacific walrus	1	12/08/2009 11:28:15	-166.535	71.1275	1790	107	DE	3	50	LS	40
75	Unidentified seal	1	13/08/2009 10:49:10	-164.175	71.112	844	901	LO	2	48	OT	X
76	Unidentified pinniped	1	13/08/2009 12:46:50	-163.534	71.2401	2897	2999	SW	3	50	OT	X
77	Bearded seal	1	13/08/2009 18:27:35	-163.014	71.2045	451	195	SW	1	51	LS	40
78	Unidentified pinniped	1	13/08/2009 18:56:20	-162.97	71.2125	1301	1403	SW	2	51	RU	20
79	Unidentified seal	1	13/08/2009 19:04:10	-162.991	71.2145	379	328	SW	1	51	SH	40
80	Ringed seal	1	13/08/2009 19:54:30	-163.132	71.2163	1024	949	SW	1	51	LS	40
81	Bearded seal	1	16/08/2009 06:00:10	-164.352	71.0523	82	164	LO	2	48	OT	X
82	Ringed seal	1	16/08/2009 08:43:24	-163.393	71.0979	55	138	SW	2	51	OT	X
83	Unidentified seal	1	19/08/2009 17:27:30	-162.267	71.1321	109	195	SW	5	52	OT	X
84	Unidentified pinniped	1	19/08/2009 20:22:11	-162.331	71.1369	383	468	DE	5	51	OT	X
85	Unidentified seal	1	20/08/2009 00:21:16	-161.447	70.9474	164	234	SW	4	51	OT	X
86	Unid. Mstc. Whale	1	20/08/2009 04:36:40	-160.392	70.7564	1301	1378	BL	3	51	OT	X
87	Unid. Mstc. Whale	1	20/08/2009 04:36:40	-160.392	70.7564	719	724	BL	3	51	OT	X
88	Harbor porpoise	6	20/08/2009 08:35:04	-160.215	70.6323	1024	1087	PO	3	21	IA	X
89	Bearded seal	1	20/08/2009 14:38:25	-160.216	70.6321	233	107	LO	3	21	IA	X
91	Unid. Mstc. Whale	1	20/08/2009 15:58:59	-160.279	70.6553	4285	4369	BL	2	23	OT	X
90	Unid. Mstc. Whale	1	20/08/2009 15:58:59	-160.279	70.6553	1024	1100	SW	2	23	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (yd) [c]	CPA (yd) [d]	Behavior [e]	Bf [f]	Water Depth (yd)	Vessel Activity [g]	Airgun Volume (in^3)
92	Pacific walrus	3	20/08/2009 16:07:55	-160.296	70.6661	626	446	SW	2	26	OT	X
93	Pacific walrus	1	20/08/2009 16:15:49	-160.285	70.6743	656	741	SW	2	26	OT	X
94	Bearded seal	1	20/08/2009 16:23:22	-160.274	70.6809	1024	1100	SW	2	26	OT	X
95	Pacific walrus	2	20/08/2009 16:29:50	-160.265	70.6863	1024	1100	SW	2	27	OT	X
96	Pacific walrus	1	20/08/2009 16:43:51	-160.24	70.6971	1024	526	LG	2	27	OT	X
97	Bearded seal	1	20/08/2009 16:50:45	-160.241	70.7024	289	367	SW	2	25	OT	X
98	Pacific walrus	1	20/08/2009 17:17:17	-160.342	70.7267	719	766	SW	2	40	OT	X
99	Pacific walrus	3	20/08/2009 17:34:15	-160.445	70.7437	1790	1835	SW	2	51	OT	X
100	Bowhead whale	2	20/08/2009 17:36:20	-160.458	70.7461	1790	1792	BL	2	52	OT	X
101	Gray whale	1	20/08/2009 17:48:23	-160.533	70.7607	2897	2974	BL	2	49	OT	X
102	Unid. Mstc. Whale	4	20/08/2009 18:12:10	-160.682	70.792	4285	4308	BL	3	51	OT	X
103	Unid. Mstc. Whale	2	20/08/2009 18:34:20	-160.82	70.8252	1790	1867	SW	3	55	OT	X
104	Unid. Mstc. Whale	2	20/08/2009 18:36:53	-160.835	70.8292	2897	2974	BL	3	54	OT	X
105	Gray whale	1	20/08/2009 18:43:50	-160.878	70.8399	719	344	SW	3	56	OT	X
106	Pacific walrus	3	20/08/2009 19:13:52	-161.083	70.8735	233	312	SW	3	53	OT	X
107	Pacific walrus	3	20/08/2009 19:41:17	-161.268	70.9059	1790	1108	SW	3	50	OT	X
108	Unid. Mstc. Whale	1	20/08/2009 20:16:29	-161.498	70.9573	1024	1050	BL	3	53	OT	X
109	Unidentified pinniped	1	20/08/2009 20:24:25	-161.549	70.9693	55	138	U	3	51	OT	X
110	Unidentified pinniped	1	21/08/2009 14:37:00	-163.585	71.3636	719	795	DE	5	50	ST	40
111	Bearded seal	1	22/08/2009 08:58:25	-163.347	71.3074	451	500	DI	1	50	LS	40
112	Unidentified seal	1	22/08/2009 11:21:02	-163.379	71.3128	553	639	LO	1	51	LS	40
113	Unidentified pinniped	1	22/08/2009 15:04:12	-163.279	71.364	547	515	DE	3	49	LS	40
114	Bearded seal	1	23/08/2009 12:27:15	-163.167	71.323	379	430	SW	1	51	SH	10
115	Unidentified pinniped	1	23/08/2009 17:25:47	-163.374	71.3228	1301	560	SW	1	51	LS	40
116	Pacific walrus	1	23/08/2009 18:43:05	-163.175	71.3186	1790	1835	SW	1	51	LS	40
117	Pacific walrus	1	23/08/2009 22:42:14	-163.549	71.294	1024	908	SW	3	49	SH	10
118	Pacific walrus	1	24/08/2009 22:34:00	-163.275	71.2912	55	85	DI	3	51	LS	40
119	Pacific walrus	2	25/08/2009 09:19:20	-163.284	71.3249	553	467	SW	3	50	LS	40
120	Ringed seal	1	25/08/2009 10:27:30	-163.327	71.2848	289	312	SW	2	51	SH	40

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (yd) [c]	CPA (yd) [d]	Behavior [e]	Bf [f]	Water Depth (yd)	Vessel Activity [g]	Airgun Volume (in^3)
121	Unidentified seal	1	25/08/2009 22:58:00	-163.397	71.3527	1024	430	SW	3	50	SH	10
122	Pacific walrus	1	27/08/2009 08:03:56	-163.135	71.341	379	341	SW	3	52	SH	10
123	Pacific walrus	1	27/08/2009 10:05:12	-163.457	71.3405	1024	921	SW	2	50	LS	40
124	Ringed seal	1	27/08/2009 10:34:29	-163.539	71.3421	289	302	SW	2	49	OT	X
125	Pacific walrus	1	27/08/2009 10:47:30	-163.565	71.342	1024	1005	SW	2	49	OT	X
126	Pacific walrus	1	27/08/2009 10:51:25	-163.573	71.3418	1024	1070	SW	2	50	OT	X
127	Pacific walrus	1	27/08/2009 11:16:10	-163.587	71.3292	553	631	SW	1	50	RC	X
128	Pacific walrus	1	27/08/2009 12:05:30	-163.509	71.2977	451	481	SW	1	50	OT	X
129	Pacific walrus	1	27/08/2009 13:31:14	-163.217	71.2916	451	528	SW	3	51	OT	X
130	Pacific walrus	2	27/08/2009 14:12:45	-163.228	71.3	1024	1100	SW	2	51	OT	X
131	Pacific walrus	1	27/08/2009 14:38:26	-163.168	71.2949	1790	1878	SW	3	50	OT	X
132	Pacific walrus	2	27/08/2009 16:46:35	-163.495	71.3099	379	401	SW	3	50	OT	X
133	Pacific walrus	2	27/08/2009 17:46:17	-163.285	71.3056	1790	459	SA	3	51	OT	X
134	Pacific walrus	1	27/08/2009 18:28:16	-163.145	71.3	1790	1878	SW	3	52	OT	X
135	Pacific walrus	4	27/08/2009 18:41:56	-163.187	71.299	1790	724	SA	3	51	OT	X
136	Pacific walrus	3	27/08/2009 19:01:05	-163.257	71.3005	1301	639	SW	3	51	OT	X
137	Pacific walrus	7	27/08/2009 19:11:12	-163.293	71.3012	1790	632	LO	2	50	OT	X
138	Ringed seal	1	27/08/2009 19:39:12	-163.381	71.3031	109	195	SW	1	50	OT	X
139	Pacific walrus	2	27/08/2009 19:43:31	-163.396	71.3035	1024	766	SW	1	50	OT	X
140	Unidentified seal	1	27/08/2009 20:43:11	-163.486	71.3108	272	340	SW	2	50	OT	X
141	Pacific walrus	2	27/08/2009 20:50:15	-163.459	71.3098	109	197	SW	2	50	OT	X
142	Unidentified seal	1	27/08/2009 21:24:30	-163.326	71.3074	164	221	SA	2	50	OT	X
143	Pacific walrus	5	27/08/2009 21:25:14	-163.323	71.3074	547	487	SW	2	50	OT	X
144	Bearded seal	1	27/08/2009 21:27:40	-163.314	71.3072	55	142	SW	2	50	OT	X
145	Pacific walrus	4	27/08/2009 21:38:10	-163.274	71.3063	875	704	SW	2	51	OT	X
146	Bearded seal	1	27/08/2009 22:08:45	-163.171	71.3037	553	631	SW	1	52	OT	X
147	Unidentified seal	1	27/08/2009 22:17:38	-163.152	71.3073	273	352	SA	1	52	OT	X
148	Pacific walrus	2	27/08/2009 22:22:10	-163.167	71.3084	875	433	SA	1	52	OT	X
149	Pacific walrus	2	28/08/2009 06:36:07	-163.184	71.3126	328	379	SW	2	52	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (yd) [c]	CPA (yd) [d]	Behavior [e]	Bf [f]	Water Depth (yd)	Vessel Activity [g]	Airgun Volume (in^3)
150	Pacific walrus	2	28/08/2009 07:23:20	-163.237	71.3009	553	641	SW	2	52	OT	X
151	Pacific walrus	1	28/08/2009 08:19:30	-163.442	71.3052	379	467	SW	3	50	OT	X
152	Pacific walrus	1	28/08/2009 10:10:50	-163.259	71.307	553	560	SW	2	51	OT	X
153	Pacific walrus	1	28/08/2009 10:29:35	-163.186	71.3054	1024	711	SW	2	52	OT	X
154	Pacific walrus	1	28/08/2009 10:56:18	-163.195	71.301	1301	639	SW	3	51	OT	X
155	Bearded seal	1	28/08/2009 12:14:50	-163.492	71.3071	289	357	SW	2	51	OT	X
156	Pacific walrus	2	28/08/2009 13:22:24	-163.335	71.3094	379	411	SW	2	50	OT	X
157	Pacific walrus	2	28/08/2009 14:55:15	-163.323	71.3135	1024	459	LO	3	50	OT	X
158	Pacific walrus	1	28/08/2009 15:19:20	-163.416	71.3155	553	639	SW	3	51	OT	X
159	Pacific walrus	3	28/08/2009 15:32:19	-163.457	71.3163	844	631	SW	3	50	OT	X
160	Pacific walrus	1	28/08/2009 17:38:10	-163.179	71.3151	547	509	SA	3	52	OT	X
161	Pacific walrus	1	28/08/2009 18:26:05	-163.278	71.3116	451	516	SW	2	50	OT	X
162	Pacific walrus	1	28/08/2009 21:29:47	-163.156	71.3191	328	406	SA	3	51	OT	X
163	Pacific walrus	2	28/08/2009 21:37:27	-163.183	71.3197	719	528	SA	3	52	OT	X
164	Pacific walrus	2	29/08/2009 14:01:39	-163.409	71.3316	109	197	SW	6	51	OT	X
165	Bearded seal	1	29/08/2009 16:56:29	-163.415	71.337	93	179	SW	6	52	OT	X
166	Ringed seal	1	29/08/2009 17:09:49	-163.464	71.338	55	142	LO	6	50	OT	X
167	Pacific walrus	4	29/08/2009 20:47:08	-163.432	71.3365	219	306	SW	5	51	OT	X
168	Unidentified pinniped	1	29/08/2009 21:08:57	-163.509	71.338	766	853	SW	5	50	OT	X
169	Ringed seal	1	29/08/2009 22:05:10	-163.368	71.3317	87	175	LO	5	51	OT	X
170	Pacific walrus	1	30/08/2009 08:21:21	-163.458	71.3082	383	448	SW	1	50	OT	X
171	Pacific walrus	3	30/08/2009 09:34:55	-163.417	71.3236	383	448	SW	4	51	OT	X
172	Ringed seal	1	30/08/2009 10:41:15	-163.408	71.3208	553	214	SW	2	52	OT	X
173	Pacific walrus	3	30/08/2009 10:59:38	-163.417	71.3364	1024	795	SW	2	51	OT	X
174	Unidentified seal	1	30/08/2009 11:52:03	-163.5	71.3391	553	631	SW	2	50	OT	X
175	Unidentified seal	1	30/08/2009 12:08:51	-163.527	71.3216	719	766	LO	2	50	OT	X
176	Pacific walrus	1	30/08/2009 15:16:00	-163.248	71.2451	258	337	LG	5	50	OT	X
177	Pacific walrus	2	30/08/2009 19:48:30	-161.329	70.8646	66	153	SW	7	53	OT	X
178	Pacific walrus	2	30/08/2009 20:06:20	-161.185	70.8448	164	252	SW	7	52	OT	X

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009. Heading codes are described in footnotes beneath the table.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (yd) [c]	CPA (yd) [d]	Behavior [e]	Bf [f]	Water Depth (yd)	Vessel Activity [g]	Airgun Volume (in^3)
179	Pacific walrus	2	31/08/2009 10:51:20	-160.229	70.6533	1024	1111	LO	6	24	OT	X
180	Pacific walrus	3	31/08/2009 11:20:30	-160.308	70.6295	437	523	SW	6	23	OT	X
181	Pacific walrus	1	31/08/2009 11:52:10	-160.401	70.6039	1301	1389	DI	6	24	OT	X
182	Pacific walrus	2	31/08/2009 14:02:35	-160.748	70.5032	1790	1835	SW	4	23	OT	X
183	Unid. Mstc. Whale	1	31/08/2009 14:21:41	-160.793	70.4915	2897	2942	BL	4	22	OT	X
184	Pacific walrus	3	31/08/2009 14:49:15	-160.864	70.4745	1790	1867	SW	4	22	OT	X
185	Pacific walrus	1	02/09/2009 10:57:10	-160.999	70.4537	1790	1854	LO	2	22	OT	X
186	Harbor porpoise	2	02/09/2009 14:08:55	-162.317	70.5443	547	632	PO	3	40	OT	X
187	Unid. Mstc. Whale	1	02/09/2009 19:22:56	-164.853	70.2534	4285	553	DE	3	47	OT	X
193	Unid. Toothed Whale	1	06/09/2009 17:55:30	-165.506	70.0183	11	97	SW	3	46	OT	X
194	Unid. Mstc. Whale	1	06/09/2009 20:07:00	-165.078	70.2547	719	795	BL	3	48	OT	X
195	Unidentified pinniped	3	07/09/2009 11:32:35	-162.979	71.2476	16	102	DI	2	47	SH	10
196	Pacific walrus	1	07/09/2009 11:53:00	-162.983	71.2471	27	112	LO	2	46	RU	20
197	Spotted seal	1	09/09/2009 14:39:31	-159.817	70.8555	219	297	SW	6	47	OT	X
198	Unidentified seal	1	09/09/2009 19:55:00	-160.595	70.6958	44	122	DI	3	47	OT	X
199	Ringed seal	1	10/09/2009 15:23:58	-163.094	71.2344	196	103	LO	1	51	SH	40
200	Ringed seal	1	10/09/2009 15:52:35	-163.098	71.2091	168	225	SW	1	51	SH	10
201	Ringed seal	1	10/09/2009 19:43:30	-163.037	71.1953	196	231	SW	1	50	SH	40
202	Pacific walrus	2	11/09/2009 09:30:00	-163.211	71.1988	379	430	LO	2	51	SH	40
203	Pacific walrus	1	11/09/2009 09:54:08	-163.213	71.1876	213	287	DI	1	51	SH	10
204	Unidentified seal	1	12/09/2009 11:16:00	-167.377	71.1794	412	478	DE	2	52	OT	X
205	Unidentified seal	1	12/09/2009 12:28:30	-167.607	71.1539	168	182	SW	2	52	OT	X
206	Ringed seal	1	13/09/2009 15:28:55	-168.319	71.098	109	190	SW	2	57	SH	40
207	Pacific walrus	1	13/09/2009 22:35:30	-168.313	71.122	273	95	LO	1	56	LS	40
208	Unidentified seal	1	16/09/2009 07:05:43	-162.91	71.1897	33	113	DI	1	49	SH	40
209	Pacific walrus	1	17/09/2009 12:45:57	-167.517	68.3663	27	114	SW	X	47	OT	X
227	Pacific walrus	2	25/09/2009 17:17:49	-168.39	68.6124	55	142	SW	5	57	OT	X
228	Unidentified pinniped	1	27/09/2009 19:45:00	-163.57	71.228	328	339	SW	2	49	RC	X
229	Unidentified seal	1	28/09/2009 10:07:50	-163.491	71.2708	272	360	SW	1	49	LS	40

Table K.1 cont…. All vessel-based marine mammal detections during the Chukchi Sea shallow hazard and site clearance survey, 30 Jul–9 Oct 2009.

Sighting ID [a]	Species	No. [b]	Date (AKDT)	Long (°W)	Lat (°N)	Initial Sighting Distance (yd) [c]	CPA (yd) [d]	Behavior [e]	Bf [f]	Water Depth (yd)	Vessel Activity [g]	Airgun Volume (in^3)
231	Ringed seal	1	28/09/2009 14:49:25	-163.494	71.2836	328	395	LO	1	49	OT	X
232	Unidentified seal	1	28/09/2009 15:10:30	-163.533	71.2641	451	503	SW	1	49	OT	X
233	Ringed seal	1	28/09/2009 15:23:03	-163.555	71.2528	412	498	SW	1	49	OT	X
234	Ringed seal	1	28/09/2009 15:29:32	-163.568	71.2473	44	122	SI	1	49	OT	X
235	Ringed seal	1	28/09/2009 15:41:05	-163.565	71.2559	497	301	SW	1	49	OT	X
236	Ringed seal	1	28/09/2009 15:54:12	-163.541	71.2683	196	274	SW	1	49	OT	X
237	Unidentified seal	1	28/09/2009 16:38:06	-163.48	71.2893	196	274	SW	1	50	OT	X
238	Unidentified seal	1	28/09/2009 18:03:57	-163.512	71.2813	553	639	SW	1	49	OT	X
239	Ringed seal	1	28/09/2009 18:19:53	-163.48	71.2961	289	323	LO	1	50	OT	X
240	Ringed seal	1	28/09/2009 18:39:35	-163.5	71.2776	289	323	SW	1	49	OT	X
241	Ringed seal	1	28/09/2009 18:43:41	-163.507	71.2736	180	236	LO	1	49	OT	X
242	Ringed seal	1	28/09/2009 18:58:05	-163.535	71.2594	164	234	SW	1	49	OT	X
243	Ringed seal	1	28/09/2009 19:46:08	-163.524	71.2736	22	109	DI	1	49	OT	X
244	Ringed seal	1	28/09/2009 20:40:39	-163.511	71.2702	55	97	SW	1	49	OT	X
245	Unidentified seal	1	29/09/2009 10:35:50	-163.156	71.2498	289	367	LO	2	51	OT	X
246	Unidentified seal	1	29/09/2009 15:58:30	-165.837	71.2746	379	465	SW	1	432	OT	X

[a] Sighting ID = Sequential number given to sighting by MMOs, 1 - 33 and subsequent number gaps were observed during transit (e.g. Bering Sea)

[b] No. = Number of individual marine mammal(s)

[c] Initial Sighting Distance (yd) = distance of marine mammal(s) from the MMOs when initially detected

[d] CPA (yd) = Closest Point of Approach of the marine mammal(s) to the airgun array

[e] Behavior = Initial behavior observed by MMOs, codes: BL = Blow (cetacean surfacing), DE - Dead, DI = Dive, LG = Log (rest motionless at water surface), LO = Look, PO = Porpoise (repeated swimming and diving near water surface), SA = Surface active (splashing, rolling,etc., often social in nature), SI = Sink (pinnipeds, as opposed to Dive), SW = Swim, U = Unknown

[f] Bf = Beaufort Wind Force, See Appendix F for definitions

g Vessel Activity = Vessel activity at the time of initial detection, codes: DP = Deploying Survey Gear, IA = Idle (at anchor), LS = Survey Line Shooting, OT = Other (e.g., transit), RC = Recovering Survey Gear, RU = Ramp Up / Power Up of Airgun Array, ST = Seismic Testing of Airgun Array

APPENDIX L: NMFS STRANDING REPORTS

MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ NMFS REGIONAL #: _____ (NMFS USE) NATIONAL DATABASE#: _____ (NMFS USE)

COMMON NAME: UNIDENTIFIED SEAL GENUS: Unknown SPECIES: Unknown

EXAMINER Letterholder: _____

Name: Kris Hartin, Affiliation: LGL Alaska Research Associates, Inc.

Address: 1101 E 76th Ave, Suite B, Anchorage, AK 99518 Phone: (907) 562-3339

LOCATION OF INITIAL OBSERVATION
State: AK County: _____
City: _____
Body of Water: CHUKCHI SEA
Locality Details: _____
Latitude: 71 17.97 N ☒ actual
Longitude: 163 23.24 W ☐ estimated
How lat/long determined (Check ONE):
☒ GPS
☐ Map
☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE#: _____ (NMFS USE)
Group Event: ☐ YES ☒ NO
If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ actual ☐ estimated
Findings of Human Interaction: ☐ YES ☒ NO ☐ Could not Be Determined (CBD)
If Yes, Check one or more: ☐ 1. Boat Collision ☐ 2. Shot ☐ 3. Fishery Interaction
☐ 4. Other Human Interaction: _____
Describe How Determined: _____
Gear Collected? ☐ YES ☒ NO Gear Disposition: Seismic gear onboard prior to sighting
Other Findings upon Level A: ☐ YES ☒ NO ☐ CBD
If Yes, Check one or more: ☐ 1. Illness ☐ 2. Injury
☐ 3. Other Findings: _____
Describe How Determined: _____

INITIAL OBSERVATION
Date: Year: 2009 Month: AUGUST Day: 08
First Observed: ☐ Beach or Land ☒ Floating ☐ Swimming

CONDITION AT INITIAL OBSERVATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☒ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal
☐ 6. Unknown

LEVEL A EXAMINATION ☒ Not Able to Examine
Date: Year: _____ Month: _____ Day: _____

CONDITION AT EXAMINATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)
☐ 1. Left at Site
☐ 2. Immediate Release at Site
☐ 3. Relocated
☐ 4. Disentangled
☐ 5. Died at Site
☐ 6. Euthanized at Site
☐ 7. Transferred to Rehabilitiation: Date: _____ Facility: _____
☐ 8. Died during Transport
☐ 9. Euthanized during Transport
☐ 10. Other: _____

CONDITION/DETERMINATION (Check one or more)
☐ 1. Sick
☐ 2. Injured
☐ 3. Out of Habitat
☐ 8. Unknown/CBD
☐ 4. Deemed Healthy
☐ 5. Abandoned/Orphaned
☐ 6. Inaccessible
☐ 9. Other: _____
7. Location Hazardous:
☐ a. To animal
☐ b. To public
Comments: _____

MORPHOLOGICAL DATA

SEX (Check ONE)
☐ 1. Male
☐ 2. Female
☒ 3. Unknown

AGE CLASS (Check ONE)
☐ 1. Adult
☐ 2. Subadult
☐ 3. Yearling
☐ 4. Pup/Calf
☒ 5. Unknown

Straight Length: 50 ☐ cm ☒ in ☐ actual ☒ estimated
Weight: 300 ☐ kg ☒ lb ☐ actual ☒ estimated

PHOTOS/VIDEOS TAKEN: ☒ YES ☐ NO
Photo/Video Disposition: VERY BLURRY, LOW LIGHT

TAG DATA
Tags Were:
Present at Time of Stranding (pre-existing): ☐ YES ☐ NO
Applied during Stranding Response: ☐ YES ☐ NO

ID #	Color	Type	Placement * (Circle ONE)	Applied	Present
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐

* D = Dorsal; DF= Dorsal Fin; L = Lateral Body
LF=Left Front; LR = Left Rear; RF = Right Front; RR = Right Rear

WHOLE CARCASS STATUS (Check one or more)
☒ 1. Left at site
☐ 2. Buried
☐ 3. Rendered
☐ 4. Towed: Lat _____ Long _____
☐ 5. Sunk: Lat _____ Long _____
☐ 6. Frozen for Later Examination
☐ 7. Landfill
☐ 8. Unknown
☐ 9. Other: _____

SPECIMEN DISPOSITION (Check one or more)
☐ 1. Scientific collection
☐ 2. Educational collection
☐ 3. Other: _____
Comments: _____

NECROPSIED ☐ YES ☐ NO Date: _____
NECROPSIED BY: _____

NOAA Form 89-864 (rev. 2004)
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PLEASE USE THE BACK SIDE OF THIS FORM FOR ADDITIONAL REMARKS

ADDITIONAL REMARKS

ADDITIONAL IDENTIFIER: Observed 09 August 2009, 0317 AKDT (If animal is restranded, please indicate any previous field numbers here)

AN UNIDENTIFIED SEAL CARCASS WAS SEEN FLOATING AT SURFACE APPROXIMATELY 50M FROM OBSERVER JUST OFF THE STARBOARD BOW. CAMERA WAS TAKEN TO STARBOARD BRIDGE WING WHERE OBSERVERS WERE ABLE TO GET A VERY GOOD LOOK AT CARCASS AND TAKE THREE PHOTOS (PHOTOS WERE BLURRED BY LOW LIGHTING CONDITION). CARCASS APPEARED TO BE AN ICE SEAL, ~50 INCHES AND 300 LBS, DEAD FOR A LONG TIME (MUCH > 72 HOURS). THE CARCASS WAS IN AN INTERMEDIATE STATE OF DECOMPOSITION; FLESH THAT APPEARED MOTTLED WITH ROT, A PUTRID STENCH, AND VERY BLOATED ABDOMEN. THE VESSEL HAD NOT CONDUCTED ANY SEISMIC ACTIVITIES WITHIN 16 KM OF THE CARCASS LOCATION WITHINTHE LAST 24 HRS, AND THE STATE OF DECOMPOSITION INDICATED THAT THE CARCASS PREDATED THE COMMENCEMENT OF ALL SEISMIC OPERATIONS IN THE AREA. THE MAIN ICE EDGE WAS APPROXIMATELY 5 MILES NE OF THE CARCASS.

DISCLAIMER

THESE DATA SHOULD NOT BE USED OUT OF CONTEXT OR WITHOUT VERIFICATION. THIS SHOULD BE STRICTLY ENFORCED WHEN REPORTING SIGNS OF HUMAN INTERACTION DATA.

DATA ACCESS FOR LEVEL A DATA

UPON WRITTEN REQUEST, CERTAIN FIELDS OF THE LEVEL A DATA SHEET WILL BE RELEASED TO THE REQUESTOR PROVIDED THAT THE REQUESTOR CREDIT THE STRANDING NETWORK AND THE NATIONAL MARINE FISHERIES SERVICE. THE NATIONAL MARINE FISHERIES SERVICE WILL NOTIFY THE CONTRIBUTING STRANDING NETWORK MEMBERS THAT THESE DATA HAVE BEEN REQUESTED AND THE INTENT OF USE. ALL OTHER DATA WILL BE RELEASED TO THE REQUESTOR PROVIDED THAT THE REQUESTOR OBTAIN PERMISSION FROM THE CONTRIBUTING STRANDING NETWORK AND THE NATIONAL MARINE FISHERIES SERVICE.

PAPERWORK REDUCTION ACT INFORMATION:

PUBLIC REPORTING BURDEN FOR THE COLLECTION OF INFORMATION IS ESTIMATED TO AVERAGE 30 MINUTES PER RESPONSE, INCLUDING THE TIME FOR REVIEWING INSTRUCTIONS, SEARCHING EXISTING DATA SOURCES, GATHERING AND MAINTAINING THE DATA NEEDED, AND COMPLETING AND REVIEWING THE COLLECTION OF INFORMATION. SEND COMMENTS REGARDING THIS BURDEN ESTIMATE OR ANY OTHER ASPECT OF THE COLLECTION OF INFORMATION, INCLUDING SUGGESTIONS FOR REDUCING THE BURDEN TO: CHIEF, MARINE MAMMAL CONSERVATION DIVISION, OFFICE OF PROTECTED RESOURCES, NOAA FISHERIES, 1315 EAST-WEST HIGHWAY, SILVER SPRING, MARYLAND 20910. NOT WITHSTANDING ANY OTHER PROVISION OF THE LAW, NO PERSON IS REQUIRED TO RESPOND TO, NOR SHALL ANY PERSON BE SUBJECTED TO A PENALTY FOR FAILURE TO COMPLY WITH, A COLLECTION OF INFORMATION SUBJECT TO THE REQUIREMENTS OF THE PAPERWORK REDUCTION ACT, UNLESS THE COLLECTION OF INFORMATION DISPLAYS A CURRENTLY VALID OFFICE OF MANAGEMENT AND BUDGET (OMB) CONTROL NUMBER.

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MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ NMFS REGIONAL #: _____ (NMFS USE) NATIONAL DATABASE#: _____ (NMFS USE)

COMMON NAME: Pacific Walrus GENUS: Odobenus SPECIES: rosmarus divergens

EXAMINER Letterholder: _____

Name: Craig Reiser Affiliation: LGL Alaska Research Associates, Inc.

Address: 1101 E 76th Ave, Suite B, Anchorage, AK 99518 Phone: (907) 562-3339

LOCATION OF INITIAL OBSERVATION

State: AK County: _____

City: _____

Body of Water: Chukchi Sea

Locality Details: _____

Latitude: 71d 7.59m N ☒ actual

Longitude: 166d 32.59 W ☐ estimated

How lat/long determined (Check ONE):

☒ GPS
☐ Map
☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE#: _____ (NMFS USE)

Group Event: ☐ YES ☒ NO

If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ actual ☐ estimated

Findings of Human Interaction: ☒ YES ☐ NO ☐ Could not Be Determined (CBD)

If Yes, Check one or more: ☐ 1. Boat Collision ☒ 2. Shot ☐ 3. Fishery Interaction

☒ 4. Other Human Interaction: Head was removed, poaching suspected

Describe How Determined: vessel approached within 20 meters of carcass, photos attached

Gear Collected? ☐ YES ☒ NO Gear Disposition: Inactive seismic gear in tow

Other Findings upon Level A: ☐ YES ☐ NO ☐ CBD

If Yes, Check one or more: ☐ 1. Illness ☐ 2. Injury

☐ 3. Other Findings: See page 2 for description of carcass investigation

Describe How Determined: _____

INITIAL OBSERVATION

Date: Year: 2009 Month: August Day: 12

First Observed: ☐ Beach or Land ☒ Floating ☐ Swimming

CONDITION AT INITIAL OBSERVATION (Check ONE)

☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☒ 4. Advanced decomposition
☐ 5. Mummified/Skeletal
☐ 6. Unknown

LEVEL A EXAMINATION ☒ Not Able to Examine

Date: Year: _____ Month: _____ Day: _____

CONDITION AT EXAMINATION (Check ONE)

☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)

☒ 1. Left at Site
☐ 2. Immediate Release at Site
☐ 3. Relocated
☐ 4. Disentangled
☐ 5. Died at Site
☐ 6. Euthanized at Site
☐ 7. Transferred to Rehabilitiation: Date: _____ Facility: _____
☐ 8. Died during Transport
☐ 9. Euthanized during Transport
☐ 10. Other: _____

CONDITION/DETERMINATION (Check one or more)

☐ 1. Sick
☐ 2. Injured
☐ 3. Out of Habitat
☐ 8. Unknown/CBD
☐ 4. Deemed Healthy
☐ 5. Abandoned/Orphaned
☐ 6. Inaccessible
☐ 9. Other: _____
7. Location Hazardous:
☐ a. To animal
☐ b. To public

Comments: _____

MORPHOLOGICAL DATA

SEX (Check ONE)

☐ 1. Male
☐ 2. Female
☒ 3. Unknown

AGE CLASS (Check ONE)

☒ 1. Adult
☐ 2. Subadult
☐ 3. Yearling
☐ 4. Pup/Calf
☐ 5. Unknown

Straight Length: unknown ☐ cm ☐ in ☐ actual ☐ estimated

Weight: unknown ☐ kg ☐ lb ☐ actual ☐ estimated

PHOTOS/VIDEOS TAKEN: ☒ YES ☐ NO

Photo/Video Disposition: several photos taken from vessel, see attached

TAG DATA

Tags Were:

Present at Time of Stranding (pre-existing): ☐ YES ☐ NO

Applied during Stranding Response: ☐ YES ☐ NO

ID #	Color	Type	Placement * (Circle ONE)	Applied	Present
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐

* D = Dorsal; DF= Dorsal Fin; L = Lateral Body

LF=Left Front; LR = Left Rear; RF = Right Front; RR = Right Rear

WHOLE CARCASS STATUS (Check one or more)

☒ 1. Left at site
☐ 2. Buried
☐ 3. Rendered
☐ 4. Towed: Lat _____ Long _____
☐ 5. Sunk: Lat _____ Long _____
☐ 6. Frozen for Later Examination
☐ 7. Landfill
☐ 8. Unknown
☐ 9. Other: _____

SPECIMEN DISPOSITION (Check one or more)

☐ 1. Scientific collection
☐ 2. Educational collection
☐ 3. Other: _____

Comments: _____

NECROPSIED ☐ YES ☐ NO Date: _____

NECROPSIED BY: _____

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PLEASE USE THE BACK SIDE OF THIS FORM FOR ADDITIONAL REMARKS

ADDITIONAL REMARKS

ADDITIONAL IDENTIFIER: Observed 12 August 2009, 1128 AKDT (If animal is restranded, please indicate any previous field numbers here)

A suspected marine mammal carcass was observed by MMOs aboard the Mt Mitchell at 11:28 AKDT, 12 August 2009. Birds were concentrated at the location and an oil sheen was present. The vessel was able to approach within 20 meters of the carcass and it was confirmed to be a Pacific walrus without a head. At least two bullet holes were visible on the carcass. It was bloated and in an advanced state of decomposition. See attached photos for details.

The vessel had recently acquired a seismic production line at the time of the sighting. All airguns were shut down after the suspected carcass was observed. Airguns were not ramped back up until the state of the carcass had been confirmed and the on-site investigation was complete.

DISCLAIMER

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DATA ACCESS FOR LEVEL A DATA

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MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ NMFS REGIONAL #: _____ (NMFS USE) NATIONAL DATABASE#: _____ (NMFS USE)

COMMON NAME: Unidentified Pinniped GENUS: _____ SPECIES: _____

EXAMINER Letterholder: _____

Name: Juan Gracia Affiliation: LGL Alaska Research Associates, Inc.

Address: 1101 E 76th Ave, Suite B, Anchorage, AK 99518 Phone: (907) 562-3339

LOCATION OF INITIAL OBSERVATION
State: AK County: _____
City: _____
Body of Water: Chukchi Sea
Locality Details: _____
Latitude: 71d 8.20m N ☒ actual
Longitude: 162d 19.76 W ☐ estimated
How lat/long determined (Check ONE):
☒ GPS
☐ Map
☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE#: _____ (NMFS USE)
Group Event: ☐ YES ☒ NO
If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ actual ☐ estimated
Findings of Human Interaction: ☐ YES ☒ NO ☒ Could not Be Determined (CBD)
If Yes, Check one or more: ☐ 1. Boat Collision ☐ 2. Shot ☐ 3. Fishery Interaction
☐ 4. Other Human Interaction: _____
Describe How Determined: _____
Gear Collected? ☐ YES ☒ NO Gear Disposition: All gear aboard vessel, vessel in transit
Other Findings upon Level A: ☐ YES ☐ NO ☐ CBD
If Yes, Check one or more: ☐ 1. Illness ☐ 2. Injury
☐ 3. Other Findings: See page 2 for description of carcass
Describe How Determined: _____

INITIAL OBSERVATION
Date: Year: 2009 Month: August Day: 19
First Observed: ☐ Beach or Land ☒ Floating ☐ Swimming

CONDITION AT INITIAL OBSERVATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal
☒ 6. Unknown

LEVEL A EXAMINATION ☒ Not Able to Examine
Date: Year: _____ Month: _____ Day: _____

CONDITION AT EXAMINATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)
☒ 1. Left at Site
☐ 2. Immediate Release at Site
☐ 3. Relocated
☐ 4. Disentangled
☐ 5. Died at Site
☐ 6. Euthanized at Site
☐ 7. Transferred to Rehabilitiation: Date: _____ Facility: _____
☐ 8. Died during Transport
☐ 9. Euthanized during Transport
☐ 10. Other: _____

CONDITION/DETERMINATION (Check one or more)
☐ 1. Sick
☐ 2. Injured
☐ 3. Out of Habitat
☒ 8. Unknown/CBD
☐ 4. Deemed Healthy
☐ 5. Abandoned/Orphaned
☐ 6. Inaccessible
☐ 9. Other: _____
7. Location Hazardous: ☐ a. To animal ☐ b. To public
Comments: _____

MORPHOLOGICAL DATA

SEX (Check ONE)
☐ 1. Male
☐ 2. Female
☒ 3. Unknown

AGE CLASS (Check ONE)
☒ 1. Adult
☐ 2. Subadult
☐ 3. Yearling
☐ 4. Pup/Calf
☐ 5. Unknown

Straight Length: unknown ☐ cm ☐ in ☐ actual ☐ estimated
Weight: unknown ☐ kg ☐ lb ☐ actual ☐ estimated

PHOTOS/VIDEOS TAKEN: ☒ YES ☐ NO
Photo/Video Disposition: several photos taken from vessel, see attached

TAG DATA
Tags Were:
Present at Time of Stranding (pre-existing): ☐ YES ☐ NO
Applied during Stranding Response: ☐ YES ☐ NO

ID #	Color	Type	Placement * (Circle ONE)	Applied	Present
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐

* D = Dorsal; DF= Dorsal Fin; L = Lateral Body
LF=Left Front; LR = Left Rear; RF = Right Front; RR = Right Rear

WHOLE CARCASS STATUS (Check one or more)
☒ 1. Left at site
☐ 2. Buried
☐ 3. Rendered
☐ 4. Towed: Lat _____ Long _____
☐ 5. Sunk: Lat _____ Long _____
☐ 6. Frozen for Later Examination
☐ 7. Landfill
☐ 8. Unknown
☐ 9. Other: _____

SPECIMEN DISPOSITION (Check one or more)
☐ 1. Scientific collection
☐ 2. Educational collection
☐ 3. Other: _____
Comments: _____

NECROPSIED ☐ YES ☐ NO Date: _____
NECROPSIED BY: _____

NOAA Form 89-864 (rev. 2004)
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PLEASE USE THE BACK SIDE OF THIS FORM FOR ADDITIONAL REMARKS

ADDITIONAL REMARKS

ADDITIONAL IDENTIFIER: Observed 19 August 2009, 2022 AKDT (If animal is restranded, please indicate any previous field numbers here)

A marine mammal carcass was observed by MMOs aboard the Mt Mitchell at 20:22 AKDT, 19 August 2009. Birds were concentrated at the location and acted as a sighting cue. Seas were rough and did not allow for a thorough investigation or close approach. The vessel was able to circle once and approach the carcass to within 300 m. Several photographs were taken. The carcass was the size of a large pinniped, brownish in color, and floating flush with the water line. It was dorsal-side up and did not provide views of the ventral surface or head. Pacific walrus was suspected based on size and color, but diagnostic features were unable to be documented. The stage of decomposition also could not be determined. The vessel was in transit to Wainright for a crew change at the time of the observation. The carcass location was approximately 51 nautical miles northwest of Wainright.

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MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ **NMFS REGIONAL #:** _____ (NMFS USE) **NATIONAL DATABASE#:** _____ (NMFS USE)

COMMON NAME: Unidentified Pinniped **GENUS:** _____ **SPECIES:** _____

EXAMINER Letterholder: _____

Name: Craig Reiser Affiliation: LGL Alaska Research Associates, Inc.

Address: 1101 E 76th Ave, Suite B, Anchorage, AK 99518 Phone: (907) 562-3339

LOCATION OF INITIAL OBSERVATION
State: AK County: _____
City: _____
Body of Water: Chukchi Sea
Locality Details: _____
Latitude: 71d 21.75m N ☒ actual
Longitude: 163d 35.16m W ☐ estimated
How lat/long determined (Check ONE):
☒ GPS
☐ Map
☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE#: _____ (NMFS USE)
Group Event: ☐ YES ☒ NO
If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ actual ☐ estimated
Findings of Human Interaction: ☐ YES ☒ NO ☒ Could not Be Determined (CBD)
If Yes, Check one or more: ☐ 1. Boat Collision ☐ 2. Shot ☐ 3. Fishery Interaction
☐ 4. Other Human Interaction: _____
Describe How Determined: _____
Gear Collected? ☐ YES ☒ NO Gear Disposition: Towing seismic gear, preparing for line
Other Findings upon Level A: ☐ YES ☐ NO ☐ CBD
If Yes, Check one or more: ☐ 1. Illness ☐ 2. Injury
☐ 3. Other Findings: See page 2 for description of carcass
Describe How Determined: _____

INITIAL OBSERVATION
Date: Year: 2009 Month: August Day: 21
First Observed: ☐ Beach or Land ☒ Floating ☐ Swimming

CONDITION AT INITIAL OBSERVATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☒ 4. Advanced decomposition
☐ 5. Mummified/Skeletal
☐ 6. Unknown

LEVEL A EXAMINATION ☒ Not Able to Examine
Date: Year: _____ Month: _____ Day: _____

CONDITION AT EXAMINATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)
☒ 1. Left at Site
☐ 2. Immediate Release at Site
☐ 3. Relocated
☐ 4. Disentangled
☐ 5. Died at Site
☐ 6. Euthanized at Site
☐ 7. Transferred to Rehabilitiation: Date: _____ Facility: _____
☐ 8. Died during Transport
☐ 9. Euthanized during Transport
☐ 10. Other: _____

CONDITION/DETERMINATION (Check one or more)
☐ 1. Sick
☐ 2. Injured
☐ 3. Out of Habitat
☒ 8. Unknown/CBD
☐ 4. Deemed Healthy
☐ 5. Abandoned/Orphaned
☐ 6. Inaccessible
☐ 9. Other: _____
7. Location Hazardous: ☐ a. To animal ☐ b. To public
Comments: _____

MORPHOLOGICAL DATA

SEX (Check ONE)
☐ 1. Male
☐ 2. Female
☒ 3. Unknown

AGE CLASS (Check ONE)
☒ 1. Adult
☐ 2. Subadult
☐ 3. Yearling
☐ 4. Pup/Calf
☐ 5. Unknown

Straight Length: unknown ☐ cm ☐ in ☐ actual ☐ estimated
Weight: unknown ☐ kg ☐ lb ☐ actual ☐ estimated

PHOTOS/VIDEOS TAKEN: ☒ YES ☐ NO
Photo/Video Disposition: photo taken from vessel, see attached

TAG DATA
Tags Were:
Present at Time of Stranding (pre-existing): ☐ YES ☐ NO
Applied during Stranding Response: ☐ YES ☐ NO

ID #	Color	Type	Placement * (Circle ONE)	Applied	Present
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐

* D = Dorsal; DF= Dorsal Fin; L = Lateral Body
LF=Left Front; LR = Left Rear; RF = Right Front; RR = Right Rear

WHOLE CARCASS STATUS (Check one or more)
☒ 1. Left at site
☐ 2. Buried
☐ 3. Rendered
☐ 4. Towed: Lat _____ Long _____
☐ 5. Sunk: Lat _____ Long _____
☐ 6. Frozen for Later Examination
☐ 7. Landfill
☐ 8. Unknown
☐ 9. Other: _____

SPECIMEN DISPOSITION (Check one or more)
☐ 1. Scientific collection
☐ 2. Educational collection
☐ 3. Other: _____
Comments: _____

NECROPSIED ☐ YES ☐ NO Date: _____
NECROPSIED BY: _____

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PLEASE USE THE BACK SIDE OF THIS FORM FOR ADDITIONAL REMARKS

ADDITIONAL REMARKS

ADDITIONAL IDENTIFIER: Observed 21 August 2009, 14:37 AKDT (If animal is restranded, please indicate any previous field numbers here)

A marine mammal carcass was observed by MMOs aboard the Mt Mitchell at 14:37 AKDT, 21 August 2009. Birds were concentrated at the location and acted as a sighting cue. An oil sheen was also evident as the vessel approached. Seas were rough and the vessel was towing seismic gear in preparation for a production line. A ramp up had just been completed and all airguns were shut down immediately. The vessel was able to approach the carcass to within 300 m, but could not investigate further due to gear in tow. Several photographs were taken. The carcass was the size of a large pinniped, whitish in color, and floating above the water line. It was dorsal-side up and did not provide views of the ventral surface or head. Pacific walrus was suspected based on size, shape, and a magnification of photos, but diagnostic features were unable to be documented. The stage of decomposition was clearly advanced. The carcass location was approximately 75 nautical miles northwest of Wainwright.

This carcass resembled the unidentified pinniped carcass from 19 August and was in the same general area of Burger, but it is difficult to confirm this as the same carcass given the significant difference in appearance. The 19 August carcass was approximately 51 nautical miles northwest of Wainwright.

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MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ NMFS REGIONAL #: _____ (NMFS USE) NATIONAL DATABASE#: _____ (NMFS USE)

COMMON NAME: Unidentified Pinniped GENUS: _____ SPECIES: _____

EXAMINER Letterholder: _____

Name: Craig Reiser Affiliation: LGL Alaska Research Associates, Inc.

Address: 1101 E 76th Ave, Suite B, Anchorage, AK 99518 Phone: (907) 562-3339

LOCATION OF INITIAL OBSERVATION

State: AK County: _____

City: _____

Body of Water: Chukchi Sea

Locality Details: _____

Latitude: 71d 21.83m N ☒ actual

Longitude: 163d 16.60m W ☐ estimated

How lat/long determined (Check ONE):

☒ GPS
☐ Map
☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE#: _____ (NMFS USE)

Group Event: ☐ YES ☒ NO

If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ actual ☐ estimated

Findings of Human Interaction: ☐ YES ☒ NO ☒ Could not Be Determined (CBD)

If Yes, Check one or more: ☐ 1. Boat Collision ☐ 2. Shot ☐ 3. Fishery Interaction

☐ 4. Other Human Interaction: _____

Describe How Determined: _____

Gear Collected? ☐ YES ☒ NO Gear Disposition: Towing seismic gear

Other Findings upon Level A: ☐ YES ☐ NO ☐ CBD

If Yes, Check one or more: ☐ 1. Illness ☐ 2. Injury

☐ 3. Other Findings: See page 2 for description, same carcass observed 21 Aug

Describe How Determined: photos match, accompanying bird community the same both days

INITIAL OBSERVATION

Date: Year: 2009 Month: August Day: 22

First Observed: ☐ Beach or Land ☒ Floating ☐ Swimming

CONDITION AT INITIAL OBSERVATION (Check ONE)

☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☒ 4. Advanced decomposition
☐ 5. Mummified/Skeletal
☐ 6. Unknown

LEVEL A EXAMINATION ☒ Not Able to Examine

Date: Year: _____ Month: _____ Day: _____

CONDITION AT EXAMINATION (Check ONE)

☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)

☒ 1. Left at Site
☐ 2. Immediate Release at Site
☐ 3. Relocated
☐ 4. Disentangled
☐ 5. Died at Site
☐ 6. Euthanized at Site
☐ 7. Transferred to Rehabilitiation: Date: _____ Facility: _____
☐ 8. Died during Transport
☐ 9. Euthanized during Transport
☐ 10. Other: _____

CONDITION/DETERMINATION (Check one or more)

☐ 1. Sick
☐ 2. Injured
☐ 3. Out of Habitat
☒ 8. Unknown/CBD
☐ 4. Deemed Healthy
☐ 5. Abandoned/Orphaned
☐ 6. Inaccessible
☐ 9. Other: _____
7. Location Hazardous: ☐ a. To animal ☐ b. To public

Comments: _____

MORPHOLOGICAL DATA

SEX (Check ONE)

☐ 1. Male
☐ 2. Female
☒ 3. Unknown

AGE CLASS (Check ONE)

☒ 1. Adult
☐ 2. Subadult
☐ 3. Yearling
☐ 4. Pup/Calf
☐ 5. Unknown

Straight Length: unknown ☐ cm ☐ in ☐ actual ☐ estimated

Weight: unknown ☐ kg ☐ lb ☐ actual ☐ estimated

PHOTOS/VIDEOS TAKEN: ☒ YES ☐ NO

Photo/Video Disposition: photo taken from vessel, see attached

TAG DATA

Tags Were:

Present at Time of Stranding (pre-existing): ☐ YES ☐ NO

Applied during Stranding Response: ☐ YES ☐ NO

ID #	Color	Type	Placement * (Circle ONE)	Applied	Present
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐

* D = Dorsal; DF= Dorsal Fin; L = Lateral Body

LF=Left Front; LR = Left Rear; RF = Right Front; RR = Right Rear

WHOLE CARCASS STATUS (Check one or more)

☒ 1. Left at site
☐ 2. Buried
☐ 3. Rendered
☐ 4. Towed: Lat _____ Long _____
☐ 5. Sunk: Lat _____ Long _____
☐ 6. Frozen for Later Examination
☐ 7. Landfill
☐ 8. Unknown
☐ 9. Other: _____

SPECIMEN DISPOSITION (Check one or more)

☐ 1. Scientific collection
☐ 2. Educational collection
☐ 3. Other: _____

Comments: _____

NECROPSIED ☐ YES ☐ NO Date: _____

NECROPSIED BY: _____

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PLEASE USE THE BACK SIDE OF THIS FORM FOR ADDITIONAL REMARKS

ADDITIONAL REMARKS

ADDITIONAL IDENTIFIER: Observed 22 August 2009, 15:04 AKDT (If animal is restranded, please indicate any previous field numbers here)

A marine mammal carcass was observed by MMOs aboard the Mt Mitchell at 15:04 AKDT, 22 August 2009. It was the same carcass observed 24 hours earlier in nearly the exact same location. Photos (see attached) supported this conclusion in addition to the same accompanying bird species and numbers. The oil sheen was also comparable. The vessel was able to approach the carcass to within 200 m to confirm its identity. The carcass was the size of a large pinniped, whitish in color, and floating above the water line. It was dorsal-side up and did not provide views of the ventral surface or head. Pacific walrus was suspected based on size and shape, but diagnostic features were unable to be documented. The stage of decomposition was clearly advanced. The carcass location was approximately 75 nautical miles northwest of Wainwright.

Location of carcass when observed on 21 August: 71° 21.75' N, 163° 35.16' W
Location of carcass when observed on 22 August: 71° 21.83' N, 163° 16.60' W

DISCLAIMER

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DATA ACCESS FOR LEVEL A DATA

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MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ NMFS REGIONAL #: _____ (NMFS USE) NATIONAL DATABASE#: _____ (NMFS USE)

COMMON NAME: Unidentified Mysticete Whale GENUS: Unknown SPECIES: Unknown

EXAMINER Letterholder: _____

Name: Craig Reiser Affiliation: LGL Alaska Research Associates, Inc.

Address: 1101 E 76th Ave, Suite B, Anchorage, AK 99518 Phone: (907) 562-3339

LOCATION OF INITIAL OBSERVATION
State: AK County: _____
City: _____
Body of Water: Chukchi Sea
Locality Details: _____
Latitude: 70d 15.18m N ☒ actual
Longitude: 164d 51.33m W ☐ estimated
How lat/long determined (Check ONE):
☒ GPS
☐ Map
☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE#: _____ (NMFS USE)
Group Event: ☐ YES ☒ NO
If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ actual ☐ estimated
Findings of Human Interaction: ☐ YES ☒ NO ☒ Could not Be Determined (CBD)
If Yes, Check one or more: ☐ 1. Boat Collision ☐ 2. Shot ☐ 3. Fishery Interaction
☐ 4. Other Human Interaction: _____
Describe How Determined: _____
Gear Collected? ☐ YES ☒ NO Gear Disposition: All gear aboard vessel, vessel in transit
Other Findings upon Level A: ☐ YES ☐ NO ☐ CBD
If Yes, Check one or more: ☐ 1. Illness ☐ 2. Injury
☐ 3. Other Findings: See page 2 for description, see attached photos
Describe How Determined: _____

INITIAL OBSERVATION
Date: Year: 2009 Month: September Day: 02
First Observed: ☐ Beach or Land ☒ Floating ☐ Swimming

CONDITION AT INITIAL OBSERVATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☒ 4. Advanced decomposition
☐ 5. Mummified/Skeletal
☐ 6. Unknown

LEVEL A EXAMINATION ☒ Not Able to Examine
Date: Year: _____ Month: _____ Day: _____

CONDITION AT EXAMINATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)
☒ 1. Left at Site
☐ 2. Immediate Release at Site
☐ 3. Relocated
☐ 4. Disentangled
☐ 5. Died at Site
☐ 6. Euthanized at Site
☐ 7. Transferred to Rehabilitiation: Date: _____ Facility: _____
☐ 8. Died during Transport
☐ 9. Euthanized during Transport
☐ 10. Other: _____

CONDITION/DETERMINATION (Check one or more)
☐ 1. Sick
☐ 2. Injured
☐ 3. Out of Habitat
☒ 8. Unknown/CBD
☐ 4. Deemed Healthy
☐ 5. Abandoned/Orphaned
☐ 6. Inaccessible
☐ 9. Other: _____
7. Location Hazardous: ☐ a. To animal ☐ b. To public
Comments: _____

MORPHOLOGICAL DATA

SEX (Check ONE)
☒ 1. Male
☐ 2. Female
☐ 3. Unknown

AGE CLASS (Check ONE)
☒ 1. Adult
☐ 2. Subadult
☐ 3. Yearling
☐ 4. Pup/Calf
☐ 5. Unknown

Straight Length: ~40' ☐ cm ☐ in ☐ actual ☒ estimated
Weight: unknown ☐ kg ☐ lb ☐ actual ☐ estimated

PHOTOS/VIDEOS TAKEN: ☒ YES ☐ NO
Photo/Video Disposition: photos taken from vessel, see attached

TAG DATA
Tags Were:
Present at Time of Stranding (pre-existing): ☐ YES ☐ NO
Applied during Stranding Response: ☐ YES ☐ NO

ID #	Color	Type	Placement * (Circle ONE)	Applied	Present
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐

* D = Dorsal; DF= Dorsal Fin; L = Lateral Body
LF=Left Front; LR = Left Rear; RF = Right Front; RR = Right Rear

WHOLE CARCASS STATUS (Check one or more)
☒ 1. Left at site
☐ 2. Buried
☐ 3. Rendered
☐ 4. Towed: Lat _____ Long _____
☐ 5. Sunk: Lat _____ Long _____
☐ 6. Frozen for Later Examination
☐ 7. Landfill
☐ 8. Unknown
☐ 9. Other: _____

SPECIMEN DISPOSITION (Check one or more)
☐ 1. Scientific collection
☐ 2. Educational collection
☐ 3. Other: _____
Comments: _____

NECROPSIED ☐ YES ☐ NO Date: _____
NECROPSIED BY: _____

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PLEASE USE THE BACK SIDE OF THIS FORM FOR ADDITIONAL REMARKS

ADDITIONAL REMARKS

ADDITIONAL IDENTIFIER: Observed 02 Sep 2009, 19:22 AKDT (If animal is restranded, please indicate any previous field numbers here)

A marine mammal carcass was observed by MMOs aboard the Mt Mitchell at 17:22 AKDT, 02 September 2009. It could only be identified as an unidentified male mysticete whale. Decomposition was advanced and distinguishing ID characteristics were not readily observable. It was ventral-side up with exposed genitalia. Length of the carcass was estimated to be approximately 40 feet. The vessel was able to approach the carcass to within 500 meters. See attached photos. The vessel was in transit from Wainwright to Nome when the carcass was detected. The location was approximately 60 nautical miles WSW of Icy Cape.

DISCLAIMER

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MARINE MAMMAL STRANDING REPORT - LEVEL A DATA

FIELD #: _____ NMFS REGIONAL #: _____ (NMFS USE) NATIONAL DATABASE#: _____ (NMFS USE)

COMMON NAME: Unidentified Seal GENUS: _____ SPECIES: _____

EXAMINER Letterholder: _____

Name: Stephanie Thibedeau Affiliation: ASRC Energy Services

Address: 2700 Gambell St., Suite 200, Anchorage, AK 99503 Phone: 907-334-1507

LOCATION OF INITIAL OBSERVATION
State: AK County: _____
City: _____
Body of Water: _____
Locality Details: _____
Latitude: 64° 31.79' N ☒ actual
Longitude: 166° 58.06m W ☐ estimated
How lat/long determined (Check ONE):
☒ GPS
☐ Map
☐ Internet/Software

OCCURRENCE DETAILS ☐ Restrand GE#: _____ (NMFS USE)
Group Event: ☐ YES ☒ NO
If Yes, Type: ☐ Cow/Calf Pair ☐ Mass Stranding # Animals: _____ ☐ actual ☐ estimated
Findings of Human Interaction: ☐ YES ☒ NO ☒ Could not Be Determined (CBD)
If Yes, Check one or more: ☐ 1. Boat Collision ☐ 2. Shot ☐ 3. Fishery Interaction
☐ 4. Other Human Interaction: _____
Describe How Determined: _____
Gear Collected? ☐ YES ☒ NO Gear Disposition: Towing Seismic Gear, gear was NOT active
Other Findings upon Level A: ☐ YES ☒ NO ☐ CBD
If Yes, Check one or more: ☐ 1. Illness ☐ 2. Injury
☐ 3. Other Findings: _____
Describe How Determined: _____

INITIAL OBSERVATION
Date: Year: 2009 Month: October Day: 5
First Observed: ☐ Beach or Land ☒ Floating ☐ Swimming

CONDITION AT INITIAL OBSERVATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☒ 4. Advanced decomposition
☐ 5. Mummified/Skeletal
☐ 6. Unknown

LEVEL A EXAMINATION ☒ Not Able to Examine
Date: Year: _____ Month: _____ Day: _____

CONDITION AT EXAMINATION (Check ONE)
☐ 1. Alive
☐ 2. Fresh dead
☐ 3. Moderate decomposition
☐ 4. Advanced decomposition
☐ 5. Mummified/Skeletal

INITIAL LIVE ANIMAL DISPOSITION (Check one or more)
☒ 1. Left at Site
☐ 2. Immediate Release at Site
☐ 3. Relocated
☐ 4. Disentangled
☐ 5. Died at Site
☐ 6. Euthanized at Site
☐ 7. Transferred to Rehabilitiation: Date: _____ Facility: _____
☐ 8. Died during Transport
☐ 9. Euthanized during Transport
☐ 10. Other: _____

CONDITION/DETERMINATION (Check one or more)
☐ 1. Sick
☐ 2. Injured
☐ 3. Out of Habitat
☒ 8. Unknown/CBD
☐ 4. Deemed Healthy
☐ 5. Abandoned/Orphaned
☐ 6. Inaccessible
☐ 9. Other: _____
7. Location Hazardous: ☐ a. To animal ☐ b. To public
Comments: _____

MORPHOLOGICAL DATA

SEX (Check ONE)
☐ 1. Male
☐ 2. Female
☒ 3. Unknown

AGE CLASS (Check ONE)
☐ 1. Adult
☐ 2. Subadult
☐ 3. Yearling
☐ 4. Pup/Calf
☒ 5. Unknown

Straight Length: Unknown ☐ cm ☐ in ☐ actual ☐ estimated
Weight: Unknown ☐ kg ☐ lb ☐ actual ☐ estimated

PHOTOS/VIDEOS TAKEN: ☐ YES ☒ NO
Photo/Video Disposition: _____

TAG DATA
Tags Were:
Present at Time of Stranding (pre-existing): ☐ YES ☐ NO
Applied during Stranding Response: ☐ YES ☐ NO

ID #	Color	Type	Placement * (Circle ONE)	Applied	Present
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐
			D DF L LF LR RF RR	☐	☐

* D = Dorsal; DF= Dorsal Fin; L = Lateral Body
LF=Left Front; LR = Left Rear; RF = Right Front; RR = Right Rear

WHOLE CARCASS STATUS (Check one or more)
☒ 1. Left at site
☐ 2. Buried
☐ 3. Rendered
☐ 4. Towed: Lat _____ Long _____
☐ 5. Sunk: Lat _____ Long _____
☐ 6. Frozen for Later Examination
☐ 7. Landfill
☐ 8. Unknown
☐ 9. Other: _____

SPECIMEN DISPOSITION (Check one or more)
☐ 1. Scientific collection
☐ 2. Educational collection
☐ 3. Other: _____
Comments: _____

NECROPSIED ☐ YES ☐ NO Date: _____
NECROPSIED BY: _____

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ADDITIONAL REMARKS

ADDITIONAL IDENTIFIER: Observed 5 Oct. 2009, 17:50 AKDT (If animal is restranded, please indicate any previous field numbers here)

At 17:50 AKDT, 5 October 2009, a group of feeding seagulls drew the attention of MMOs aboard the Mt. Mitchell to a marine mammal carcass floating in the water. The Mt. Mitchell was in transit to a prospect area when the carcass was observed aft of the starboard beam, approximately 400 meters from the vessel. The ship was travelling at 12 knots; the ship was not turned around for photos of the carcass which was initially sighted on the ship's starboard quarter.

The marine mammal carcass was classified as an unidentified seal based on its length, which was ~0.9-1.2 m (3-4 ft). It was bloated and whitish in color, and floating above the water line. The carcass appeared to be in an advanced state of decomposition and the animal was believed to have been dead for at least 72 hrs.

The carcass was sighted more than 440 nautical miles from the prospect area where seismic operations were last conducted. Surveying had ended the 2nd of October 2009, three days before the carcass was sighted.

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