

APPENDICES TO:

MARINE MAMMAL MONITORING AND MITIGATION DURING OPEN WATER SEISMIC EXPLORATION BY SHELL OFFSHORE INC. IN THE CHUKCHI AND BEAUFORT SEAS, JULY–NOVEMBER 2007: 90-DAY REPORT

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and

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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 the date of this Authorization through August 1, 2008, 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* and *M/V Henry Christoffersen* conducting deep and shallow-hazard seismic survey programs in the Chukchi and Beaufort seas, as specified in SOI's November 22, 2006 application.

3 (a) The species authorized for incidental harassment takings are: bowhead whales (*Balaena mysticetus*), gray whales (*Eschrichtius robustus*), 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 the following acoustic sources 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*:

(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 in³ (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 (907-271-3023), NMFS and the Chief of the Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service, at (301) 713-2289, ext 110, or his designee.

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 serious injury 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 whenever the required seismic vessel marine mammal observer (MMO), required by condition 7(a)(i)), is not onboard in conformance with condition 7(a)(i), or the coastal or offshore aerial, and/or the dedicated vessel and passive acoustic monitoring programs 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 or WG. Operators of support vessels and aircraft should, at all times,

conduct their activities at the maximum distance possible from such concentrations of whales. 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.

(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) Operate in full compliance with the agreed-upon Conflict Avoidance Agreement; or (B) If the signed Conflict Avoidance Agreement has expired or been nullified by the Holder of this Authorization, the following mitigation measures must be fully implemented:

(I) for the purposes of reducing or eliminating conflicts between subsistence whaling activities and Shell's seismic program, the Holder of this Authorization will establish and operate at least five Communication Centers to be staffed by Inupiat operators. The Communication Centers will be operated 24 hours/day during the 2007 fall subsistence bowhead whale hunt.

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

(III) During the bowhead whaling season, aircraft shall not operate below 1500 ft unless approaching, landing or taking off, or unless engaged in providing assistance to a whaler or in poor weather (low ceilings) or other emergency situations.

(IV) All geophysical activity in the Beaufort Sea and Chukchi seas shall be restricted from conducting seismic as set forth below:

(1) *Kaktovik*: No geophysical activity from the Canadian border to the Canning River (~146 deg. 4 min. W) from 25th August to the end of the fall bowhead whale hunt

in Kaktovik and Nuiqsut;

(2) *Nuiqsut*: No geophysical activity from the Canning River (~146 deg. 4 min. W) to Point Storkersen (~ 148 deg. 45 min. W) from August 25th to the end of the fall bowhead whale hunt 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 10 to the end of the fall bowhead whale hunt in Barrow.

(4) *Chukchi Sea*: Geophysical exploration may occur beginning July 20, but in any case geophysical exploration activities may not occur closer than 60 miles from the Chukchi Sea coast at any point.

(5) Seismic vessel transits in the Chukchi Sea spring lead system must not occur prior to July 1, 2008.

(V) Upon notification by Communication 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.

(VII) Geophysical exploration may resume following the close of the fall 2007 bowhead whale subsistence hunt in Barrow, Wainwright, and Point Hope.

(VIII)(a) Post-Season Review: No later than 90 days following the end of the fall 2007 bowhead subsistence hunt, Shell 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 AEWG at a mutually agreed upon place on the North Slope to review the results of the 2007 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) No later than 90 days following completion of geophysical operations in the Chukchi Sea, Shell will host a meeting in each of the following villages: Wainwright, 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 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 practicable, 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 or track will be calculated and implemented.

(iii) Exclusion and Monitoring-Safety Zones:

(A) Establish and monitor with trained observers 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 1 μ Pa rms. For purposes of the field verification test, described in condition 7(d), this radius is estimated to be 0.75 mi (1.2 km) from the seismic source.

(B) Establish and monitor with trained observers 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 μ Pa rms. For purposes of the field verification test described in condition 7(d), this radius is estimated to be 0.3 mi (0.5 km) from the seismic source.

(C) Establish and monitor with trained observers a preliminary exclusion zone for cetaceans and pinnipeds surrounding the high-resolution seismic airgun array on the *M/V Henry Christoffersen* where the received level would be 180 dB and 190 dB re 1 μ Pa 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 balaenopterid 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 power-down the seismic airgun array and/or other acoustic sources to ensure that sound pressure levels at the shortest distance to the aggregation do not exceed 160 dB rms; and (b) Not proceed with powering up the seismic airgun array until biological observers on board the support "chase" vessel(s) or survey aircraft confirm that no balaenopterid aggregations have been detected within the 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 power-down the seismic airgun array and/or other acoustic sources to ensure that sound pressure levels are reduced by at least 50 percent; 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.

(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 $\mu\text{Pa}_{\text{rms}}$), 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 shut-down 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 condition 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/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. If observations are made or credible reports are received that one or more marine mammals are within the area of this activity in an injured or mortal state, or are indicating acute distress, the seismic airgun array will be immediately shut down and the Chief of the Permits, Conservation and Education Division, Office of Protected Resources or a staff member contacted. The airgun array will not be restarted until review and approval has been given by the Director, Office of Protected Resources or his designee.

(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 (1) 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 biologically-trained, on-site individuals to be onboard the *M/V Gilavar* and *M/V Henry Christoffersen*, 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 are:

(A) Between August 16 and September 15, 2007, 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 2007 survey, there must be at least 3 MMOs onboard each source vessel at any time during all seismic operations.

(C) Between July 20, 2008 and August 1, 2008, 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, to (A) ensure that no marine mammals enter the appropriate safety zone whenever the seismic array is 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 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 biological observer 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 biological observers 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 biological observers must be provided with and use appropriate night-vision devices, Big Eyes, and reticulated and/or laser range finding binoculars.

(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 designed approved in advance 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 described in Shell's revised 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, 2007, and (B) daily, weather permitting, from September 1, 2007, 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 biological observer(s) and a third observer 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, 2007, 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 observer or his/her designee will 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 measure and report within 5 days of completing the test:

(i)(A) the empirical distances from the airgun array to broadband received levels of 190, 180, 170, 160, and 120 dB(rms) re 1 microPa, and

(i)(B) the radiated sounds vs. distance from the primary 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. Research

(a) The holder of the Authorization, in cooperation with other oil company participants must conduct all research described in the "Marine Mammal Monitoring and Mitigation Plan for Seismic Exploration in the Alaskan Chukchi and Beaufort Seas, 2007." 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 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 2007 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 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 2007.

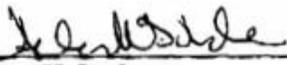
(e) The draft comprehensive report will be reviewed by participants at the 2008 Open Water Scientific Meeting to be held in Anchorage AK in the spring of 2008. The draft comprehensive report will be accepted by the National Marine Fisheries Service as the final comprehensive report upon incorporation 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 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 to the extent one exists.

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.



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

8/20/07
Date



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

JUN 26 2008

Ms. Susan Childs
Regulatory Coordinator
Shell Oil Exploration and Production
3601 C. Street, Suite 1334
Anchorage, Alaska 99503

Dear Ms. Childs:

Thank you for your letter of June 19, 2008, to the National Marine Fisheries Service (NMFS) requesting an extension of the Incidental Harassment Authorization (IHA) issued to Shell Offshore Inc. (SOI) on August 20, 2007. The IHA authorized SOI and its contractor, WesternGeco 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, subject to the conditions set forth in the IHA. The IHA, which was issued pursuant to section 101(a)(5)(D) of the Marine Mammal Protection Act (MMPA) is currently valid from August 20, 2007, through August 1, 2008, or until a new IHA is issued, whichever is earlier. For reasons described in this letter, NMFS hereby amends condition 1 of SOI's August 20, 2007 IHA by extending the period of validity through August 19, 2008.

SOI submitted its application for an IHA for the 2008 field season on October 16, 2007, in order to take marine mammals incidental to SOI's seismic activity in the Beaufort and Chukchi seas, beginning on August 1, 2008 and continuing through the open water season of 2008, through July 31, 2009. The proposed IHA for this action was published in the *Federal Register* on June 25, 2008.

NMFS recognizes that due to the late publication date of the proposed IHA, it is possible there will be a gap in MMPA "take" coverage between August 1, 2008, and the period in which NMFS expects to render a final decision on SOI's 2008 IHA request.

In your letter you note that SOI would have to cease collecting seismic data during this period [without an IHA] and, therefore, is concerned regarding the potential significant down time and resulting substantial expenses associated with the "gap", and subsequent stand-down, between the current expiration of the 2007 IHA (August 2, 2008) and issuance of the 2008 IHA. Your letter further emphasized that this would threaten SOI's ability to conduct its 2008 seismic program. This concern resulted in the letter submitted by SOI requesting an extension of the 2007 IHA from August 2, 2008 through August 19, 2008.

NMFS has reviewed your request and concurs with SOI that the seismic activities to be conducted during this brief extension period (August 2 – August 19, 2008) have already been analyzed and are the same activities for which MMPA "take" coverage had been authorized under the 2007 IHA.



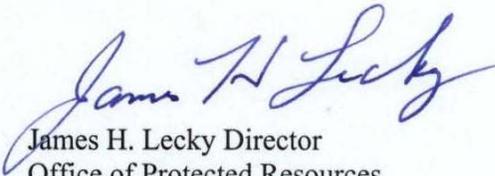
Therefore, seismic activities to be conducted during the brief extension will not result in environmental impacts not previously considered and analyzed by NMFS when it issued the 2007 IHA. In addition, SOI has agreed and NMFS requires, through this letter that all of the mitigation and monitoring measures, stipulations and other conditions of the originally-issued 2007 IHA will continue through August 19, 2008, as part of the extension.

As a result, condition 1 of the IHA issued to SOI on August 20, 2007 is hereby amended to read:

1. This Authorization is valid from the date of this Authorization (i.e., August 20, 2007) through August 19, 2008. This Authorization may be superseded by a new Incidental Harassment Authorization issued to SOI for the 2008 open water season, but in no case shall this Authorization be valid beyond August 19, 2008.

This letter should be attached to the IHA issued to SOI on August 20, 2007. Please contact either me, Michael Payne or Ken Hollingshead, at 301-713-2289 if you need additional information.

Sincerely,



James H. Lecky Director
Office of Protected Resources

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/V Alpha 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 in³ (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 (NNIFS) 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)(II), 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 through 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 10th. 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 AEW.

(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.

(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.

(VII)(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 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.

(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 $1 \mu\text{Pa rms}$. 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 $1 \mu\text{Pa rms}$. 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 $1 \mu\text{Pa rms}$, 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.

(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 $\mu\text{Pa}_{\text{rms}}$), 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@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) 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 μ Pa 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 biologically trained, 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:

(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 sighted within the 180/190-dB safety zone or aggregations of 12 or more non-migratory bowhead whales or gray whales are sighted 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 described 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 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) 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.

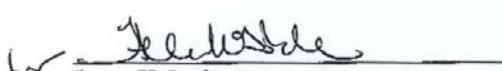
11. The Plan of Cooperation and that portion of the Conflict Avoidance Agreement outlining the steps that will be taken to cooperate and communicate with the native communities to ensure the availability of marine mammals for subsistence uses, must be implemented.

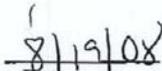
12. This Authorization may be modified, suspended or withdrawn if the Holder fails to

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


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 (*Histiophoca 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*),

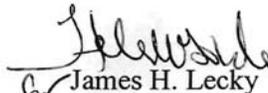


beluga whales (*Delphinapterus leucas*), killer whales (*Orcinus orca*), harbor porpoise (*Phocoena phocoena*), ringed seals (*Phoca hispida*), ribbon seals (*Histiophoca fasciata*), spotted seals (*Phoca largha*), and bearded seals (*Erignathus barbatus*).

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

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



IN REPLY REFER TO:

AFES/MMM

United States Department of the Interior

FISH AND WILDLIFE SERVICE

1011 E. Tudor Road

Anchorage, Alaska 99503-6199



JUL 8 2008

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

Dear Ms. Childs:

This responds to your April 15, 2008, request for Letters of Authorization (LOA) for the incidental and intentional take of polar bears in relation to the Shell Offshore, Inc. (Shell) 2008 Chukchi Sea Open-water Exploration Program.

Enclosed is a LOA (08-01-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, in partnership with geophysical contractors, will be conducting a three-dimensional (3D) seismic survey, site clearance, and shallow hazard surveys in the Chukchi Sea. The proposed start date for this project is mid-July 2008.

If any changes develop in your project during the 2008 open-water season, such as flight paths, 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, 2008. 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, 2009).

In addition to protection measures for marine mammals described in the Shell polar bear



Ms. Susan Childs

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interaction plan (Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska, April 2008), 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 any 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.

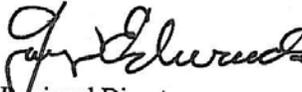
A reasonable and prudent measure and implementing terms and conditions were included for the MMM in the Tier 1 BO and have been incorporated into the LOA process. Issuance of this ITS with the LOA completes ESA requirements for authorization of incidental take of the polar bear. Compliance with the terms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

Ms. Susan Childs

3

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,


Acting Regional Director

Enclosure

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



IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE

1011 E. Tudor Road
Anchorage, Alaska 99503-6199



AFES/MMM

ISSUED: July 7, 2008
EXPIRES: November 30, 2008

**LETTER OF AUTHORIZATION
(08-01-CS)**

Shell Offshore, Inc. (Shell) is hereby authorized to take, by Level B Harassment only, small numbers of polar bears and Pacific walrus incidental to activities occurring during the 2008 Chukchi Sea Open-water Exploration Program. Shell and its geophysical contractors will be conducting site clearance, shallow hazard surveys, and a 3D seismic program in the Chukchi Sea. A detailed description of the authorized activity can be found in the "2008 Open Water Program Work Plan, Outer continental Shelf, Chukchi Sea, Alaska," dated April 2008.

The LOA is valid from the date of issuance to November 30, 2007. 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. The Operations Manager will be fully aware, understand and capable of implementing the conditions of this authorization.
2. This Authorization is valid only for activities (including support vessels and aircraft) described in Shell's April 15, 2008 application. Changes in the siting, timing, scope or nature of project activities will require prior review and approval.
3. 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 Seismic Exploration in the Alaskan Chukchi and Beaufort Seas, 2008*, October 2007. Received by the Service April 16, 2008.
 - (b) *Polar Bear Interaction Plan (Polar Bear and Pacific Walrus Awareness and Interaction Plan, North Slope and Chukchi Sea, Alaska, April 2008)*.
 - (c) *2007 Plan of Cooperation with addendums Nos. 1 and 2*, including corresponding 2008 documentation.

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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. Prohibitions:

(a) Intentional take and lethal incidental take of walruses or polar bears is prohibited and may result in the modification, suspension or revocation of this Authorization.

(b) 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.

7. Mitigation, monitoring and reporting requirements:

(a) Operators must operate in full compliance with the mitigation, monitoring and reporting requirements identified in 50 CFR 18.118 and the approved documents identified in Condition 3 above.

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

8. 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.

9. A copy of this Authorization, the Service-approved Marine Mammal Monitoring and Mitigation Plan, the Service-approved Polar Bear Interaction Plan, and the Service-approved Plan of Cooperation 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.

10. 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.

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 walrus 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 walrus and polar bears.

6. Prohibitions:

(a) Intentional take and lethal incidental take of walrus or polar bears is prohibited and may result in the modification, suspension or revocation of this Authorization.

(b) 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.

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(a) Operators must operate in full compliance with the mitigation, monitoring and reporting requirements identified in 50 CFR 18.118 and the approved documents identified in Condition 3 above.

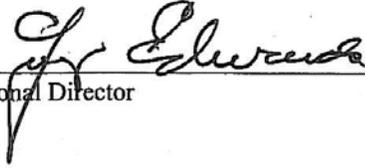
(b) *Sound source verification report.* The results of field source verification and the distances to the various sound radii are to be reported to the Service within 5 days of completing the measurements.

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

8. 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.

9. A copy of this Authorization, the Service-approved Marine Mammal Monitoring and Mitigation Plan, the Service-approved Polar Bear Interaction Plan, and the Service-approved Plan of Cooperation 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.

10. 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.

Acty 
Regional Director

JUL 8 2008
Date



IN REPLY REFER TO:

United States Department of the Interior

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



AFES/MMM

U.S. Fish and Wildlife Service

AUTHORIZATION TO TAKE, BY HARASSMENT, POLAR BEARS

ISSUED: July 7, 2008
EXPIRES: November 30, 2008

Under Sections 101 (a)(4)(A), 109(h), and 112(c) of the Marine Mammal Protection Act of 1972, as amended, Shell Offshore, Inc. (Shell) is authorized to take, by harassment, polar bears during exploration activities in association with the 2008 Chukchi Sea Open-water Exploration Program. Shell, in partnership with geophysical contractors, will be conducting site clearance, shallow hazard surveys, and a 3D seismic program in the Chukchi Sea. A detailed description of the authorized activity can be found in the, "2008 Open Water Program Work Plan, Outer continental Shelf, Chukchi Sea, Alaska," dated April 2008.

The purpose of authorizing taking by harassment, or deterrence, is to maintain human and bear safety and welfare during oil and gas activities. 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;
5. Prevent bears from entering the developed parts of the oilfield

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.

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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 restricted to harassment activities.
4. 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.
5. 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.
6. 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.
7. Hazing techniques must not cause the injury or death of a bear. Types of hazing techniques may include, but are not limited to:
 - Bear Monitors;
 - Air horns;
 - Electric fences;
 - Chemical repellents;
 - Acoustic recordings;
 - Vehicles;
 - Projectiles: cracker shells, bean bags, rubber bullets, screamers, etc.
8. 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
9. When conducting a harassment activity, operators must:
 - Choose 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);

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 restricted to harassment activities.
4. 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.
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 - Vehicles;
 - Projectiles: cracker shells, bean bags, rubber bullets, screamers, etc.
8. 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
9. When conducting a harassment activity, operators must:
 - Choose 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

10. 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)

11. 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.

Signed: 
Date: JUL 8 2008

APPENDIX C: CONFLICT AVOIDANCE AGREEMENT

July 17, 2008

Pete Slaiby
General Manager
Shell Exploration & Production Company
3601 C Street, Suite 1334
Anchorage, Alaska 99503

Dear Pete:

It was good to meet you Barrow last week, and thank you for your July 14 letter. I appreciate Shell's willingness to sign the CAA and am pleased to enclose the CAA with an addendum containing the modifications on which the AEWG is able to agree with Shell.

With respect to the unresolved issues mentioned in your July 14 letter, the Kaktovik whalers and the AEWG have agreed to Shell's request for an August 25 end date and accept Shell's proposed language on that issue. The AEWG has also agreed to modify the safe harbor language to permit vessels to seek safe harbor in any emergency, not just ones that threaten human life. We trust that the definition of emergency will not be abused.

With regard to the request to move the September 10 end date for Chukchi operations, the AEWG is unable to accept the proposed change because of the concerns we have previously expressed regarding the potential for deflection of the lead whales, which would adversely affect the hunt even though it may occur at a later date.

I look forward to receiving a signed copy of the CAA with addendum.

Thank you again for Shell's continued participation in the CAA process.

Sincerely,


Harry Brower
Chairman

Attachment

cc: AEWG Commissioners
Village WCA Presidents
Mayor Edward Itta, North Slope Borough
President George Edwardson, Inupiat Community of Arctic Slope
Roberta Quintavell, President, Arctic Slope Regional Corporation
Senator Ted Stevens
Senator Lisa Murkowski
Congressman Don Young
John Goll, Minerals Management Service
Jim Lecky, National Oceanic and Atmospheric Administration
Michael Payne, NMFS
Ken Hollingshead, NMFS
Marvin Odum, Shell Oil, President of the Americas
Susan Childs, Shell Oil

ADDENDUM

This addendum, as agreed to between Shell Exploration & Production (Shell) and the Alaska Eskimo Whaling Commission (AEWC), hereby is incorporated as an integral part of the 2008 Conflict Avoidance Agreement (CAA).

All of the terms and conditions of the 2008 CAA shall remain in force, except that the text in this appendix shall apply in lieu of the text in the CAA as noted below.

1. Section II (General Terms and Conditions), H (Pre-Season Sound Signature Tests), Second Paragraph.

Each sound signature test shall be conducted at a site mutually agreed upon by the Industry Participant conducting such test and the AEW. Each Industry Participant conducting such sound signature test(s) will provide a minimum of seven days notice of its intent to perform such test. Industry Participant will provide transportation for an appropriate number of representatives from: AEW and the whaling captains of the Villages of Barrow, Nuiqsut, Kaktovik, Wainwright and Pt. Hope. Industry Participant(s) will also invite the AEW and NSB to observe sound signature tests for Vessels to be used in the Chukchi Sea, and transportation will be provided by the appropriate Industry Participant(s). In order to facilitate the participation of interested Subsistence Participants in any sound signature test(s), Industry Participant(s) will make a good faith effort to provide three weeks notice of its intent to perform such test.

2. Section IV (Avoiding Conflicts During the 2008 Open Water Season), Introductory Two Paragraphs.

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 throughout the bowhead whale migration in the Beaufort and Chukchi Seas, 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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3. Section IV (Avoiding Conflicts During the 2008 Open Water Season), A (General Provisions for Avoiding Interference with Bowhead Whales or Subsistence Whale Hunting Activities), Numbered Paragraph 2 (Aircraft Altitude Floor and Flight Paths), Paragraph 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.

4. Section IV (Avoiding Conflicts During the 2008 Open Water Season), B (Operating Limitations), Numbered

paragraph 1(Geophysical Operations), a (Beaufort Sea), (i) (Kaktovik)

(i) 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, Industry Operators will communicate and collaborate with AEWG on any planned vessel movement in and around Kaktovik and Cross Island to avoid impacts to whale hunt.

5. Section IV (Avoiding Conflicts During the 2008 Open Water Season), B (Operating Limitations). Numbered paragraph 1 (Geophysical Operations), b (Chukchi Sea).

- (i) Geophysical activity may not commence in the Chukchi Sea prior to July 20, 2008.
- (ii) Geophysical activity in the Chukchi Sea may occur beginning July 20, 2008 and will end September 10, 2008.
- (iii) Geophysical activities shall not be conducted within 60 miles of any point on the Chukchi Sea coast.
- (iv) Geophysical exploration may resume following the close of the fall 2008 bowhead 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 AEWG.
- (v) Safe harbor will not be taken within 50 miles of any village, except in an emergency threatening life or property, and then ships shall be moved to a distance of at least 50 miles from the village as the threat to life or property has passed, and shall be moved out to sea as soon as weather permits.

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- (vi) Any vessel operating within 60 miles of the Chukchi Sea coast will follow the communications procedures set forth in Section III of this Agreement. All vessels will adhere to the conflict avoidance measures set forth in Section IV. A. of this Agreement.
- (vii) If a dispute should arise, the resolution process set forth in Section VI of this Agreement shall apply.

6. Section IV (Avoiding Conflicts During the 2008 Open Water Season), B (Operating Limitations). Numbered paragraph 2 (Drilling Operations) b (Sampling of Drilling Muds and Cuttings).

For all drilling operations, whether for exploration or production, in the Beaufort, Chukchi, and Bering Seas habitat of the bowhead whale, the operator shall cooperate with the AEWG 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 Arctic Ocean.

FINAL DRAFT (Rev. 1)

**2008 OPEN WATER SEASON
PROGRAMMATIC CONFLICT AVOIDANCE AGREEMENT**

BETWEEN

**BP EXPLORATION (ALASKA), INC.
SHELL OFFSHORE, INC
PIONEER NATURAL RESOURCES ALASKA, INC.
ENI US Operating Co. Inc –
PGS Onshore
ASRC Energy Services**

AND

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

**Final for Signature
May 30, 2008**

FINAL DRAFT (Rev. 1)
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I. INTRODUCTION

Unless otherwise specified, this Conflict Avoidance/Mitigation Agreement is intended to apply to all nearshore and offshore oil and gas exploration, development, and production activities by or for any Industry Participant, and barge vessel traffic by or for any Signatory during the 2008 OPEN WATER SEASON in the BEAUFORT and/or CHUKCHI SEAS.

Unless otherwise specified, Vessels and locations covered by this Agreement include those identified in the Agreement, as well as any others that are employed by or for the Industry Participants in the Beaufort and/or Chukchi Seas during the 2008 summer and fall open water season.

All parties identified in the Agreement by name and whose representative(s) has signed the Agreement, including all contractors of such parties, are referred to in this document, jointly, as the "Participants" or where appropriate as the "Industry Participants" or the "Subsistence Participants". Any and all other entities who later become parties to this Agreement or whose activities become subject to this Agreement are referred to in this document as the "Covered Parties". Unless otherwise specified, the term "Industry Participant" shall include such Covered Parties and such Covered Parties shall be subject to all terms and conditions of this Agreement that apply to the Industry Participants.

The Participants agree that, unless otherwise specified, the mitigation measures identified in the Agreement, which are intended to mitigate the potential impacts of oil and gas exploration, drilling, seismic, development, or production and related activities on marine mammals, including migrating bowhead whales and the Alaskan Eskimo Subsistence hunt of those whales, are designed to apply to all activities of each Participant during the 2008 summer and fall 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.

II. GENERAL TERMS AND CONDITIONS

A. STATEMENT OF PURPOSE

The purpose of this Agreement is to provide:

1. Equipment and procedures for communications between Subsistence Participants and the Industry Participants; and
2. Avoidance guidelines and other mitigation measures to be followed

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by the Industry Participants working in or transiting the vicinity of active subsistence whaling crews, or 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. Additional Provisions of the Agreement:

- a. measures to be taken in the event of an emergency occurring during the term of this Agreement; and
- b. dispute resolution procedures.

B. LIMITATIONS OF OBLIGATIONS

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 and Pt. Hope, Pt. Lay Whaling Captains' Associations, or of any other Whaling Captains' Association be taken as an endorsement of any Arctic or Beaufort 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 Document 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 migration or the bowhead 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 migration or the bowhead 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 from the oil and gas industry operate the Beaufort Sea during the summer or fall of 2008 the, Participants shall exercise their good-faith efforts to bring those parties into this Agreement.

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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 2008 bowhead subsistence whale hunting season, the Participants will provide to all signatories 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 AEWG IS NOT RESPONSIBLE FOR, OR A PARTY TO, ANY AGREEMENT AMONG MEMBERS OF THE OIL AND GAS INDUSTRY** who are Participants in the Agreement or other Covered Parties, concerning the apportionment of expenses necessary for the implementation of this Agreement.

6. In adhering to this Agreement, neither the Participants nor any Covered Party 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, liability, or other obligations with respect to any other Participant beyond those stated in this Agreement.

C. OIL AND GAS INDUSTRY VESSELS AND EQUIPMENT

The Industry Participants hold or have applied for

- A Letter of Authorization from U.S. National Marine Fisheries Service (NOAA Fisheries), pursuant to Section 101 (a)(5)(A) of the Marine Mammal Protection Act (2008 LOAs);
- An Incidental Harassment Authorization from U.S. National Marine Fisheries Service (NOAA Fisheries), pursuant to Section 101 (a)(5)(D) of the Marine Mammal Protection Act (2008 IHAs); or
- A permit from the North Slope Borough that stipulates that the Industry Participant enter into a conflict avoidance agreement

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before conducting certain activities in the marine environment (2008 NSB Permits).

The only 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 and/or Chukchi Seas in support of activities described in their respective applications for 2008 LOAs, 2008 IHAs, or 2008 NSB Permits during the Term of this Agreement are those:

1. Identified in each Industry participant's application, if any, for a 2008 LOA, 2008 IHA or used in activities for which the Industry Participant holds a 2008 NSB Permit, and listed in Attachment II to this Agreement.
2. For and in support of the Monitoring Plan, if any, identified within each Industry Participant's 2008 LOA, 2008 IHA, or conducted pursuant to its 2008 NSB Permits as agreed to between the Industry Participant and the NSB Division of Wildlife Management (NSB DWM), and listed in Attachment III to this Agreement.

The vessels and other equipment identified in 1. and 2. above are referred to in this Agreement as "the Vessels".

NONE OF THE INDUSTRY PARTICIPANTS INTENDS TO OPERATE ANY OTHER VESSEL IN SUPPORT OF ACTIVITIES DESCRIBED IN THEIR RESPECTIVE APPLICATIONS FOR 2008 LOAs, 2008 IHAs, or 2008 NSB PERMITS DURING THE TERM OF THIS AGREEMENT.

However, 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 Communications System Coordination Center (Com-Center), as identified in Section III. B. of this Agreement, and in writing, of their identity and their intended use, including location of use.

D. BARGE TRAFFIC

The Participants may also employ barges to transport materials through the Beaufort or Chukchi Seas during the term of this Agreement. Any Participant who employs a barge to transport materials through the Beaufort or Chukchi Seas during the term of this Agreement shall require the barge operator to comply with Sections III. C. 1 and Section III. D of

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this Agreement while employed by that Industry Participant.

E. SUBSISTENCE WHALE HUNTING BOATS

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

The subsistence whaling crews of the Village of Nuiqsut plan to use twelve (12) boats for subsistence whale hunting during the late summer and fall of 2008.

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

The subsistence whaling crews of the Village of Kaktovik plan to use eight (8) boats for subsistence whale hunting during the late summer and fall of 2008.

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

The subsistence whaling crews of the Village of Barrow plan to use forty (40) boats for subsistence whale hunting during the late summer and fall of 2008.

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

The subsistence whaling crews of the Village of Wainwright plan to use four (4) boats for subsistence whale hunting during the fall of 2008.

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 ten (10) boats for subsistence whale hunting during the late fall of 2008.

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 four (4) boats for subsistence whale hunting during the fall of 2008.

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

F. INDIVIDUALS TO CONTACT

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1. 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.

2. WesternGeco's Local Representative-Subcontractor to Shell

JOHN DAVIS will be WesternGeco's local representative 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) 360-3518 Cell Phone.

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

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

4. 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.

5. ENI's Local Representative

6. 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.

7. Contact Persons for ASRC Energy Services

Jana Lage, Principal Marine Geophysicist, Marine Services, will be AES's local representative during the Term of this Agreement and

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will be available by telephone at (907) 339-6452 (Direct), (907) 382-4405 (Cell), (907) 339-6219 (Fax).

8. Contact Persons for 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).

9. Contact Persons for 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).

10. Contact Persons for 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.

11. Contact Persons for the Village of Wainwright

For purposes of this Agreement, the individuals to contact for the Village of Wainwright will be: JACK PANIK at (907)763-2421 (Home); (907)763-2915 (Work), 763-2171 (Fax), and WALTER NAYAKIK at (907)763-2915 (Work).

12. Contact persons for 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) .

13. Contact persons for 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)

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833-6467 (Home), (907) 833-3838

14. Contact Persons for the AEW

For purposes of this Agreement, the individuals to contact for the AEW shall be: HARRY BROWER, JR. at (907) 852-2910 and (907) 852-0350 (Work) and TERESA JUDKINS at (907) 852-2392.

G. TERM

The Term of the Agreement shall commence with the signing of this document by the designated Signatories and shall terminate upon completion of the Nuiqsut, Kaktovik, Barrow, Wainwright, Pt Lay, and Pt. Hope 2008 Fall Bowhead Hunt; or the Beaufort Sea Post Season Meeting required under Section II.H.1. below, or the Chukchi Sea Post-Season Village (Barrow, Wainwright, Pt. Lay, and Pt. Hope) Meetings required under Section II.H.2. below, whichever is later.

H. POST-SEASON REVIEW/PRESEASON INTRODUCTION

1. Nuiqsut, Kaktovik, Barrow Joint Meeting

Following the end of the fall 2008 bowhead whale subsistence hunt and prior to the 2009 Pre-Season Introduction Meetings, the Industry Participants will host a joint meeting with all whaling captains of the Villages of Nuiqsut, Kaktovik and Barrow, the Inupiat Communicator(s) (defined below) and with the Chairman and Executive Director of the AEW, at a mutually agreed upon time and place on the North Slope of Alaska, to review the results of the 2008 fall season, unless it is agreed by all designated individuals or their representatives that such a meeting is not necessary.

2. Chukchi Sea Post-Season Village Meetings

Following the completion of Chukchi Sea operations and prior to the 2009 Pre-Season Introduction Meetings, the Industry Participants involved will hold 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 operations and to discuss any concerns residents of those villages might have regarding the operations. The

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meetings will include the Inupiat Communicators stationed on the Industry Participants' Vessels in the Chukchi Sea. The Chairman and Executive Director of the AEWG will be invited to attend the meeting(s).

3. Pre-season Introduction Meetings

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 2009 open water season. Each Industry Participant should provide hand-outs explaining their planned activities that the whaling captains can review. 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 2009 Open Water Season Meeting.

4. Map of Planned Industry Participant Activities

The Industry Participants, jointly, shall prepare and provide the AEWG with a large-scale map of the Beaufort and Chukchi Seas showing the locations and types of activities planned by each Industry Participant. This map will be for use by the AEWG and Industry Participants during the 2009 CAA Meeting.

I. PRE-SEASON SOUND SIGNATURE TESTS

For purposes of obtaining a sound signature for Industry Participants' sound sources, the Industry Participants shall conduct a test of both the geophysical equipment and the Vessels identified in the Appendices to this Agreement, within 72 hours of initiating or having initiated operations in the Beaufort or Chukchi Seas. 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.

Each sound signature test shall be conducted at a site mutually agreed upon by the Industry Participant conducting such test and the AEWG. Each Industry Participant conducting such sound signature test(s) shall provide a minimum of three weeks notice to the AEWG. For sound signature tests conducted in the Beaufort Sea, the Industry Participant conducting such tests shall provide transportation for a mutually agreed number of representatives from each of: the AEWG, the whaling captains of the Villages of Barrow, Nuiqsut, and Kaktovik, and the NSB DWM to observe the sound signature tests. For sound signature tests conducted in the Chukchi Sea, the Industry Participant conducting such

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tests shall provide transportation for a mutually agreed number of representative each from the AEW, the whaling captains of the Villages of Barrow, Wainwright and Pt. Hope, and the NSB DWM to observe the sound signature tests.

Within five (5) days of completing the test(s), each Industry Participant and/or its contractor conducting such test(s) will make all data collected during the test(s) available upon request to the AEW and NSBDWM and will provide the AEW and NSBDWM the preliminary analysis of that data, as well as any other sound signature data that is available and that the AEW, the NSB Department of Wildlife Management, 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. The final data analysis will be provided to the AEW and the NSB Department of Wildlife Management as soon as it becomes available to the Industry Participant. 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 AEW and the NSB Department of Wildlife Management.

J. MONITORING PLANS

Each Industry Participant agrees to prepare and implement a noise impact study monitoring plan ("Monitoring Plan: Attachment III") to collect data designed to determine the effects of its operations on fall migrating bowhead whales and other affected marine mammals. Industry Participants whose operations are limited exclusively to vessel traffic will submit sound signature data for each vessel they are using and marine mammal sighting data.

The Monitoring Plans shall be designed in cooperation with the AEW, the NSB Department of Wildlife Management, NOAA Fisheries, the U.S. Minerals Management Service, (MMS) and any other entities or individuals designated by one of these organizations.

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.

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.

Prior impact study results shall be incorporated into the Monitoring Plans

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prepared by each Industry Participant. Each such Monitoring Plan shall be subject to stake-holder peer review at the 2008 Open Water Season Peer Review Meeting convened by NOAA Fisheries. Draft plans will be submitted to the North Slope Borough and Alaska Eskimo Whaling Commission three weeks prior to the Open Water Meeting. Peer review and acceptance of each such Monitoring plan through this process shall be completed prior to the commencement of each Industry Participants' 2008 operations in the Beaufort or Chukchi Seas. Each completed, peer reviewed, and approved Monitoring Plan shall be part of the IHA issued by NOAA Fisheries for each Industry Participant who has applied for an IHA, or who is required to engage in monitoring pursuant to a North Slope Borough permit.

Each Industry Participant conducting site-specific monitoring will make raw data, including datasheets, field notes, and electronic data, available to the NSB at the end of the season.

Each Industry Participant conducting site-specific monitoring will permit and encourage open communications among their contractors and the AEW and North Slope Borough.

Each Industry Participant will submit a summary of monitoring plan results and progress to the AEW and North Slope Borough every two weeks during the operating season.

K. 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 2008. The results of this workshop will be presented at the 2009 Open Water Meeting.

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III. OPEN WATER SEASON COMMUNICATIONS EQUIPMENT AND PROCEDURES

A. COMMUNICATIONS EQUIPMENT

1. Communications Equipment to be Provided to Subsistence Whale Hunting Crews

The Industry Participants will provide (or participate in the provision of) the communications equipment described in Sections III.A.1.a. and III.A.1.b. The Industry Participants conducting operations in the Beaufort Sea will fund the provision of communications equipment for the whaling captains of Kaktovik and Nuiqsut. The Industry participants conducting operations in the Chukchi Sea will fund the provision of communications equipment for the whaling captains of Barrow, Wainwright, Pt. Hope, and Pt. Lay.

a. All-Channel, Water-Resistant VHF Radios:

- i) Kaktovik Subsistence Whaling Boats: 8
- ii) Kaktovik Base and Search and Rescue: 2
- iii) Nuiqsut Subsistence Whaling Boats: 12
- iv) Nuiqsut Base and Search and Rescue: 3
- v) Barrow Base and Search and Rescue: 2
- vi) Wainwright base and Search and Rescue: 2
- vii) Wainwright Subsistence Whaling Boats: 4
- viii) Pt. Hope Base and Search and Rescue: 2
- ix) Pt. Hope Subsistence Whaling Boats: 10
- x) Pt. Lay Base and Search and Rescue: 2
- xi) Pt. Lay Subsistence Whaling Boats: 4

These VHF radios are specifically designed for marine use and allow monitoring of Channel 16 while using or listening to another channel. The whaling boats from each of the two villages have been assigned individual VHF channels for vessel-to-vessel and vessel-to-Com-Center communications. The Nuiqsut whaling crews will use Channel 68. Channel 69 will be used by the Kaktovik whaling crews. Channel 72 will be used by Barrow whaling crews. The Wainwright Whaling Crews will use Channel 12. The Pt. Lay Whaling Crews will use Channel 72. The Pt. Hope Whaling Crews will use Channel 68..

b. Satellite Telephones:

- i) Kaktovik Base Phones: 2

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- ii) Kaktovik Subsistence Whaling Boats: 8
- iii) Nuiqsut Base Phones: 2
- iv) Nuiqsut Subsistence Whaling Boats: 12
- v) Barrow Subsistence Whaling Boats: 2
- vi) Wainwright Subsistence Whaling Boats: 4
- vii) Pt. Lay Subsistence Whaling Boats: 2

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.

c. Distribution and Return of Equipment: the distribution of the VHF radios, and satellite telephone equipment to whaling captains for use during the 2008 fall bowhead subsistence whale hunting season shall be completed no later than August 15, 2008. All such units and telephone equipment provided under this Agreement, whether in this Section or otherwise, will be returned by the Subsistence Participants promptly to the Industry Participant or the person providing such units and equipment at the end of each Village's 2008 fall bowhead whale subsistence hunt.

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

The 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 on-board communicators have been assigned Channel 7 for their exclusive use in communicating with the Com-Center.

3. Radio Installation and User Training

The Whaling captains of Nuiqsut, Kaktovik, Wainwright 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, 2008, as scheduled by the Whaling Captains' Associations of Nuiqsut, Kaktovik, Barrow, Wainwright, Pt. Lay, Pt. Hope and the Industry Participant operating the Com-Centers.

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B. THE COMMUNICATIONS SYSTEM COORDINATION CENTERS (COM-CENTERS) Note: 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.

1. Set Up and Operation

Subject to the terms of Section II.B. of this Agreement, the Industry Participants conducting operations in the Beaufort Sea jointly will arrange for the funding of Com-Centers in Deadhorse and Kaktovik, and the Industry Participants conducting operations in the Chukchi Sea jointly will arrange for the funding of Com-Centers in Barrow, Wainwright, and Pt. Hope. All five 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 2008 subsistence bowhead whale hunt. One of the Industry Participants or its contractor will be designated as the operator of the Com-Centers, then the operator shall be designated AEWG. Each Industry Participant shall contribute to the funding of the Com-Centers covering the areas in which it conducts 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. The procedure to be followed by the Com-Center Operators are set forth below.

2. Staffing

Each Com-Center shall have an operator ("Com-Center Operator") on duty 24 hours per day from the third week of August until the end of the bowhead whale subsistence hunt in Kaktovik for the Kaktovik Com-Center; Nuiqsut for the Deadhorse Com-Center; Barrow for the Barrow Com-Center; Wainwright for the Wainwright Com-Center; **Pt. Lay for the Pt. Lay Com-Center, which will be located in the Pt. Lay Whaling Captains' Association building; and Pt. Hope for the Pt. Hope Com-Center, which will be located in the Pt. Hope Whaling Captains' Association building.** All Com-Center staff shall be local hire.

3. Duties of the Com-Center Operators

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 Section II.C., Section II.D.

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or Section II.E of this Agreement. The record of all reporting calls should contain the following information:

- a. Industry Vessel:
 - i) Name of caller/vessel.
 - ii) Vessel location/speed/direction.
 - iii) Time of call.
 - iv) Anticipated movements between this call and the next report.
 - v) Reports of any industry/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/whale or whaler conflict.

- c. 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:
 - i) Name of industry vessel.
 - ii) Name of subsistence whaling captain.
 - iii) Location of vessels.
 - iv) Nature of conflict.

If all Vessels and boats covered by Section II. C., Section II.D. or Section II.E 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.

As soon as location information is provided by a Vessel or boat covered by Section II.C., Section II.D. or Section II.E 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.

If, in receiving information or plotting it, a Com-Center Operator observes that operations by Industry Participants might conflict with subsistence whaling activities,

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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.

C. COM-CENTER GENERAL COMMUNICATIONS SCHEME

1. Reporting Positions for Vessels Owned or Operated by the Industry Participants

All Vessels shall report to the appropriate Com-Center at least once every six hours commencing with a call at 06:00 hours. Each call shall report the following information:

- a. Vessel name/operator of vessel/charter of vessel/project.
- b. Vessel location/speed/direction.
- c. Plans for movement between the time of the call and the time of the next call; furthermore, 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 Northstar Island. 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.

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 announce 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.

2. Reporting Positions for Subsistence Whale Hunting Crews

- a. 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. All subsistence whaling captains shall report to such Com-Center the initial GPS coordinates of their whaling camps. Additional communications shall be made on an as needed basis. Each call shall report the following information:

- i) The crew's location and general direction of travel:

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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.

ii) 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 below in Section V, on Avoiding Conflicts.

iii) 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.

b. 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 _____.

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

d. 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.

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

D. OBTAINING INFORMATION

1. Monitoring VHF Channel 16

All vessels covered by parts II.C., II.D., and II.E. of this Agreement should 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 Section II.C. or Section II.D. of this Agreement to determine the positions of all of their vessels and to

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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 Section II.C. or Section II.D. of this Agreement has been informed of or has determined the location of subsistence whale hunting boats in its vicinity, the On-Board Communicator is encouraged to contact those boats in order to coordinate movement and take necessary avoidance precautions.

E. THE ON-BOARD INUPIAT COMMUNICATOR

1. Employment and Duties of the Communicator

Each Vessel owned or operated by each of the Industry Participants other than those limited exclusively to vessel traffic, shall employ an On-Board Inupiat Communicator (Communicator). Industry Participants whose seismic acquisition operations are limited to an area exclusively within the barrier islands need employ a Communicator on its sound source vessel only. Each Communicator is to be employed as a Marine Mammal Monitor for the duration of the 2008 operating season on the source Vessel on which he or she is stationed.

As a member of the crew, the Communicator 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.

Once the source Vessel on which the Communicator is employed is in the vicinity of a whaling area and the whalers have launched their boats, the Communicator's primary duty will be to carry out the communications responsibilities set out in these guidelines. At all other times, the Communicator 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.

2. Communications

It is the Communicator's responsibility to call the appropriate Center as set out in Section III.B. above. The Communicator will be responsible for all radio contacts between Vessels owned or operated by

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each of the Industry Participants and whaling boats covered under Sections II.C. and D. 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.

The Communicator is encouraged to contact directly subsistence whaling boats that may be in the vicinity to ensure that conflicts are avoided to the greatest possible extent.

The Communicator will maintain a record of his or her communications with each Com-Center and the subsistence whaling boats.

F. STANDARDIZED LOG BOOKS

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

IV. AVOIDING CONFLICTS DURING THE 2008 OPEN WATER SEASON

Federal law requires that offshore oil and gas activities **will not have an unmitigable adverse impact on the availability of marine mammal resources for taking for subsistence uses.** (MMPA §§ 100 (a)(5)(A), (D)).

To assist the Industry Participants in meeting this statutory requirement, the following Operating Guidelines apply throughout the bowhead whale migration in the Beaufort and Chukchi Seas, 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.

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

1. Routing Vessels and Aircraft

- a. 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 (as reported pursuant to Section III.C.2. above) whaling activity.

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b. Beaufort Sea

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

c. Chukchi Sea

Vessels should remain a minimum of 30 miles offshore during transit.

2. Aircraft Altitude Floor and Flight Path

AIRCRAFT SHALL NOT OPERATE BELOW 1500 FEET unless approaching, landing or taking off, or unless engaged in providing assistance to a whaler or in poor weather (low ceilings) or other emergency situations.

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.

3. 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 kts in the proximity of feeding whales or whale aggregations.

4. Vessels Operating in Proximity to 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:

- a. reducing vessel speed within 900 feet of the whale(s);
- b. steering around the whale(s) if possible;

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- c. operating the Vessel(s) in such a way as to avoid separating members of a group of whales from other members of the group;
- d. operating the Vessel(s) to avoid causing a whale to make multiple changes in direction; and
- e. checking the waters immediately adjacent to the Vessel(s) to ensure that no whales will be injured when the propellers are engaged.

5. Good Faith Understanding of Vessel Traffic after August 15, 2008

After August 15, 2008 an Industry Participant conducting Vessel traffic within the bowhead migration route shall first consult with the AEWC and affected village whaling captains when the bowhead whale migration is in motion. It is understood that any supply vessels that are caught in the ice or the circulating ice pack will stay close to the ice edge or 35 miles offshore, whichever distance is closer to shore, throughout the migration route and during the subsistence whaling activities. As used in this paragraph, "migration route" means the fall bowhead whale migration beginning in the Canadian Beaufort Sea and extending to St. Lawrence Island, Alaska. If any operator requires emergency vessel movement, the Operating Guidelines set forth in this Section IV. of this Agreement will dictate the procedures to be followed.

B. OPERATING LIMITATIONS1. Geophysical Operations

The AEWC agrees to this 2008 CAA with the understanding that **only** two (2) geophysical operations will occur at any one time in either the Beaufort or the Chukchi Seas. The Industry Participants conducting geophysical 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. The following operating limitations are to be observed and the operations are to be accompanied by a Monitoring Plan as set forth in Section II.J. and Attachment III. of this Agreement.

a. Beaufort Sea

All geophysical activity in the Beaufort Sea shall be confined

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as set forth below.

(i) Kaktovik: No geophysical activity from the Canadian border to the Canning River (~146 deg. 4 min. W) from 10 August to close of fall bowhead whale hunt in Kaktovik and Nuiqsut.¹

(ii) 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 allowed from August 5 until completion of operations²

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

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

(iii) 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 15 September to close of fall bowhead whale hunting in Barrow.

b. Chukchi Sea

(i) Geophysical activity may not commence in the Chukchi Sea prior to July 20, 2008.

¹ Marine mammal subsistence hunting in any village shall be considered closed when the hunt in that village has ended, or in the case of the bowhead whale subsistence hunt, the village quota has been exhausted (as announced by the village Whaling Captains' Association or the AEWC).

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 in³.

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(ii) Geophysical activity may occur beginning July 20 and ending September 10, 2008, unless otherwise specifically authorized by the Whaling Captains' Associations of Wainwright, Pt. Lay, and Pt. Hope, and the AEW, but in any case no closer than 60 miles from the Chukchi Sea coast at any point.

(iii) Geophysical exploration may resume following the close of the fall 2008 bowhead whale subsistence hunt in Barrow, Wainwright, Pt. Lay, and Pt. Hope, unless specifically authorized by the Whaling Captains' Associations of Barrow, Wainwright, Pt. Lay, and Pt. Hope, and the AEW.

(iv) Safe harbor will not be taken within 50 miles of any village, except when human life is in danger, and then ships shall be moved to a distance of at least 50 miles from the village at the earliest possible opportunity, and shall be moved out to sea as soon as weather permits.

(v) Any vessel operating within 60 miles of the Chukchi Sea coast will follow the communications procedures set forth in Section III of this Agreement. All vessels will adhere to the conflict avoidance measures set forth in Section IV.A. of this Agreement.

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

2. Drilling Operations

a. Zero Discharge of Drilling Muds, Cuttings, Ballast Water, and Produced Water

For all drilling operations, whether for exploration, development, or production, in the Beaufort, Chukchi, and Bering Seas habitat of the bowhead whale, no discharge of drilling muds, cuttings, ballast water, or produced water shall be allowed into the marine environment. All such material shall be disposed of through reinjection or backhaul for onshore disposal.

b. Sampling of Drilling Muds and Cuttings

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For all exploratory drilling operations, in the Beaufort, Chukchi, and Bering Seas habitat of the bowhead whale, the operator, upon written request by the AEW, shall cooperate with the AEW and North Slope Borough in the collection of samples, by representatives of the NSB Department of Wildlife Management, from all drilling muds and cuttings, irrespective of storage or disposal procedures.

c. Monitoring of Gray Water, Black Water, and Heated Water

For all exploratory drilling operations in the Beaufort, Chukchi, and Bering Seas habitat of the bowhead whale, the operator shall cooperate with the AEW 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 Arctic Ocean.

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 **north of 71.25 N or at the edge of the arctic ice pack, whichever is closer to shore, and west of 146.4 W.**

e. 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.

C. 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.

V. REGULATORY COMPLIANCE

A. UNITED STATES COAST GUARD REQUIREMENTS

The Industry Participants shall comply with all applicable United States

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Coast Guard (USCG) requirements for safety, navigation and notice.

B. ENVIRONMENTAL REGULATIONS AND STATUTES

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

C. OTHER REGULATORY REQUIREMENTS

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

VI. DISPUTE RESOLUTION

Subject to the terms of Section II.B.7 of this Agreement, all disputes arising between any Industry participants and any Subsistence Participants shall be addressed as follows:

First between the affected Participant(s) in consultation with the affected village Whaling Captains' Association and the Industry Participant(s)' Local Representative.

If the dispute cannot be resolved to the satisfaction of all affected Participants, it shall be addressed by the affected Participants in consultation with the AEWC.

If the dispute cannot be satisfactorily resolved in this manner, it shall be addressed with the AEWC and the Participants in consultation with representatives of NOAA Fisheries.

VII. 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 appropriated 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

33 U.S.C. 916c provides for the use of a vessel to tow a whale taken in a

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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.

VIII. OIL SPILL MITIGATION

Unless otherwise agreed with the AEWC, Industry Operators engaged in oil production or in drilling operations in or near known or suspected oil reservoirs will agree to adhere to the AEWC/NSB/Inupiat Community of the Arctic Slope oil spill mitigation agreement. **(GNP) This must be completed by Shell for this 2008 CAA for the drilling operations in Camden Bay.**

APPENDIX D: DESCRIPTION OF VESSELS AND EQUIPMENT

Vessels

M/V Gilavar



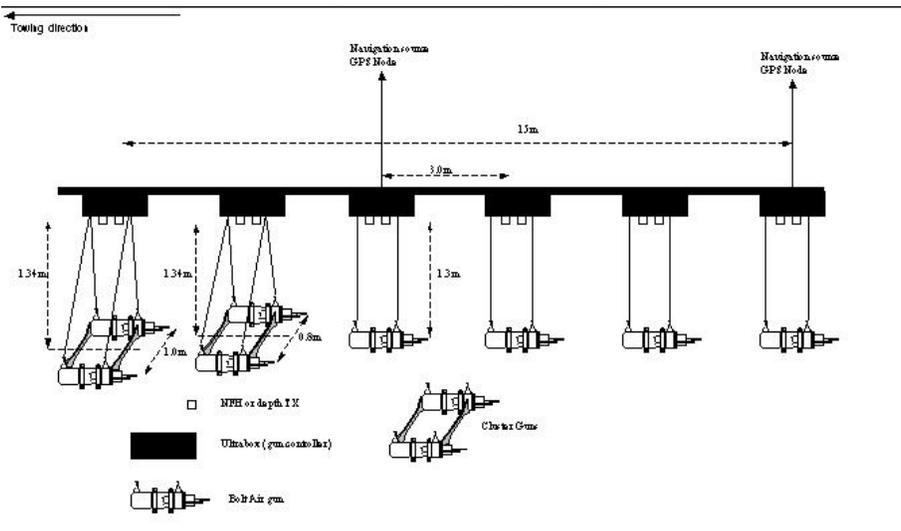
SOI's seismic source vessel, the *Gilavar*, was built in Norway in 1981. The *Gilavar* is owned by Caspian Geophysical Ltd., of Baku, Azerbaijan, and its current port of registry is Panama. The overall length of the *Gilavar* is 84.9 m (279 ft) and its gross tonnage is 3779 metric tons with a mean draft of 5.9 m (19 ft). The total fuel capacity of the *Gilavar* is 916 m³ with a fuel consumption rate ranging from 24 to 35 m³ per day. The *Gilavar* has a helicopter deck rated for a Bell 214 or Super Puma. The *Gilavar* is equipped with fresh water making capabilities, and a sludge and waste oil incinerator.

Airgun Description and Safety Radii: *Gilavar*

Aboard the *Gilavar*, SOI used WesternGeco's 3147 in³ Bolt-Gun Array for its 3-D seismic survey operations in the Chukchi Sea. WesternGeco's source arrays were composed of three identically tuned Bolt-Gun sub-arrays operated at an air pressure of 2000 psi. Each sub-array was 15 m in length, and was 8 m from the adjacent array(s). The individual airguns ranged in volume from 30 to 235 in³, and each sub-array included two 235 in³ and two 125 in³ airguns in two-gun clusters. A 30 in³ airgun was used for mitigation when marine mammals were observed within or about to enter the applicable safety radius. The airgun arrays were towed at a depth of 6 m. The system also included four to six hydrophone streamers with hydrophones distributed over a length of 4200 m and spaced 100 m apart, which recorded reflected sound energy. Air compressors aboard the *Gilavar* were the source of high pressure air used to operate the airgun arrays. Seismic pulses were emitted at intervals of 25 m (~10 sec) while the *Gilavar* traveled at a speed of 4 to 5 knots (7.4–9.3 km/h). In general, the *Gilavar* towed this system along a predetermined survey track, although adjustments were occasionally made during the field season to avoid obstacles or during repairs to the equipment.

In general, the signature produced by an array composed of multiple sub-arrays has the same shape as that produced by a single sub-array while the overall acoustic output of the array is determined by the number of sub-arrays employed. The gun arrangement for each of the three 1049-in³ sub-arrays was detailed in SOI's IHA application. As indicated in the application's diagram, each sub-array was composed of six tuning elements; two 2-gun clusters and four single guns. The standard configuration of a source array for 3-D surveys consists of one or more 1049 in³ sub-arrays. When more than one sub-array is used, as here, the arrays are lined up parallel to each other with 8 m (26 ft) cross-line separation between them. This separation was chosen to minimize the dimensions of the array in order to approximate point source radiation characteristics for frequencies in the nominal seismic processing band. For the 3147 in³ array the overall dimensions were 15 m (49 ft) long by 16 m (52.5 ft) wide.

Standard 1049 in³ sub-array - 3 subarrays comprise each 3147 in³ Source



Information on WesternGeco's source arrays was taken from the IHA application.

As noted above, the sub-array was composed of six tuning elements; two 2-gun clusters and four single guns. The clusters had their component guns arranged in a fixed side-by-side fashion with the distance between the gun ports set to maximize the bubble suppression effects of clustered guns. A near-field hydrophone was mounted about 1 m above each gun station (one phone was used per cluster). One depth transducer per position was mounted on the gun's ultrabox, and a high pressure transducer was mounted at the aft end of the sub-array to monitor high pressure air supply. All the data from these sensors were transmitted to the vessel for input into the onboard systems and recording to tape.

M/V Henry Christoffersen

The *Henry Christoffersen* was built in Victoria, B.C., Canada, and is owned by Northern Transportation Company, Ltd. Its port of registry is Edmonton, Alberta, Canada. The overall length of the *Henry Christoffersen* is 47 m (153 ft) and the gross tonnage is 783 metric tons. The *Henry Christoffersen* is powered by four Caterpillar V16 D399 diesel engines and can travel at a speed of 14 knots. The fuel capacity of the *Henry Christoffersen* is 313 m³ and the fuel consumption rate is ~13.2 m³ per day. The *Henry Christoffersen* conducted shallow hazards and site clearance surveys in the Beaufort Sea during the 2007 open-water season.

High-Resolution Seismic Profiling

Reflected sound energy, often called acoustic or seismic energy, can produce graphic images of seafloor and sub-seafloor features. High-resolution profiling systems transmit the acoustic energy from various sources called transducers that are attached to the hull of the vessel or towed astern. Part of this energy is reflected from the seafloor and from geologic strata below the seafloor. This reflected energy is received by one or more hydrophones or a streamer, and the signals are recorded to produce seismic records or profiles. Seismic profiles often take the form of geologic cross-sections along the course traveled by the survey vessel.

The *Henry Christoffersen* operated several high-resolution profiling systems simultaneously in the Beaufort Sea to obtain detailed records of seafloor and near seafloor conditions. A typical survey included

- a dual-frequency sub-bottom profiler (Datasonics CAP6000 Chirp II; 2–7 or 8–23 kHz) as a shallow penetration or sub-bottom profiler; transducer depth ~1 m; pulse interval 0.25–5 sec;
- a Datasonics SPR-1200 Bubble Pulser as a medium penetration system, nominally operating at 400 Hz and pulse interval 0.5–5 sec (but see Chapter 3 for empirical data on measured frequency output);
- a high resolution multi-channel seismic system comprised of a two 10 in³ airgun array with a total volume of 20 in³ with predominant output at 0–150 Hz. This small airgun system should not be confused with the much larger system deployed from the *Gilavar* for deep-penetration seismic exploration for hydrocarbons.

These profiling systems complement each other since each system achieves different degrees of resolution and depths of sub-seafloor penetrations.

Side Scan Sonar

SOI used a Datasonics SIS-1500 side scan sonar system to collect data on seafloor topography. Unlike seismic profiling systems, which produce a vertical profile along the vessel's path, side scan sonar systems provide graphic records that show two-dimensional (map) views of seafloor topography and of objects on the seafloor. The sonar images provide a swath display/record covering an area on the seafloor up to several hundred feet on both sides of the survey trackline. The side scan sonar transmits very high-frequency acoustic signals (190–210 kHz) and records the reflected energy from the seafloor. Signals reflected from the seafloor are displayed on a continuous record produced by a two-channel recorder. Reflected signals normally appear as dark areas on the record whereas shadows behind objects appear as light or white areas. The intensity and distribution of reflections displayed on the sonar image depend on the composition and surface texture of the reflecting features, on their size, and on their orientation with respect to the transducers. Line spacing and display range are designed to ensure 100 percent coverage of the proposed survey area in the prime survey line direction, with additional tie-lines acquired in an orthogonal direction. Side scan sonar data are useful for mapping areas of boulders, rock outcrops, and other areas of rough seafloor, and for determining the location and trends of seafloor scarps and ice gouges. These data are also used to locate shipwrecks, pipelines, and other objects on the seafloor.

Multi-beam Bathymetry

A Seabat 8101 multi-beam bathymetric sonar was used to determine water depths in the surveyed area. Multi-beam bathymetric systems are either hull mounted or towed astern of the survey vessel. The system transmits acoustic signals (200–500 kHz; 240 kHz in this project) from multiple projectors propagating to either side of the vessel at angles that vary from vertical to near horizontal. The locations of the soundings cover a swath whose width may be equal to many times the water depth. By adjusting the spacing of the survey tracklines such that adjacent swaths overlap, SOI obtained depth information for 100 percent of the bottom in the survey area. The time required to receive the signals as well as signal intensity, position, and other characteristics for echoes received across the swath were used to calculate the depth where each individual beam in the swath reached the bottom. Acoustic systems similar to the ones used by SOI have been described in detail by NMFS previously (see 66 FR 40996, 6 Aug 2001; 70 FR 13466, 21 Mar 2005).

R/V Cape Flattery

The R/V *Cape Flattery* was built in 1990 by McDermott, Inc. and its home port is Seattle. The *Cape Flattery* has an overall length of 56.7 m (186 ft) and a width of 12.2 m (40 ft). The gross tonnage is 496 GRT. The *Cape Flattery* is powered by a Cummins KTA 50, 1250 hp engine with reinjes wav870 7x1 reduction gear and a bow thruster. The maximum speed of the *Caper Flattery* is 12 kt and fuel consumption is 1700 gal/day at 11 kt. The vessel has a fuel capacity of 246 m³ and a range of 6000 mi. There are three Cummins 1728 generator engines, three 650 kW generators, and one Cummins nt855 auxiliary power unit. The *Cape Flattery* had a 10-ton crane with a 72 in reach and a 3-ton knuckle boon with a 36 in reach. The draft when loaded is ~3.7 m (12 ft). The upper deck space on the *Cape Flattery* has 171 m² (1840 ft²) of space on the main deck and 59 m² (640 ft²) on the upper deck. The *Cape Flattery* will accommodate a crew of four plus 36 passengers.

The *Cape Flattery* conducted shallow hazards and site clearance surveys for SOI in the Chukchi Sea in 2008. High resolution profiling systems onboard the *Cape Flattery* included

- a small airgun array comprised of four-10in³ airguns;
- a Reson Seabat 7125 Multi-beam Echo Sounder;
- an Odom Echotrack MK III Echo Sounder;
- an Oceanscience UCTD;
- a 100 kHz side scan sonar;
- a 3.5 kHz sub-bottom profiler;
- a 400 Hz bubble pulser.

R/V Alpha Helix



In addition to the Henry C. SOI also used the R/V Alpha Helix to conduct shallow hazard surveys in the Beaufort Sea. The Alpha Helix later assisted the Cape Flattery during shallow hazards surveys in the Chukchi Sea.

The *Alpha Helix* is an oceanographic research vessel built in 1966. Its overall length is 40.5 m (133 ft) and the width is 9.4 m (31 ft) with a draft of 4.2 m (13.8 ft) when loaded. The gross tonnage is 289 GRT. The main engine is an EMD-8-567CR with a total of 820 horsepower at 800 rpm. The *Alpha Helix* has variable pitch propellers and cruising speed is 10 kt with a maximum speed to 11 kt. The range is 6500 miles at 9.5 kt. The *Alpha Helix* has three Detroit 8V71 diesel generators and is equipped with a 1500 kg (3300 lb) A frame, a S.W.L. deck crane, and a bow thruster. The fuel capacity is 87 m³ (29,250 gal) and the potable water storage capacity is 5000 gal. The aft deck is 1280 ft², and the Alpha Helix has an 7.5 m² (81 ft²) wet lab and a 42.5 m² (457 ft²) dry lab. The Alpha Helix has an eight person crew with space for 15 scientists.

High resolution profiling systems onboard the *Alpha Helix* included

- a small airgun array comprised of two-10in³ airguns;
- a 3.5 kHz sub-bottom profiler;

M/V Gulf Provider



The *Gulf Provider* was the Gilavar's primary supply vessel and also served as monitoring vessel during the 2008 seismic surveys in the Chukchi and Beaufort seas. The *Gulf Provider* was built in Jennings, Louisiana, in 1979 and was re-built in 2001. The current port of registry is Panama. The overall length of the *Gulf Provider* is 57.8 m (190 ft) and the gross tonnage is 926 metric tons. The fuel capacity of the *Gulf Provider* is 530 m³ (140,000 gal) and the fuel consumption rate is 6-10 m³ (1585–2641 gal) per day. The *Gulf Provider* is powered by two Caterpillar D-399 diesel engines and is equipped with a waste oil and sludge incinerator.

M/V Theresa Marie



The *Theresa Marie* was built in Seattle in 1974 and the home port is Petersburg, Alaska. The overall length of the *Theresa Marie* is 28 m (93 ft) and the width is 9 m (30 ft) with a gross tonnage of 190 tons. The main deck is ~21 x 9 m (70 x 30 ft) and supports a module used for bunk space and showers, and a lounge area. A second module on the main deck houses a watermaker and space for heated storage. A 6-ton hydraulic crane with a safe working capacity of 2700 lbs and extended reach of 10 m (33 ft) is located on the port side. The vessel is powered by a 940 hp 16V149 Detroit diesel attached to a Twin Disc MG 5301 with 5.98:1 reduction driving a 1.9 m (76 in) propeller. A new drive train was installed in the *Theresa Marie* in 2002 and the vessel is capable of 10 kt. Two generators are onboard including a Detroit Series 50 engine with a 200 kW generator on the starboard side, and a 4-71 Detroit with a 125 kW generator on the port side. The *Theresa Marie* has a capacity of 30,000 gal of fuel, 4000 gal of fresh water, 750 gal of lube oil, 260 gal of hydraulic oil, 160 gal of waste oil, and a 250 gal sewage holding tank.

M/V Torsvik

The *Torsvik* was one of the two primary monitoring vessels for the *Gilavar* during seismic exploration activities in the Chukchi and Beaufort seas in 2008. The *Torsvik* was built in Denmark in 1979 and the home port is Hósvík, Faroe Islands. The overall length of the *Torsvik* is 39.2 m (129 ft), the width is 8.5 m (28 ft), and the gross weight is 370 metric tons. The fuel capacity of the *Torsvik* is 180 m³ (47,550 gal), and the draft is 3.75 m (12 ft). The *Torsvik* is powered by an 880 BHP (648 KW) B & W Alpha Diesel, type 408/26V0 engine. The maximum speed of the *Torsvik* is 12 kt with a cruising speed of 10 kt. The *Torsvik* is equipped with three 55 kW type ECC-BRF-250 generators, one crane, two winches, and water maker. The *Torsvik* has a bunk capacity for 31 people.

MV Norseman II



The *Norseman II* was built in Seattle at the Marco Shipyard in 1979. In 2007 the *Norseman II* underwent major modification adding the new dining, work area and lounge along with 4 staterooms and bathrooms. The vessel measures 115 ft in length, 27 ft wide and draws 13 ft when loaded. The main engine is a Caterpillar 398 operating at 850 hp. The gross tonnage is 199 tons. Fuel capacity is 44,000 gallons and cruising speed is 10.5 knots. The *Norseman II* operated as a chase/monitoring vessel for the *Gilavar*, and was involved in the deployment and retrieval of acoustic equipment in both the Chukchi and Beaufort seas in 2007.

APPENDIX E: UNDERWATER SOUND MEASUREMENT RESULTS

English Units Tables and Figures from Chapter 3

Table 1. *MV Gilivar* SSV coordinates, Kakapo Prospect, Alaska. (ref. **Error! Reference source not found.**)

	Latitude	Longitude	UTM (N)	UTM (E)	DEPTH (ft)
OBH A	70.0440 N	165.7082 W	7770931	473024	140
OBH B	70.0370 N	145.6749 W	7770143	474284	130
OBH C	70.0088 N	165.5422 W	7766941	479313	130
OBH D	69.8792 N	164.9451 W	7752397	502107	120
OBH E	69.9932 N	165.8152 W	7765322	468873	140
OBH F	69.6643 N	166.4000 W	7729061	445701	130
Point X	70.0464 N	165.7192 W	7771207	472612	140
Start	70.4258 N	165.0134 W	7813353	469921	140
Stop	70.2066 N	165.4251 W	7788969	483949	140

Table 2. *MV Gilivar* SSV survey line and OBH deployment locations, and water depths for the Como prospect. (ref. **Error! Reference source not found.**)

Location	Latitude	Longitude	Water Depth	CPA (ft)
OBH A	70° 58.714'W	151° 26.528'W	63.6 ft	2090
OBH B	70° 59.366'N	151° 25.265'W	64.6 ft	6790
OBH C	71° 02.034'N	151° 19.815'W	69.6 ft	26340
OBH D	71° 18.220'N	150° 46.510'W	78.7 ft	131490
OBH E	71° 00.520'N	151° 36.779'W	66.6 ft	280
OBH F	71° 14.492'N	152° 43.938'W	138 ft	147210
Gilivar Track Start	70° 43.460'N	150° 19.070' W	63.0 ft	–
Gilivar Track End	70° 59.921' N	151° 33.968' W	65.9 ft	–

Table 3. Deployment locations, water depth, and total deployment period (deployment to recovery) of the OBH recorders for the sound level measurements. (ref. **Error! Reference source not found.**)

OBH	Latitude	Longitude	Water Depth	Total Deployment Period (Hours)
S02	70° 24' 27.5981" N	146° 02' 28.8311" W	108 ft	17.3
S03	70° 24' 05.3888" N	146° 03' 24.6975" W	108 ft	17.1

Table 4. Forward-endfire sound level threshold distances for the full 3147 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	1200	1500
180	3600	4600
170	10000	12000
160	26000	30000
120	360000	390000

Table 5. Broadside sound level threshold distances for the full 3147 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	1800	2000
180	5600	6600
170	17000	19000
160	39000	43000
120	250000*	250000*

*Extrapolated from maximum measurement range of 34.9 km (21.7 mi).

Table 6. Sound level threshold distances for the 30 in³ mitigation airgun. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	460*	520*
180	1000*	1200*
170	2300*	2700*
160	5200*	6200*
120	130000	150000

*Extrapolated from minimum measurement range of 8 km (5 mi).

Table 7. Maximum cumulative SEL for each OBH off the seismic survey line. (ref. **Error! Reference source not found.**)

Distance off seismic survey line	Cumulative SEL (dB re 1 μ Pa ² s)				
	Flat-weighted	Low Frequency Cetaceans	Mid-Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds underwater
0.31 mi	196.3	195.8	186.1	184.0	190.0
1.2 mi	190.8	190.3	182.7	180.8	185.9
5 mi	185.6	185.5	180.5	178.6	183.4

Table 8. Best fit (least squares) equation to cumulative SEL vs. range for different m-weighting and distances to injury criterion proposed by Southall et al. (2007). (ref. **Error! Reference source not found.**)

Weighting	Best fit equation	Injury Criteria (dB re 1 $\mu\text{Pa}^2\text{s}$)	Distance to Injury Criteria (ft)
Flat	RL = 193.6 – 8.9 LOG R	-	-
LFC	RL = 193.1 – 8.6 LOG R	198	890
MFC	RL = 184.5 – 4.7 LOG R	198	3
HFC	RL = 182.5 – 4.5 LOG R	198	3
PINN	RL = 188.1 – 5.5 LOG R	186	7900

Table 9. Sound level threshold distances for the support vessel *RV Norseman II* at 10.4 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μPa)	Best fit range (ft)	90 th percentile range (ft)
140	100	190
130	620	1100
120	3600	7000

Table 10. Sound level threshold distances for the *MV Gilavar* at 3.8 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μPa)	Best fit range (ft)	90 th percentile range (ft)
140	720*	890*
130	4600	5600
120	29000	36000

*Extrapolated from minimum measurement range of 500 m (0.31 mi).

Table 11. Aft sound level threshold distances for the *Gulf Provider* at 12.6 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μPa)	Best fit range (ft)	90 th percentile range (ft)
140	250*	310*
130	3000	3600
120	30000	43000

*Extrapolated from minimum measurement range of 350 m (1150 ft).

Table 12. Forward sound level threshold distances for the *Gulf Provider* at 12.6 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μPa)	Best fit range (ft)	90 th percentile range (ft)
140	110*	130*
130	890*	1000*
120	6900	7900

*Extrapolated from minimum measurement range of 350 m (1150 ft).

Table 13. Aft sound level threshold distances for the *Torsvik* at 12.0 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	240*	260*
130	1500	1600
120	9200	10000

*Extrapolated from minimum measurement range of 630 m (2060 ft).

Table 14. Forward sound level threshold distances for the *Torsvik* at 12.0 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	52*	72*
130	490	700
120	4300	5900

*Extrapolated from minimum measurement range of 630 m (2060 ft).

Table 15. Sound level threshold distances for the *Theresa Marie* at 10.5 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	52*	79*
130	820	1200
120	13000	19000

*Extrapolated from minimum measurement range of 100 m (330 ft).

Table 16 - Times, locations, and water depths of the twelve temperature and salinity profile casts obtained during the present study. (ref. **Error! Reference source not found.**)

Station	Time (AKDT)	Latitude	Longitude	Max Depth (ft)
OBH A	5/Sep/08 11:16	70° 58.7'N	151° 25.5'W	62
OBH A	6/Sep/08 12:28	70° 58.7'N	151° 25.5'W	62
OBH B	5/Sep/08 12:38	70° 59.4'N	151° 25.3'W	62
OBH B	6/Sep/08 12:54	70° 59.4'N	151° 25.3'W	62
OBH C	5/Sep/08 13:32	71° 02.0'N	151° 19.8'W	69
OBH C	6/Sep/08 13:51	71° 02.0'N	151° 19.8'W	69
OBH D	5/Sep/08 16:12	71° 18.2'N	151° 26.5'W	290*
OBH D	6/Sep/08 17:45	71° 18.2'N	151° 26.5'W	490*
OBH E	5/Sep/08 10:29	71° 00.5'N	151° 36.8'W	62
OBH E	6/Sep/08 11:25	71° 00.5'N	151° 36.8'W	62
OBH F	5/Sep/08 07:03	71° 14.5'N	152° 43.9'W	130
OBH F	6/Sep/08 08:08	71° 14.5'N	152° 43.9'W	130

*Depths are different here because of a lack of rope on 5-Sep. Also, the maximum operating depth of the CTD profiler was 150 m (490 ft).

Table 17. Forward-endfire sound level threshold distances for the full 3147 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	79 (†)	170 (†)
180	690	1400
170	4900	9200
160	22000	31000
150	52000	66000
140	89000	100000
130	130000	150000
120	180000	190000

(†) Distances to the 190 dB re μ Pa level were extrapolated from data at longer ranges.

Table 18. Broadside sound level threshold distances for the full 3147 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	2,500	3,000
180	8,200	9,500
170	18,000	19,000
160	30,000	31,000
150	– (†)	– (†)
140	– (†)	– (†)
130	– (†)	– (†)
120	≤ 150,000 (‡)	≤ 150,000 (‡)

(†) Due to the presence of interfering airgun signals on OBH D (45 km, or 28 mi, range at CPA), broadside threshold ranges between 150 dB and 130 dB re 1 μ Pa could not be accurately estimated.

(‡) The level of the interfering airgun signals on OBH D was approximately 120 dB re μ Pa. Therefore the 120 dB re 1 μ Pa threshold range for was constrained to less than 45 km, or 28 mi, from the array.

Table 19. Broadside sound level threshold distances for the 30 in³ mitigation airgun. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	30 (†)	43 (†)
180	150	190
170	690	890
160	3000	3,600
150	10,000	12,000
140	26,000	29,000
130	49,000	52,000
120	75,000	79,000

(†) Distances to the 190 dB re 1 μ Pa level were extrapolated from data at longer ranges.

Table 20. Maximum cumulative SEL for each OBH off the seismic survey line. (ref. **Error! Reference source not found.**)

Distance off seismic survey line	Cumulative SEL (dB re 1 $\mu\text{Pa}^2\text{s}$)				
	Flat-weighted	Low Frequency Cetaceans	Mid-Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds underwater
0.4 mi	189.5	189.5	185.5	183.7	188.0
1.2 mi	186.7	186.6	182.9	181.2	185.4
5 mi	174.2	174.2	171.6	170.3	173.4

Table 21. Sound threshold level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) from 2 x 10 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μPa)	Best fit range (ft)	90 th percentile range (ft)
190	110*	150*
180	300*	390*
170	790	1050
160	2070	2700
120	49000	59000

*Extrapolated from minimum measurement range of 190 m (623 ft).

Table 22. Sound threshold level distances for 190, 180, 170, 160 and 120 dB re 1 μPa (*rms*) from single 10 in³ airgun. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μPa)	Best fit range (ft)	90 th percentile range (ft)
190	130*	170*
180	295*	390*
170	660	850
160	1400	1900
120	36000	46000

*Extrapolated from minimum measurement range of 190 m (620 ft).

Table 23. Sound threshold level distances for 160, 150, 140, 130 and 120 dB re 1 μPa (*rms*) from the Geopulse sub-bottom profiler. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μPa)	Best fit range (ft)	90 th percentile range (ft)
190	36*	46*
180	82*	98*
170	180*	210*
160	390*	460*
120	850	1020

*Extrapolated from minimum measurement range of 190 m (620 ft).

Table 24. Sound threshold level distances for 120-150 dB re 1 μ Pa (*rms*) for the *RV Alpha Helix* sailing at 4.5 kts during operation of the 2 x 10 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
150	3.3*	3.3*
140	23*	36*
130	240*	360
120	2400	1020

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 25. Sound threshold level distances for 190, 180, 170, 160 and 120 dB re 1 μ Pa (*rms*) from 2 x 10 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	23*	33*
180	89*	120*
170	330	460
160	1200	1600
120	49000	52000

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 26. Sound threshold level distances for 190, 180, 170, 160 and 120 dB re 1 μ Pa (*rms*) from single 10 in³ airgun. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	13*	13*
180	46*	59*
170	190*	240*
160	760	920
120	46000	52000

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 27. Sound threshold level distances for 160, 150, 140, 130 and 120 dB re 1 μ Pa (*rms*) from Datasonics SPR-1200 Bubble Pulser sub-bottom profiler. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
160	20*	30*
150	75*	110*
140	280*	390
130	1020	1400
120	3300	4600

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 28. Sound threshold level distances for 160, 150, 140, 130 and 120 dB re 1 μ Pa (*rms*) from the ODEC Strata Box sub-bottom profiler. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
160	7*	10*
150	30*	39*
140	130*	170*
130	560	760
120	2400	3200

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 29. Sound threshold level distances for 120-150 dB re 1 μ Pa (*rms*) for the *MV Henry Christofferson* sailing at 3.5 kts during operation of the 2 x 10³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
150	-	-
140	43*	59*
130	560	790
120	7500	10000

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 30. Sound threshold level distances for 120-150 dB re μ Pa (*rms*) for the *MV Henry Christofferson* sailing at full speed (10 kts). (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
150	20*	36*
140	150*	250*
130	1100	1800
120	7900	13000

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 31. Sound threshold level distances for 160, 150, 140, 130 and 120 dB re 1 μ Pa (*rms*) for the sub-bottom profiler (3.5 kHz). (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
160	16*	20*
150	49*	62*
140	150*	200*
130	490*	620*
120	1600	2000

*Extrapolated from minimum measurement range of 200 m (660 ft).

Table 32. Sound threshold level distances for 100-140 dB re 1 μ Pa (*rms*) for the Alpha Helix sailing at 4.5 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	23*	30*
130	150*	220*
120	1100	1500
110	7500	11000
100	52000‡	79000‡

*Extrapolated from minimum measurement range of 200 m (660 ft).

‡Extrapolated from maximum measurement range of 8000 m (5 mi).

Table 33. Sound threshold level distances to 190, 180, 170, 160 and 120 dB re 1 μ Pa (*rms*) for the 4 x 10 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	150*	160*
180	460*	530*
170	1400	1600
160	3900	4600
120	75000‡	79000‡

*Extrapolated from minimum measurement range of 194 m (640 ft).

‡Extrapolated from maximum measurement range of 15000 m (9.3 mi).

Table 34. Sound threshold level distances to 190, 180, 170, 160 and 120 dB re 1 μ Pa (*rms*) for the 2 x 10 in³ airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	46*	56*
180	160*	200*
170	660*	760
160	2400	2700
120	79000‡	82000‡

*Extrapolated from minimum measurement range of 208 m (680 ft).

‡Extrapolated from maximum measurement range of 15000 m (9.3 mi).

Table 35. Sound threshold level distances to 190, 180, 170, 160 and 120 dB re 1 μ Pa (*rms*) for a single 10 in³ airgun. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
190	23*	26*
180	92*	105*
170	330*	390*
160	1200	1400
120	49000	52000‡

*Extrapolated from minimum measurement range of 199 m (653 ft).

‡Extrapolated from maximum measurement range of 15000 m (9.3 mi).

Table 36: Sound threshold level distances for 160, 150, 140, 130 and 120 dB re 1 μ Pa (*rms*) for the sub-bottom profiler (3.5 kHz). (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
160	36*	59*
150	110*	170*
140	320*	490
130	920	1400
120	2500	3600

*Extrapolated from minimum measurement range of 197 m (650 ft).

Table 37: Sound threshold level distances for 160, 150, 140, 130 and 120 dB re 1 μ Pa (*rms*) from bubble pulser (400 Hz) sub-bottom profiler. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
160	3*	10*
150	23*	52*
140	160*	330*
130	850	1500
120	3000	4300

*Extrapolated from minimum measurement range of 151 m (495 ft).

Table 38: Sound threshold level distances for 100-140 dB re 1 μ Pa (*rms*) for the *Cape Flattery* (vessel noise alone) sailing at 4.0 kts while towing the airgun array. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	20*	30*
130	130*	180*
120	850	1200
110	5600	7500
100	36000‡	49000‡

*Extrapolated from minimum measurement range of 208 m (680 ft).

‡Extrapolated from maximum measurement range of 8000 m (5 mi).

Table 39. Sound threshold level distances for 100-140 dB re 1 μ Pa for the *Norseman II* sailing at 17.6 km/h (9.5 kts). (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	320	430
130	900	1100
120	2400	3100
110	6200	8200
100	17000	22000

Table 40. Sound threshold level distances for 100-140 dB re 1 μ Pa for the *Arctic Seal* sailing at 18.5 km/h (10 kts). (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	280*	360
130	790*	1100
120	2200	2900
110	6200	8200
100	17000	23000

Table 41. Sound threshold level distances for 100-140 dB re 1 μ Pa for the *Point Barrow* sailing at 11.5 km/h (6.2 kts). (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	95	290
130	360	1100
120	1300	3900
110	4900	15000
100	19000	56000

Table 42. Sound threshold level distances for 100-140 dB re 1 μ Pa for the *Annika Marie* sailing at 5 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	89	160
130	270	460
120	760	1400
110	2300	3900
100	6600	12000

Table 43. Sound level threshold horizontal distances for the support vessel *Maxime* sailing at 8 kts. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	Best fit range (ft)	90 th percentile range (ft)
140	26*	36*
130	120	150
120	490	620
110	2000	2600
100	8200	11000

*Extrapolated from minimum horizontal measurement distance of 20 m (66 ft).

Table 44. Sound level threshold distances for the 3147 in³ airgun array and mitigation gun from seismic vessel *Gilivar* at the Kakapo site. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)		190	180	170	160	120
3147 in ³ Airgun Array Endfire Range (ft)	Best Fit	1200	3600	10000	26000	360000
	90 th Percentile	1500	4600	12000	30000	390000
3147 in ³ Airgun Array Broadside Range (ft)	Best Fit	1800	5600	17000	39000	250000*
	90 th Percentile	2000	6600	19000	43000	250000*
Mitigation Gun Range (ft)	Best Fit	460**	1100**	2300**	5200**	130000
	90 th Percentile	530**	1200**	2700**	6200**	150000

*Extrapolated from maximum measurement range of 34.9 km (21.7 mi).

**Extrapolated from minimum measurement range of 8 km (5 mi).

Table 45. Measured M-Weighted cumulative SEL off the seismic survey line at the Kakapo site. (ref. **Error! Reference source not found.**)

Distance off seismic survey line	Cumulative SEL (dB re 1 μ Pa ² s)				
	Flat-weighted	Low Frequency Cetaceans	Mid-Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds underwater
0.31 mi	196.3	195.8	186.1	184.0	190.0
1.2 mi	190.8	190.3	182.7	180.8	185.9
5 mi	185.6	185.5	180.5	178.6	183.4

Table 46. Best fit (least squares) equation to cumulative SEL vs. range for different M-weighting and distances to auditory injury criterion. (ref. **Error! Reference source not found.**)

Weighting	Best fit equation	Injury Criteria (dB re 1 μ Pa ² s)	Distance to Injury Criteria (ft)
Flat	RL = 193.6 – 8.9 LOG R	-	-
LFC	RL = 193.1 – 8.6 LOG R	198	890
MFC	RL = 184.5 – 4.7 LOG R	198	3.3
HFC	RL = 182.5 – 4.5 LOG R	198	3.3
PINN	RL = 188.1 – 5.5 LOG R	186	7900

Table 47. Sound level threshold distances for the 3147 in³ airgun array and mitigation gun from seismic vessel *Gilivar* at the Como site. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)		190	180	170	160	150	140	130	120
3147 in ³ Airgun Array Endfire Range (ft)	Best Fit	79*	690	4900	22000	52000	89000	130000	180000
	90 th Percentile	170*	1400	9200	31000	66000	100000	150000	190000
3147 in ³ Airgun Array Broadside Range (ft)	Best Fit	2500	8200	18000	30000	– (†)	– (†)	– (†)	≤ 150,000 (‡)
	90 th Percentile	3000	9500	19000	31000	– (†)	– (†)	– (†)	≤ 150,000 (‡)
Mitigation Gun Range (ft)	Best Fit	33 (††)	150	690	3000	10000	26000	49000	75000
	90 th Percentile	43 (††)	190	890	3600	12000	29000	52000	79000

*Distances to the 190 dB re 1 μ Pa level were extrapolated from data at longer ranges.

(†) Due to the presence of interfering airgun signals on OBH D (45 km, or 28 mi, range at CPA), broadside threshold ranges between 150 dB and 130 dB re 1 μ Pa could not be accurately estimated.

(‡) The level of the interfering airgun signals on OBH D was approximately 120 dB re 1 μ Pa. Therefore the 120 dB re 1 μ Pa threshold range for was constrained to less than 45 km, or 28 mi, from the array.

(††) Distances to the 190 dB re 1 μ Pa level were extrapolated from data at longer ranges.

Table 48. Maximum cumulative SEL for each OBH off the seismic survey line at the Como site. (ref. **Error! Reference source not found.**)

Distance off seismic survey line	Cumulative SEL (dB re 1 μ Pa ² s)				
	Flat-weighted	Low Frequency Cetaceans	Mid-Frequency Cetaceans	High Frequency Cetaceans	Pinnipeds underwater
0.4 mi	189.5	189.5	185.5	183.7	188.0
1.2 mi	186.7	186.6	182.9	181.2	185.4
5 mi	174.2	174.2	171.6	170.3	173.4

Table 49. Sound level threshold distances for the airgun arrays and Geopulse sub-bottom profiler on the *Alpha Helix* in Camden Bay. (ref. **Error! Reference source not found.**)

Rms SPL (dB re 1 μ Pa)		190	180	170	160	120
2 x 10 ³ Airgun Array Range (ft)	Best Fit	110*	300*	790	2100	49000
	90 th Percentile	150*	390*	1100	2700	59000
1 x 10 ³ Airgun Range (ft)	Best Fit	130*	300*	660	1400	36000
	90 th Percentile	170*	390*	850	1900	46000
Geopulse sub-bottom profiler Range (ft)	Best Fit	36*	82*	180*	390*	853
	90 th Percentile	46*	98*	210*	460*	1100

*Extrapolated from minimum measurement range of 190 m (623 ft).

Table 50. Sound level threshold distances for the airgun arrays, bubble pulser, and ODEC Strata box from the *Henry C* in Camden Bay. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)		190	180	170	160	120
2 x 10 ³ Airgun Array Range (ft)	Best Fit	23*	89*	330	1200	49000
	90 th Percentile	33*	120*	460	1600	52000
1 x 10 ³ Airgun Range (ft)	Best Fit	13*	46*	190*	760	46000
	90 th Percentile	13*	59*	240*	920	52000
Datasonics SPR-1200 Bubble Pulser Range (ft)	Best Fit	20*	75*	280*	1000	3300
	90 th Percentile	30*	110*	390	1400	4600
ODEC Strata Box	Best Fit	7*	30*	130*	560	2400
	90 th Percentile	10*	39*	170*	760	3200

*Extrapolated from minimum measurement range of 90 m (295 ft).

Table 51. Sound threshold level distances for the Geopulse sub-bottom profiler (3.5 kHz) on the *Alpha Helix* in the Chukchi Sea. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)	190	180	170	160	120
Best Fit (ft)	16*	49*	490*	490*	1600
90 th Percentile (ft)	20*	62*	200*	620*	2000

*Extrapolated from minimum measurement range of 200 m (660 ft).

Table 52. Sound level threshold distances for the airgun array configurations and sub-bottom profilers on the *Cape Flattery* in the Chukchi Sea. (ref. **Error! Reference source not found.**)

rms SPL (dB re 1 μ Pa)		190	180	170	160	120
4 x 10 ³ Airgun Array Range (ft)	Best Fit	150*	460*	1400	3900	75000‡
	90 th Percentile	160*	530*	1600	4600	79000‡
2 x 10 ³ Airgun Array Range (ft)	Best Fit	46*	160*	660*	2400	79000‡
	90 th Percentile	56*	200*	760	2700	82000‡
1 x 10 ³ Airgun Range (ft)	Best Fit	23*	92*	330*	1200	49000
	90 th Percentile	26*	110*	390*	1400	52000‡
Sub-bottom Profiler Range (ft)	Best Fit	36 (†)	110 (†)	320 (†)	920	2500
	90 th Percentile	59 (†)	170 (†)	490	1400	3600
Bubble Pulser	Best Fit	3**	23**	160**	850	3000
	90 th Percentile	10**	52**	330**	1500	4300

*Extrapolated beyond the minimum measurement range of 190 m (623 ft).

‡Extrapolated from maximum measurement range of 15000 m (9.3 mi).

(†)Extrapolated from minimum measurement range of 197 m (646 ft).

**Extrapolated from minimum measurement range of 151 m (495 ft).

Table 53. Vessel characteristics and sound level measurements. (ref. **Error! Reference source not found.**)

Vessel Name	Vessel Type	Vessel Speed (kts)	Power (hp)	Measurement Location	Measurement Depth (ft)	Range to 120 dB re 1 μ Pa (ft)	
						Best Fit	90 th Percentile
Cape Flattery	Converted torpedo test craft	4	1250	Chukchi Sea	148	850	1200
Alpha Helix	Research vessel	4.5	825	Chukchi Sea	148	1100	1500
Alpha Helix	Research vessel	4.5	825	Camden Bay	72	2400	3600
Henry C	River tug	3.5	4500	Camden Bay	108	7500	10000
Henry C	River tug	10	4500	Camden Bay	108	7900	13000
Gulf Provider	Seismic support vessel	12.6	2250	Kakapo Site	141	33000 (aft) / 6900 (forward)	43000 (aft) / 7900 (forward)
Torsvik	Support Vessel	12	880	Kakapo Site	141	9200 (aft) / 4300 (forward)	10000 (aft) / 5900 (forward)
Theresa Marie	Support Vessel	10.5	-	Kakapo Site	141	13000	19000
MV Gilivar	Seismic vessel	3.8	3218	Kakapo Site	141	29000	36000
Norseman II	Converted fishing vessel	10.4	850	Kakapo Site	135	3600	6600
Norseman II	Converted fishing vessel	9.5	850	Prudhoe Bay	66	2400	3100
Arctic Seal	Supply vessel	10	1700	Prudhoe Bay	66	2200	2900
Point Barrow	Arctic tug	6	2110	Prudhoe Bay	66	1300	3900
Annika Marie	Research vessel	5	436	Prudhoe Bay	33	760	1400
Maxime	Shallow draft landing vessel	8	900	Barrow	75	490	620

APPENDIX F: 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 *Gilavar* 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. In addition to the MMOs onboard the *Gilavar*, SOI placed 3-4 MMOs on each of the chase and support vessels. 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 2-14 day observer training course, depending on previous MMO experience, designed to familiarize them with the operational and data recording procedures, reporting protocols, and IHA stipulations. The IHA stipulations and requirements were also explained to the Operations Manager and Head Airgun Operator(s) aboard the *Gilavar* and other source vessels 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 seismic source vessels (*Gilavar*, *Henry C.*, *Alpha Helix*, *Cape Flattery*) during all daytime seismic operations, and during any nighttime power ups of the airgun(s), as specified in the IHAs. MMOs onboard the chase vessels also monitored marine mammals during much of the time that seismic operations were occurring. 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 stand-by during ongoing seismic operations at night, but was not necessarily on watch.
- Bridge personnel watched for marine mammals during seismic operations at night and were required to call for the airgun(s) to be shut down if a marine mammal was observed within or

about to enter the applicable safety zone. Bridge personnel also notified the MMO on stand-by if marine mammals were observed in or about to enter the safety radii.

- 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 ~210°, 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 μ Pa-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.

Course 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 possible mitigation measure was to adjust the ship track and/or speed to avoid close approach to the mammal. However, given the presence of the streamer(s) and airgun(s) behind the vessel, the turning rate of the vessel while this gear is deployed is limited, and course alteration is generally not a practical mitigation method for a seismic vessel. Instead, the marine mammal's activities and movements relative to the seismic vessel were closely monitored. 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).

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 SOI's seismic 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 μ Pa (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 G: 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 H: BACKGROUND ON MARINE MAMMALS IN THE CHUKCHI AND BEAUFORT SEAS

TABLE F-1. The habitat, abundance and conservation status of marine mammals potentially inhabiting the project areas.

Species	Habitat	Abundance	ESA ¹	IUCN ²	CITES ³
Odontocetes Beluga whale <i>(Delphinapterus leucas)</i>	Offshore, Coastal, Ice edges	50,000 ⁴ 39,257 ⁵	Not listed	VU	
Narwhal <i>(Monodon monoceros)</i>	Offshore, Ice edge	Rare ⁶	Not listed	DD	II
Killer whale <i>(Orcinus orca)</i>	Widely distributed		Not listed	LR-cd	II
Harbor Porpoise <i>(Phocoena phocoena)</i>	Coastal, inland waters, shallow offshore waters	Common (Chukchi) Uncommon (Beaufort)	Not listed	VU	II
Mysticetes Bowhead whale <i>(Balaena mysticetus)</i>	Pack ice & coastal	10,545 ⁷	Endangered	LR-cd	I
Gray whale <i>(Eschrichtius robustus)</i> (eastern Pacific population)	Coastal, lagoons	488 ⁸ 17,500 ⁹	Not listed	LR-cd	I
Minke whale <i>(Balaenoptera acutorostrata)</i>	Shelf, coastal	Small numbers	Not listed	LR-cd	I
Fin whale <i>(Balaenoptera physalus)</i>	Slope, mostly pelagic	Rare (Chukchi)	Endangered	EN	I
Humpback whale <i>(Megaptera novaeangliae)</i>	Shelf, coastal	Rare	Endangered	–	–
Pinnipeds Bearded seal <i>(Erignathus barbatus)</i>	Pack ice	300,000- 450,000 ¹⁰ 4863 ¹¹	In review for listing	–	–
Spotted seal <i>(Phoca largha)</i>	Pack ice	1000 ¹²	In review for listing	–	–
Ringed seal <i>(Pusa hispida)</i>	Landfast & pack ice	Up to 3.6 million ¹³ ~208,000- 252,000 ¹⁴ 326,500 ¹⁵	In review for listing	–	–
Ribbon seal <i>(Histriophoca fasciata)</i>	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 (USD/IMMS 1996).

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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 I: CHUKCHI SEA VESSEL-BASED SEISMIC MONITORING RESULTS

Part 1: Tables and Figures Referenced from Chapter 5

TABLE I.1. Total marine mammal sightings (individuals) during the Chukchi Sea survey (18 Jul - 31 Aug 2008) from the *Gilavar* and its monitoring vessels. There were no polar bear sightings during this survey.

Species	<i>Gilavar</i>	Monitoring Vessels	Total
Cetaceans			
Fin Whale	1 (2)	1 (3)	2 (5)
Gray Whale	10 (23)	20 (44)	30 (67)
Harbor Porpoise	2 (7)	7 (13)	9 (20)
Humpback Whale	0	1 (1)	1 (1)
Killer Whale	0	2 (2)	2 (2)
Minke Whale	13 (18)	8 (9)	21 (27)
Unidentified Mysticete Whale	12 (13)	19 (25)	31 (38)
Unidentified Whale	0	8 (12)	8 (12)
Total Cetaceans	38 (63)	66 (109)	104 (172)
Seals			
Bearded Seal	4 (4)	6 (6)	10 (10)
Ringed Seal	17 (20)	61 (64)	78 (84)
Spotted Seal	6 (6)	15 (19)	21 (25)
Unidentified Pinniped	2 (2)	1 (15)	3 (17)
Unidentified Seal	14 (14)	79 (80)	93 (94)
Total Seals	43 (46)	162 (184)	205 (230)
Pacific Walruses			
In Water	0	1 (1)	1 (1)
On Ice	0	1 (2)	1 (2)
Total Pacific Walruses	0	2 (3)	2 (3)
Grand Total of All Sightings	81 (109)	230 (296)	311 (405)

TABLE I.2. Visual observation effort for cetaceans during the Chukchi Sea survey (18 Jul - 31 Aug 2008) from the *Gilavar* and its monitoring vessels. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and seismic status. Ramp-up effort is included in the "Seismic" category. These data meet the criteria described in Chapter 4, *Analysis*.

<i>Beaufort Wind Force</i>	Useable MMO Watch Effort						<i>Total</i>
	0	1	2	3	4	5	
<i>Gilavar</i>							
Effort in km							
Non-seismic	0	116	180	383	425	270	1374
Seismic	0	0	37	145	116	12	310
Total	0	117	217	528	541	283	1685
Effort in h							
Non-seismic	0	14	22	46	48	29	159
Seismic	0	0	4	17	14	1	37
Total	0	14	26	63	62	31	196
Effort in mi							
Non-seismic	0	72	112	238	264	168	854
Seismic	0	0	23	90	72	8	193
Total	0	72	135	328	336	176	1047
<i>Monitoring Vessels</i>							
Effort in km							
Non-seismic	181	1006	3292	3054	2298	785	10616
Seismic	19	286	1054	835	232	360	2785
Total	200	1291	4346	3889	2530	1145	13401
Effort in h							
Non-seismic	13	76	239	250	208	71	857
Seismic	1	28	98	72	21	34	256
Total	14	104	337	322	230	105	1113
Effort in mi							
Non-seismic	112	625	2046	1898	1428	488	6596
Seismic	12	177	655	519	144	223	1730
Total	124	802	2700	2416	1572	711	8327
<hr/>							
Total Effort in km	200	1408	4563	4417	3071	1427	15085
Total Effort in h	14	118	363	385	292	136	1308
Total Effort in mi	124	875	2835	2744	1908	887	9374

TABLE I.3. Numbers of sightings (number of individuals) of cetaceans observed by seismic state during the Chukchi Sea survey (18 July – 31 Aug 2008) from the *Gilavar*, and its Monitoring Vessels. These data meet the criteria described in Chapter 4, *Analysis*.

Species	Seismic	Non-Seismic	Total
<i>Gilavar</i>			
Cetaceans			
Mysticetes			
Gray Whale	0	3 (5)	3 (5)
Minke Whales	0	3 (4)	3 (4)
Unidentified Mysticete Whale	0	6 (6)	6 (6)
Odontocetes			
Harbor Porpoise	0	2 (7)	2 (7)
<i>Gilavar Total Cetaceans</i>	0	14 (22)	14 (22)
Monitoring Vessels			
Cetaceans			
Unidentified Whale	0	5 (7)	5 (7)
Mysticetes			
Fin Whale	0	1 (3)	1 (3)
Gray Whale	1 (1)	16 (37)	17 (38)
Harbor Porpoise	3 (6)	3 (5)	6 (11)
Humpback Whale	0	1 (1)	1 (1)
Minke Whale	0	5 (5)	5 (5)
Unidentified Mysticete Whale	0	16 (21)	16 (21)
Odontocetes			
Harbor Porpoise	3 (6)	6 (5)	9 (11)
Monitoring Vessels Total Cetaceans	4 (7)	47 (79)	51 (86)
Grand Total Cetaceans	4 (7)	61 (101)	65 (108)

TABLE I.4. Visual observation effort for pinnipeds and Pacific walruses during the Chukchi Sea survey (18 Jul - 31 Aug 2008) from the *Gilavar* and its monitoring vessels. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and seismic status. Ramp-up effort is included in the "Seismic" category. These data meet the criteria described in Chapter 4, *Analysis*.

<i>Beaufort Wind Force</i>	Daylight MMO Watch Effort						<i>Total</i>
	0	1	2	3	4	5	
<i>Gilavar</i>							
Effort in km							
Non-seismic	0	131	278	875	936	407	2628
Seismic	0	24	184	705	484	153	1550
Total	0	156	462	1580	1420	561	4178
Effort in h							
Non-seismic	0	16	34	107	108	46	311
Seismic	0	3	22	84	58	19	185
Total	0	19	55	191	166	65	496
Effort in mi							
Non-seismic	0	82	173	544	582	253	1633
Seismic	0	15	114	438	301	95	963
Total	0	97	287	981	883	348	2596
<i>Monitoring Vessels</i>							
Effort in km							
Non-seismic	226	1311	4166	4121	2952	997	13773
Seismic	4	247	793	546	116	176	1883
Total	230	1558	4960	4667	3068	1173	15656
Effort in h							
Non-seismic	16	96	302	334	265	88	1101
Seismic	0	27	84	58	13	22	204
Total	16	123	387	392	278	109	1305
Effort in mi							
Non-seismic	140	815	2589	2561	1834	619	8558
Seismic	2	153	493	339	72	110	1170
Total	143	968	3082	2900	1907	729	9728
Total Effort in km	230	1714	5422	6247	4489	1734	19834
Total Effort in h	16	142	442	582	445	174	1801
Total Effort in mi	143	1065	3369	3881	2789	1078	12325

TABLE I.5. Numbers of sightings (number of individuals) of pinnipeds observed by seismic state during the Chukchi Sea survey (18 July – 31 Aug 2008) from the *Gilavar*, and its Monitoring Vessels. These data meet the criteria described in Chapter 4, *Analysis*.

Species	Seismic	Non-Seismic	Total
<i>Gilavar</i>			
Seals			
Bearded Seal	0	3 (3)	3 (3)
Ringed Seal	3 (3)	11 (14)	14 (17)
Spotted Seal	1 (1)	2 (2)	3 (3)
Unidentified Pinniped	0	2 (2)	2 (2)
Unidentified Seal	4 (4)	9 (9)	13 (13)
<i>Gilavar Total Seals</i>	8 (8)	27 (30)	35 (38)
Monitoring Vessels			
Seals			
Bearded Seal	1 (1)	3 (3)	4 (4)
Ringed Seal	9 (9)	34 (36)	43 (45)
Spotted Seal	0	12 (16)	12 (16)
Unidentified Pinniped	0	1 (15)	1 (15)
Unidentified Seal	7 (7)	48 (49)	55 (56)
<i>Monitoring Vessels Total Seals</i>	17 (17)	98 (119)	115 (136)
<i>Grand Total Seals</i>	25 (25)	125 (149)	150 (174)

Part 2: English Units Tables and Figures from Chapter 5 and this Appendix

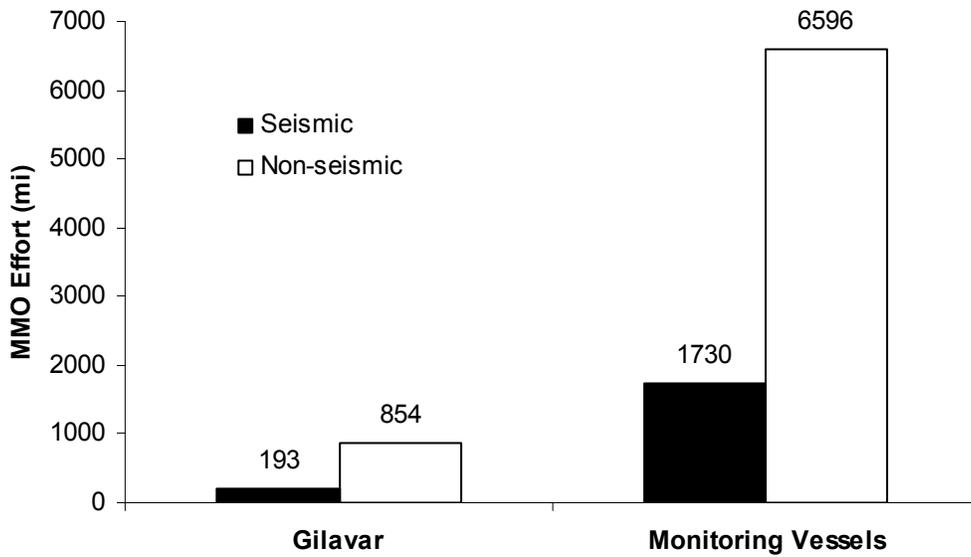


FIGURE I.5.1E. Cetacean MMO effort (mi) in the Chukchi Sea study area (18 Jul - 31 Aug 2008) from the *Gilavar* and its monitoring vessels.

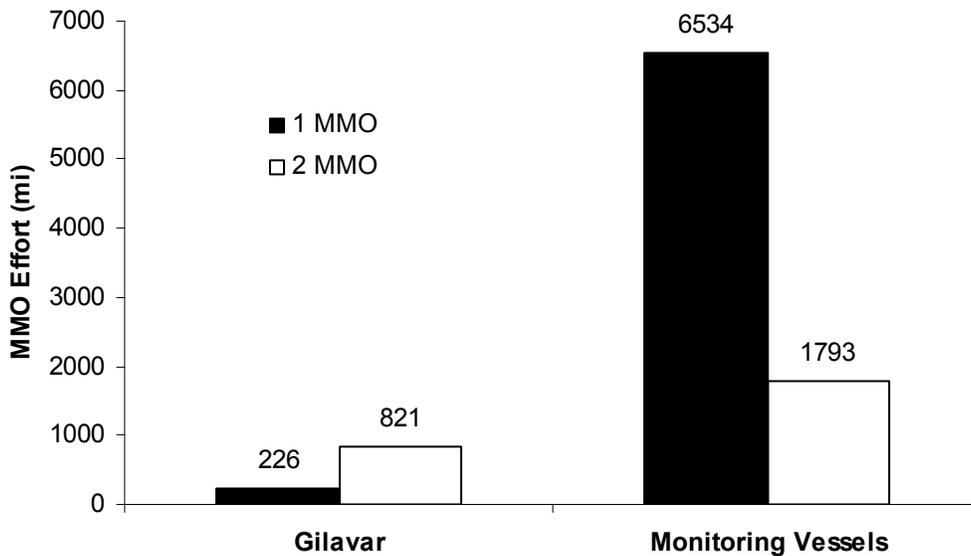


FIGURE I.5.2E. Cetacean MMO effort (mi) by number of observers in the Chukchi Sea study area (18 Jul - 31 Aug 2008) from the *Gilavar* and its monitoring vessels.

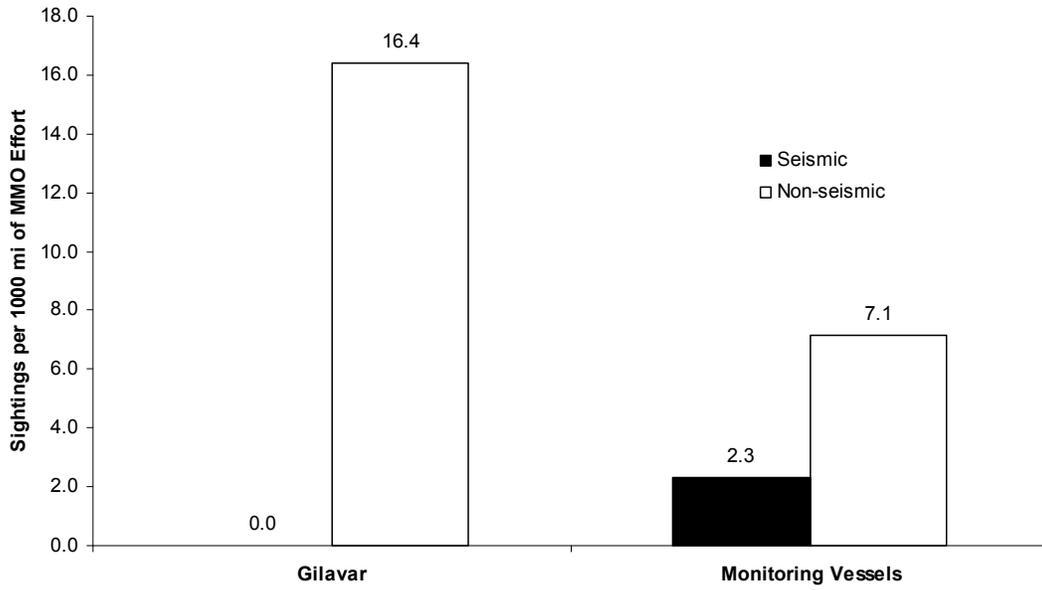


FIGURE I.5.4E. Cetacean sightings rates by seismic state from the *Gilavar* and its monitoring vessels during the Chukchi Sea survey (18 Jul – 31 Aug 2008).

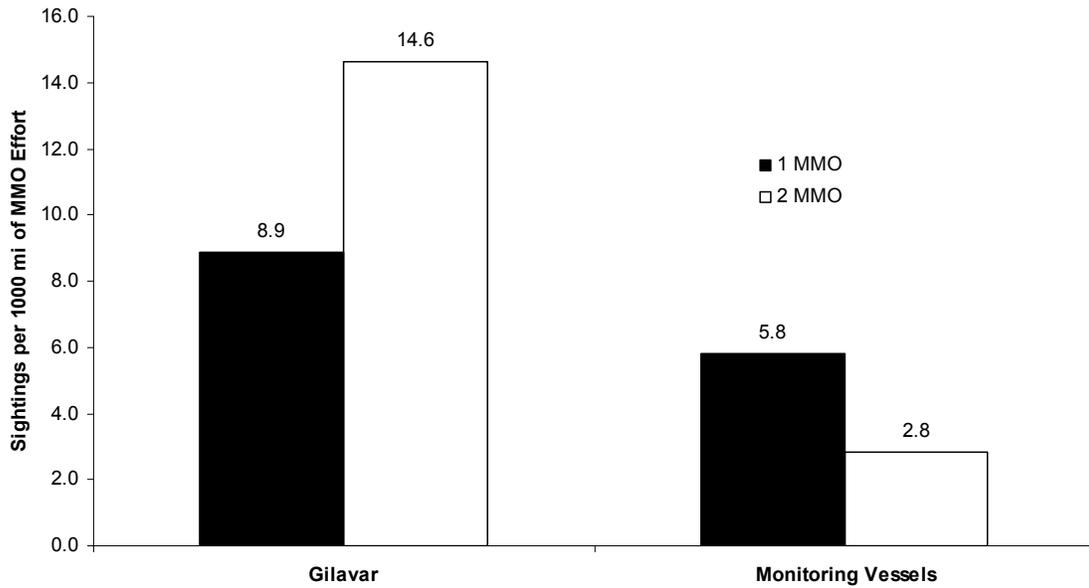


FIGURE I.5.5E. Cetacean sightings rates by number of MMOs on watch from the *Gilavar* and its monitoring vessels during the Chukchi Sea survey (18 Jul – 31 Aug 2008).

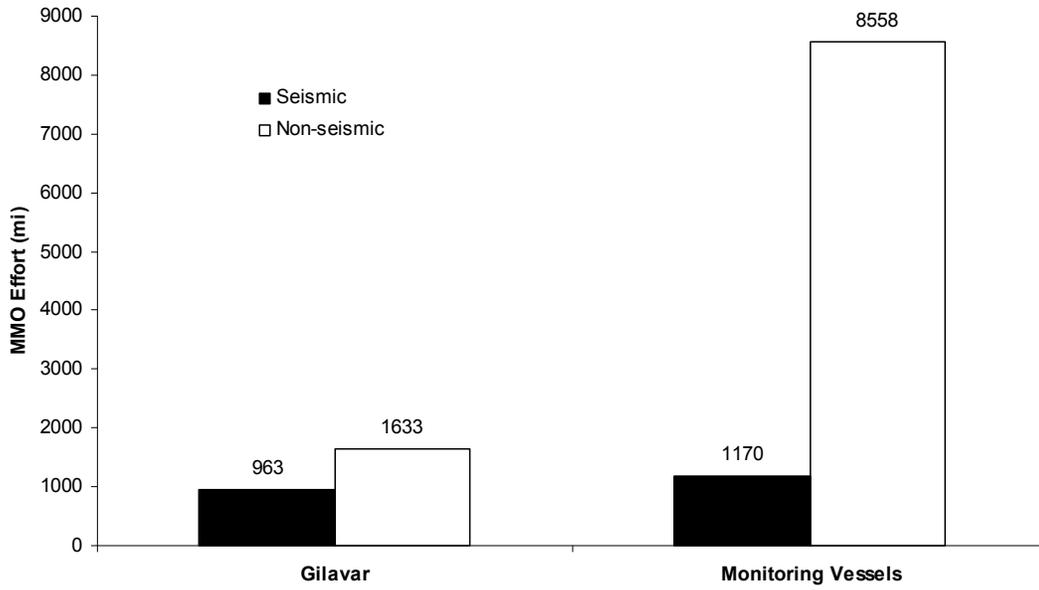


FIGURE I.5.6E. Pinniped MMO effort (mi) in the Chukchi Sea study area (18 Jul - 31 Aug 2008) from the *Gilavar* and its monitoring vessels.

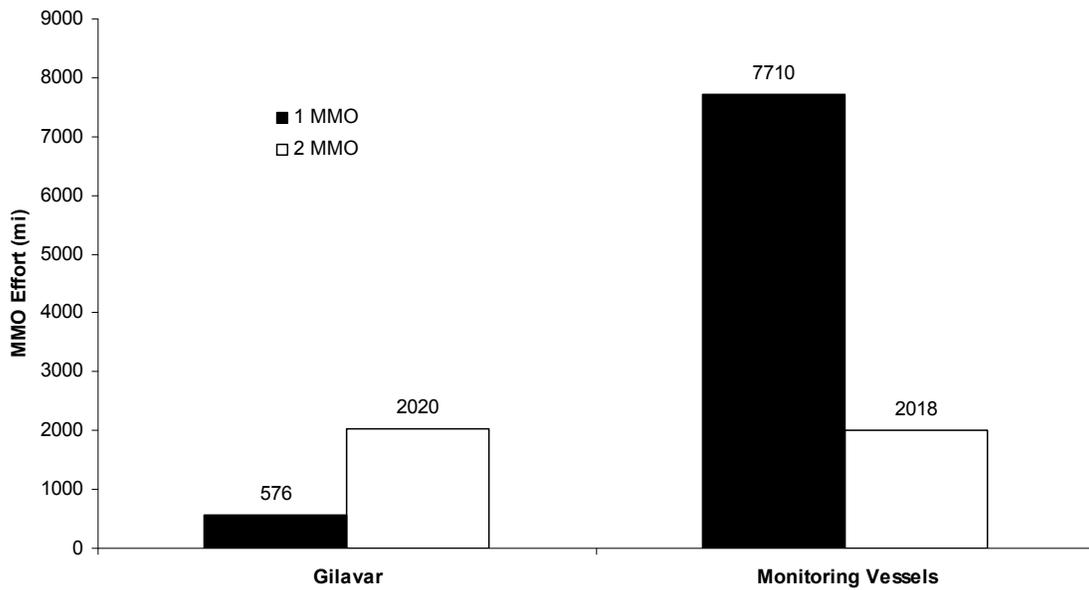


FIGURE I.5.7E. Pinniped MMO effort (mi) by number of observers in the Chukchi Sea study area (18 Jul - 31 Aug 2008) from the *Gilavar* and its Monitoring Vessels.

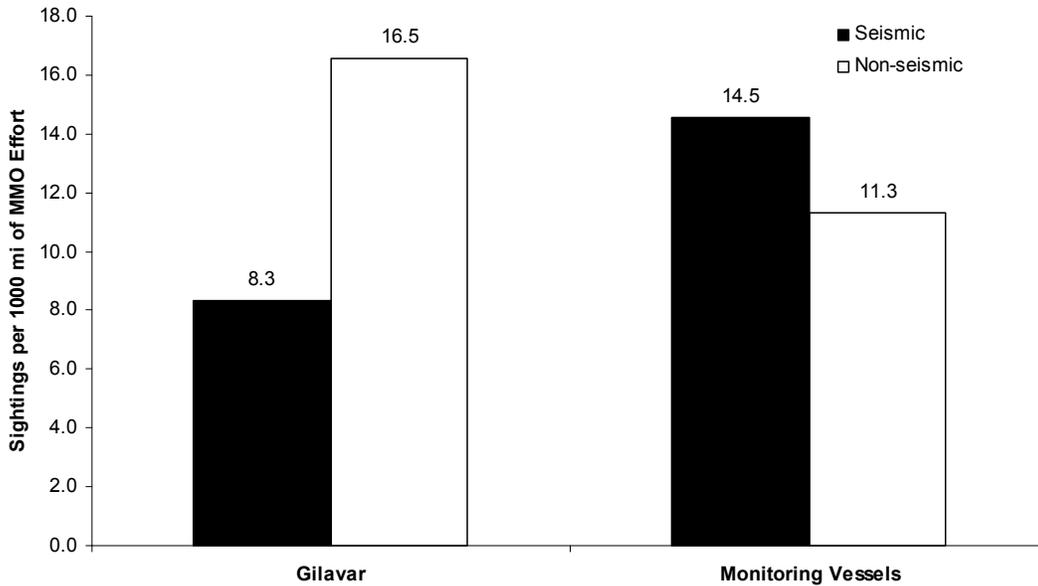


FIGURE I.5.9E. Seal sightings rates by seismic state from the *Gilavar* and its monitoring vessels during the Chukchi Sea survey (18 Jul - 31 Aug 2008).

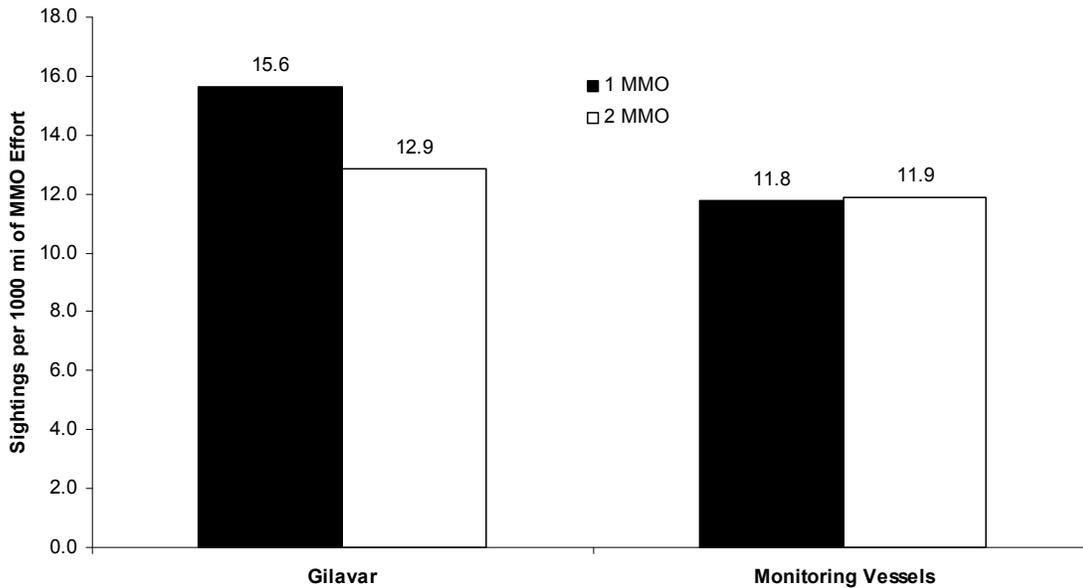


FIGURE I.5.10E. Seal sightings rates by number of MMOs from the *Gilavar* and its monitoring vessels during the Chukchi Sea survey (18 Jul - 31 Aug 2008).

TABLE I.5.3E. Comparison of cetacean CPA distances by seismic period from the *Gilavar* and its monitoring vessels during the Chukchi Sea survey (18 Jul - 31 Aug 2008). The overall mean includes both seismic and non-seismic CPA distances in the calculation.

Vessel and Seismic Status	Mean CPA ^a (yd)	s.d.	Range (yd)	n
<i>Gilavar</i> Seismic	--	--	--	--
<i>Gilavar</i> Non-seismic	2528	1378	650-5048	19
<i>Gilavar</i> Overall Mean	2528	1378	650-5048	14
Monitoring Vessels Seismic	137	130	55-328	4
Monitoring Vessels Non-seismic	1322	1488	22-5468	47
Monitoring Vessels Overall Mean	1229	1463	22-5468	51

^a CPA = *Closest Point of Approach*. For *Gilavar* this value is the marine mammal's closest point of approach to the airgun array, for monitoring vessels this value is the marine mammal's closest point of approach to the MMO/vessel.

TABLE I.5.6E. Comparison of seal CPA distances by seismic period from MMO sightings aboard the *Gilavar* and its monitoring vessels during the Chukchi Sea survey (18 Jul – 31 Aug 2008). The overall mean includes both seismic and non-seismic CPA distances in the calculation.

Vessel and Seismic Status	Mean CPA ^a (yd)	s.d.	Range (yd)	n
<i>Gilavar</i> Seismic	589	236	346-926	8
<i>Gilavar</i> Non-seismic	857	500	328-2328	27
<i>Gilavar</i> Overall Mean	796	464	328-2328	35
Monitoring Vessels Seismic	93	133	11-482	17
Monitoring Vessels Non-seismic	157	261	5-2018	98
Monitoring Vessels Overall Mean	149	247	5-2018	115

^a CPA = *Closest Point of Approach*. For *Gilavar* this value is the marine mammal's closest point of approach to the airgun array, for monitoring vessels this value is the marine mammal's closest point of approach to the MMO/vessel.

TABLE I.5.9E. Power downs for marine mammals sighted in the *Gilavar*'s 190-dB safety radius (610 m; 667 yd) for seals during the Chukchi Sea seismic survey (18 Jul - 31 Aug 2008).

Sighting ID	Species	Group Size	Day in 2007 UTC	Water Depth (yd)	Reaction to Vessel ^a	Distance to airguns at first detection (yd)	CPA ^b to airguns (yd)
GIL200889	Spotted seal	1	28-Jul	43.2	LO	677	677
GIL2008145	Unidentified seal	1	21-Aug	45.4	LO	348	348
GIL2008148	Ringed seal	1	23-Aug	45.6	CD	638	638
GIL2008149	Unidentified seal	1	26-Aug	44.0	LO	346	346
GIL2008151	Spotted seal	1	27-Aug	46.2	NO	394	394

^a Observed reaction of animal to vessel: CD=Change Direction, LO=Look at Vessel, NO=None

^b CPA=Closest Point of Approach

TABLE I.5.11E. Densities of marine mammals in offshore areas of the Alaskan Chukchi Sea by seismic state for the Chukchi Sea seismic survey (18 Jul - 31 Aug 2008). Densities are corrected for $f(0)$ and $g(0)$ biases.

Species	Non-seismic Densities	Seismic Densities
	(No. individuals / 1000 mi ²)	(No. individuals / 1000 mi ²)
Cetaceans		
Gray Whale	0.6188	0.0566
Humpback Whale	0.0254	0.0000
Fin Whale	0.0364	0.0000
Minke Whale	0.0511	0.0000
Harbor Porpoise	0.2998	0.7851
Unidentified Mysticete Whale	0.5988	0.0000
Unidentified Whale	0.2289	0.0000
Cetacean Total	1.8591	0.8418
Seals		
Bearded Seal	0.6665	0.2559
Ringed Seal	7.3251	8.9799
Spotted Seal	3.1583	0.1492
Ribbon Seal	0.0177	0.0000
Unidentified Seal	9.3133	5.2519
Unidentified Pinniped	1.1755	0.0000
Seal Total	21.6565	14.6370
Pacific Walruses	0.0229	0.0000

TABLE I.5.12E. Estimated areas (km²) ensonified with various sound levels during the Chukchi Sea seismic survey (18 Jul - 31 Aug 2008). Maximum area ensonified is shown with overlapping areas counted multiple times, total area ensonified shown with overlapping areas counted only once.

Area (mi²)	Level of ensonification (dB re1μPa (rms))				
	≥ 120	≥ 160	≥ 170	≥ 180	≥ 190
Including Overlap Area	1,235,524	34,081	11,583	3343	958
Excluding Overlap Area	51,504	3455	1653	825	399

APPENDIX J: CHUKCHI SEA VESSEL-BASED SHALLOW HAZARDS AND SITE CLEARANCE MONITORING RESULTS

Part 1: Tables and Figures Referenced from Chapter 6

Table J.1. Number of sightings (number of individuals) of marine mammals during the Chukchi Sea shallow hazards survey (22 Aug – 13 Sep 2008) from the *Cape Flattery* and *Alpha Helix*. All survey sightings are show regardless of whether they met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	<i>Cape Flattery.</i>	<i>Alpha Helix</i>	<i>Total</i>
Cetaceans			
Bowhead Whale	0	5 (13)	5 (13)
Gray Whale	1 (1)	2 (4)	3 (5)
Harbor Porpoise	1 (1)	0	1 (1)
Unidentified Mysticete Whale	0 ()	5 (9)	5 (9)
<i>Total Cetaceans</i>	2 (2)	12 (26)	14 (28)
Seals			
Bearded Seal	1 (1)	36 (47)	37 (48)
Bearded Seal (On Ice)	0	1 (1)	1 (1)
Ringed Seal	7 (7)	9 (9)	16 (16)
Unidentified Pinniped	0	14 (14)	14 (14)
Unidentified Seal	5 (5)	39 (41)	44 (46)
<i>Total Seals</i>	13 (13)	99 (112)	112 (125)
Pacific Walruses			
In Water	0	13 (23)	13 (23)
On Ice	0	3 (42)	3 (42)
<i>Total Pacific Walruses</i>	0	16 (65)	16 (65)
<i>Grand Total of All Sightings</i>	15 (15)	127 (203)	142 (218)

TABLE J.2. Visual observation effort for cetaceans from the *Cape Flattery* and *Alpha Helix* during the Chukchi Sea shallow hazards survey (22 Aug- 13 Sep 2008). Effort shown is that which met the data-analysis criteria discussed in Chapter 4, *Analyses*. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and airgun status. Ramp-up effort is included in the "Seismic" category.

<i>Beaufort Wind Force</i>	MMO Watch Effort						<i>Total</i>
	0	1	2	3	4	5	
<i>Cape Flattery</i>							
Effort in km							
Non-seismic	0	45	163	493	507	174	1382
Seismic	0	10	110	191	30	20	360
Total	0	55	273	684	536	194	1742
Effort in h							
Non-seismic	0	5	21	49	55	16	146
Seismic	0	2	17	29	5	3	55
Total	0	7	39	78	59	19	201
Effort in mi							
Non-seismic	0	28	101	306	315	108	859
Seismic	0	6	68	119	18	12	224
Total	0	34	170	425	333	120	1083
<i>Alpha Helix</i>							
Effort in km							
Non-seismic	9	442	458	239	273	267	1688
Seismic	0	0	0	0	7	2	8
Total	9	442	458	239	279	268	1696
Effort in h							
Non-seismic	1	32	35	16	22	20	126
Seismic	0	0	0	0	1	0	1
Total	1	32	35	16	23	20	127
Effort in mi							
Non-seismic	6	275	285	148	169	166	1049
Seismic	0	0	0	0	4	1	5
Total	6	275	285	148	174	167	1054
<hr/>							
Total Effort in km	9	498	731	923	816	462	3439
Total Effort in h	1	39	73	93	82	39	328
Total Effort in mi	6	309	454	573	507	287	2137

TABLE J.3. Visual observation effort for pinnipeds from the *Cape Flattery* and *Alpha Helix* during the Chukchi Sea shallow hazards survey (22 Aug- 13 Sep 2008). Effort shown is that which met the data-analysis criteria discussed in Chapter 4, *Analyses*. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and airgun status. Ramp-up effort is included in the "Seismic" category.

<i>Beaufort Wind Force</i>	MMO Watch Effort						Total
	0	1	2	3	4	5	
<i>Cape Flattery</i>							
Effort in km							
Non-seismic	0	45	167	505	512	180	1410
Seismic	0	10	110	191	30	20	360
Total	0	55	276	697	542	200	1770
Effort in h							
Non-seismic	0	5	22	51	56	17	151
Seismic	0	2	17	29	5	3	55
Total	0	7	39	80	60	20	206
Effort in mi							
Non-seismic	0	28	104	314	318	112	876
Seismic	0	6	68	119	18	12	224
Total	0	34	172	433	337	124	1100
<i>Alpha Helix</i>							
Effort in km							
Non-seismic	9	444	458	239	301	314	1765
Seismic	0	0	0	0	0	0	0
Total	9	444	458	239	301	314	1765
Effort in h							
Non-seismic	1	33	35	16	25	24	133
Seismic	0	0	0	0	0	0	0
Total	1	33	35	16	25	24	133
Effort in mi							
Non-seismic	6	276	285	148	187	195	1097
Seismic	0	0	0	0	0	0	0
Total	6	276	285	148	187	195	1097
Total Effort in km	9	499	735	935	842	514	3535
Total Effort in h	1	39	74	96	86	44	339
Total Effort in mi	6	310	457	581	523	319	2196

Table J.4. Numbers of sightings (number of individuals) of cetaceans by seismic state from the *Cape Flattery* and *Alpha Helix* during the Chukchi Sea shallow hazards survey (22 Aug – 13 Sep 2008). Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	Seismic	Non-Seismic	Total
<i>Cape Flattery</i>			
Gray Whale	0	1 (1)	1 (1)
Harbor Porpoise	0	1 (1)	1 (1)
<i>Cape Flattery Total Cetaceans</i>	0	2 (2)	2 (2)
<i>Alpha Helix</i>			
Bowhead Whale	0	5 (13)	5 (13)
Gray Whale	0	2 (4)	2 (4)
Unidentified Mysticete Whale	0	4 (6)	4 (6)
<i>Alpha Helix Total Cetaceans</i>	0	11 (23)	11 (23)
<i>Grand Total Cetaceans</i>	0	13 (25)	13 (25)

Table J.5. Numbers of sightings (number of individuals) of seals by seismic state from the *Cape Flattery* and *Alpha Helix* during the Chukchi Sea shallow hazards survey (22 Aug – 13 Sep 2008). Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	Seismic	Non-Seismic	Total
<i>Cape Flattery</i>			
Bearded Seal	0	1 (1)	1 (1)
Ringed Seal	0	7 (7)	7 (7)
Unidentified Seal	0	4 (4)	4 (4)
<i>Cape Flattery Total Seals</i>	0	12 (12)	12 (12)
<i>Alpha Helix</i>			
Bearded Seal	0	34 (45)	34 (45)
Bearded Seal (On Ice)	0	1 (1)	1 (1)
Ringed Seal	0	7 (7)	7 (7)
Unidentified Seal	0	12 (12)	12 (12)
Unidentified Pinniped	0	38 (40)	38 (40)
<i>Alpha Helix Total Seals</i>	0	92 (105)	92 (105)
<i>Grand Total Seals</i>	0	104 (117)	104 (117)

Table J.6. Numbers of sightings (number of individuals) of Pacific walrus by seismic state from the *Alpha Helix* during the Chukchi Sea shallow hazards survey (22 Aug – 13 Sep 2008). There were no sightings of Pacific walrus from the *Cape Flattery*. Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	Seismic	Non-Seismic	Total
<i>Cape Flattery</i>			
Pacific Walrus in Water	0	0	0
Pacific Walrus on Ice	0	0	0
<i>Cape Flattery Total Pacific Walruses</i>	0	0	0
<i>Alpha Helix</i>			
Pacific Walrus in Water	0	8 (16)	8 (16)
Pacific Walrus on Ice	0	3 (42)	3 (42)
<i>Alpha Helix Total Pacific Walruses</i>	0	11 (58)	11 (58)
<i>Grand Total Pacific Walruses</i>	0	11 (58)	11 (58)

Part 2: English Units Tables and Figures from Chapter 6 and this Appendix

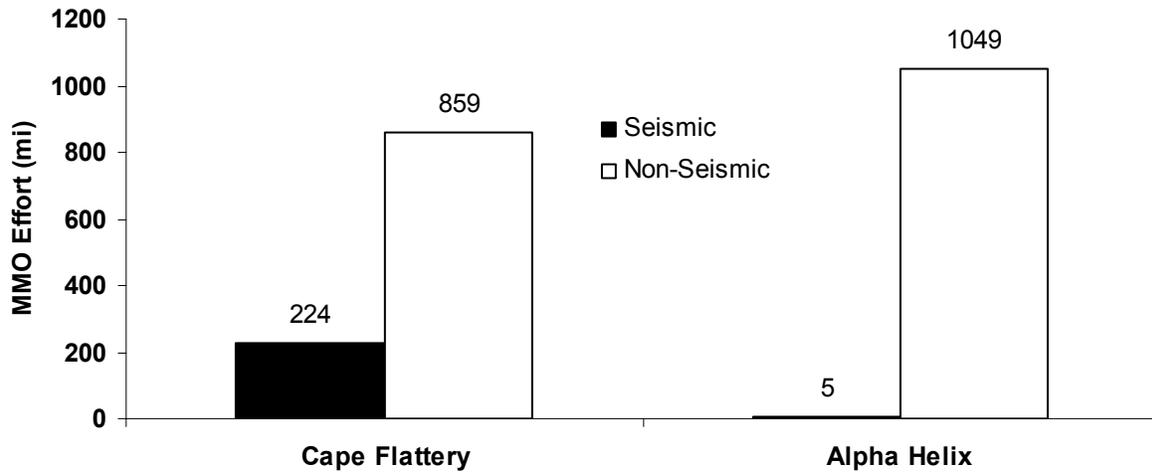


FIGURE J.6.1E. Marine mammal observer effort (km) from the *Cape Flattery* and *Alpha Helix* by seismic activity in the Chukchi Sea study area (22 Aug – 13 Sep 2008).

TABLE J.6.4E. Pacific walrus CPA distances recorded in water and on ice from the *Alpha Helix* during the Chukchi Sea shallow hazards survey (22 Aug- 13 Sep 2008). There were no Pacific walrus observed during seismic periods.

Species and Seismic Status	Mean CPA		Range	<i>n</i> Sightings
	(yd) ^a	s.d.	(yd)	
Pacific Walrus in Water				
Non-Seismic	166	159	49-517	8
Pacific Walrus on Ice				
Non-Seismic	973	1003	128-2081	3

^a CPA = *Closest Point of Approach*. For Alpha Helix: this value is the marine mammal's closest point of approach to the airgun array.

TABLE J.6.6E. Estimated densities of marine mammals in offshore areas of the Chukchi Sea based on effort and sightings from the *Cape Flattery*. Densities are corrected for $f(0)$ and $g(0)$ biases.

Species	Non-seismic Densities	Seismic Densities
	(No. individuals / 1000 mi ²)	(No. individuals / 1000 mi ²)
Cetaceans		
Gray Whale	0.052	0.000*
Harbor Porpoise	0.039	0.000*
Cetacean Total	0.091	0.000*
Seals		
Bearded Seal	2.543	0.000*
Ringed Seal	1.231	0.000*
Unidentified Seal	1.453	0.000*
Seal Total	5.227	0.000*
Pacific Walruses	0.000*	0.000*

* Estimates based on less than 500 km of effort

TABLE J.6.7E. Estimated areas (mi²) ensonified to various sound levels during the Chukchi Sea shallow hazards survey (22 Aug - 13 Sep 2008). Maximum area ensonified is shown with overlapping areas counted multiple times, total area ensonified shown with overlapping areas counted only once.

Area (mi ²)	Level of ensonification (dB re 1 μ Pa (rms))				
	120	160	170	180	190
Including Overlap Area	30,123	625	193	59	18
Excluding Overlap Area	3,434	243	131	49	16

TABLE J.6.8E. Estimated numbers of individual cetaceans exposed to received sound levels $\geq 160, 170, 180,$ and 190 dB (rms) and average number of exposures per individual during the Chukchi Sea shallow hazards survey (22 Aug- 13 Sep 2008). Estimates were based on densities of cetaceans calculated from effort during seismic and non-seismic periods.

Exposure level in dB re 1 μ Pa (rms)	Non-seismic Densities		Seismic Densities	
	Individuals	Exposures per Individual	Individuals	Exposures per Individual
≥ 160	1*	2.6	0**	2.6
≥ 170	1*	1.5	0**	1.5
≥ 180	1*	1.2	0**	1.2
≥ 190	1*	1.1	0**	1.1

* Actual value less than 1.

** Estimates based on less than 350 mi of effort

TABLE J.6.9E. Estimated numbers of individual seals exposed to received sound levels ≥ 160 , 170, 180, and 190 dB (rms) and average number of exposures per individual within the Chukchi Sea shallow hazards survey period (22 Aug- 13 Sep 2008).

Exposure level in dB re 1 μ Pa (rms)	Non-seismic Densities		Seismic Densities	
	Individuals	Exposures per Individual	Individuals	Exposures per Individual
≥ 160	1	2.6	0**	2.6
≥ 170	1	1.5	0**	1.5
≥ 180	1*	1.2	0**	1.2
≥ 190	1*	1.1	0**	1.1

** Estimates based on less than 350 mi of effort

APPENDIX K: BEAUFORT SEA VESSEL-BASED SEISMIC MONITORING RESULTS

Part 1: Tables and Figures Referenced from Chapter 7

TABLE K.1. Number of sightings (number of individuals) of marine mammals from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug - 10 Oct 2008). All survey sightings are show regardless of whether they met the data-analysis criteria discussed in Chapter 4, *Analyses*.

Species	<i>Gilavar</i>	Monitoring Vessels	<i>Total</i>
Cetaceans			
Bowhead Whale	16 (28)	23 (49)	39 (77)
Minke Whale	1 (2)	0	1 (2)
Unidentified Mysticete Whale	14 (25)	19 (26)	33 (51)
Unidentified Whale	0	14 (22)	14 (22)
<i>Total Cetaceans</i>	31 (55)	56 (97)	87 (152)
Seals			
Bearded Seal	16 (17)	53 (57)	69 (74)
Ringed Seal	148 (160)	332 (384)	480 (544)
Spotted Seal	0	29 (29)	29 (29)
Unidentified Seal	53 (59)	616 (778)	669 (837)
Unidentified Pinniped	1 (1)	3 (3)	4 (4)
<i>Total Seals</i>	218 (237)	1033 (1251)	1251 (1488)
Pacific Walruses	0	2 (2)	2 (2)
<i>Grand Total of All Sightings</i>	249 (292)	1091 (1350)	1340 (1642)

TABLE K.2. Marine mammal observer cetacean effort from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug - 10 Oct 2008). Effort shown is that which met the data-analysis criteria discussed in Chapter 4, *Analyses*. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and airgun status. Ramp-up effort is included in the "Seismic" category.

Beaufort Wind Force	MMO Watch Effort						Total
	0	1	2	3	4	5	
<i>Gilavar</i>							
Effort in km							
Non-seismic	0	4	8	40	10	14	77
Seismic	0	37	73	133	72	34	348
Total	0	41	81	173	81	48	425
Effort in h							
Non-seismic	0	0	1	4	1	2	9
Seismic	0	4	8	15	8	4	40
Total	0	5	9	20	9	6	49
Effort in mi							
Non-seismic	0	3	5	25	6	9	48
Seismic	0	23	45	82	45	21	216
Total	0	25	51	107	51	30	264
Monitoring Vessels							
Effort in km							
Non-seismic	83	747	1637	964	999	456	4886
Seismic	199	606	1320	1009	670	292	4096
Total	282	1353	2956	1973	1669	748	8982
Effort in h							
Non-seismic	6	50	113	80	77	46	372
Seismic	15	51	127	91	65	25	374
Total	21	101	240	171	142	71	746
Effort in mi							
Non-seismic	52	464	1017	599	621	283	3036
Seismic	124	376	820	627	416	182	2545
Total	175	840	1837	1226	1037	465	5581
<hr/>							
Total Effort in km	282	1394	3038	2146	1751	796	9407
Total Effort in h	21	106	250	190	151	77	795
Total Effort in mi	175	866	1888	1334	1088	495	5845

TABLE K.3. Numbers of sightings (number of individuals) of cetaceans by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008). Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, *Analyses*.

Species	Seismic	Non-Seismic	Total
<i>Gilavar</i>			
Bowhead Whale	0	2 (5)	2 (5)
Unidentified Mysticete Whale	0	1 (1)	1 (1)
<i>Gilavar Total Cetaceans</i>	0	3 (6)	3 (6)
Monitoring Vessels			
Bowhead Whale	7 (9)	6 (19)	13 (28)
Unidentified Mysticete Whale	5 (6)	10 (15)	15 (21)
Unidentified Whale	2 (3)	5 (9)	7 (12)
<i>Monitoring Vessels Total Cetaceans</i>	14 (18)	21 (43)	35 (61)
<i>Grand Total Cetaceans</i>	14 (18)	24 (49)	38 (67)

TABLE K.4. Marine mammal observer pinniped effort from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug - 10 Oct 2008). Effort shown is that which met the data-analysis criteria discussed in Chapter 4, *Analyses*. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and airgun status. Ramp-up effort is included in the "Seismic" category.

Beaufort Wind Force	Useable MMO Watch Effort						Total
	0	1	2	3	4	5	
<i>Gilavar</i>							
Effort in km							
Non-seismic	6	29	112	132	247	186	712
Seismic	4	293	406	839	503	302	2348
Total	10	322	518	972	750	488	3060
Effort in h							
Non-seismic	1	4	13	15	33	25	91
Seismic	0	35	48	98	59	36	276
Total	1	38	61	113	92	61	367
Effort in mi							
Non-seismic	4	18	69	82	153	116	442
Seismic	2	182	252	522	313	188	1459
Total	6	200	322	604	466	303	1901
Monitoring Vessels							
Effort in km							
Non-seismic	299	1438	2566	1842	1487	794	8425
Seismic	62	339	1141	741	456	204	2943
Total	361	1777	3707	2583	1943	998	11368
Effort in h							
Non-seismic	21	96	180	143	115	71	625
Seismic	7	37	121	75	49	21	309
Total	27	133	301	218	164	92	935
Effort in mi							
Non-seismic	186	894	1595	1145	924	493	5235
Seismic	39	211	709	460	284	127	1828
Total	224	1104	2303	1605	1207	620	7064
<hr/>							
Total Effort in km	371	2100	4225	3555	2693	1486	14428
Total Effort in h	29	171	363	331	256	152	1302
Total Effort in mi	230	1305	2625	2209	1673	923	8965

TABLE K.5. Numbers of sightings (number of individuals) of seals by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008). Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, *Analyses*.

Species	Seismic	Non-Seismic	Total
<i>Gilavar</i>			
Bearded Seal	13 (13)	1 (1)	14 (14)
Ringed Seal	95 (103)	32 (34)	127 (137)
Unidentified Seal	41 (46)	2 (2)	43 (48)
Unidentified Pinniped	1 (1)	0	1 (1)
<i>Gilavar Total Seals</i>	150 (163)	35 (37)	185 (200)
Monitoring Vessels			
Bearded Seal	12 (13)	26 (28)	38 (41)
Ringed Seal	107 (121)	135 (153)	242 (274)
Spotted Seal	6 (6)	10 (10)	16 (16)
Unidentified Seal	128 (138)	328 (452)	456 (590)
Unidentified Pinniped	0	2 (2)	2 (2)
<i>Monitoring Vessels Total Seals</i>	253 (278)	501 (645)	754 (923)
<i>Grand Total Seals</i>	403 (441)	536 (682)	939 (1123)

Part 2: English Units Tables and Figures from Chapter 7

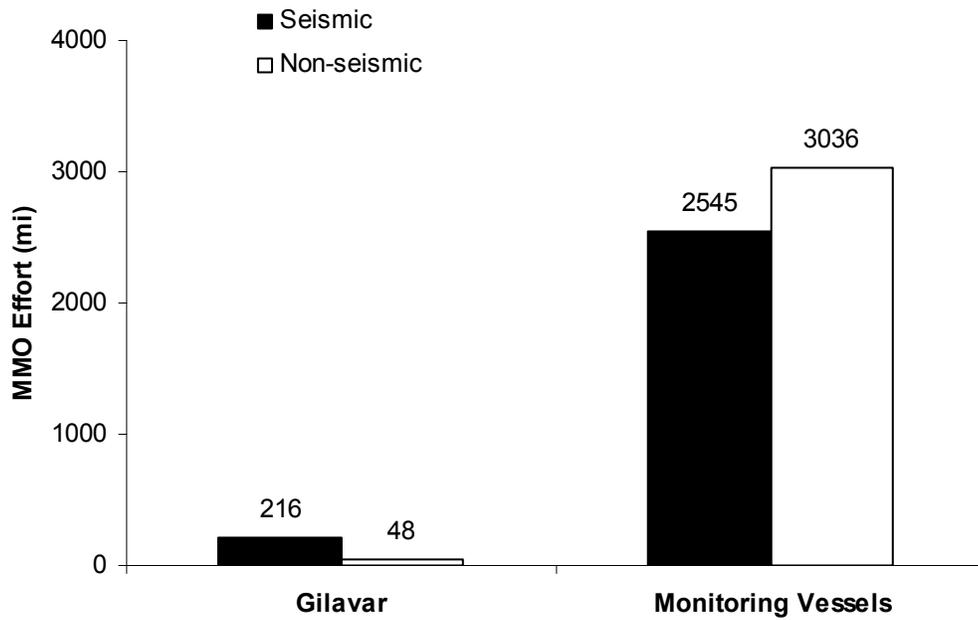


FIGURE 7.1E. Marine mammal observer cetacean effort (mi) by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008).

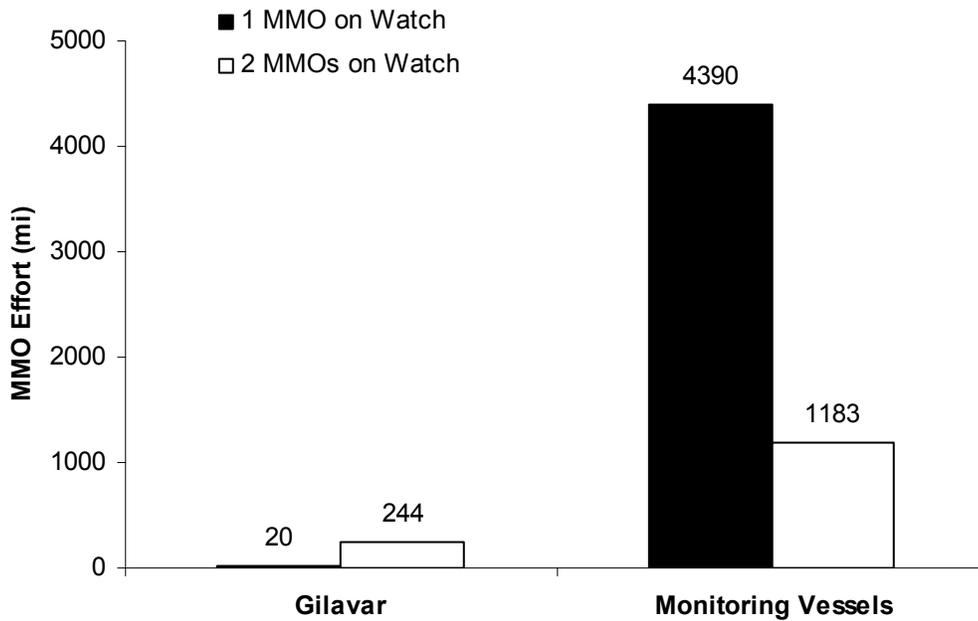


FIGURE 7.2E. Marine mammal observer effort (mi) for cetaceans by number of MMOs on watch from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008).

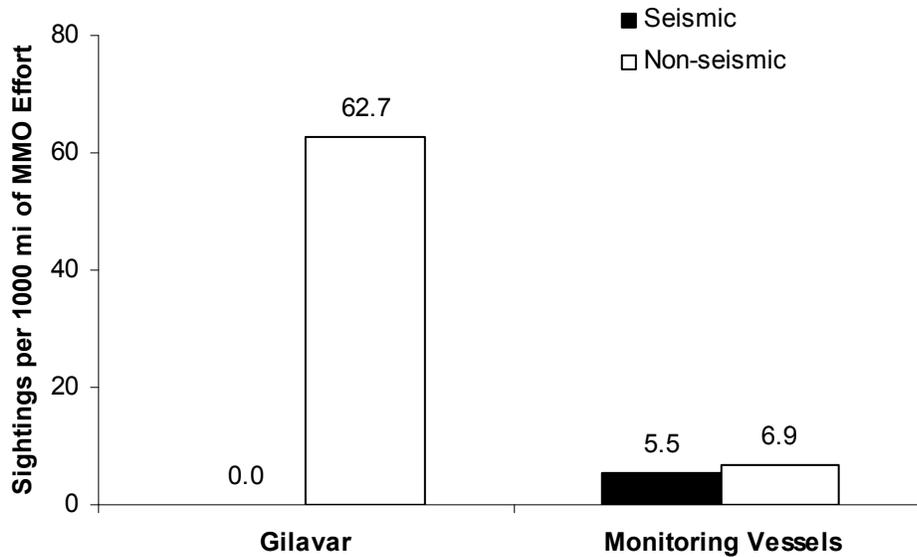


FIGURE 7.4E. Sighting rates for cetaceans by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008). Please note the small amount of cetacean effort for the *Gilavar* makes a meaningful comparison of sighting rates with monitoring vessels tenuous.

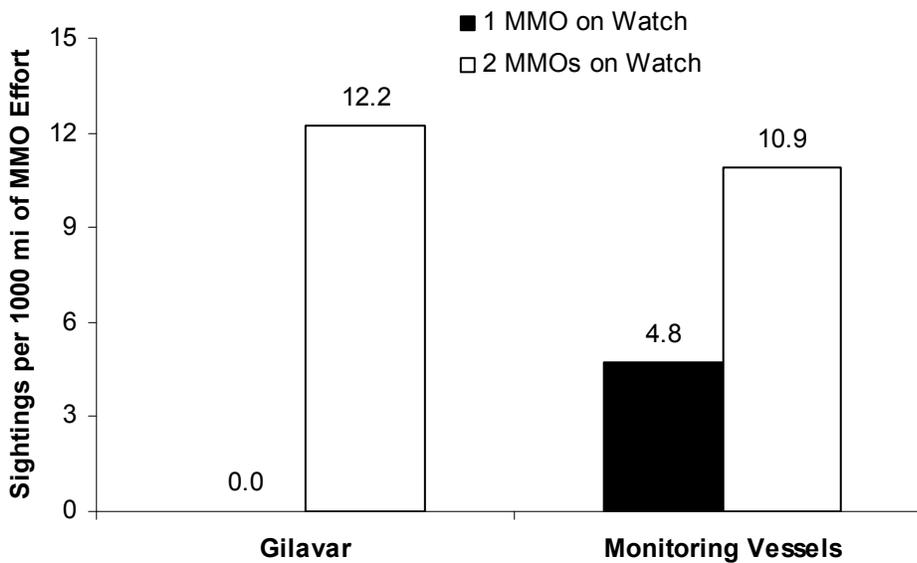


FIGURE 7.5E. Sighting rates for cetaceans by number of MMOs on watch from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008). Please note the small amount of cetacean effort for the *Gilavar* makes a meaningful comparison of sighting rates with monitoring vessels tenuous.

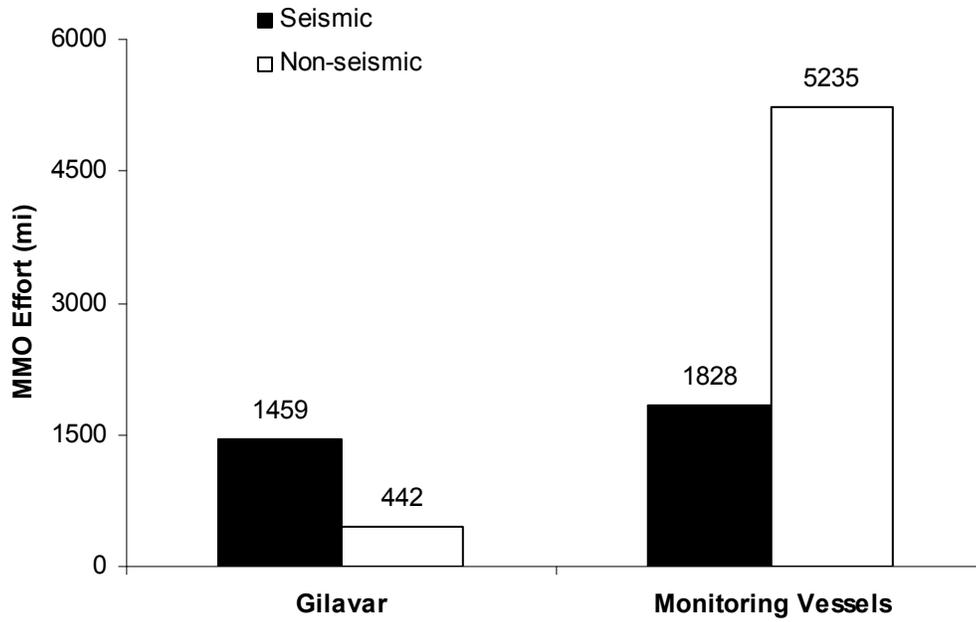


FIGURE 7.6E. Marine mammal observer effort (mi) for pinnipeds by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008).

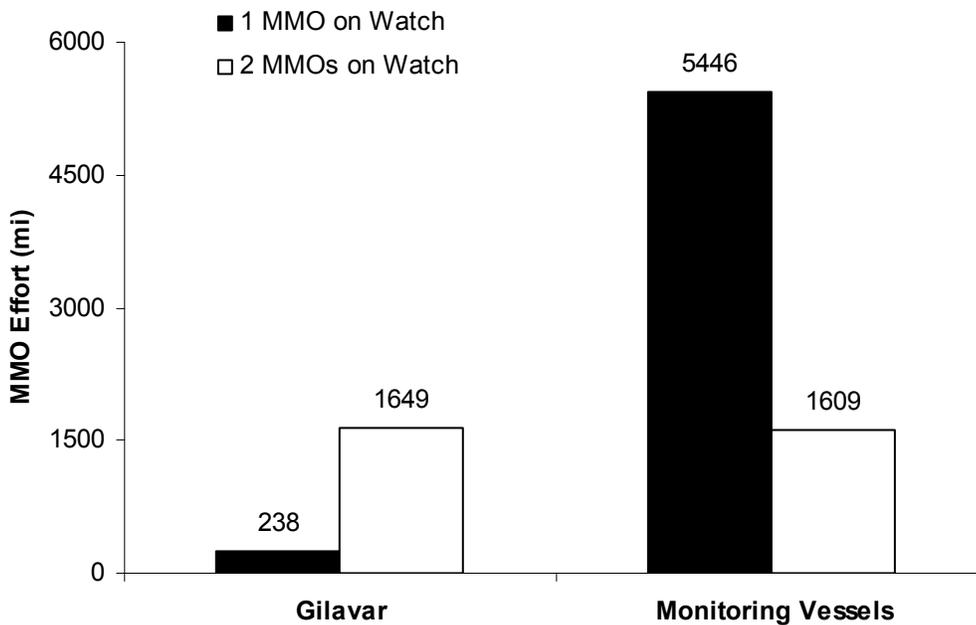


FIGURE 7.7E. Marine mammal observer effort (mi) for pinnipeds by number of MMOs on watch from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008).

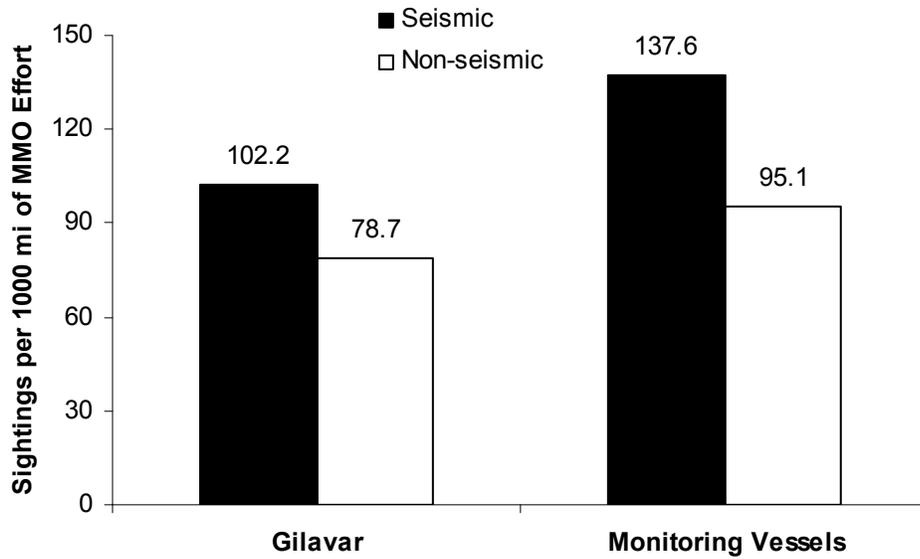


FIGURE 7.9E. Sighting rates for seals by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008).

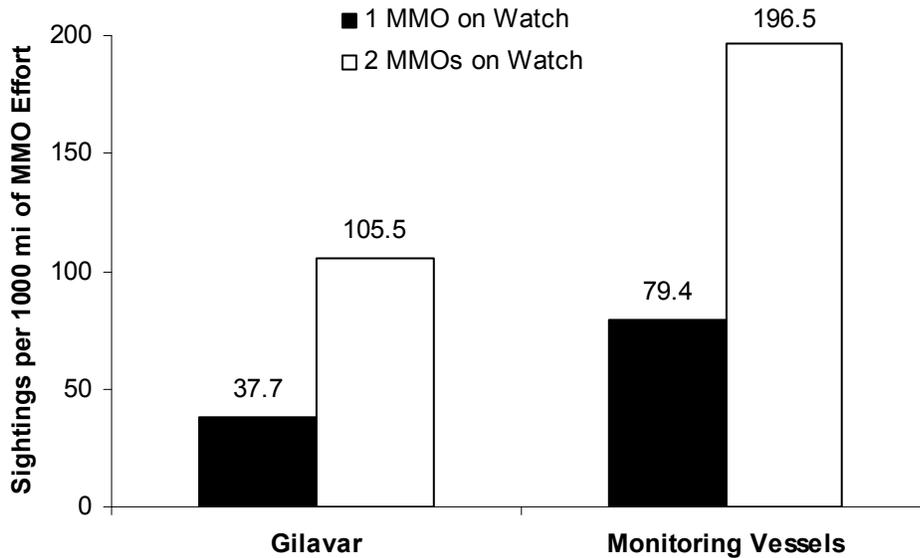


FIGURE 7.10E. Sighting rates for seals by number of MMOs on watch from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug – 10 Oct 2008).

TABLE 7.3E. Comparison of cetacean CPA distances by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey ((31 Aug – 10 Oct 2008).

Vessel and Seismic Status	Mean CPA^a (yd)	s.d.	Range (yd)	n
<i>Gilavar</i> Seismic	--	--	--	--
<i>Gilavar</i> Non-seismic	2168	679	1149-2800	3
<i>Gilavar</i> Overall Mean	2168	679	1449-2800	3
Monitoring Vessels Seismic	1681	1120	547-3843	14
Monitoring Vessels Non-seismic	1336	917	219-3281	21
Monitoring Vessels Overall Mean	1474	1002	219-3843	35

^a CPA = *Closest Point of Approach*. For *Gilavar* this value is the marine mammal's closest point of approach to the airgun array, for monitoring vessels this value is the marine mammal's closest point of approach to the MMO/vessel.

TABLE 7.7E. Comparison of seal CPA distances by seismic state from the *Gilavar* and monitoring vessels during the Beaufort Sea seismic survey (31 Aug - 10 Oct 2008).

Vessel and Seismic Status	Mean CPA^a (yd)	s.d.	Range (yd)	n
<i>Gilavar</i> Seismic	830	443	283-2859	150
<i>Gilavar</i> Non-seismic	691	231	341-1282	35
<i>Gilavar</i> Overall Mean	804	414	283-2859	185
Monitoring Vessels Seismic	161	182	11-1141	253
Monitoring Vessels Non-seismic	205	236	1-1859	501
Monitoring Vessels Overall Mean	190	220	1-1859	754

^a CPA = *Closest Point of Approach*. For *Gilavar* this value is the marine mammal's closest point of approach to the airgun array, for monitoring vessels this value is the marine mammal's closest point of approach to the MMO/vessel.

TABLE 7.11E. List of power downs for marine mammals within the *Gilavar's* 180 and 190 dB (rms) safety radii during the Beaufort Sea seismic survey (31 Aug - 10 Oct).

Sighting ID	Species	Group Size	Date	Water Depth (yd)	Reaction to Vessel ^a	Distance (yd) to airguns at first detection	CPA ^b (yd) to airguns
	Unidentified mysticete						
999*	whale	1	8-Sep	20	NA	2927	2927
184	Ringed seal	1	9-Sep	17	LO	506	506
187	Ringed seal	1	10-Sep	16	NO	656	656
207	Ringed seal	1	10-Sep	17	LO	651	651
225	Ringed seal	1	10-Sep	16	LO	926	571
257	Ringed seal	1	10-Sep	15	LO	531	531
270	Ringed seal	1	10-Sep	15	LO	616	616
272	Ringed seal	1	11-Sep	16	LO	359	359
999*	Pacific walrus	1	11-Sep	16	NA	4733	4733
274	Unidentified pinniped	1	11-Sep	15	NO	503	503
275	Ringed seal	1	12-Sep	16	LO	702	702
289	Ringed seal	1	13-Sep	36	LO	926	659
296	Ringed seal	1	19-Sep	37	NO	701	476
297	Ringed seal	1	19-Sep	37	NO	616	616
	Unidentified mysticete						
999*	whale	2	19-Sep	36	NA	3163	3163
304	Ringed seal	1	23-Sep	37	LO	550	550
305	Ringed seal	1	23-Sep	38	IS	593	593
309	Ringed seal	1	23-Sep	37	NO	727	727
316	Unidentified seal	1	24-Sep	37	NO	702	702
322	Bearded seal	1	24-Sep	37	NO	399	399
323	Unidentified seal	1	25-Sep	37	NO	1134	734
325	Ringed seal	1	25-Sep	35	NO	734	734
326	Unidentified seal	1	25-Sep	36	NO	701	701
329	Bearded seal	1	25-Sep	36	LO	396	396
331	Ringed seal	1	25-Sep	35	LO	829	829
332	Ringed seal	1	25-Sep	36	NO	616	616
336	Ringed seal	1	25-Sep	36	LO	1006	734
341	Unidentified seal	1	25-Sep	36	LO	659	659
347	Unidentified seal	1	26-Sep	37	NO	659	659
348	Ringed seal	1	26-Sep	36	NO	608	608
349	Bearded seal	1	26-Sep	35	NO	702	702
352	Bearded seal	1	26-Sep	35	LO	647	647
354	Ringed seal	1	26-Sep	35	LO	411	411
363	Bearded seal	1	26-Sep	35	LO	651	328
364	Ringed seal	1	26-Sep	35	LO	531	531
371	Bearded seal	1	27-Sep	35	LO	367	367
999*	Bowhead whale	1	28-Sep	1	NA	3044	3044
400	Unidentified seal	1	1-Oct	14	NO	832	832
401	Unidentified seal	1	1-Oct	12	LO	795	795
402	Unidentified seal	1	5-Oct	15	NO	458	458
403	Ringed seal	1	5-Oct	15	LO	948	948
405	Unidentified seal	1	7-Oct	15	NO	367	367
406	Ringed seal	1	8-Oct	16	LO	839	839
408	Unidentified seal	1	9-Oct	15	NO	458	458

999* = animal(s) sighted by monitoring vessel MMOs and determined to be within or approaching the 180 dB safety radius.

^a Observed reaction of animal to vessel: IS=Increase Speed, LO=Look at Vessel, NO=None, NA=Not Applicable as sighting was reported by a monitoring vessel

^b CPA=Closest Point of Approach

TABLE 7.15E. Densities of marine mammals in offshore areas of the Alaskan Beaufort Sea by seismic state for the Beaufort Sea seismic survey (31 Aug - 10 Oct 2008). Densities are corrected for f(0) and g(0) biases.

Species	Non-seismic Densities	Seismic Densities
	(No. individuals / 1000 mi ²)	(No. individuals / 1000 mi ²)
Cetaceans		
Bowhead Whale	5.948	2.509
Unidentified Mysticete Whale	42.990	1.672
Unidentified Whale	2.367	0.836
Cetacean Total	51.304	5.017
Seals		
Bearded Seal	23.273	61.231
Ringed Seal	312.261	443.383
Spotted Seal	18.047	19.944
Unidentified Seal	572.303	338.035
Unidentified Pinniped	1.513	3.456
Seal Total	927.398	866.049
Pacific Walruses	0.000	0.492

TABLE 7.16E. Estimated areas (mi²) ensonified to various sound levels during the Beaufort Sea seismic survey (31 Aug - 10 Oct). Maximum area ensonified is shown with overlapping areas counted multiple times, total area ensonified shown with overlapping areas counted only once.

Area (mi²)	Level of ensonification (dB re1μPa (rms))				
	120	160	170	180	190
Including Overlap Area	853,431	63,357	25,022	8,966	2,741
Excluding Overlap Area	15,401	2,325	1,349	806	512

APPENDIX L: BEAUFORT SEA VESSEL-BASED SHALLOW HAZARDS AND SITE CLEARANCE MONITORING RESULTS

Part 1: Tables and Figures Referenced from Chapter 8

TABLE L.1. Number of sightings (number of individuals) of marine mammals during the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008) from the *Henry C.* and *Alpha Helix*. All survey sightings are show regardless of whether they met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	<i>Henry C.</i>	<i>Alpha Helix</i>	<i>Total</i>
Cetaceans			
Beluga Whale	2 (3)	0	2 (3)
Bowhead Whale	8 (9)	6 (7)	14 (16)
Gray Whale	0	2 (2)	2 (2)
Unidentified Whale	1 (2)	0	1 (2)
<i>Total Cetaceans</i>	11 (14)	8 (9)	19 (23)
Seals			
Bearded Seal	16 (16)	13 (13)	29 (29)
Ringed Seal	170 (219)	14 (21)	184 (240)
Spotted Seal	1 (1)	0	1 (1)
Unidentified Pinniped	1 (1)	10 (10)	11 (11)
Unidentified Seal	22 (23)	116 (158)	138 (181)
<i>Total Seals</i>	210 (260)	153 (202)	363 (462)
Polar Bears			
In Water	0	4 (4)	4 (4)
On Ice	0	2 (19)	2 (19)
<i>Total Polar Bears</i>	0	6 (23)	6 (23)
<i>Grand Total of All Sightings</i>	221 (274)	167 (234)	388 (508)

TABLE L.2. Visual observation effort for cetaceans from the *Henry C.* and *Alpha Helix* during the Beaufort Sea shallow hazards survey (21 Jul- 24 Aug 2008). Effort shown is that which met the data-analysis criteria discussed in Chapter 4, *Analyses*. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and airgun status. Ramp-up effort is included in the "Seismic" category.

Beaufort Wind Force	MMO Watch Effort						Total
	0	1	2	3	4	5	
Henry C.							
Effort in km							
Non-seismic	44	403	562	600	206	78	1894
Seismic	15	89	296	300	142	18	859
Total	59	492	859	901	348	95	2754
Effort in h							
Non-seismic	5	49	74	74	28	11	242
Seismic	2	13	43	44	21	3	125
Total	7	62	117	118	49	14	367
Effort in mi							
Non-seismic	28	251	350	373	128	48	1177
Seismic	9	55	184	187	88	11	534
Total	37	306	533	560	216	59	1711
Alpha Helix							
Effort in km							
Non-seismic	0	272	641	1030	654	101	2699
Seismic	0	0	100	81	65	5	251
Total	0	272	741	1111	719	106	2950
Effort in h							
Non-seismic	0	34	69	103	60	11	278
Seismic	0	0	11	9	8	1	29
Total	0	34	81	113	69	11	308
Effort in mi							
Non-seismic	0	169	398	640	406	63	1677
Seismic	0	0	62	50	40	3	156
Total	0	169	461	691	447	66	1833
Total Effort in km	59	764	1600	2012	1067	201	5703
Total Effort in h	7	96	197	230	118	25	674
Total Effort in mi	37	475	994	1250	663	125	3544

TABLE L.3. Visual observation effort for pinnipeds from the *Henry C.* and *Alpha Helix* during the Beaufort Sea shallow hazards survey (21 Jul- 24 Aug 2008). Effort shown is that which met the data-analysis criteria discussed in Chapter 4, *Analyses*. Effort categories include kilometers, hours and miles, subdivided by Beaufort wind force and airgun status. Ramp-up effort is included in the "Seismic" category.

<i>Beaufort Wind Force</i>	MMO Watch Effort						Total
	0	1	2	3	4	5	
<i>Henry C.</i>							
Effort in km							
Non-seismic	44	420	591	630	220	84	1989
Seismic	15	92	298	301	142	28	875
Total	59	512	889	930	362	112	2864
Effort in h							
Non-seismic	5	51	78	78	31	12	255
Seismic	2	13	43	44	21	4	127
Total	7	64	121	121	52	16	382
Effort in mi							
Non-seismic	28	261	367	391	137	52	1236
Seismic	9	57	185	187	88	18	543
Total	37	318	552	578	225	70	1780
<i>Alpha Helix</i>							
Effort in km							
Non-seismic	0	274	735	1116	754	108	2986
Seismic	0	0	54	50	0	0	104
Total	0	274	789	1166	754	108	3090
Effort in h							
Non-seismic	0	34	80	114	74	12	314
Seismic	0	0	7	6	0	0	13
Total	0	34	87	120	74	12	326
Effort in mi							
Non-seismic	0	170	457	693	468	67	1856
Seismic	0	0	33	31	0	0	64
Total	0	170	490	724	468	67	1920
Total Effort in km	59	786	1678	2096	1116	220	5954
Total Effort in h	7	99	208	241	125	28	708
Total Effort in mi	37	488	1043	1302	693	137	3700

Table L.4. Numbers of sightings (number of individuals) of cetaceans by seismic state from the *Henry C.* and *Alpha Helix* during the Chukchi Sea shallow hazards survey (21 Jul – 24 Aug 2008). Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	Seismic	Non-Seismic	Total
<i>Henry C.</i>			
Beluga Whale	0	1 (2)	1 (2)
Bowhead Whale	0	7 (8)	
Unidentified Whale	0	1 (2)	1 (2)
<i>Henry C. Total Cetaceans</i>	0	9 (12)	9 (12)
<i>Alpha Helix</i>			
Bowhead Whale	0	6 (7)	6 (7)
Gray Whale	0	2 (2)	2 (2)
<i>Alpha Helix Total Cetaceans</i>	0	8 (9)	8 (9)
<i>Grand Total Cetaceans</i>	0	17 (21)	17 (21)

Table L.5. Numbers of sightings (number of individuals) of seals by seismic state from the *Henry C.* and *Alpha Helix* during the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008). Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	Seismic	Non-Seismic	Total
<i>Henry C.</i>			
Bearded Seal	3 (3)	9 (9)	12 (12)
Ringed Seal	17 (17)	101 (141)	118 (158)
Spotted Seal	0	1 (1)	1 (1)
Unidentified Seal	3 (3)	15 (16)	18 (19)
<i>Henry C. Total Seals</i>	23 (23)	126 (167)	149 (190)
<i>Alpha Helix</i>			
Bearded Seal	1 (1)	12 (12)	13 (13)
Ringed Seal	0	14 (21)	14 (21)
Unidentified Seal	0	116 (158)	116 (158)
Unidentified Pinniped	0	10 (10)	10 (10)
<i>Alpha Helix Total Seals</i>	1 (1)	152 (201)	153 (202)
<i>Grand Total Seals</i>	24 (24)	278 (368)	302 (392)

Table L.6. Numbers of sightings (number of individuals) of polar bears by seismic state from the *Alpha Helix* during the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008). There were no sightings of polar bears from the *Henry C.* Sightings shown are those that met the data-analysis criteria discussed in Chapter 4, Analyses.

Species	Seismic	Non-Seismic	Total
<i>Henry C.</i>			
Polar Bears in Water	0	0	0
Polar Bears on Ice	0	0	0
<i>Henry C. Total Polar Bears</i>	0	0	0
<i>Alpha Helix</i>			
Polar Bears in Water	1 (1)	3 (3)	4 (4)
Polar Bears on Ice	0	2 (19)	2 (19)
<i>Alpha Helix Total Polar Bears</i>	1 (1)	5 (22)	6 (23)
<i>Grand Total Polar Bears</i>	1 (1)	5 (22)	6 (23)

Part 2: English Units Tables and Figures from Chapter 8 and this Appendix

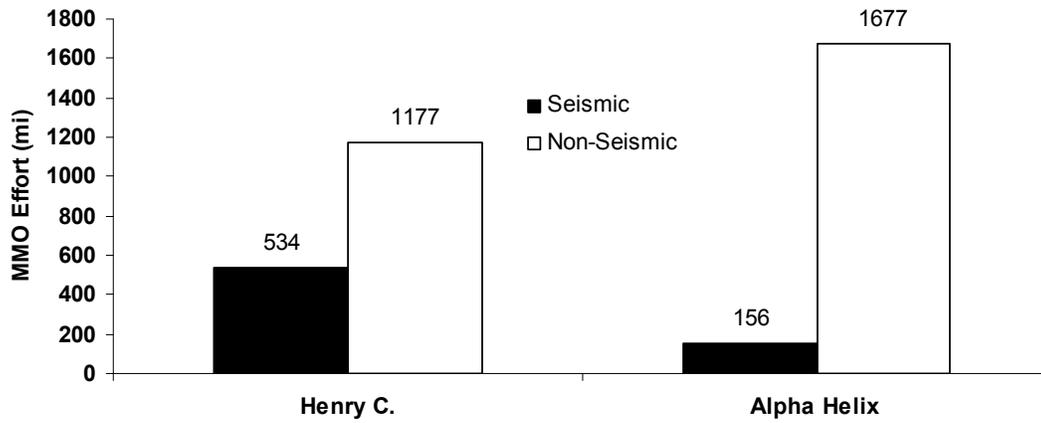


FIGURE L.8.1E. Marine mammal observer effort (mi) from the *Henry C.* and *Alpha Helix* by seismic activity during the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008).

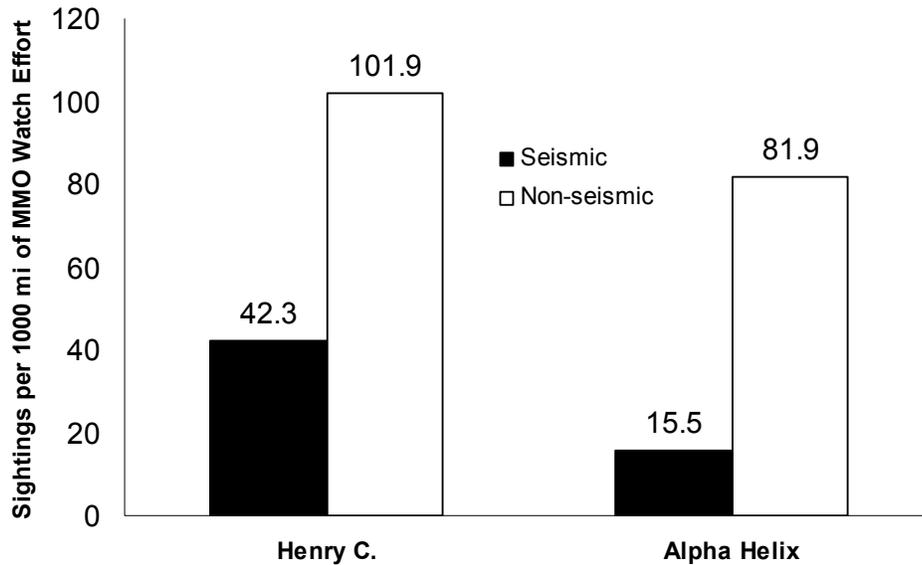


FIGURE L.8.3E. Seal sightings rate for the *Henry C.* and *Alpha Helix* during the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008).

TABLE L.8.3E. Seal CPA recorded from the *Henry C.* and *Alpha Helix* during the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008).

Vessel and Seismic Status	Mean CPA ^a (yd)	s.d.	Range (yd)	n
Henry C. Seismic	270	153	80-670	23
Henry C. Non-seismic	246	211	42-1561	126
Henry C. Overall Mean	249	203	42-1561	149
Alpha Helix Seismic	203	NA	203	1
Alpha Helix Non-seismic	193	141	27-913	152
Alpha Helix Overall Mean	193	141	27-913	153

^a CPA = *Closest Point of Approach*. This value is the marine mammal's closest point of approach to the airgun array.

TABLE L.8.6E. Estimated densities of marine mammals in offshore areas of the Beaufort Sea based on effort and sightings from the *Henry C.* and *Alpha Helix* (see Chapter 4 for more details). Densities were corrected for $f(0)$ and $g(0)$ biases.

Species	Non-seismic Densities	Seismic Densities
	(No. individuals / 1000 mi ²)	(No. individuals / 1000 mi ²)
Cetaceans		
Beluga Whale	0.165	0.000
Bowhead Whale	0.487	0.000
Gray Whale	0.047	0.000
Unidentified Whale	0.055	0.000
Cetacean Total	0.754	0.000
Seals		
Bearded Seal	6.815	9.363
Ringed Seal	41.938	22.809
Ribbon Seal	0.056	0.000
Unidentified Pinniped	1.852	0.000
Unidentified Seal ^a	56.380	4.025
Seal Total	107.042	36.197

^a Unidentified Seals includes spotted and unidentified seals

TABLE L.8.7E. Estimated areas (mi²) ensonified to various sound levels during the Beaufort Sea shallow hazards survey (21 Jul - 24 Aug 2008). Maximum area ensonified is shown with overlapping areas counted multiple times, total area ensonified shown with overlapping areas counted only once.

Area (mi ²)	Level of ensonification (dB re1μPa (rms))				
	120	160	170	180	190
Henry C.					
Including Overlap Area	21991	486	136	36	9
Excluding Overlap Area	1402	244	107	32	9
Alpha Helix					
Including Overlap Area	1546	56	22	9	3
Excluding Overlap Area	700	25	12	5	2

TABLE L.8.8E. Estimated numbers of individual cetaceans exposed to received sound levels ≥160, 170, 180, and 190 dB (rms) and average number of exposures per individual for the *Henry C.* and *Alpha Helix* during the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008). Estimates are based on "corrected" densities of cetaceans calculated from effort and sightings data during seismic and non-seismic periods.

Exposure level in dB re 1μPa (rms)	Non-seismic Densities		Seismic Densities	
	Individuals	Exposures per Individual	Individuals	Exposures per Individual
Henry C				
≥160	1*	2.0	0	2.0
≥170	1*	1.3	0	1.3
≥180	1*	1.1	0	1.1
≥190	1*	1.0	0	1.0
Alpha Helix				
≥160	1*	2.2	0	2.2
≥170	1*	1.8	0	1.8
≥180	1*	1.8	0	1.9
≥190	1*	1.5	0	1.7

* Actual value less than 1.

TABLE L.8.9E. Estimated numbers of individual seals exposed to received sound levels ≥ 160 , 170, 180, and 190 dB (rms) and average number of exposures per individual for the *Henry C.* and *Alpha Helix* within the Beaufort Sea shallow hazards survey (21 Jul – 24 Aug 2008).

Exposure level in dB re 1 μ Pa (rms)	Non-seismic Densities		Seismic Densities	
	Individuals	Exposures per Individual	Individuals	Exposures per Individual
Henry C				
≥ 160	26	2.0	9	2.0
≥ 170	11	1.3	4	1.3
≥ 180	3	1.1	1	1.1
≥ 190	1	1.0	1*	1.0
Alpha Helix				
≥ 160	3	2.2	1	2.2
≥ 170	1	1.8	1*	1.8
≥ 180	1	1.8	1*	1.9
≥ 190	1*	1.5	1*	1.7

* Actual value less than 1.

APPENDIX M: MARINE MAMMAL MONITORING RESULTS DURING AERIAL SURVEYS OF THE BEAUFORT SEA

Part 1: Tables and Figures Referenced from Chapter 9

Jul-Aug Surveys of Camden Bay

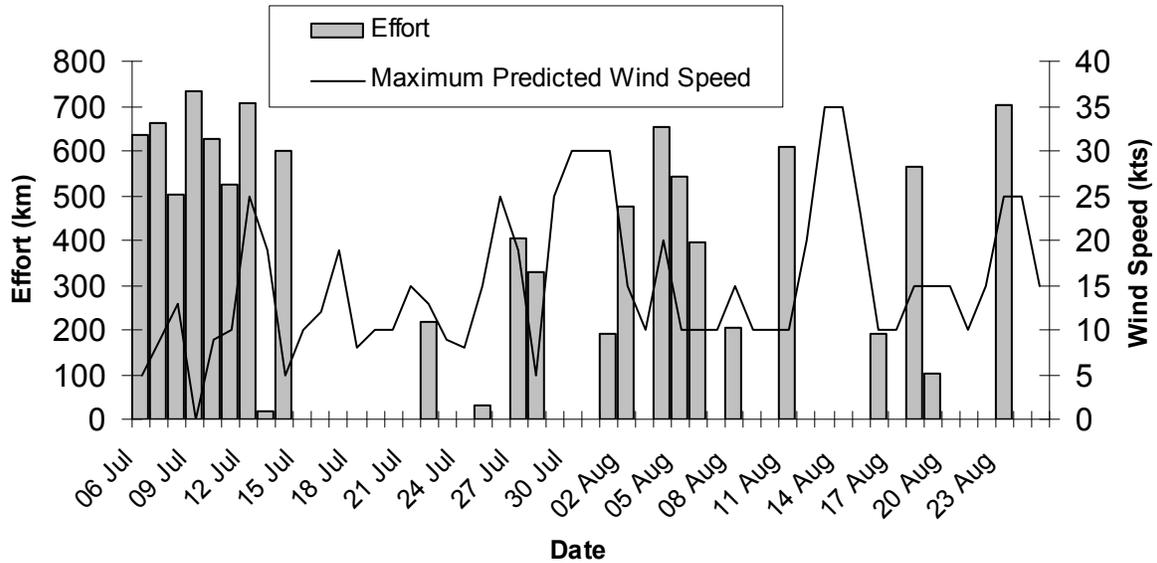


Figure M.1. Relationship between aerial survey effort and maximum predicted wind speed in Camden Bay from 6 Jul to 23 Aug.

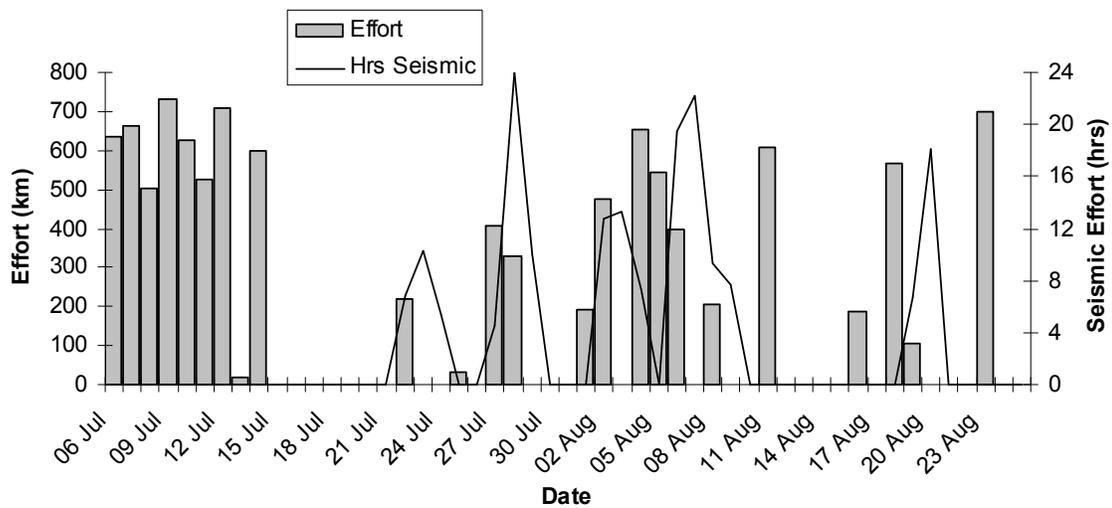


Figure M.2. Relationship between aerial survey effort and seismic activity in Camden Bay from 6 Jul to 23 Aug.

TABLE M.1. Sighting rates of bowhead whales in 5-km distance from shore bins by survey area and seismic state in Camden Bay from 6 Jul to 23 Aug. Dashes represent bins in which no effort was collected. Numbers in bold indicate maximum values.

Distance bin	West				Central				East				All			
	Pre	Seismic	Post	Non	Pre	Seismic	Post	Non	Pre	Seismic	Post	Non	Pre	Seismic	Post	Non
0-5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10-15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.8	0.0	0.0	0.0	10.2	0.0	0.0
15-20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20-25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25-30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30-35	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9
35-40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8
40-45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45-50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50-55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55-60	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60-65	0.0	0.0	0.0	0.0	14.6	0.0	0.0	0.0	70.0	0.0	0.0	0.0	24.0	0.0	0.0	0.0
65-70	0.0	--	--	0.0	7.0	0.0	--	0.0	11.0	0.0	0.0	0.0	7.9	0.0	0.0	0.0
70-75	0.0	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75-80	--	--	--	--	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
80-85	--	--	--	--	--	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85-90	--	--	--	--	--	--	--	--	0.0	--	--	--	0.0	--	--	--
Average	0.0	0.0	0.0	0.0	1.3	0.0	0.0	2.3	4.5	1.5	0.0	0.0	1.8	0.6	0.0	0.7

TABLE M.2. All bowhead sightings observed during seismic activities in Camden Bay from 6 Jul through 23 Aug.

Date	Time	Number	On/Off Transect	Distance (km) from center of seismic patch	Heading	Start of seismic	Time elapsed since start of seismic
19 Aug	18:45:46	1	On	54.8	150	19-Aug 17:20:37	1.4

Aug-Oct Surveys in Harrison Bay

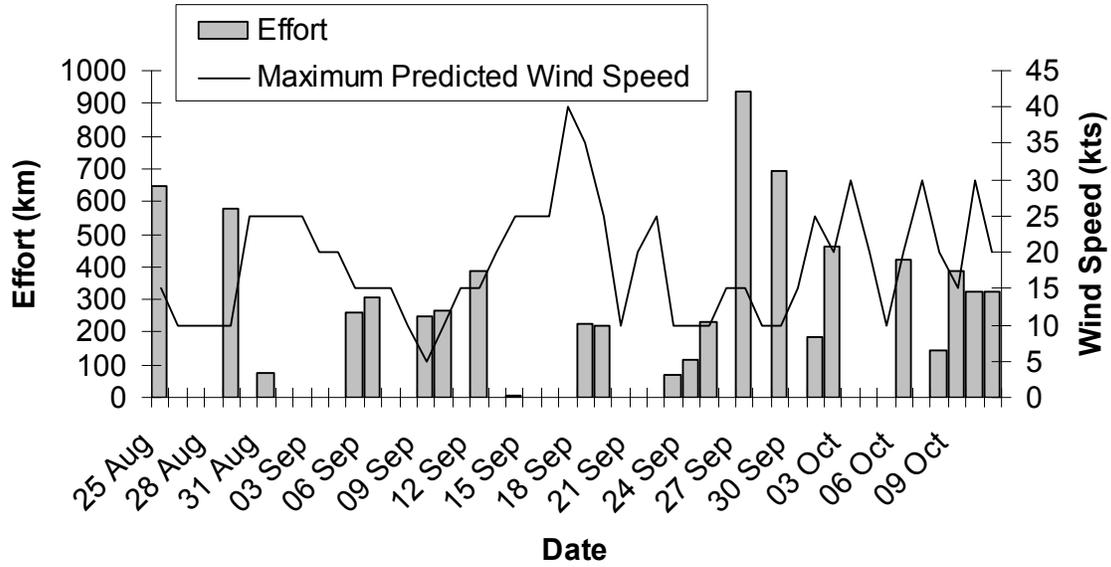


FIGURE M.3. Relationship between aerial survey effort and maximum predicted wind speed in Harrison Bay from 25 Aug to 11 Oct.

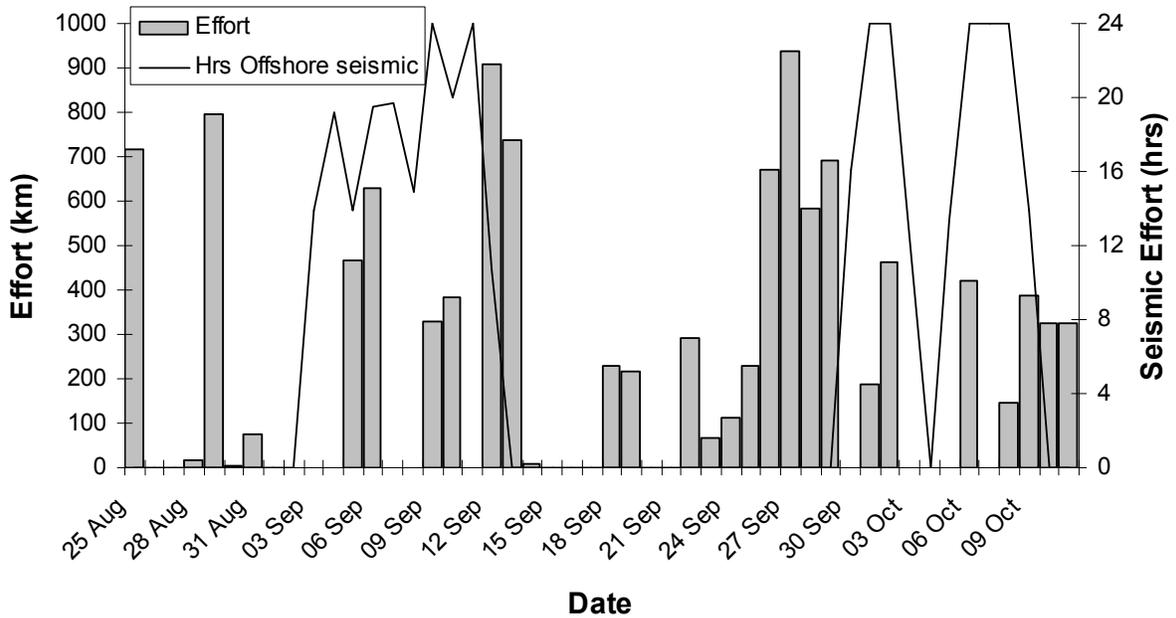


Figure M.4. Relationship between aerial survey effort and seismic activity in Harrison Bay from 25 Aug to 11 Oct

TABLE M.3. Sighting rates of bowhead whales in 5-km distance from shore bins by survey area and seismic state in Harrison Bay from 25 Aug to 11 Oct. Dashes represent bins in which no effort was collected. Numbers in bold indicate maximum values.

Distance bin	West			Central			East			All		
	Seismic	Post	Non	Seismic	Post	Non	Seismic	Post	Non	Seismic	Post	Non
0-5	--	--	--	0	0	0	0	0	0	0	0	0
5-10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10-15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.2	0.0	0.0	7.3	0.0
15-20	0.0	0.0	0.0	0.0	0.0	3.3	45.5	0.0	0.0	4.8	0.0	2.6
20-25	0.0	0.0	0.0	0.0	0.0	3.6	0.0	0.0	0.0	0.0	0.0	2.4
25-30	0.0	0.0	0.0	21.1	0.0	50.9	68.9	31.6	47.4	18.5	6.2	39.9
30-35	15.8	0.0	12.2	0.0	0.0	3.9	0.0	0.0	0.0	8.4	0.0	5.4
35-40	8.5	0.0	0.0	0.0	0.0	5.0	0.0	48.4	0.0	4.1	8.0	2.9
40-45	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.7	0.0	0.0
45-50	17.9	34.9	0.0	10.7	25.6	0.0	0.0	0.0	0.0	0.0	20.1	0.0
50-55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55-60	0.0	0.0	0.0	0.0	101.0	8.6	0.0	0.0	0.0	0.0	30.9	4.7
60-65	0.0	0.0	0.0	0.0	0.0	9.2	0.0	0.0	0.0	0.0	0.0	5.1
65-70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
70-75	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
75-80	0.0	0.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
80-85	0.0	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
85-90	--	--	--	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0
90-95	--	--	--	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
95-100	--	--	--	0.0	0.0	0.0	--	--	0.0	0.0	0.0	0.0
100-105	--	--	--	--	0.0	0.0	--	--	--	--	0.0	0.0
105-110	--	--	--	0.0	0.0	--	--	--	--	0.0	0.0	--
110-115	--	--	--	0.0	--	0.0	--	--	--	0.0	--	0.0
Average	2.6	2.3	0.8	1.4	5.8	3.8	6.0	6.7	2.5	2.4	3.3	2.9

TABLE M.4. All bowhead sightings observed during seismic activities in Harrison Bay from 25 Aug to 11 Oct. Dashes indicate sightings for which headings were not recorded.

Date	Time	Number	Source	On/Off Transect	Distance (km) from center of seismic patch	Heading	Start of seismic	Time elapsed since start of seismic
05 Sep	17:53:04	2	Offshore	On	32.3	330	05 Sep 2008 17:45:00	0:08:04
05 Sep	17:53:58	1	Offshore	On	32.7	350	05 Sep 2008 17:45:00	0:08:58
06 Sep	13:59:00	1	Offshore	Off	38.5	67	06 Sep 2008 11:54:00	2:05:00
06 Sep	14:32:41	1	Offshore	Off	30.0	10	06 Sep 2008 11:54:00	2:38:41
06 Sep	15:09:07	2	Offshore	Off	31.0	280	06 Sep 2008 11:54:00	3:15:07
06 Sep	15:09:59	2	Offshore	Off	34.0	280	06 Sep 2008 11:54:00	3:15:59
06 Sep	16:40:01	2	Offshore	On	56.5	1	06 Sep 2008 11:54:00	4:46:01
06 Sep	16:40:43	1	Offshore	On	58.1	269	06 Sep 2008 11:54:00	4:46:43
06 Sep	17:14:36	2	Offshore	On	77.5	272	06 Sep 2008 11:54:00	5:20:36
06 Sep	17:15:28	1	Offshore	Off	76.0	--	06 Sep 2008 11:54:00	5:21:28
06 Sep	17:39:54	1	Offshore	On	100.2	270	06 Sep 2008 11:54:00	5:45:54
06 Sep	17:39:56	2	Offshore	On	100.3	270	06 Sep 2008 11:54:00	5:45:56
06 Sep	18:45:58	1	Offshore	On	55.6	0	06 Sep 2008 11:54:00	6:51:58
02 Oct	18:34:12	1	Offshore	On	28.9	91	30 Sep 2008 07:55:00	59:00:00
09 Oct	12:29:50	1	Offshore	On	58.8	268	05 Oct 2008 10:04:00	98:24:00
09 Oct	12:31:32	2	Offshore	On	60.0	300	05 Oct 2008 10:04:00	98:24:00

Sep Surveys of Camden Bay

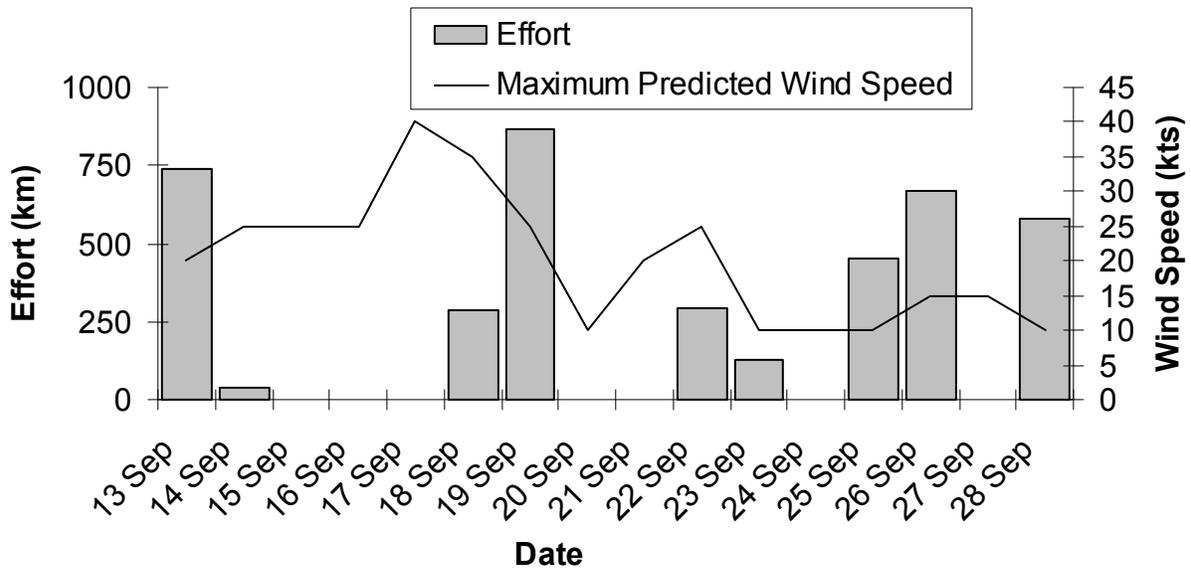


Figure M.5. Relationship between aerial survey effort and maximum predicted wind speed in Camden Bay from 13 Sep to 28 Sep 2008.

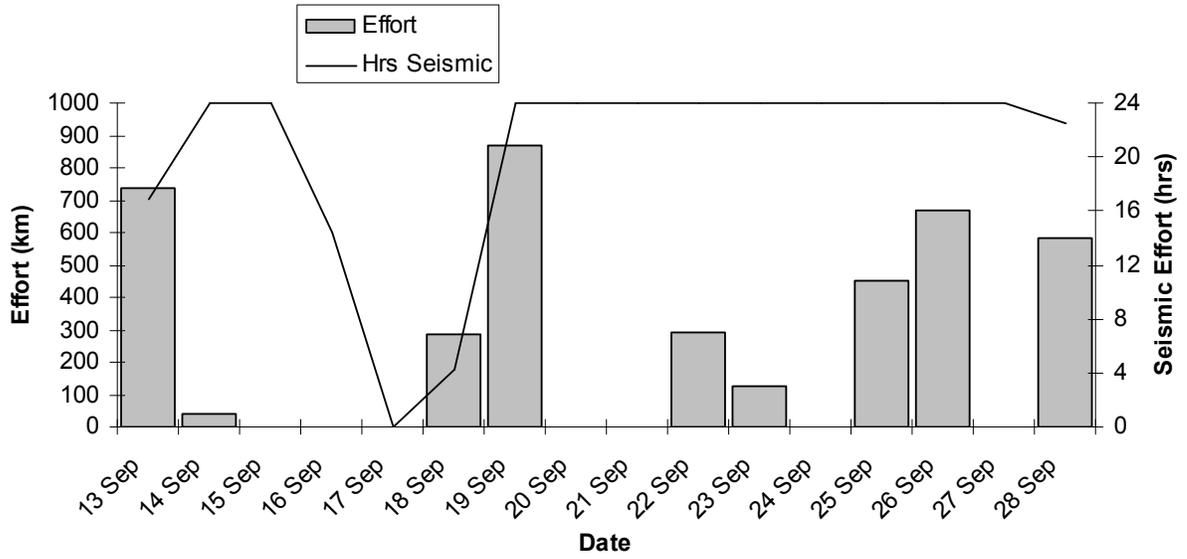


Figure M.6. Relationship between aerial survey effort and hours of seismic data acquisition in Camden Bay from 13 Sep to 28 Sep 2008.

TABLE M.5. Sighting rates of bowhead whales in 5-km distance bins by survey area and seismic state in Camden Bay from 13 Sep through 28 Sep 2008. Dashes represent bins in which no effort was collected. Numbers in bold indicate maximum values.

Distance bin	West		Central		East		All	
	Seismic	Non-Seismic	Seismic	Non-Seismic	Seismic	Non-Seismic	Seismic	Non-Seismic
0-5	0.0	0.0	73.9	0.0	0.0	0.0	16.1	0.0
5-10	39.0	0.0	0.0	0.0	0.0	0.0	21.7	0.0
10-15	65.3	144.5	0.0	--	0.0	0.0	27.3	45.2
15-20	53.5	0.0	13.5	265.1	0.0	0.0	27.4	82.2
20-25	36.4	0.0	0.0	66.2	16.2	0.0	22.1	24.5
25-30	0.0	0.0	0.0	0.0	30.4	0.0	7.6	0.0
30-35	10.9	0.0	0.0	0.0	13.5	0.0	9.1	0.0
35-40	0.0	0.0	0.0	0.0	19.7	--	5.2	0.0
40-45	10.6	--	0.0	0.0	0.0	--	4.5	0.0
45-50	0.0	0.0	0.0	--	0.0	--	0.0	0.0
50-55	0.0	--	0.0	--	0.0	--	0.0	--
55-60	0.0	--	0.0	--	0.0	--	0.0	--
60-65	0.0	--	0.0	--	0.0	--	0.0	--
65-70	0.0	--	0.0	--	0.0	--	0.0	--
70-75	0.0	--	0.0	--	0.0	--	0.0	--
75-80	0.0	--	0.0	--	0.0	--	0.0	--
80-85	0.0	--	0.0	--	0.0	--	0.0	--
85-90	0.0	--	0.0	--	0.0	--	0.0	--
90-95	0.0	--	0.0	--	0.0	--	0.0	--
95-100	0.0	--	0.0	--	0.0	--	0.0	--
100-105	--	--	0.0	--	0.0	--	0.0	--
105-110	--	--	0.0	--	0.0	--	0.0	--
110-115	--	--	0.0	--	0.0	--	0.0	--
115-120	--	--	0.0	--	--	--	0.0	--
120-125	--	--	0.0	--	--	--	0.0	--
Average	10.8	16.1	3.5	41.4	3.5	0.0	5.6	15.2

TABLE M.6. All bowhead sightings observed during seismic activities in Camden Bay from 13 Sep to 28 Sep, 2008. Dashes indicate sightings for which headings were not recorded and the term "Various" is used for groups of individuals with different headings.

Date	Time	Number	On/Off Transect	Distance (km) from center of seismic patch	Heading	Start of seismic	Time (hrs) elapsed since start of seismic
13 Sep	12:07:49	1	On	49.9	280	13-Sep 07:11:00	4.9
13 Sep	12:10:37	1	On	51.9	272	13-Sep 07:11:00	5.0
13 Sep	12:12:19	1	On	54.0	280	13-Sep 07:11:00	5.0
13 Sep	12:28:35	1	On	33.4	--	13-Sep 07:11:00	5.3
13 Sep	12:29:03	1	On	32.2	271	13-Sep 07:11:00	5.3
13 Sep	12:34:04	1	On	25.9	180	13-Sep 07:11:00	5.4
13 Sep	13:47:21	3	On	46.7	Various	13-Sep 07:11:00	6.6
13 Sep	13:49:02	1	Off	40.9	269	13-Sep 07:11:00	6.6
13 Sep	14:43:17	1	On	56.6	280	13-Sep 07:11:00	7.5
13 Sep	14:44:27	1	On	59.8	280	13-Sep 07:11:00	7.6
13 Sep	18:38:38	1	On	81.9	--	13-Sep 07:11:00	11.5
13 Sep	18:39:45	1	On	79.9	--	13-Sep 07:11:00	11.5
13 Sep	19:16:55	1	On	102.1	--	13-Sep 07:11:00	12.1
19 Sep	14:11:31	1	On	59.4	200	18-Sep 19:47:00	18.4
19 Sep	14:11:33	1	On	59.5	--	18-Sep 19:47:00	18.4
19 Sep	14:24:35	1	On	38.1	280	18-Sep 19:47:00	18.6
19 Sep	14:24:44	1	On	37.9	--	18-Sep 19:47:00	18.6
19 Sep	14:27:10	1	On	35.5	300	18-Sep 19:47:00	18.7
19 Sep	14:29:28	2	On	35.0	Various	18-Sep 19:47:00	18.7
19 Sep	14:29:50	1	On	35.2	--	18-Sep 19:47:00	18.7
19 Sep	15:31:01	1	On	26.5	70	18-Sep 19:47:00	19.7
19 Sep	15:31:21	2	On	26.0	0,150	18-Sep 19:47:00	19.7
19 Sep	15:32:11	1	On	24.5	--	18-Sep 19:47:00	19.8
19 Sep	15:32:11	2	On	24.5	--	18-Sep 19:47:00	19.8
19 Sep	15:32:30	1	On	24.3	--	18-Sep 19:47:00	19.8
19 Sep	16:07:40	1	On	29.6	--	18-Sep 19:47:00	20.3
19 Sep	16:08:16	1	On	31.9	--	18-Sep 19:47:00	20.4
22 Sep	18:48:40	1	Off	57.0	267	18-Sep 19:47:00	95.0
22 Sep	19:03:41	1	On	74.0	0	18-Sep 19:47:00	95.3
22 Sep	19:04:33	1	On	74.3	--	18-Sep 19:47:00	95.3
25 Sep	16:45:23	1	On	81.2	271	18-Sep 19:47:00	165.0
26 Sep	12:11:25	1	On	49.4	--	18-Sep 19:47:00	184.4
26 Sep	12:11:42	1	On	49.4	270	18-Sep 19:47:00	184.4
26 Sep	13:11:50	1	Off	31.3	313	18-Sep 19:47:00	185.4
26 Sep	15:42:46	1	Off	40.8	296	18-Sep 19:47:00	187.9
26 Sep	15:50:52	1	Off	40.4	179	18-Sep 19:47:00	188.1
26 Sep	15:52:24	1	Off	40.7	318	18-Sep 19:47:00	188.1
28 Sep	13:03:41	1	On	39.6	271	18-Sep 19:47:00	233.3

Part 2: English Units Tables and Figures from Chapter 9 and this Appendix

Jul-Aug Surveys of Camden Bay

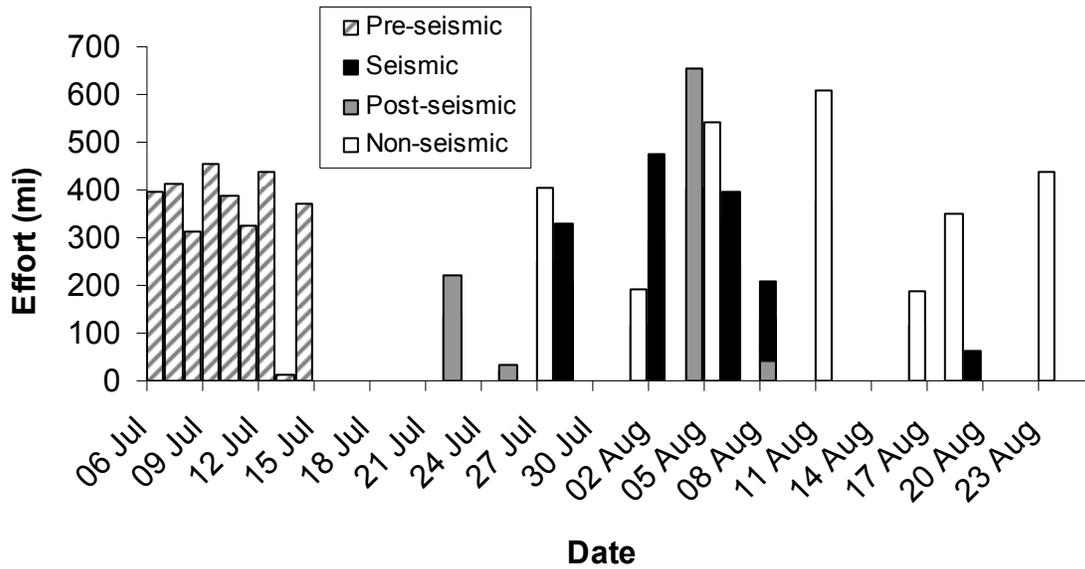


FIGURE M.9.1E. Survey effort by seismic state in Camden Bay from 6 Jul to 23 Aug.

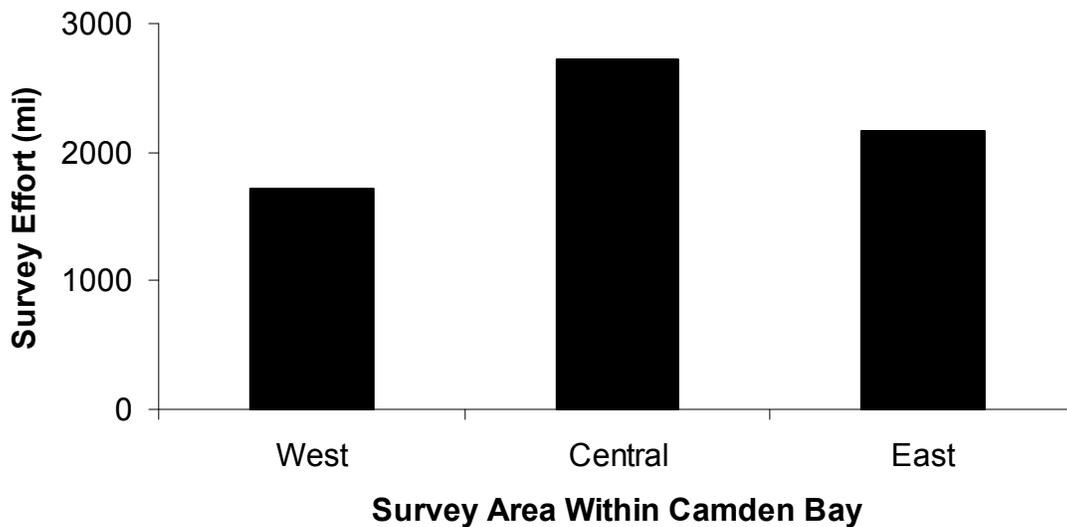


FIGURE M.9.2E. Aerial survey effort in west, central, and east areas of Camden Bay from 6 Jul to 23 Aug.

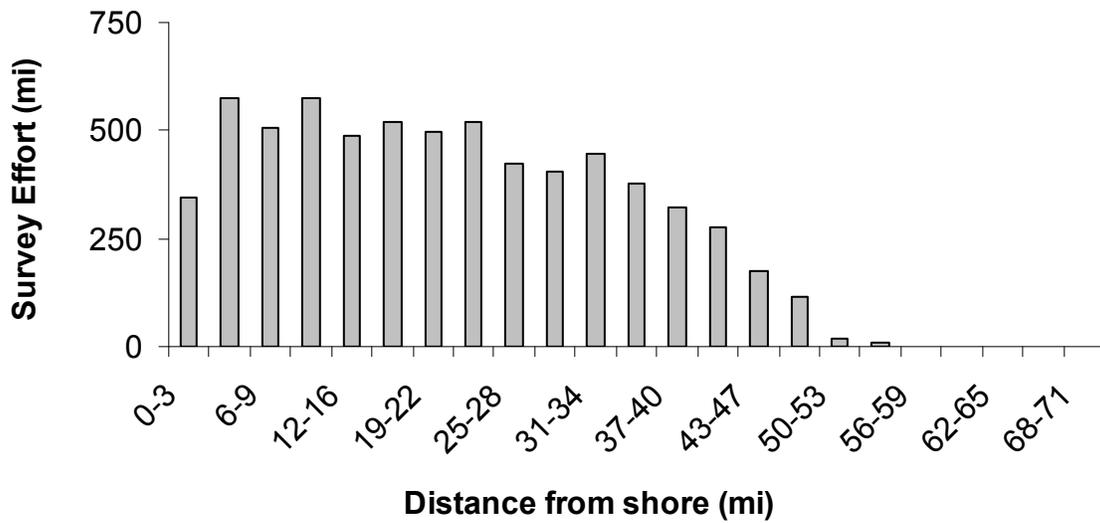


FIGURE M.9.3E. Aerial survey effort by 3-mi distance-from-shore bin in Camden Bay from 6 Jul to 23 Aug.

TABLE M.9.1E. Summary of aerial survey effort and sighting rates for bowhead and beluga whales in Camden Bay from 6 Jul through 23 Aug 2008. Numbers of sightings and individuals in parentheses were based on <310 mi of effort and should be viewed with caution. Sighting rates were not calculated (“NC”) when effort was less than 155 mi.

Date	Survey No.	Effort (mi)	Percent of Survey Area	Bowhead Whale				Beluga Whale				
				Sightings	Individuals	Sightings/ 1000 mi	Individuals/ 1000 mi	Sightings	Individuals	Sightings/ 1000 mi	Individuals/ 1000 mi	
06 Jul	1	395	42	0	0	0.0	0.0	2	5	5.1	12.7	
07 Jul	2	413	43	1	1	2.4	2.4	4	7	9.7	17.0	
08 Jul	3	311	33	0	0	0.0	0.0	0	0	0.0	0.0	
09 Jul	4	454	48	5	8	11.0	17.6	72	198	158.5	435.8	
10 Jul	5	389	41	0	0	0.0	0.0	11	17	28.3	43.7	
11 Jul	6	327	34	0	0	0.0	0.0	1	3	3.1	9.2	
12 Jul	7	439	46	2	2	4.6	4.6	7	18	16.0	41.0	
13 Jul	8	11	1	(0)	(0)	NC	NC	(0)	(0)	NC	NC	
14 Jul	9	372	39	0	0	0.0	0.0	10	18	26.9	48.4	
22 Jul	10	137	14	(0)	(0)	NC	NC	(0)	(0)	NC	NC	
25 Jul	11	20	2	(0)	(0)	NC	NC	(0)	(0)	NC	NC	
27 Jul	12	252	27	(0)	(0)	0.0	0.0	(1)	(1)	4.0	4.0	
28 Jul	13	204	21	(0)	(0)	0.0	0.0	(2)	(2)	9.8	9.8	
01 Aug	14	118	12	(0)	(0)	NC	NC	(0)	(0)	NC	NC	
02 Aug	14	295	31	(0)	(0)	0.0	0.0	(7)	(7)	23.8	23.8	
04 Aug	15	406	43	0	0	0.0	0.0	1	1	2.5	2.5	
05 Aug	16	336	35	0	0	0.0	0.0	0	0	0.0	0.0	
06 Aug	17	247	26	(0)	(0)	0.0	0.0	(0)	(0)	0.0	0.0	
08 Aug	17	128	14	(0)	(0)	NC	NC	(0)	(0)	NC	NC	
11 Aug	18	377	40	0	0	0.0	0.0	2	2	5.3	5.3	
16 Aug	19	117	12	(0)	(0)	NC	NC	(0)	(0)	NC	NC	
18 Aug	20	351	37	0	0	0.0	0.0	0	0	0.0	0.0	
19 Aug	21	64	7	(1)	(1)	NC	NC	(0)	(0)	NC	NC	
21 Aug	22	0	0	(0)	(0)	NC	NC	(0)	(0)	NC	NC	
23 Aug	22	435	46	3	6	6.9	13.8	1	1	2.3	2.3	
Total	22	6597	100	12	18	1.82	2.73	0	121	280	18.34	42.44

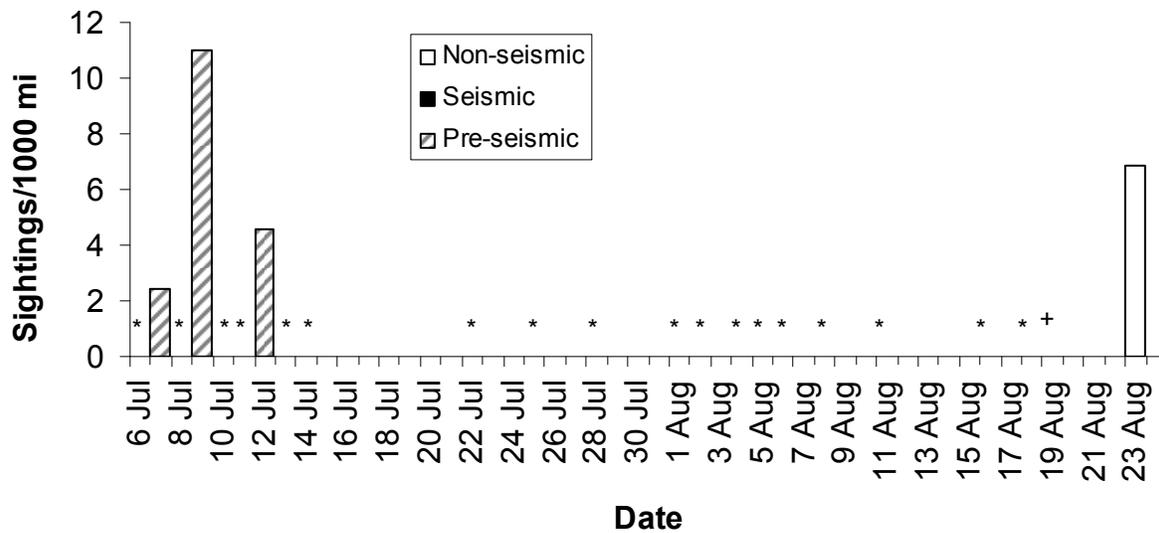


FIGURE M.9.4E. Bowhead whale sighting rates from aerial surveys of the central Beaufort Sea from 6 Jul through 23 Aug 2008. Days on which surveys were conducted but no sightings were recorded are indicated by an asterisk. Sighting rates for surveys with less than 250 km (311 mi) of effort were not calculated, but are indicated with a plus-sign. Seismic activities at the time of sightings are indicated by fill pattern.

Table M.9.2E. Bowhead whale sightings and sighting rates during aerial surveys in Camden Bay by seismic state from 6 Jul through 23 Aug 2008.

		Pre-seismic	Seismic	Post-seismic	Non-seismic	Total
West	Sightings	0	0	0	0	0
	Individuals	0	0	0	0	0
	Sightings/1000 km	0.0	0.0	0.0	0.0	0.0
	Individuals/1000 km	0.0	0.0	0.0	0.0	0.0
Central	Sightings	3	0	0	3	6
	Individuals	3	0	0	6	9
	Sightings/1000 km	1.4	0.0	0.0	2.4	1.4
	Individuals/1000 km	1.4	0.0	0.0	4.7	2.1
East	Sightings	5	1	0	0	6
	Individuals	8	1	0	0	9
	Sightings/1000 km	4	2	0	0	2
	Individuals/1000 km	6	2	0	0	3
All areas	Sightings	8	1	0	3	12
	Individuals	11	1	0	6	18
	Sightings/1000 km	1.6	0.7	0.0	0.9	1.1
	Individuals/1000 km	2.2	0.7	0.0	1.9	1.7

TABLE M.9.3E. Chi-square test comparing differences in number of bowhead whale sightings by seismic state during aerial surveys in Camden Bay, 6 Jul through 23 Aug, 2008.

	Pre-seismic	Seismic	Post-seismic	Non-seismic	χ^2	One-tailed <i>P</i>
Sightings (obs.)	8	1	0	3	2.416	0.491
Sightings (exp.)	5.7	1.6	1.1	3.6		
Effort (mi)	3110.4	895.4	604.6	1986.4		

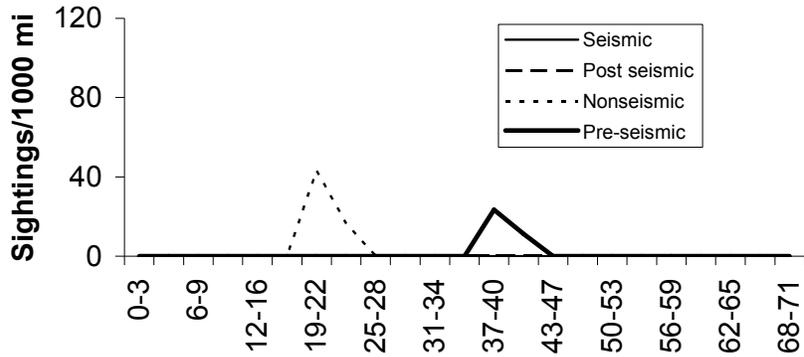
TABLE M.9.4E. Chi-square test comparing bowhead sighting rates in the east, west, and central areas during aerial surveys in Camden Bay, 6 Jul through 23 Aug, 2008.

	West	Central	East	χ^2	One-tailed <i>P</i>
Sightings (obs.)	0	6	6	22.595	0.108
Sightings (exp.)	3	5	4		
Effort (mi)	1719.1	2717.6	2160.1		

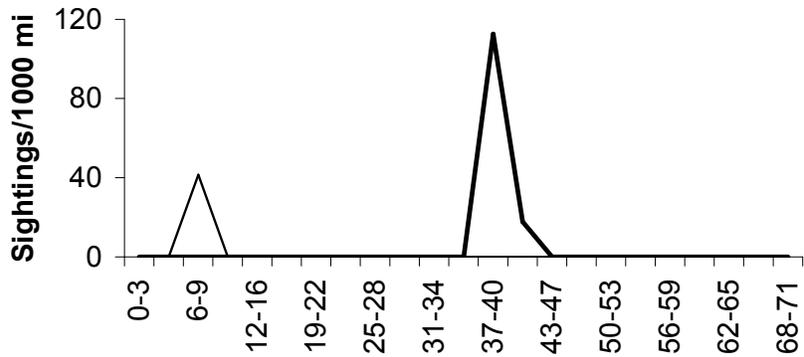
TABLE M.9.5E. Estimated numbers of bowhead whales in the aerial survey area in Camden Bay, 6 Jul through 23 Aug 2008. Estimates were obtained using DISTANCE software for each individual survey. Numbers in parentheses should be interpreted with caution due to low effort (<311 mi). Estimates include allowance for $f(0)$ (as calculated by DISTANCE) and $g(0)$ (value of 0.144 from Thomas et al. 2002).

Survey No.	Date	Effort (mi)	Sightings	Density (No./1000 mi ²)	Est. No. Whales	95% C.I.
1	06 Jul	395	0	0.0	0	-- --
2	07 Jul	413	1	15.9	56	11 292
3	08 Jul	311	0	0.0	0	-- --
4	09 Jul	454	5	115.5	406	166 992
5	10 Jul	389	0	0.0	0	-- --
6	11 Jul	327	0	0.0	0	-- --
7	12 Jul	439	2	29.9	105	25 450
8	13 Jul	11	(0)	NC	NC	-- --
9	14 Jul	372	0	0.0	0	-- --
10	22 Jul	137	(0)	NC	NC	-- --
11	25 Jul	20	(0)	NC	NC	-- --
12	27 Jul	252	(0)	0.0	(0)	-- --
13	28 Jul	204	(0)	0.0	(0)	-- --
14	1, 2 Aug	413	0	0.0	0	-- --
15	04 Aug	406	0	0.0	0	-- --
16	05 Aug	336	0	0.0	0	-- --
17	6, 8 Aug	376	0	0.0	0	-- --
18	11 Aug	377	0	0.0	0	-- --
19	16 Aug	117	(0)	NC	NC	-- --
20	18 Aug	351	0	0.0	0	-- --
21	19 Aug	64	(1)	NC	NC	-- --
22	23 Aug	435	3	90.4	318	76 1330

(A) Central area



(B) Eastern area



(C) All areas

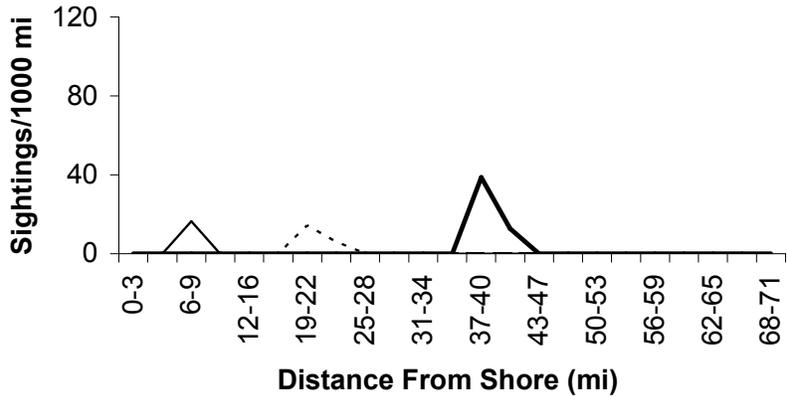


FIGURE M.9.5E. Bowhead sighting rates within 3 mi distance from shore bins during aerial surveys from 6 Jul through 23 Aug, (A) central area, (B) eastern area, (C) all areas.

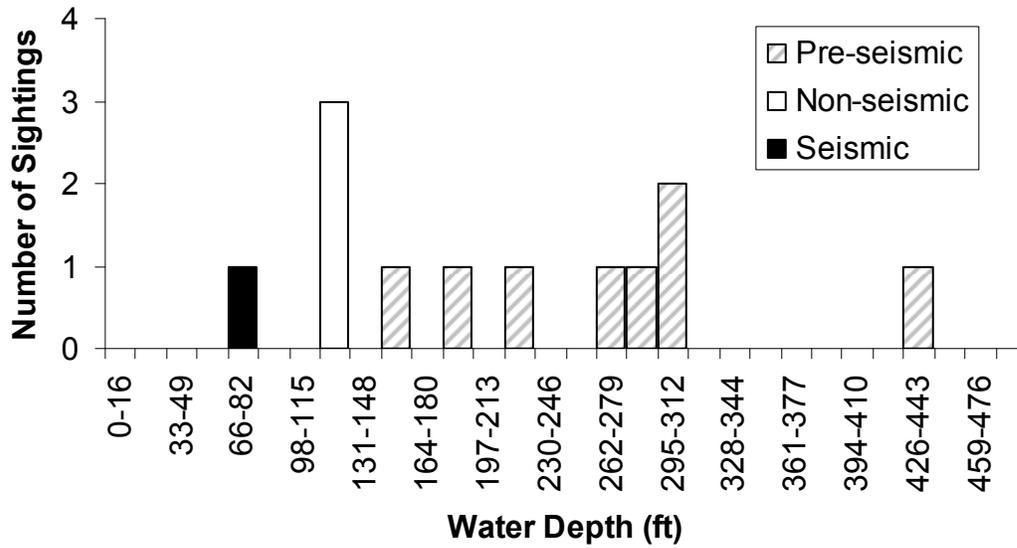


FIGURE M.9.6E. Number of bowhead whale sightings within 16-ft depth intervals during aerial surveys from 6 Jul through 23 Aug. Seismic activities at the time of sightings are shown.

TABLE M.9.6E. Minimum, maximum and mean distance (mi) of bowhead whale sightings from the center of the seismic prospect during seismic, non-seismic, and post-seismic periods in Camden Bay, 6 Jul through 23 Aug, 2008. Comparisons were made with a Kruskal-Wallis test.

Seismic State	Sightings	Distance from Prospect Center (mi)		
	<i>n</i>	Min.	Max.	Mean
Pre-seismic	8	19.7	23.7	28.3
Seismic	1	34.0	34.0	34.0
Post-seismic	0	--	--	--
Non-seismic	3	6.5	8.3	11.7

TABLE M.9.7E. Estimated numbers of beluga whales in the survey area in Camden Bay, 6 Jul through 23 Aug 2008. Estimates obtained using DISTANCE software for each individual survey. Numbers in parentheses should be interpreted with caution due to low effort (311 mi). Estimates include allowance for $f(0)$ (as calculated by DISTANCE) and $g(0)$ (value of 0.144 from Thomas et al. 2002).

Survey No.	Date	Effort (mi)	Sightings	Density (No./1000 mi ²)	Est. No. Whales	95% C.I.	
1	06 Jul	395	2	21.8	76	10	598
2	07 Jul	413	4	25.0	88	24	317
3	08 Jul	311	0	0.0	0	--	--
4	09 Jul	454	72	469.9	1651	662	4116
5	10 Jul	389	11	53.2	187	38	927
6	11 Jul	327	1	15.8	55	9	348
7	12 Jul	439	7	30.7	108	16	718
8	13 Jul	11	(0)	NC	NC	--	--
9	14 Jul	372	10	69.2	243	51	1169
10	22 Jul	137	(0)	NC	NC	--	--
11	25 Jul	20	(0)	NC	NC	--	--
12	27 Jul	252	(1)	6.8	(24)	(5)	(109)
13	28 Jul	204	(2)	16.8	(59)	(13)	(275)
14	1, 2 Aug	413	7	29.1	102	30	344
15	04 Aug	406	1	4.1	15	2	102
16	05 Aug	336	0	0.0	0	--	--
17	6, 8 Aug	376	0	0.0	0	--	--
18	11 Aug	377	2	9.1	32	6	173
19	16 Aug	117	(0)	NC	NC	--	--
20	18 Aug	351	0	0.0	0	--	--
21	19 Aug	64	(0)	NC	NC	--	--
22	23 Aug	435	1	0.0	0	--	--

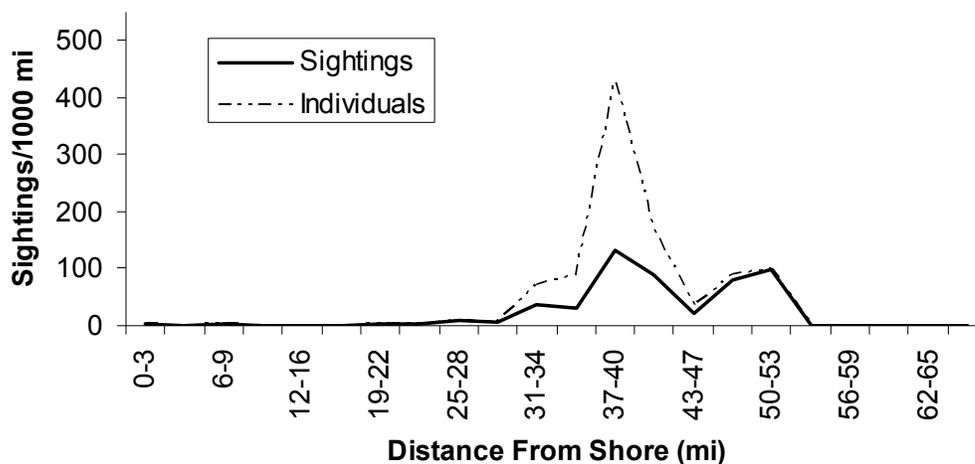


FIGURE M.9.7E. Beluga whale sighting rates by distance from shore during aerial surveys in Camden Bay from 6 Jul through 23 Aug 2008. Number of sightings/1000 mi and number of individuals/1000 mi are shown.

Aug-Oct Surveys in Harrison Bay

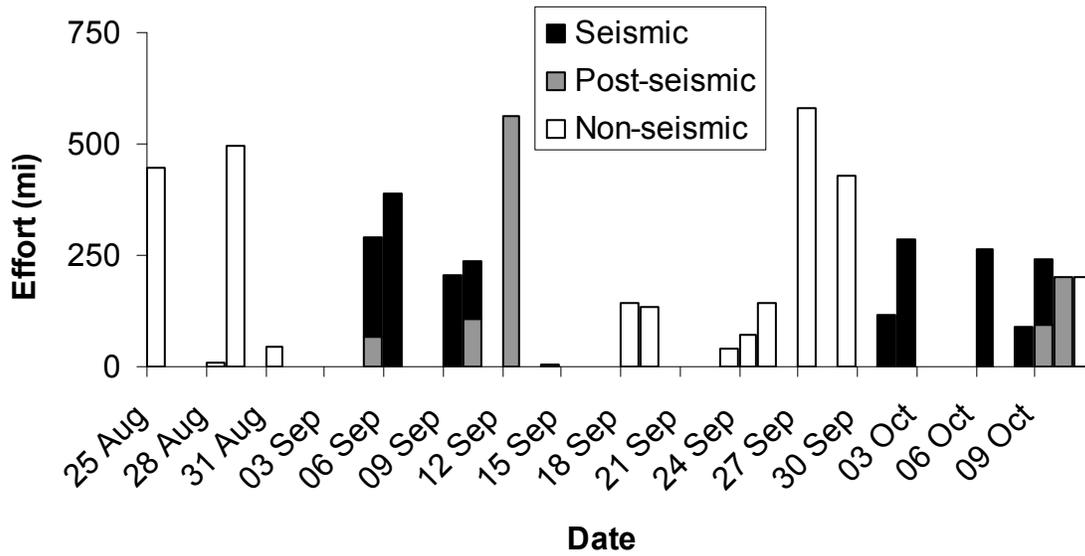


FIGURE M.9.8E. Survey effort over time from 25 Aug to 11 Oct in Harrison Bay in the Central Beaufort Sea. Offshore seismic activities on each date are shown.

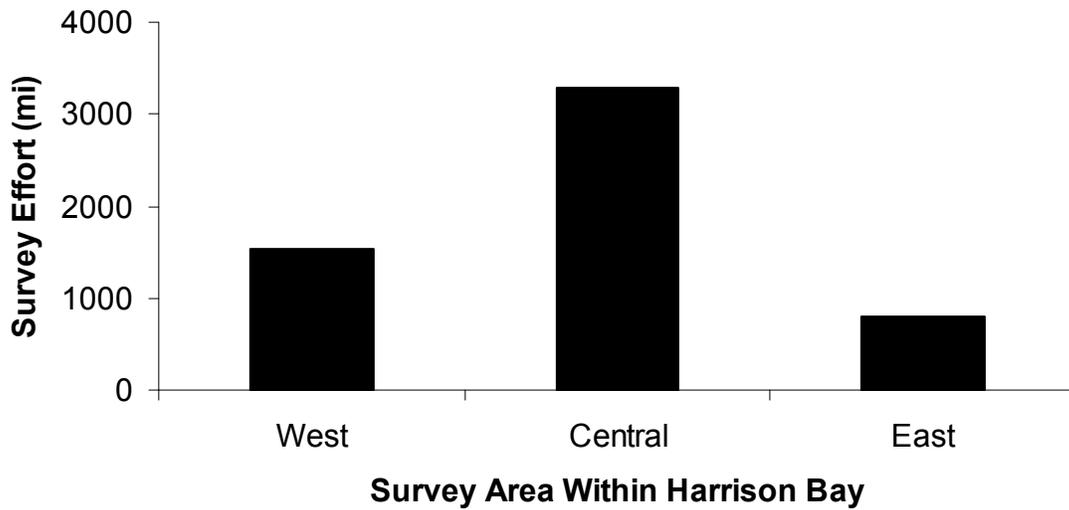


FIGURE M.9.9E. Aerial survey effort in west, central, and eastern sub-areas of Harrison Bay from 25 Aug to 11 Oct.

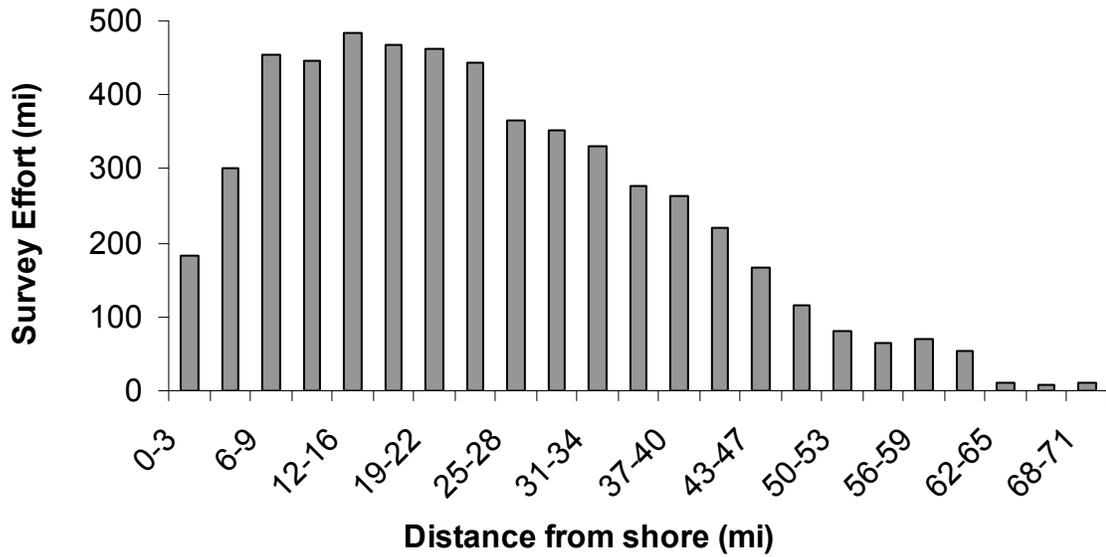


FIGURE M.9.10E. Aerial survey effort by distance from shore category in Harrison Bay from 25 Aug to 11 Oct.

TABLE M.9.8E. Summary of aerial survey effort and sighting rates for bowhead and beluga whales in Harrison Bay from 25 Aug through 11 Oct 2008. Numbers in parentheses should be interpreted with caution due to low effort (311 mi). Sighting rates were not calculated (“NC”) when effort was less than 155 mi.

Date	Survey No.	Effort (mi)	Percent of Survey Area	Bowhead Whale				Beluga Whale			
				Sightings	Individuals	Sightings/1000 mi	Individuals/1000 mi	Sightings	Individuals	Sightings/1000 mi	Individuals/1000 mi
25 Aug	23	445	46.9	1	1	2.2	2.2	0	0	0.0	0.0
28 Aug	24	10	1.1	(0)	(0)	NC	NC	(0)	(0)	NC	NC
29 Aug	24	494	52.0	11	17	22.3	34.4	0	0	0.0	0.0
30 Aug	25	2	0.2	(0)	(0)	NC	NC	(0)	(0)	NC	NC
31 Aug	25	47	4.9	(0)	(0)	NC	NC	(0)	(0)	NC	NC
05 Sep	26	289	34.7	(2)	(3)	(6.9)	(10.4)	(0)	(0)	(0.0)	(0.0)
06 Sep	27	391	46.8	6	9	15.4	23.0	0	0	0.0	0.0
09 Sep	28	204	24.4	(0)	(0)	(0.0)	(0.0)	(0)	(0)	(0.0)	(0.0)
10 Sep	29	238	28.5	(0)	(0)	(0.0)	(0.0)	(0)	(0)	(0.0)	(0.0)
12 Sep	30	564	67.6	7	9	12.4	16.0	1	1	1.8	1.8
14 Sep	32	4	0.5	(0)	(0)	NC	NC	(0)	(0)	NC	NC
18 Sep	33	142	17.0	(1)	(1)	NC	NC	(0)	(0)	NC	NC
19 Sep	51	136	16.3	(1)	(1)	NC	NC	(0)	(0)	NC	NC
23 Sep	36	42	5.0	(1)	(2)	NC	NC	(0)	(0)	NC	NC
24 Sep	52	70	10.5	(2)	(3)	NC	NC	(1)	(1)	NC	NC
25 Sep	53	143	21.3	(2)	(2)	NC	NC	(0)	(0)	NC	NC
27 Sep	53	582	86.5	2	2	3.4	3.4	5	13	8.6	22.3
29 Sep	54	430	64.0	1	1	2.3	2.3	0	0	0.0	0.0
01 Oct	55	116	17.3	(0)	(0)	NC	NC	(0)	(0)	NC	NC
02 Oct	56	287	42.6	(1)	(1)	3.5	3.5	(0)	(0)	(0.0)	(0.0)
06 Oct	57	262	38.9	(0)	(0)	(0.0)	(0.0)	(0)	(0)	(0.0)	(0.0)
08 Oct	58	90	13.3	(0)	(0)	NC	NC	(0)	(0)	NC	NC
09 Oct	58	242	35.9	(2)	(3)	8.3	12.4	(0)	(0)	(0.0)	(0.0)
10 Oct	59	202	30.0	(0)	(0)	(0.0)	(0.0)	(0)	(0)	(0.0)	(0.0)
11 Oct	60	201	29.8	(0)	(0)	(0.0)	(0.0)	(0)	(0)	(0.0)	(0.0)
Total	21	5632	100	40	55	7.10	9.77	7	15	1.24	2.66

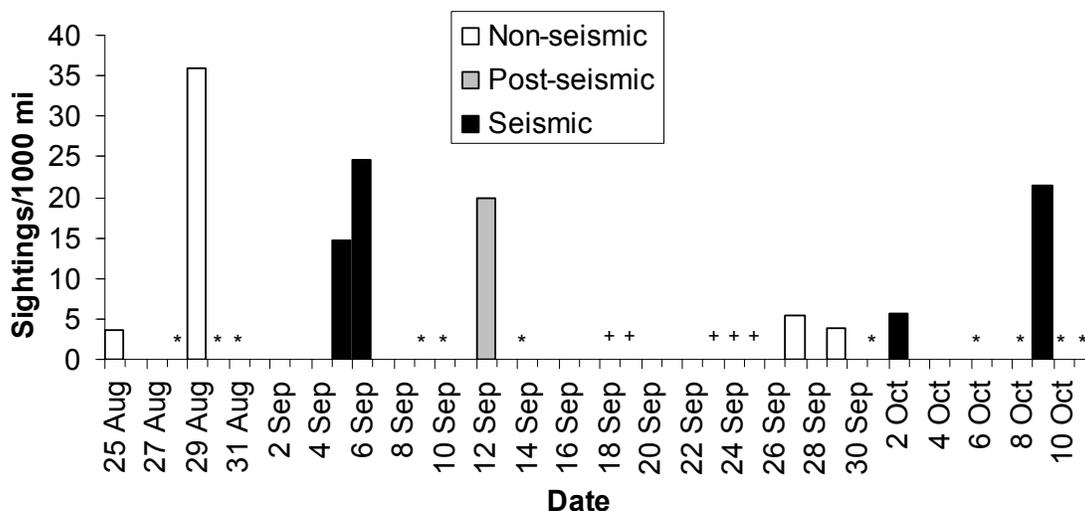


FIGURE M.9.11E. Bowhead whale sighting rates from aerial surveys in Harrison Bay from 25 Aug through 11 Oct 2008. Offshore seismic activities at the time of sightings are shown. Days on which effort was conducted but no sightings were recorded are indicated by an asterisk.

TABLE M.9.9E. Bowhead whale sightings and sighting rates during aerial surveys in Harrison Bay by seismic state from 25 Aug through 11 Oct 2008.

		Seismic	Post-seismic	Non-seismic	Total
West	Sightings	5	1	1	7
	Individuals	8	2	1	11
	Sightings/1000 mi	7.1	3.6	1.8	4.6
	Individuals/1000 mi	11.3	7.2	1.8	7.2
Central	Sightings	3	3	19	25
	Individuals	4	3	26	33
	Sightings/1000 mi	3.2	5.8	10.3	7.6
	Individuals/1000 mi	4.3	5.8	14.0	10.0
East	Sightings	3	3	2	8
	Individuals	4	4	3	11
	Sightings/1000 mi	13.5	12.7	5.9	10.0
	Individuals/1000 mi	18.1	17.0	8.8	13.8
All areas	Sightings	11	7	22	40
	Individuals	16	9	30	55
	Sightings/1000 mi	5.9	6.8	8.0	7.1
	Individuals/1000 mi	8.6	8.7	10.9	9.8

TABLE M.9.10E. Chi-square test comparing differences in number of bowhead whale sightings by seismic state during aerial surveys in Harrison Bay, 25 Aug through 11 Oct 2008.

	Seismic	Post-seismic	Non-seismic	χ^2	One-tailed <i>P</i>
Sightings (obs.)	11	7	22	0.681	0.711
Sightings (exp.)	4	4	5		
Effort (mi)	1851	1032	2748		

TABLE M.9.11E. Chi-square comparison of bowhead whale sighting rates by area within Harrison Bay during aerial surveys, 25 Aug through 11 Oct 2008.

	West	Central	East	χ^2	One-tailed <i>P</i>
Sightings (obs.)	7	25	8	2.460	0.292
Sightings (exp.)	11	23	6		
Effort (mi)	1536	3297	799		

TABLE M.9.12E. Estimated numbers of bowhead whales in the aerial survey area in Harrison Bay, 25 Aug through 11 Oct 2008. Estimates obtained using DISTANCE software for each individual survey. Numbers in parentheses should be interpreted with caution due to low effort (311 mi). Estimates include allowance for $f(0)$ (as calculated by DISTANCE) and $g(0)$ (value of 0.144 from Thomas et al. 2002).

Survey No.	Date	Effort (mi)	Sightings	Density (No./1000 mi ²)	Est. No. Whales	95% C.I.	
23	25 Aug	445	1	16.5	187	28	1234
24	28, 29 Aug	504	11	204.1	2319	470	11450
25	30, 31 Aug	48	(0)	NC	NC	NC	NC
26	5 Sep	289	(2)	(76.2)	(866)	(118)	(6337)
27	6 Sep	391	6	131.7	1496	461	4860
28	9 Sep	204	(0)	(0.0)	--	--	--
29	10 Sep	238	(0)	(0.0)	--	--	--
30	12 Sep	564	7	39.1	444	151	1304
32	14 Sep	4	(0)	NC	NC	NC	NC
33	18 Sep	142	(1)	NC	NC	NC	NC
51	19 Sep	136	(1)	NC	NC	NC	NC
36	23 Sep	42	(1)	NC	NC	NC	NC
52	24 Sep	70	(2)	NC	NC	NC	NC
53	25, 27 Sep	725	4	30.4	346	120	995
54	29 Sep	430	1	17.1	194	29	1317
55	1 Oct	116	(0)	NC	NC	NC	NC
56	2 Oct	287	(1)	(26)	(291)	(49)	(1715)
57	6 Oct	262	(0)	(0.0)	--	--	--
58	08, 09 Oct	332	2	66.5	756	80	7166
59	10 Oct	202	(0)	(0.0)	--	--	--
60	11 Oct	201	(0)	(0.0)	--	--	--

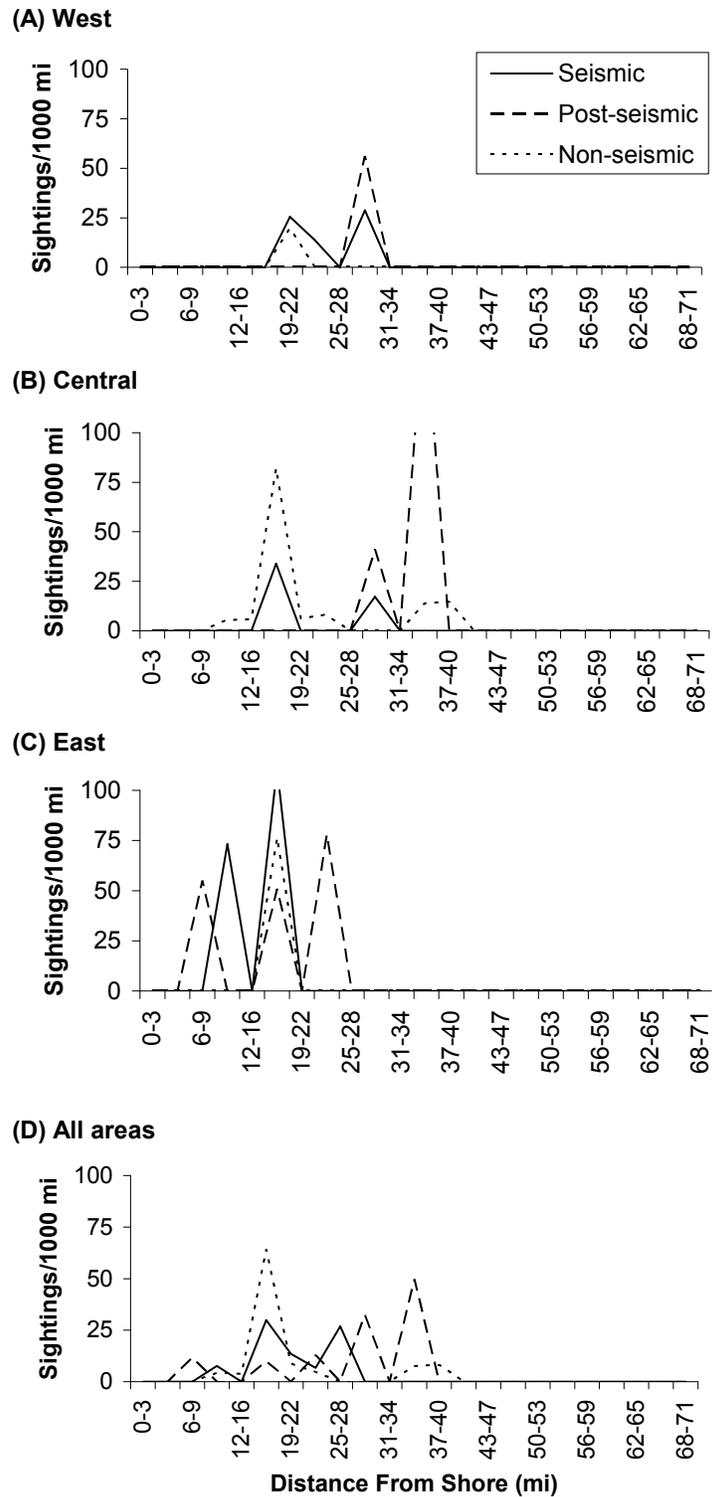


FIGURE M.9.12E. Bowhead sighting rates within 3-mi distance-from-shore bins during aerial surveys in Harrison Bay from 25 Aug through 11 Oct in the following sub-areas: (A) western area (B) central area, (C) eastern area, (D) all areas. Seismic activity at the time of sighting is shown.

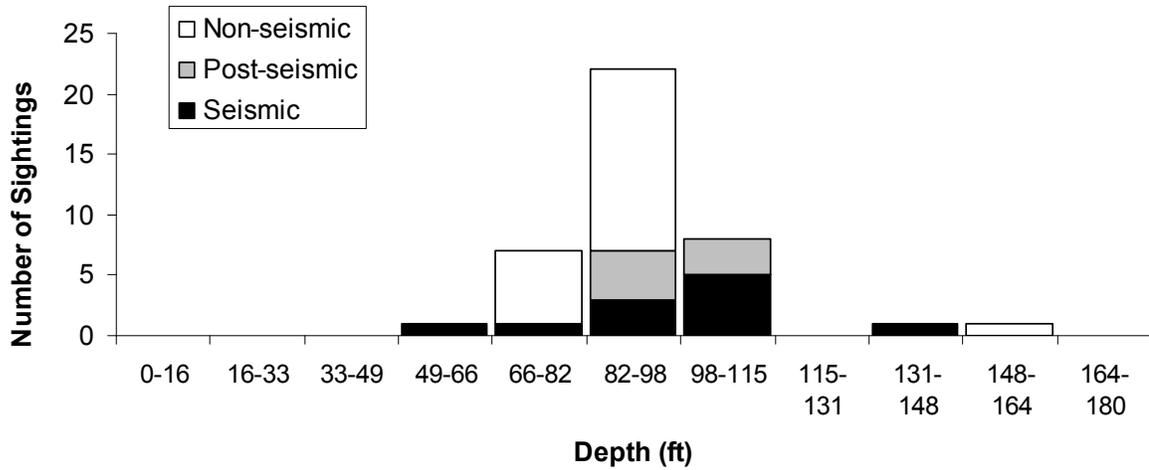


FIGURE M.9.13E. Bowhead sighting rates at 16–ft depth intervals in Harrison Bay from 25 Aug through 11 Oct. Sightings during offshore non–seismic and offshore seismic periods are shown.

TABLE M.9.13E. Mean distance (mi) of bowhead whale sightings from the center of the seismic prospect by seismic state in Harrison Bay, 25 Aug through 11 Oct, 2008. Comparisons were made with a Kruskal-Wallis test.

Seismic State	Sightings	Distance from Prospect Center (mi)			Two-tailed <i>P</i>
	<i>n</i>	Min.	Max.	Mean	
Seismic	11	17.9	62.3	37.3	<0.01
Post-seismic	7	22.7	65.1	35.4	
Non-seismic	22	8.1	52.0	19.7	

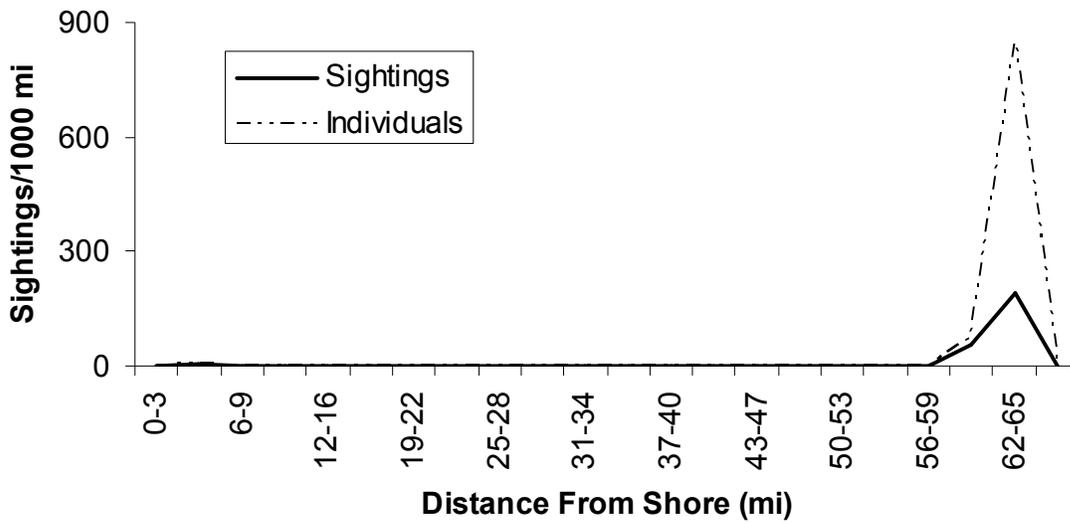


FIGURE M.9.14E. Beluga whale sighting rates and numbers of individuals by distance from shore during aerial surveys in Harrison Bay from 25 Aug through 11 Oct 2008. Number of sightings/1000 mi and number of individuals/1000 mi are shown.

Sep Surveys in Camden Bay

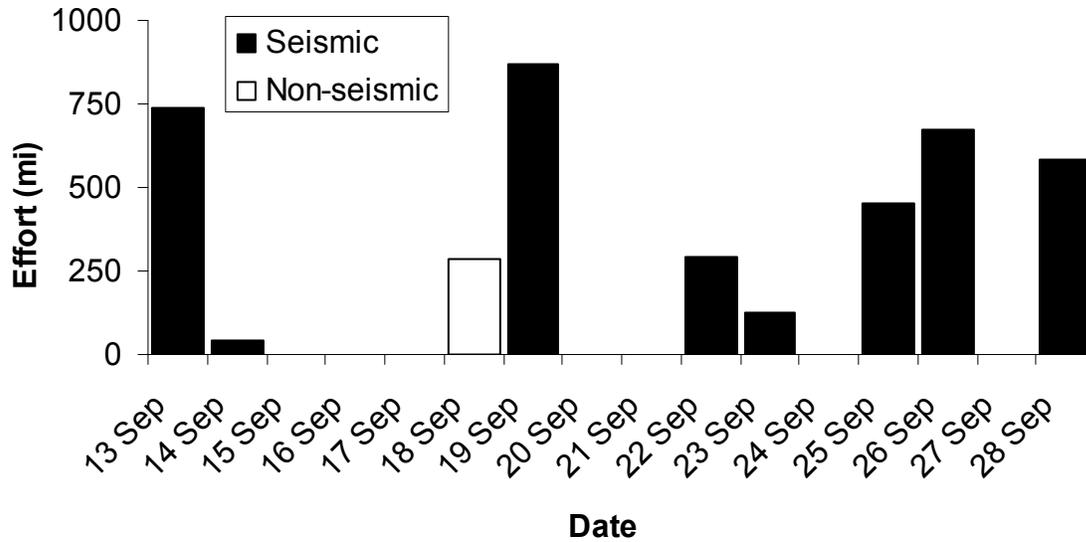


FIGURE M.9.15E. Daily survey effort by seismic state in Camden Bay from 13 Sep to 28 Sep. No effort was collected during the post-seismic period.

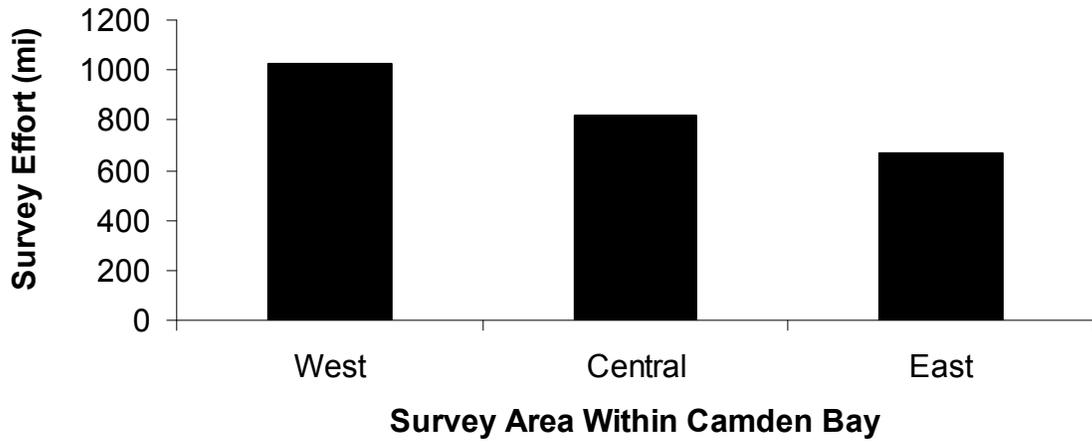


FIGURE M.9.16E. Aerial survey effort by area (west, central, east) in Camden Bay from 13 Sep to 28 Sep.

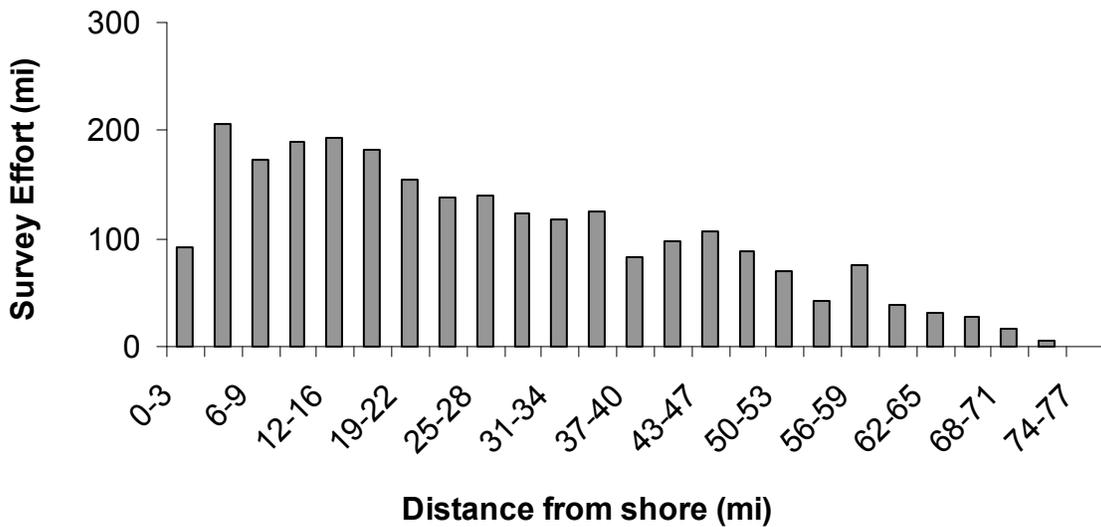


FIGURE M.9.17E. Aerial survey effort by 3-mi distance-from-shore bins in Camden Bay from 13 Sep to 28 Sep.

TABLE M.9.14E. Summary of aerial survey effort and bowhead whale sighting rates in Camden Bay from 13 Sep to 28 Sep 2008. Values in parentheses are based on less than 500 km (311 mi) of effort and should be viewed with caution. Sighting rates were not calculated ("NC") when effort was less than 250 km (155 mi).

Date	Survey No.	Effort (mi)	Percent of Survey Area	Sightings	Individuals	Sightings/1000 mi	Individuals/1000 mi
13 Sep	31	457.8	63	12	17	26.2	37.1
14 Sep	32	24.1	3	(0)	(0)	NC	NC
18 Sep	33	179.0	25	(6)	(10)	(33.5)	(55.9)
19 Sep	34	539.2	74	16	24	29.7	44.5
22 Sep	35	181.5	25	(2)	(2)	(11.0)	(11.0)
23 Sep	36	77.8	11	(0)	(0)	NC	NC
25 Sep	37	279.1	34	(1)	(1)	(3.6)	(3.6)
26 Sep	38	416.7	51	2	2	4.8	4.8
28 Sep	39	361.7	44	1	2	2.8	5.5
Total	9	2517	100	40	58	15.89	23.04

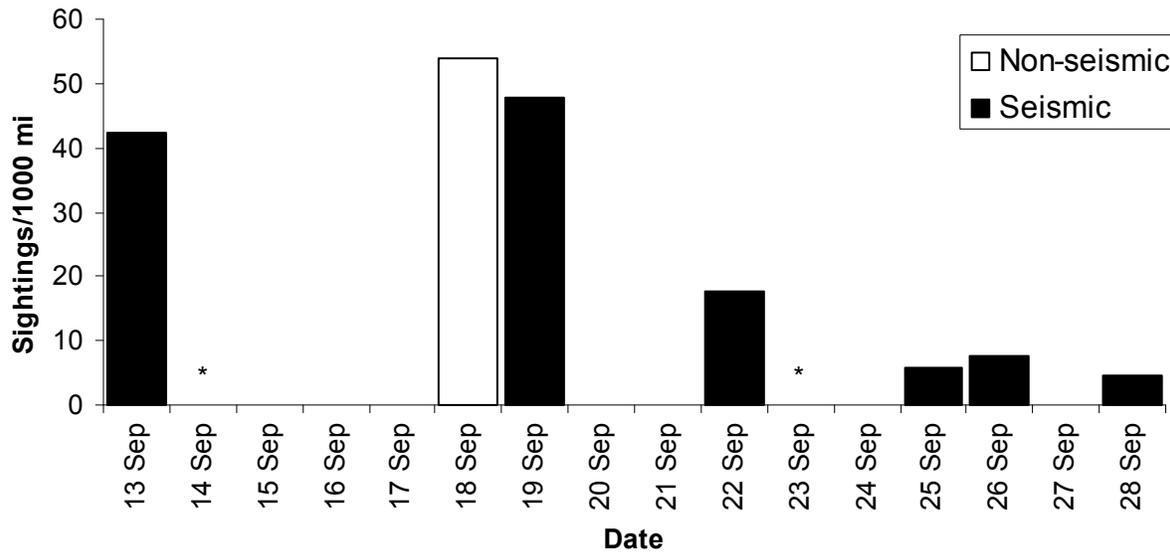


FIGURE M.9.18E. Daily bowhead whale sightings by seismic state in Camden Bay from 13 Sep to 28 Sep. Days on which effort was conducted but no sightings were recorded are indicated by an asterisk.

TABLE M.9.15E. Bowhead whale sightings and sighting rates during aerial surveys in Camden Bay by seismic state from 13 Sep through 28 Sep 2008.

Area		Seismic	Post-seismic	Non-seismic	Total
West	Sightings	26	0	1	27
	Individuals	36	0	2	38
	Sightings/1000 mi	27.4	--	12.6	26.3
	Individuals/1000 mi	38.0	--	25.2	37.0
Central	Sightings	3	0	5	8
	Individuals	6	0	8	14
	Sightings/1000 mi	3.9	--	92.1	9.7
	Individuals/1000 mi	7.8	--	147.4	17.0
East	Sightings	5	0	0	5
	Individuals	6	0	0	6
	Sightings/1000 mi	8.0	--	0.0	7.5
	Individuals/1000 mi	9.6	--	0.0	9.0
All areas	Sightings	34	0	6	40
	Individuals	48	0	10	58
	Sightings/1000 mi	14.5	--	33.5	15.9
	Individuals/1000 mi	20.5	--	55.9	23.0

TABLE M.9.16E. Chi-square test comparing differences in number of bowhead whale sightings by seismic state during aerial surveys in Camden Bay, 13 Sep through 28 Sep 2008.

	Seismic	Nonseismic	χ^2	One-tailed <i>P</i>
Sightings (obs.)	34	6	3.767	0.052
Sightings (exp.)	37.2	2.8		
Effort (mi)	2337.8	179.0		

TABLE M.9.17E Chi-square test of bowhead sighting rates by area (west, central, east) during aerial surveys in Camden Bay, 13 Sep through 28 Sep 2008.

	West	Central	East	χ^2	One-tailed <i>P</i>
Sightings (obs.)	27	8	5	11.917	0.003
Sightings (exp.)	16	13	11		
Effort (mi)	1027.0	822.0	667.9		

TABLE M.9.18E. Estimated numbers of bowhead whales in the Camden Bay survey area, 13 Sep through 28 Sep 2008. Estimates obtained using DISTANCE software for each individual survey. Numbers in parentheses are based on less than 311 mi of effort and should be interpreted cautiously. Estimates include allowance for $f(0)$ (as calculated by DISTANCE) and $g(0)$ (value of 0.144 from Thomas et al. 2002).

Survey No.	Date	Effort (mi)	Sightings	Density (No./1000 mi ²)	Est. No. Whales	95% C.I.	
31	13 Sep	457.8	12	200.6	2229	856	5805
32	14 Sep	24.1	(0)	(0.0)	(0)	--	--
33	18 Sep	179.0	(6)	(225.9)	(2510)	(546)	(11532)
34	19 Sep	539.2	16	177.1	1968	544	7116
35	22 Sep	181.5	(2)	(36.1)	(402)	(52)	(3094)
36	23 Sep	77.8	(0)	NC	NC	--	--
37	25 Sep	279.1	(1)	(23.5)	(261)	(28)	(2427)
38	26 Sep	416.7	2	31.5	350	57	2138
39	28 Sep	361.7	1	0.0	0	--	--

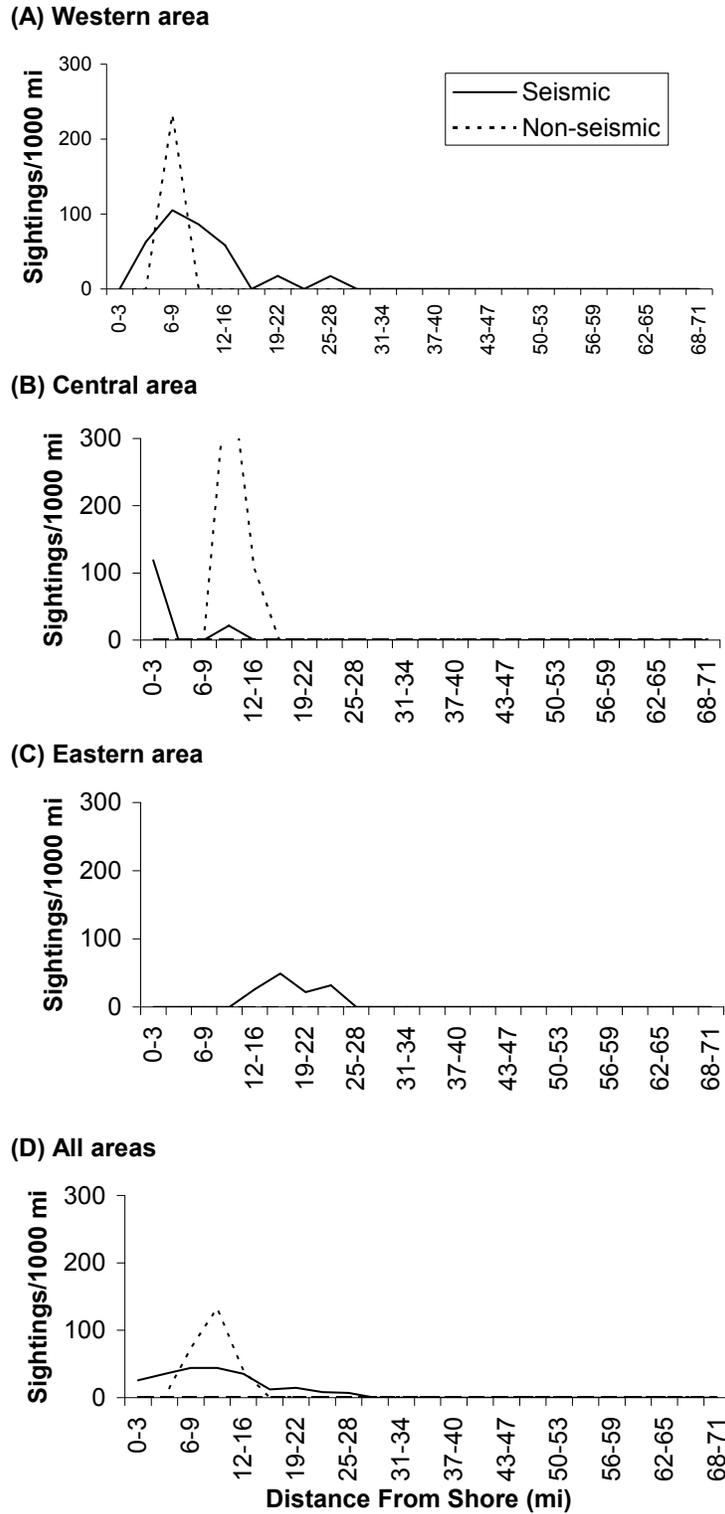


FIGURE M.9.19E. Bowhead sighting rates within 3-mi distance-from-shore bins during aerial surveys in Camden Bay from 13 Sep through 28 Sep, (A) west area, (B) central area, (C) east area, (D) all areas.

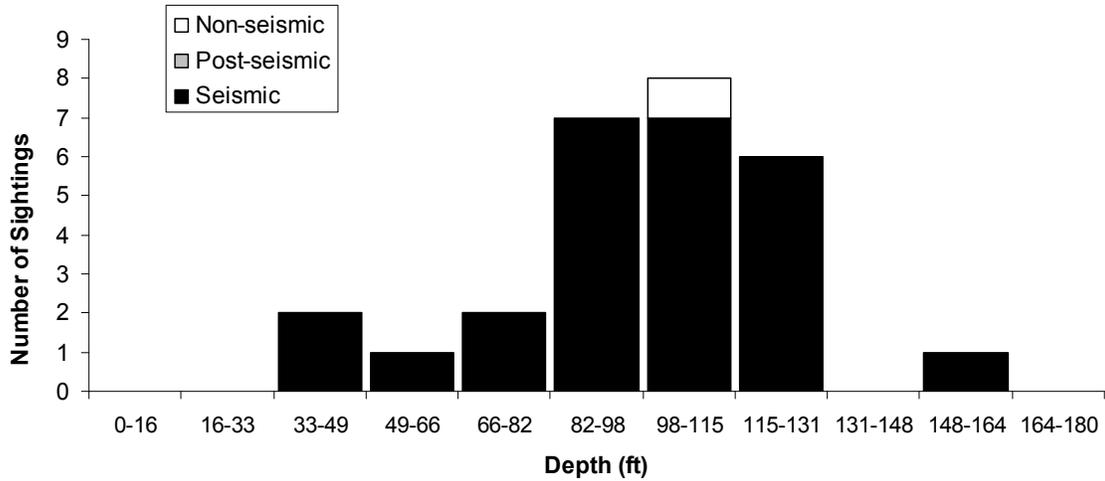


FIGURE M.9.20E. Number of bowhead sightings during aerial surveys of the central Beaufort Sea by depth (ft) and seismic state. Data were collected from 13 Sep through 28 Sep 2008.

TABLE M.9.19E. Mean distance (mi) of bowhead whale sightings from the center of the seismic prospect by seismic state in Camden Bay, 13 Sep through 28 Sep, 2008. Comparisons were made with a Kruskal-Wallis test.

Seismic State	Sightings	Distance from Prospect Center (mi)			Two-tailed <i>P</i>
	<i>n</i>	Min.	Max.	Mean	
Seismic	34	15.1	29.2	63.4	<0.01
Non-seismic	6	11.7	17.5	42.2	

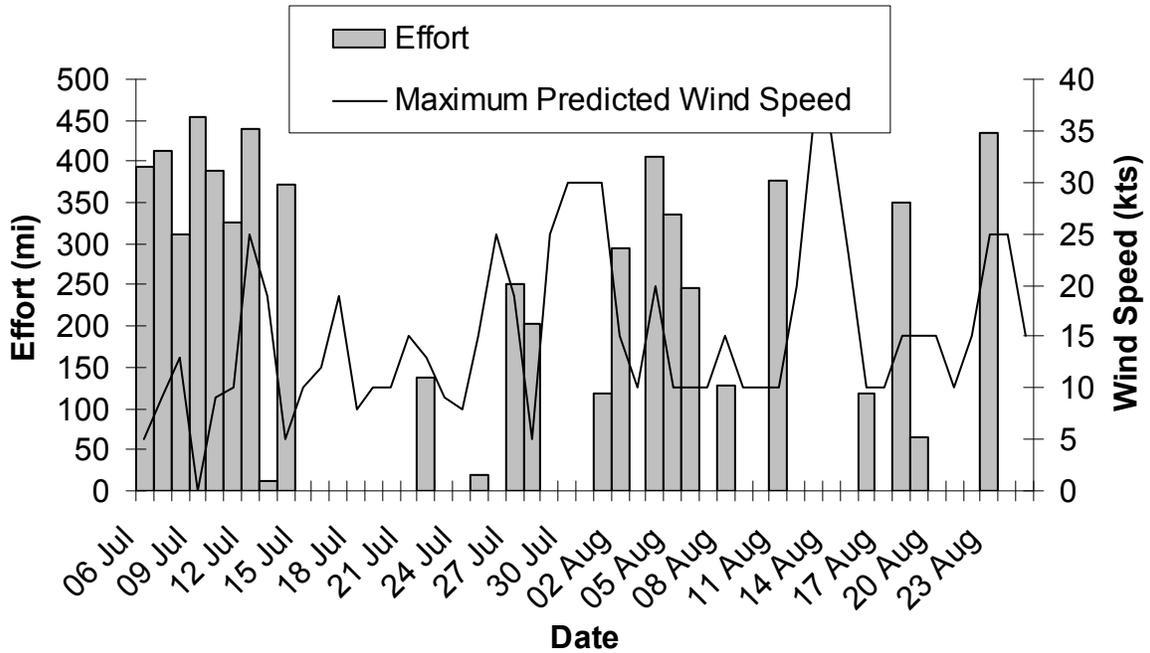


Figure M.21E. Relationship between aerial survey effort and maximum predicted wind speed in Camden Bay from 6 Jul to 23 Aug.

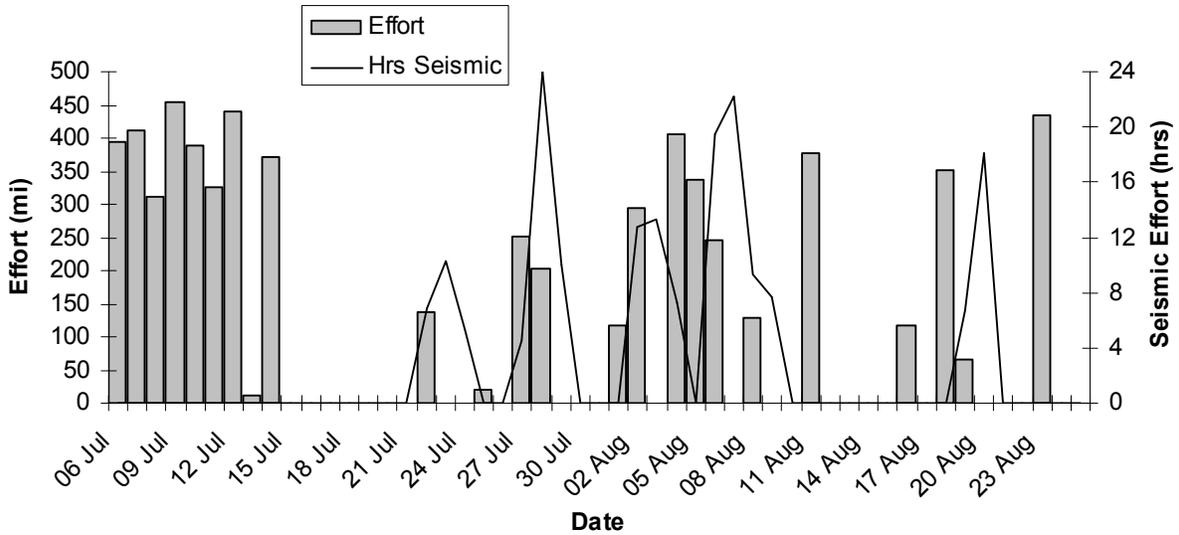


Figure M.22E. Relationship between aerial survey effort and seismic activity in Camden Bay from 6 Jul to 23 Aug.

TABLE M.20E. Sighting rates (sightings/1000 mi) of bowhead whales in 3-mi distance from shore bins by survey area and seismic state in Camden Bay from 6 Jul to 23 Aug. Dashes represent bins in which no effort was collected. Numbers in bold indicate maximum values.

Distance bin	West				Central				East				All			
	Pre	Seismic	Post	Non	Pre	Seismic	Post	Non	Pre	Seismic	Post	Non	Pre	Seismic	Post	Non
0-3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.5	0.0	0.0	0.0	16.4	0.0	0.0
9-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12-16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16-19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.4
22-25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1
25-28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28-31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31-34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34-37	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37-40	0.0	0.0	0.0	0.0	23.5	0.0	0.0	0.0	112.7	0.0	0.0	0.0	38.6	0.0	0.0	0.0
40-43	0.0	--	--	0.0	11.2	0.0	--	0.0	17.6	0.0	0.0	0.0	12.8	0.0	0.0	0.0
43-47	0.0	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47-50	--	--	--	--	0.0	0.0	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50-53	--	--	--	--	--	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53-56	--	--	--	--	--	--	--	--	0.0	--	--	--	0.0	--	--	--
Average	0.0	0.0	0.0	0.0	2.2	0.0	0.0	3.7	7.2	2.4	0.0	0.0	2.9	1.0	0.0	1.2

TABLE M.21E. All bowhead sightings observed during seismic activities in Camden Bay from 6 Jul through 23 Aug.

Date	Time	Number	On/Off Transect	Distance (mi) from center of seismic patch	Heading	Start of seismic	Time (hrs) elapsed since start of seismic
19 Aug	18:45:46	1	On	34.0	150	19-Aug 17:20:37	1.4

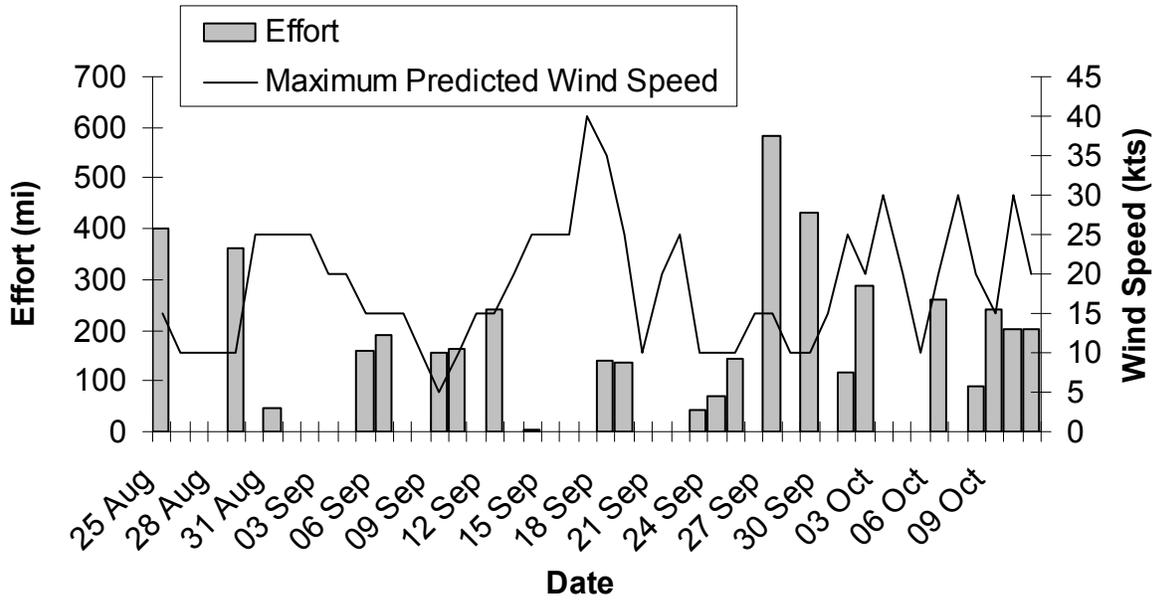


FIGURE M.23E. Relationship between aerial survey effort and maximum predicted wind speed in Harrison Bay from 25 Aug to 11 Oct.

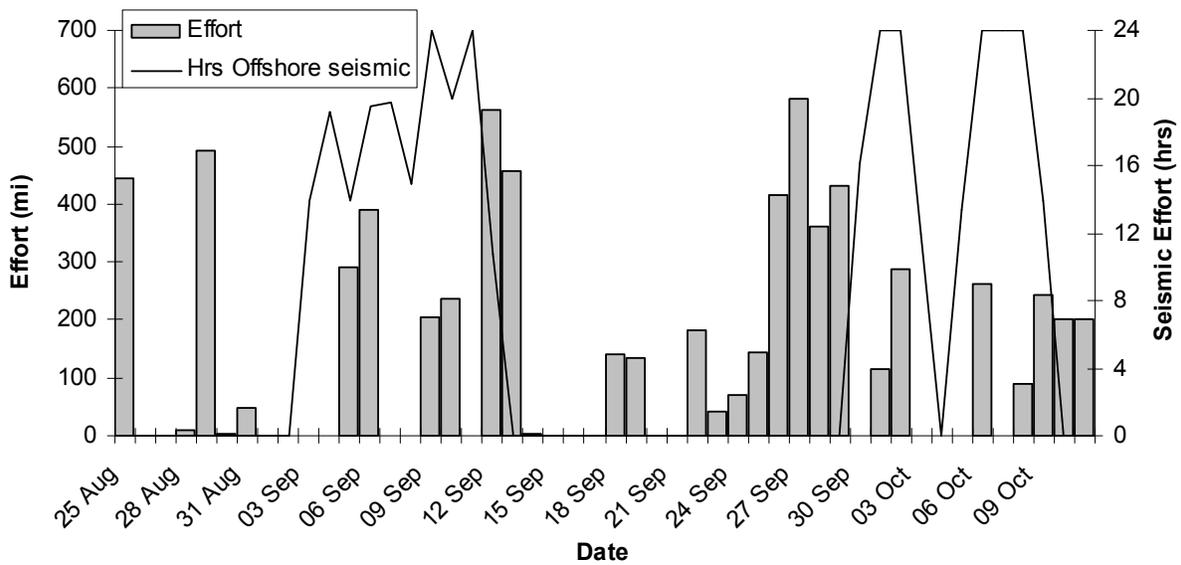


Figure M.24E. Relationship between aerial survey effort and seismic activity in Harrison Bay from 25 Aug to 11 Oct.

TABLE M.22E. Sighting rates (sightings/1000 mi) of bowhead whales in 3-mi distance from shore bins by survey area and seismic state in Harrison Bay from 25 Aug to 11 Oct. Dashes represent bins in which no effort was collected. Numbers in bold indicate maximum values.

Distance bin	West			Central			East			All		
	Seismic	Post	Non	Seismic	Post	Non	Seismic	Post	Non	Seismic	Post	Non
0-3	--	--	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
6-9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.1	0.0	0.0	11.7	0.0
9-12	0.0	0.0	0.0	0.0	0.0	5.4	73.2	0.0	0.0	7.7	0.0	4.2
12-16	0.0	0.0	0.0	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	3.8
16-19	0.0	0.0	0.0	33.9	0.0	82.0	110.9	50.9	76.4	29.9	9.9	64.2
19-22	25.4	0.0	19.7	0.0	0.0	6.3	0.0	0.0	0.0	13.6	0.0	8.7
22-25	13.8	0.0	0.0	0.0	0.0	8.1	0.0	78.0	0.0	6.6	12.9	4.6
25-28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.8	0.0	0.0
28-31	28.8	56.2	0.0	17.3	41.3	0.0	0.0	0.0	0.0	0.0	32.3	0.0
31-34	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
34-37	0.0	0.0	0.0	0.0	162.6	13.8	0.0	0.0	0.0	0.0	49.7	7.5
37-40	0.0	0.0	0.0	0.0	0.0	14.8	0.0	0.0	0.0	0.0	0.0	8.3
40-43	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43-47	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
47-50	0.0	0.0	--	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
50-53	0.0	--	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
53-56	--	--	--	0.0	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0
56-59	--	--	--	0.0	0.0	0.0	0.0	--	0.0	0.0	0.0	0.0
59-62	--	--	--	0.0	0.0	0.0	--	--	0.0	0.0	0.0	0.0
62-65	--	--	--	--	0.0	0.0	--	--	--	--	0.0	0.0
65-68	--	--	--	0.0	0.0	--	--	--	--	0.0	0.0	--
68-71	--	--	--	0.0	--	0.0	--	--	--	0.0	--	0.0
Average	4.2	3.7	1.3	2.3	9.3	6.2	9.7	10.8	4.0	3.8	5.3	4.6

TABLE M.23E. All bowhead sightings observed during seismic activities in Harrison Bay from 25 Aug to 11 Oct. Dashes indicate sightings for which headings were not recorded.

Date	Time	Number	Source	On/Off Transect	Distance (mi) from center of seismic patch	Heading	Start of seismic	Time (hrs) elapsed since start of seismic
05 Sep	17:53:04	2	Offshore	On	20.0	330	05 Sep 2008 17:45:00	0:08:04
05 Sep	17:53:58	1	Offshore	On	20.3	350	05 Sep 2008 17:45:00	0:08:58
06 Sep	13:59:00	1	Offshore	Off	23.9	67	06 Sep 2008 11:54:00	2:05:00
06 Sep	14:32:41	1	Offshore	Off	18.6	10	06 Sep 2008 11:54:00	2:38:41
06 Sep	15:09:07	2	Offshore	Off	19.2	280	06 Sep 2008 11:54:00	3:15:07
06 Sep	15:09:59	2	Offshore	Off	21.1	280	06 Sep 2008 11:54:00	3:15:59
06 Sep	16:40:01	2	Offshore	On	35.1	1	06 Sep 2008 11:54:00	4:46:01
06 Sep	16:40:43	1	Offshore	On	36.1	269	06 Sep 2008 11:54:00	4:46:43
06 Sep	17:14:36	2	Offshore	On	48.1	272	06 Sep 2008 11:54:00	5:20:36
06 Sep	17:15:28	1	Offshore	Off	47.2	--	06 Sep 2008 11:54:00	5:21:28
06 Sep	17:39:54	1	Offshore	On	62.2	270	06 Sep 2008 11:54:00	5:45:54
06 Sep	17:39:56	2	Offshore	On	62.3	270	06 Sep 2008 11:54:00	5:45:56
06 Sep	18:45:58	1	Offshore	On	34.6	0	06 Sep 2008 11:54:00	6:51:58
02 Oct	18:34:12	1	Offshore	On	18.0	91	30 Sep 2008 07:55:00	59:00:00
09 Oct	12:29:50	1	Offshore	On	36.5	268	05 Oct 2008 10:04:00	98:24:00
09 Oct	12:31:32	2	Offshore	On	37.3	300	05 Oct 2008 10:04:00	98:24:00

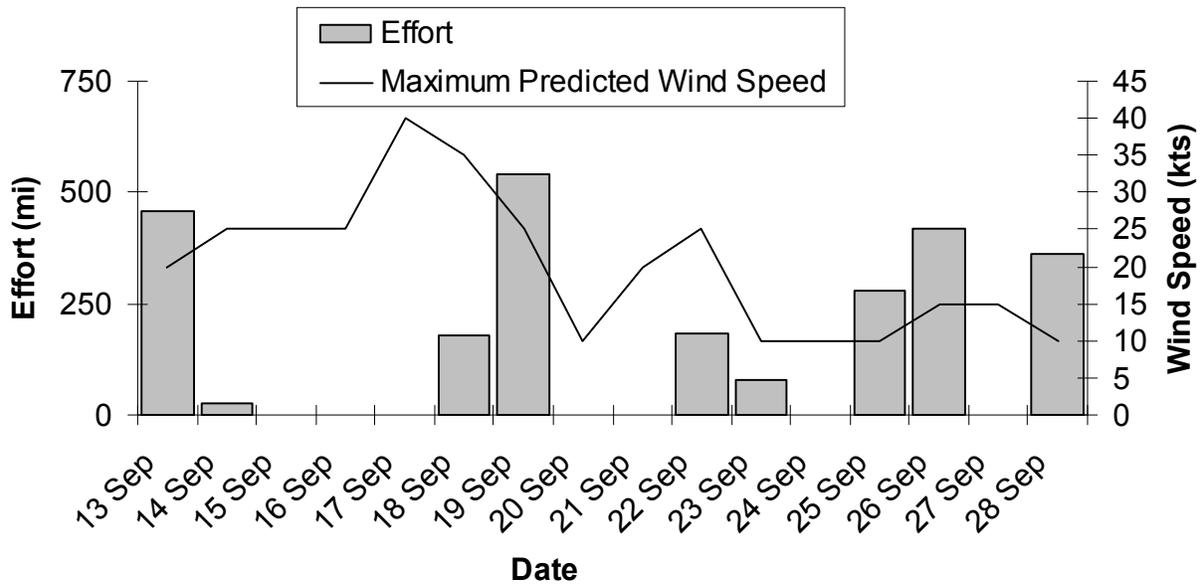


Figure M.25E. Relationship between aerial survey effort and maximum predicted wind speed in Camden Bay from 13 Sep to 28 Sep 2008.

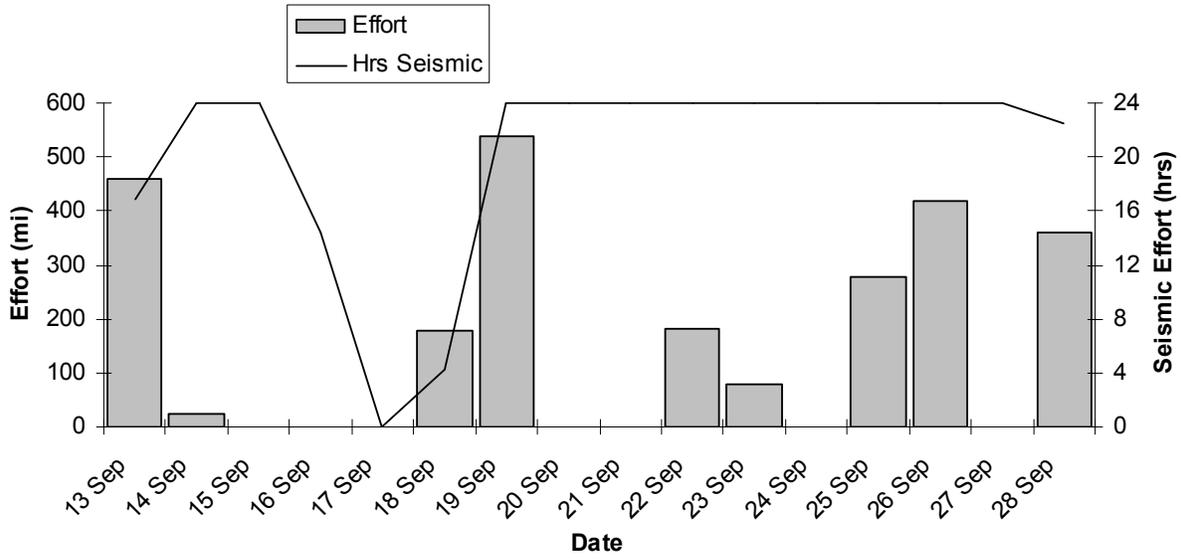


Figure M.26E. Relationship between aerial survey effort and hours of seismic data acquisition in Camden Bay from 13 Sep to 28 Sep 2008.

TABLE M.24E. Sighting rates (sightings/1000 mi) of bowhead whales in 3-mi distance bins by survey area and seismic state in Camden Bay from 13 Sep through 28 Sep 2008. Dashes represent bins in which no effort was collected. Numbers in bold indicate maximum values.

Distance bin	West			Central			East			All		
	Seismic	Post	Non	Seismic	Post	Non	Seismic	Post	Non	Seismic	Post	Non
0-3	0.0	--	0.0	119.1	--	0.0	0.0	--	0.0	25.9	--	0.0
3-6	62.8	--	0.0	0.0	--	0.0	0.0	--	0.0	34.9	--	0.0
6-9	105.2	--	232.7	0.0	--	--	0.0	--	0.0	44.0	--	72.7
9-12	86.1	--	0.0	21.8	--	426.9	0.0	--	0.0	44.1	--	132.3
12-16	58.5	--	0.0	0.0	--	106.5	26.1	--	0.0	35.6	--	39.4
16-19	0.0	--	0.0	0.0	--	0.0	48.9	--	0.0	12.3	--	0.0
19-22	17.5	--	0.0	0.0	--	0.0	21.7	--	0.0	14.7	--	0.0
22-25	0.0	--	0.0	0.0	--	0.0	19.7	--	--	8.4	--	0.0
25-28	17.1	--	--	0.0	--	0.0	0.0	--	--	7.3	--	0.0
28-31	0.0	--	0.0	0.0	--	--	0.0	--	--	0.0	--	0.0
31-34	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
34-37	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
37-40	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
40-43	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
43-47	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
47-50	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
50-53	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
53-56	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
56-59	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
59-62	0.0	--	--	0.0	--	--	0.0	--	--	0.0	--	--
62-65	--	--	--	0.0	--	--	0.0	--	--	0.0	--	--
65-68	--	--	--	0.0	--	--	0.0	--	--	0.0	--	--
68-71	--	--	--	0.0	--	--	0.0	--	--	0.0	--	--
71-74	--	--	--	0.0	--	--	--	--	--	0.0	--	--
74-78	--	--	--	0.0	--	--	--	--	--	0.0	--	--
Average	17.4	--	25.9	5.6	--	66.7	5.1	--	0.0	9.1	--	24.5

TABLE M.25E. All bowhead sightings observed during seismic activities in Camden Bay from 13 Sep to 28 Sep, 2008. Dashes indicate sightings for which headings were not recorded and the term "Various" is used for groups of individuals with different headings.

Date	Time	Number	On/Off Transect	Distance (mi) from center of seismic patch	Heading	Start of seismic	Time (hrs) elapsed since start of seismic
13 Sep	12:07:49	1	On	31.0	280	13-Sep 07:11:00	4.9
13 Sep	12:10:37	1	On	32.2	272	13-Sep 07:11:00	5.0
13 Sep	12:12:19	1	On	33.6	280	13-Sep 07:11:00	5.0
13 Sep	12:28:35	1	On	20.7	--	13-Sep 07:11:00	5.3
13 Sep	12:29:03	1	On	20.0	271	13-Sep 07:11:00	5.3
13 Sep	12:34:04	1	On	16.1	180	13-Sep 07:11:00	5.4
13 Sep	13:47:21	3	On	29.0	Various	13-Sep 07:11:00	6.6
13 Sep	13:49:02	1	Off	25.4	269	13-Sep 07:11:00	6.6
13 Sep	14:43:17	1	On	35.1	280	13-Sep 07:11:00	7.5
13 Sep	14:44:27	1	On	37.1	280	13-Sep 07:11:00	7.6
13 Sep	18:38:38	1	On	50.9	--	13-Sep 07:11:00	11.5
13 Sep	18:39:45	1	On	49.6	--	13-Sep 07:11:00	11.5
13 Sep	19:16:55	1	On	63.4	--	13-Sep 07:11:00	12.1
19 Sep	14:11:31	1	On	36.9	200	18-Sep 19:47:00	18.4
19 Sep	14:11:33	1	On	36.9	--	18-Sep 19:47:00	18.4
19 Sep	14:24:35	1	On	23.7	280	18-Sep 19:47:00	18.6
19 Sep	14:24:44	1	On	23.5	--	18-Sep 19:47:00	18.6
19 Sep	14:27:10	1	On	22.1	300	18-Sep 19:47:00	18.7
19 Sep	14:29:28	2	On	21.8	Various	18-Sep 19:47:00	18.7
19 Sep	14:29:50	1	On	21.9	--	18-Sep 19:47:00	18.7
19 Sep	15:31:01	1	On	16.5	70	18-Sep 19:47:00	19.7
19 Sep	15:31:21	2	On	16.1	0,150	18-Sep 19:47:00	19.7
19 Sep	15:32:11	1	On	15.2	--	18-Sep 19:47:00	19.8
19 Sep	15:32:11	2	On	15.2	--	18-Sep 19:47:00	19.8
19 Sep	15:32:30	1	On	15.1	--	18-Sep 19:47:00	19.8
19 Sep	16:07:40	1	On	18.4	--	18-Sep 19:47:00	20.3
19 Sep	16:08:16	1	On	19.8	--	18-Sep 19:47:00	20.4
22 Sep	18:48:40	1	Off	35.4	267	18-Sep 19:47:00	95.0
22 Sep	19:03:41	1	On	45.9	0	18-Sep 19:47:00	95.3
22 Sep	19:04:33	1	On	46.2	--	18-Sep 19:47:00	95.3
25 Sep	16:45:23	1	On	50.5	271	18-Sep 19:47:00	165.0
26 Sep	12:11:25	1	On	30.7	--	18-Sep 19:47:00	184.4
26 Sep	12:11:42	1	On	30.7	270	18-Sep 19:47:00	184.4
26 Sep	13:11:50	1	Off	19.4	313	18-Sep 19:47:00	185.4
26 Sep	15:42:46	1	Off	25.3	296	18-Sep 19:47:00	187.9
26 Sep	15:50:52	1	Off	25.1	179	18-Sep 19:47:00	188.1
26 Sep	15:52:24	1	Off	25.3	318	18-Sep 19:47:00	188.1
28 Sep	13:03:41	1	On	24.6	271	18-Sep 19:47:00	233.3

