MARINE MAMMAL COMMISSION

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Mr. P. Michael Payne, Chief
Permits, Conservation, and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910-3225

Dear Mr. Payne:

The Marine Mammal Commission, in consultation with its Committee of Scientific Advisors on Marine Mammals, has reviewed the application submitted by Shell Offshore Inc. under section 101(a)(5)(D) of the Marine Mammal Protection Act. The applicant is seeking authorization to take marine mammals by harassment incidental to a proposed open-water marine survey program in the Beaufort and Chukchi Seas, Alaska, between July and October 2010. The Commission also has reviewed the National Marine Fisheries Service's 18 May 2010 *Federal Register* notice (75 Fed. Reg. 27708) announcing receipt of the application and proposing to issue an authorization to Shell to take eight species of marine mammals by Level B harassment during the specified activity.

The application from Shell Offshore and the Service's *Federal Register* notice reveal commendable efforts to assess the potential effects of seismic surveys on marine mammals in preparation for oil and gas production in the Beaufort and Chukchi Seas. The Marine Mammal Commission provides the following recommendations and rationale to enhance those efforts and to ensure that the seismic surveys are conducted with no more than negligible effects.

RECOMMENDATIONS

The Marine Mammal Commission recommends that the National Marine Fisheries Service—

- require this and other operators to collect information necessary to evaluate the effectiveness of the mitigation measures adopted and to review and modify mitigation measures accordingly;
- review the proposed monitoring measures to ensure that they require the gathering of information on all the potentially important sources of noise and the complex sound field that the seismic survey activities create;
- work with Shell and its contractors to engage acknowledged survey experts to review the survey design and planned analyses to ensure that they will provide relatively unbiased and reliable results;
- work with Shell to coordinate a comparative analysis of the results of vessel-based, aerial, and passive acoustic monitoring methods to evaluate their relative strengths and weaknesses and determine if and how they could be improved for use with future surveys;

- require that Shell complement its vessel-based monitoring plan with towed passive acoustics to provide a more reliable estimate of the number of marine mammals taken during the course of the proposed seismic survey;
- develop a plan for collecting meaningful baseline information—that is, information that provides a reliable basis for evaluating long-term effects on the marine mammal species and stocks that may be affected by oil and gas development and production in the Beaufort Sea area;
- work with Shell to determine how the data collected during the proposed activities can be made available for other scientific purposes;
- require Shell to engage in consultations with those Alaska Native communities that may be affected by the company's activities and, to the extent feasible, seek to resolve any Alaska Native concerns through negotiation of a conflict avoidance agreement; and
- require Shell to halt its seismic survey and consult with the Service regarding any seriously injured or dead marine mammal when the injury or death may have resulted from Shell's activities.

RATIONALE

The proposed surveys are designed to gather data on site clearance, shallow hazards, ice gouge, and strudel scour in the Beaufort Sea and ice gouge in the Chukchi Sea. Various technologies will be used including a 40-in^3 airgun array, dual-frequency side scanner, single-beam echo sounder, shallow sub-bottom profiler, dual-frequency sub-bottom profiler, multi-beam echo sounder, and single-beam bathymetric sonar. Sound frequencies emitted by these sources vary from 400 Hz to 340 kHz, the upper frequencies being beyond the hearing range of marine mammals. Modeled source sound levels range from 167.2 to 225 dB re 1 μPa.

Mitigation and Monitoring

Shell has proposed a mitigation strategy based on (1) sound source measurements to determine safety zones more accurately, (2) establishment of safety and disturbance zones to be monitored by marine mammal observers on the seismic vessel, (3) a power-down when a marine mammal is detected approaching a safety zone and a shutdown when a marine mammal is observed within a zone, and (4) ramp-up of the airgun array. The National Marine Fisheries Service indicates that it will require additional mitigation measures including (a) establishment of a 120-dB safety zone and prohibition of seismic studies within that zone whenever it encompasses four or more bowhead whale mother-calf pairs, (b) establishment of a 160-dB safety zone that would prohibit firing of the seismic airguns within the zone whenever it encompasses 12 or more bowhead or gray whales involved in non-migratory behavior (e.g., feeding), (c) a requirement that vessels reduce speed when within 274 meters (300 yards) of whales and steer around those whales if possible, (d) a requirement that vessels avoid multiple changes in direction and speed when within 274 meters (300 yards) of whales, and (e) a requirement that vessels adjust speeds accordingly when weather or other conditions reduce visibility.

All of the above measures should be useful to a degree, but in some cases they are not sufficiently specific. For example, it is not clear what "power-down" actually means. An airgun array is usually powered down by reducing the number of guns that are firing. If a marine mammal is approaching a safety zone, what constitutes a useful reduction in the power of the airgun array: 5 percent, 25 percent, 50 percent, other? Similarly, if a support vessel is traveling at 15 knots and whales are observed within 274 meters (300 yards), what constitutes a meaningful reduction in speed: 1 knot, 2 knots, 5 knots, other? Is a reduction in speed from 15 knots to 13 knots of equal utility to a reduction from 10 knots to 8 knots, or should the mitigation measure impose specific speed limits rather than just a slowing of speed? The existing evidence supports the idea that it is not just a reduction in speed that matters but the actual vessel speed. If that is the case, then would it not be more useful to impose a vessel speed limit. Regarding ramp-up procedures, the Commission has long recommended that the Service require analysis and reporting of the data collected during ramp-up procedures to verify or refute the notion that those procedures are a useful mitigation measure.

Because existing mitigation measures often are unproven, the Commission considers it vital that the Service and the industry make every reasonable effort to evaluate those measures whenever possible. Such evaluation provides a basis for (1) distinguishing between measures that do and do not have protective value, (2) improving those that are useful, and (3) finding alternatives for those that are not. Without such efforts, at least some mitigation measures may give false reassurance that marine mammals are being adequately protected and/or they may impose costs on the oil and gas industry with little or no benefit to marine mammals. With these concerns in mind, the Marine Mammal Commission recommends that the National Marine Fisheries Service require this and other operators to collect information necessary to evaluate the effectiveness of the mitigation measures adopted and to review and modify mitigation measures accordingly.

In that regard, the peer-review panel convened by the Service after its March 2010 open-water meeting made several recommendations for improving mitigation and monitoring measures. One of those was that Shell monitor not only the effects of its primary sound sources (e.g., airgun arrays) but also the sounds introduced into the marine environment by various support activities, such as the ship used to pull the array, active sonar used in ship navigation, support vessels and helicopters, and autonomous underwater vehicles, should they be used. The panel correctly pointed out that the marine mammals in the area will not just hear and react to the noise from the seismic instruments but to the entire suite of sounds from the various sources associated with the activities and the complex sound field they create in combination.—what the panel referred to as a "soundscape." To understand the animals' responses to that sound field requires that all major sources of noise are monitored and taken into account. The Marine Mammal Commission concurs with the panel's assessment and recommends that the National Marine Fisheries Service review the proposed monitoring measures and ensure that operators (or their contractors) are required to collect and analyze information on all of the potentially important sources of noise and the complex sound field that the seismic survey activities create.

The peer-review panel also questioned whether the use of a single sound threshold, such as 160 dB, constitutes an adequate basis for determining when certain effects will or will not occur. At issue in this case is whether disturbance of biologically significant behavior occurs. The Service's

Federal Register notice cites a summary of information on disturbance in Southall et al. (2007) as the basis for using that level to delineate the potential for disturbance. However, that summary acknowledges that disturbance may occur at a wide range of sound levels. Furthermore, the intent of the Marine Mammal Protection Act is not just to avoid disturbance that occurs in response to a stimulus over a certain threshold. Rather, the Act requires any such disturbance to be minimized to the extent practicable, irrespective of any presumed threshold. With that in mind, it may be reasonable to start with an assumption that disturbance is not likely to occur at sound levels below 160 dB, but that assumption can and should be tested using measurements of sound fields (which Shell is planning to do at the beginning of the season) and records of responses documented by marine mammal observers. Such tests should be conducted using species-specific data, and test results should be used to inform decision makers regarding the applicability of the 160-dB threshold for the species involved and to improve future mitigation measures. The Service's *Federal Register* notice indicates that Shell will conduct such tests, and the Marine Mammal Commission encourages it to do so.

In the Beaufort Sea, Shell will be using three different but complementary forms of monitoring—vessel-based marine mammal observers, aerial surveys, and passive acoustic monitoring. Again, Shell should be commended for such comprehensive efforts to evaluate the effects of its seismic surveys. Vessel-based and aerial surveys can be used to monitor for two different purposes, the first being to determine the effectiveness of the mitigation measures being implemented and the second to estimate the number of takes and the nature of the responses (e.g., deflections in migratory path). The panel recognized that aerial surveys could be used to accomplish both objectives but also indicated that to do so, methods for analyzing the data would have to be modified to avoid certain biases. The Marine Mammal Commission concurs with that conclusion and recommends that the National Marine Fisheries Service work with Shell and its contractors to engage acknowledged survey experts to review the survey design and planned analyses to ensure that the results will be as unbiased and reliable as possible.

The Commission also notes that the comprehensive monitoring proposed by Shell using vessel-based observers, aerial surveys, and passive acoustic monitoring provides a rare opportunity to compare the results from these three types of monitoring to evaluate their strengths and weaknesses and determine how they overlap or complement each other. A comparative analysis should provide insights into the utility of each of these approaches for detecting the marine mammal species in the area surveyed and determining the extent and causes of any observed changes in habitat use and behavior. Such a comparison also should provide insight into how these survey methods might be improved in the future. With those benefits in mind, the Marine Mammal Commission recommends that the National Marine Fisheries Service work with Shell to coordinate a comparative analysis of the results of vessel-based, aerial, and passive acoustic monitoring methods to evaluate their relative strengths and weaknesses and determine if and how they could be improved for use with future surveys.

In the Chukchi Sea, Shell will use only vessel-based marine mammal observers. Shell has argued that aerial surveys in this area are not safe because they would be conducted too far from land. The Service's peer-review panel recognized that safety is always the primary consideration but

also pointed out that surveys by others have been and are being flown safely in this region. The Commission recognizes the need for safety but believes that, if Shell declines to conduct aerial surveys, it still is responsible for monitoring its impacts and should be seeking alternative monitoring measures.

Even if Shell declines to fly aerial monitoring surveys over potential production sites in the Chukchi Sea, it can still supplement its vessel-based observations using towed acoustic sensors. As has now been clearly demonstrated, passive acoustics can be used to detect animals that otherwise spend little time or are inconspicuous at the surface. Passive acoustic records would not improve the implementation of mitigation measures but would provide a basis for generating a more accurate estimate of the total number of marine mammals taken in the course of the seismic survey. For these reasons, the Marine Mammal Commission recommends that the National Marine Fisheries Service require that Shell supplement its vessel-based monitoring plan with towed passive acoustics to provide a more reliable estimate of the number of marine mammals encountered and taken during the course of the proposed seismic surveys.

Data and Analysis Issues

Baseline data. The proposed activities raise two important data issues, both of which were recognized by the Service's peer-review panel. The first involved the collection of baseline data. If all goes according to industry plan, the proposed seismic surveys are just the beginning of oil and gas operations that will be accompanied by test drilling, construction, periodic seismic studies, long-term production, regular and frequent support activities, and a possibility of accidents, such as oil spills, with potentially serious consequences. The long-term concern is that the full spectrum of direct and indirect effects of oil and gas operations, in combination, will compromise the status of marine mammal stocks in this region. Assessing such effects requires adequate baseline information, and that information is more or less available for some species (e.g., bowheads) because of extensive efforts to count them, track their movements, and evaluate contaminants in their tissues. Adequate baseline information is not available for other species that may be affected (e.g., beluga whales and ringed, bearded, and spotted seals) as they have been studied much less in this area. Key types of baseline information that need to be collected include regional or local abundance and density, habitat preferences, animal health and condition, and vital rates (i.e., reproduction and survival).

The proposed approach for collecting baseline information is not adequate. In essence, Shell proposes to have its marine mammal observers collect sighting information at times when its seismic equipment is turned off. But this may be only for a matter of hours, as it has become industry practice to continue firing a "mitigation airgun" during turns or other breaks in surveys so that operators do not have to initiate ramp-up procedures when they are ready to resume the normal survey activities. In addition, marine mammals affected by seismic surveys may not revert to their natural distribution or resume natural behavior for some time following cessation of the airgun noise. This calls into question whether measurements taken immediately or soon after a seismic survey ends actually provide an appropriate baseline of natural conditions. The best way to assess baseline conditions and evaluate impacts would be to conduct observations before a seismic survey,

the results of which could be compared to data collected during and well after the survey to evaluate potential effects and recovery from those effects, respectively.

With those kinds of shortcomings in mind, the Marine Mammal Commission recommends that the National Marine Fisheries Service's Office of Protected Resources work with the Service's National Marine Mammal Laboratory to develop a plan for collecting meaningful baseline information—that is, information that provides a reliable basis for evaluating long-term effects on the marine mammal species and stocks that may be affected by oil and gas development and production in the Beaufort Sea area.

Data availability. The second issue involves the availability of the data collected by Shell and its contractors in preparation for oil and gas operations in this region. As just noted, the data that are presently available for certain marine mammal species and stocks in the Beaufort Sea are not sufficient to characterize their status and, therefore, to provide the needed baseline information for assessing the potential impact of oil and gas operations (and other activities in the region). To its credit, Shell will be collecting extensive information in the course of conducting its seismic surveys. If those data are shared or otherwise made available for scientific purposes, they may add significantly to the body of information on local or regional marine mammal populations. Sharing such data is or should be a normal part of the scientific process; the practice promotes transparency and allows other researchers and managers to maximize the information that can be gained from Shell's monitoring studies. The peer-review panel's report placed strong emphasis on the importance of making these kinds of data available for further study. Again, the Marine Mammal Commission agrees with the panel's report and recommends that the National Marine Fisheries Service work with Shell to determine how the data collected during the proposed activities can best be made available for other scientific purposes.

Subsistence

Before issuing the requested incidental harassment authorization, the National Marine Fisheries Service is required to determine that the proposed activities will not have an unmitigable adverse effect on the availability of marine mammals for subsistence purposes. To avoid any such effects, Shell has undertaken or proposes to undertake a range of activities involving potentially affected Alaska Native communities that depend on marine mammals for subsistence. Those activities include support for communication centers in the communities to keep them informed of oil and gas operations, meetings to discuss oil and gas development plans, employment of Alaska Native representatives to monitor the communities and convey their concerns to the company, and dissemination of information to the communities. These are all good and useful measures and, once again, Shell should be commended for taking such steps.

However, informing subsistence communities of oil and gas activities is not the same as welcoming and incorporating input from them or responding to their concerns. From a business perspective, Shell faces certain pressure to establish and maintain a production schedule that may limit its flexibility to accommodate the concerns of Native communities. On the other hand, members of the subsistence communities may feel disenfranchised if they are informed of activities

but do not feel that they have a meaningful say in matters affecting them or that their concerns have been given full and adequate consideration. At least two approaches have been developed to address these issues. One involves conflict avoidance agreements in which both sides act as more or less equal participants in a negotiation that is intended to identify both company and Alaska Native concerns and find mutually acceptable resolutions. The other involves development of company plans for cooperation in which the company describes the actions it will take and the means of soliciting community input. However, it is not clear that this second approach ensures that the company will give sufficient weight to the concerns of the Alaska Native communities. In that regard, conflict avoidance agreements appear to put both sides on a more nearly equal footing, which is more likely to lead to meaningful negotiations and compromises acceptable to both parties.

Among the duties of the Marine Mammal Commission set forth in Title II of the Marine Mammal Protection Act (section 202), is to—

> recommend to the Secretary [of Commerce or the Interior], other appropriate Federal officials, and Congress such additional measures as it deems necessary or desirable to further the policies of this Act, including provisions for the protection of the Indians, Eskimos, and Aleuts whose livelihood may be adversely affected by actions taken pursuant to this Act.

In this regard, the livelihood and culture of Alaska Natives are at considerable risk because of the effects of climate change and the development that will accompany the loss of sea ice in the Arctic. Development activities include, but are not limited to, oil and gas operations. On 5 November 2009 President Obama signed a Memorandum on Tribal Consultation that reinforced Executive Order 13175 signed by President Clinton on 6 November 2000. The executive order and memorandum charge executive departments and agencies with "engaging in regular and meaningful consultation and collaboration with tribal officials in the development of Federal policies that have tribal implications." To that end, the Marine Mammal Commission recommends that the National Marine Fisheries require Shell to engage in consultations with those Alaska Native communities that may be affected by the company's activities and, to the extent feasible, seek to resolve any Alaska Native concerns through negotiation of a conflict avoidance agreement. The Commission would be pleased to participate with the Service in efforts to solicit input from Native communities and pursue meaningful consultations between those communities and the oil and gas industry.

Level A or Level B Harassment

Shell has decided to apply for an incidental harassment authorization under section 101(a)(5)(D) of the Marine Mammal Protection Act. Such authorization spans only a single year, does not require the promulgation of regulations, and cannot authorize taking by serious injury or death of a marine mammal. The alternative authorization available under section 101(a)(5)(A) would span up to five years and require the issuance of regulations but could allow for a certain number of takings by serious injury or death. Shell has indicated its intent to investigate the cause of death of any marine mammal found dead near its operations, including any unauthorized deaths that may have resulted from its operations. Conducting such investigations and determining the cause of

death will be difficult under some circumstances. For example, collecting a dead bowhead whale can be time consuming and logistically challenging. Nonetheless, investigations of this kind may be necessary for rigorous evaluation of the effects of the proposed activities and determining whether an authorization under section 101(a)(5)(A) is needed. Shell's willingness to investigate the causes of death should be commended. That being said, if a serious injury or death occurs that may have resulted from the proposed activities, then an authorization under section 101(a)(5)(D) may not be sufficient. With that in mind, the Marine Mammal Commission recommends that the National Marine Fisheries Service require Shell to halt its seismic survey and consult with the Service regarding any seriously injured or dead marine mammal when the injury or death may have resulted from Shell's activities. The Service can then make a determination as to whether modifications to the activities are sufficient to avoid additional injuries or deaths or whether Shell should obtain an incidental take authorization under section 101(a)(5)(A).

Please contact me if you have questions regarding the Commission's recommendations or rationale.

Sincerely,

Timothy J. Ragen

Timothy J. Ragen, Ph.D.
Executive Director

June 17, 2010

Via Electronic Mail

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Re: Take of Marine Mammals During Open-water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska between July and October 2010. 75 Fed. Reg. 27,708 (May 18, 2010).

Dear Mr. Payne,

Thank you for the opportunity to comment on Shell Offshore Inc. and Shell Gulf of Mexico Inc.'s (hereafter "Shell") application for an Incidental Harassment Authorization ("IHA") to the National Marine Fisheries Service ("NMFS") pursuant to the Marine Mammal Protection Act ("MMPA") for oil and gas related activities in the sensitive Beaufort and Chukchi Seas. *See* 75 Fed. Reg. 27,708 (May 18, 2010). These comments are submitted on behalf of the Alaska Eskimo Whaling Commission ("AEWC"). AEWC represents the eleven bowhead whale subsistence hunting villages of Barrow, Nuiqsut, Kaktovik, Pt. Hope, Wainwright, Kivalina, Wales, Savoonga, Gambell, Little Diomede, and Pt. Lay.

Our communities depend upon the marine mammals at stake in this application and the environment that supports them, which is changing rapidly as a result of climate change. We rely on the migration of bowhead whales and other marine mammals through the Chukchi and Beaufort Seas to feed our people and to preserve our society and culture. The ramifications of improperly managed oil and gas related activities place our continued nutritional and cultural survival at great risk. The AEWC sees the Beaufort and Chukchi Seas as the valuable and unique resources that they are and on behalf of our whaling captains, we are responsible for protecting our Inupiat way of life that they support.

The potential for any take of marine mammals by Shell in the waters that support our communities must be scrutinized with extreme care. In submitting its application, the corporation failed to comply with applicable statutory and regulatory application requirements and has otherwise failed to demonstrate that its activities comport with the requirements for

issuing an IHA. For its part, NMFS has accepted many of Shell's assertions that are contrary to both scientific research and agency experience, continues to fail to provide for independent verification of offshore operators' compliance with IHA provisions, and has otherwise failed to follow the letter of the law. The lack of information about marine mammals in the Chukchi Sea, as demonstrated throughout Shell's application and NMFS's notice, makes it clear that NMFS is not in a position to make the statutory findings required by Congress through the Marine Mammal Protection Act. Moreover, despite this lack of information, NMFS failed to rely on the best available science about marine species in the Beaufort and Chukchi Seas. For these reasons and those discussed below, NMFS's preliminary determinations are arbitrary.

NMFS should be aware up front that the AEWC and Shell were unable to reach an accord on the annual Conflict Avoidance Agreement ("CAA"), which has historically formed the basis for NMFS' statutorily required determination of no unmitigable adverse impacts to subsistence activities. NMFS does not discuss at any point in the Federal Register notice the fact that Shell and AEWC did not reach agreement on a CAA and what, if any, consideration NMFS gave to this fact in reaching its conclusions on umitigable adverse impacts to subsistence activities.

In a meeting to discuss the CAA in Barrow this past February, the AEWC's whaling captains attempted to reach a compromise agreement and made several significant concessions, and Shell's company representatives indicated that Shell was likely to agree to the terms offered by the AEWC and whaling captains at that time. Subsequent to the February negotiations, however, Shell purported to sign a different version of the CAA, which Shell had unilaterally modified on significant points that were the subject of the February compromise. The unilateral changes made by Shell were not acceptable and represent changes that the AEWC and whaling captains had not proposed or agreed to.

At this point in time, the AEWC and Shell have been unable to reach agreement on two main provisions. The first relates to provisions for zero discharge. The AEWC and whaling captains' proposed that the oil companies and the AEWC agree to work on joint comments to the Environmental Protection Agency in support of the discharge standards applicable to oil and gas operations in the Norwegian Arctic, standards which have already been implemented in Norway and are applicable to any operations Shell undertakes in the Norwegian Arctic. Shell would not agree to even this reasonable proposal. The second relates to the sound threshold for activities that should be subject to sound source verification procedures. The AEWC and whaling captains proposed a significant reduction in the number of vessels and activities subject to on-site sound source verifications, but Shell is insisting upon even further reductions, which our scientists feel would not provide adequate information on the impact to marine mammals and behavioral changes that would affect the subsistence hunt.

The AEWC is extremely disappointed in Shell's decision not to sign the 2010 CAA. Our whaling captains made very significant concessions on key mitigations measures they feel are essential in an effort to find common ground with Shell and other offshore operators. In particular, despite their strong objections to ocean discharge, the whaling captains agreed to remove the "zero volume discharge" measure that was in the 2009 CAA in return for agreement from the oil companies to join the AEWC in joint comments to the EPA as described above. Because Shell has failed to sign the agreement, the AEWC is now looking to NMFS to fulfill its

Congressional mandate and ensure that Shell's activities do not have more than a negligible impact on marine mammal stocks or an unmitigable adverse impact on the subsistence activities of our whaling captains and their crews.

If NMFS does decide to issue the final IHA, which it should not do at this time, the AEWC requests the opportunity to consult directly with NMFS on this decision, under the terms of the NOAA-AEWC Cooperative Agreement. In particular, if NMFS does move forward with the proposed IHA, AEWC requests that NMFS include in the IHA the specific mitigation measures set forth in the final CAA, which is attached to this correspondence. Those measures should be in addition to the measures already identified by NMFS in the Federal Register Notice and any additional measure deemed necessary by NMFS following review of the public comments.

Finally, we note that in recent years NMFS did not publish its response to comments on proposed IHAs activities conducted during the open water season until well after the fall subsistence hunt at Cross Island had concluded and geophysical operations had already taken place. There can be no excuse for allowing operations to take place within important areas of the Arctic Ocean prior to NMFS explaining to the local communities and whaling captains how agency responded to their comments. The fact that NMFS would not release its response to comments until after the activities had taken place casts serious doubt on the validity of NMFS' public involvement process and the underlying analysis of impacts to subsistence activities and marine mammals.

I. NMFS Should Not Issue An IHA Given The Current Suspension of Offshore Drilling in Alaska And Pending Reorganization Of The Minerals Management Service.

The United States has just experienced an environmental disaster in the Gulf of Mexico unlike any our nation has ever seen. The continuing environmental and economic damage is both shocking and saddening. In light of this recent event, President Obama wisely announced a suspension of exploration off the coast of Alaska and a six-month suspension of new deepwater oil drilling permits. The AEWC now requests that NMFS follow the President's lead in taking a second, more critical look into the risks associated with offshore activities.

The harm caused by an oil spill is not the only risk to marine mammals posed by oil and gas activities on the OCS. For many years, AEWC and the scientific community have raised concerns regarding underwater noise from geophysical activities and the threats posed to marine mammals from noise and chemical pollution, as well as increasing vessel traffic. MMS, just as it does with the risk of an oil spill, habitually downplays threats to marine mammals, and NMFS has routinely granted IHA's for geophysical operations authorized by MMS. Many times, these IHAs have been issued over the objections of the scientific and subsistence communities as well as the agencies' own scientists. In short, the systemic problems highlighted by the Deepwater Horizon incident are not limited solely to the oil spill context but also plague the government's assessment and regulations of other impacts and risks associated with oil and gas activities on the OCS.

As the Administration steps back from the rush to open the Arctic to exploratory drilling, NMFS should also take this time to reassess its approach to regulation of geophysical activities. In particular, in cooperation with the Council on Environmental Quality and other agencies of the Administration, NMFS should determine whether and to what extent the systemic problems within MMS have impacted the government's regulation of offshore oil and gas activities in addition to drilling. Until the Administration completes the reorganization of MMS and determines whether and how exploratory activities can move forward, NMFS should not be approving geophysical activities that carry with them the threat of adversely affecting marine mammals and our subsistence activities.

II. Applicable Legal Requirements.

A. The Marine Mammal Protection Act

The findings required of the Secretary pursuant to Section 101(a)(5)(D) of the MMPA are mandatory. Congress directs that the Secretary *shall find* that there will be *no more than a negligible impact* to marine mammals and *no* unmitigable adverse impact to the availability of marine mammals for subsistence taking. Thus, Congress does not give the Secretary discretion in making the mandatory findings.

This nondiscretionary congressional directive is consistent with the MMPA's overall treatment of both marine mammal and subsistence protections. Congress has set a "moratorium on the taking ... of marine mammals," 16 U.S.C. § 1371(a), with the sole exemption provided for the central role of subsistence hunting by Alaska Natives. Thus, Congress has given priority to subsistence takes of marine mammals over all other exceptions to the moratorium, which may be applied for and obtained only if certain statutory and regulatory requirements are met. One such exception is an IHA. However, incidental harassment authorizations are available only for specified activities for which the Secretary makes the mandated findings. Thus, the pursuit of those activities is subordinated, by law, to the critical subsistence uses that sustain Alaska's coastal communities.

Furthermore, an IHA can only be granted if the activity has *no* potential to result in serious injury or mortality. 16 U.S.C. § 1371(a)(5)(D). If such injury or mortality is possible, take can only be authorized pursuant to a Letter of Authorization ("LOA") that complies with 16 U.S.C. § 1371(a)(5)(A) and 50 C.F.R. § 216.105.

In order to obtain an IHA, the applicant must submit an application that comports with applicable regulatory requirements, *see* 50 C.F.R. §§ 216.104, 216.107, and NMFS "shall publish a proposed authorization" for public comment. 16 U.S.C. § 1371(a)(5)(D)(iii). If the activity to be covered by the IHA "may affect the availability of a species or stock for taking for subsistence uses" then NFMS "shall prescribe" "requirements for the independent peer review of proposed monitoring plans or other research proposals." 16 U.S.C. § 1371(a)(5)(D)(ii)-(ii)(II). Under no circumstances can the activity "reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs." 50 C.F.R. § 216.103. In deciding whether to issue an IHA, NMFS "shall evaluate each request to determine, based upon the best available scientific evidence, whether the taking . . . will have a negligible impact on the species or stock

and . . . will not have an unmitigable adverse impact on the availability of such species or stock for subsistence use." 50 C.F.R. § 216.104(c).

Additionally, an application for an IHA triggers both consultations under section 7 of the Endangered Species Act ("ESA") regarding the impacts to ESA listed species, 16 U.S.C. § 1536(a)(2), and review of the environmental impacts of activities NMFS may authorize under the National Environmental Policy Act ("NEPA").

III. NMFS Is Not In A Position To Issue An IHA Until Both The Agency And Shell Comply With All Procedural And Informational Requirements Of The MMPA .

A. Shell's Application Must Be Returned As Incomplete And Inappropriate.

At the outset, we note our disappointment in NMFS for putting out for public comment a woefully incomplete application from Shell for an IHA that fails to provide the mandatory information required by the MMPA and NMFS's implementing regulations. Without the required information, NMFS cannot make the determinations required under the MMPA. *See* 16 U.S.C. § 1371(a)(5)(D)(iii). For this reason, we ask that NMFS return Shell's application as incomplete, *see* 50 C.F.R. § 216.104(b)(3) ("Applications that are determined to be incomplete or in appropriate for the type of taking requested will be returned to the applicant"), or else the agency risks making arbitrary and indefensible determinations under the MMPA.

Indeed, NMFS has previously explained that:

> in order for NMFS to accept an incidental harassment application, such application must be complete, accurate (to the extent possible), and address in some detail the information items requested as part of the application. If an application does not provide documentary evidence sufficient for NMFS to make a preliminary determination that the activity is likely to result in only a small take (by harassment) of marine mammals and have no more than a negligible impact on the species or stocks impacted or their habitat, *NMFS will return the application as Sincomplete*.

60 Fed. Reg. 28,379, 28,381 (May 31, 1995) (emphasis added). The following is a list of information that is missing from Shell's application:

- A description of the "age, sex, and reproductive condition" of marine mammals that will be impacted, particularly in regard to bowhead whales. 50 C.F.R. § 216.104(a)(6);
- The economic "availability and feasibility . . . of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks, their habitat, and on their availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance" 50 C.F.R. § 216.104(a)(11);
- "Suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects." 50 C.F.R. § 216.104(a)(14).

B. The IHA Cannot Be Approved Because NFMS Has Failed To Provide Public Comment On The Draft Authorization

The plain language of both the MMPA and NMFS' implementing regulations require that NMFS provide the opportunity for public comment on the "proposed incidental harassment *authorization*," 50 C.F.R. § 216.104(b)(1)(i) (emphasis added); 16 U.S.C. § 1371(a)(5)(D)(iii), and not just on the application itself as NMFS has done here. The authorization itself must prescribe certain requirements such as "permissible methods for taking by harassment," "means of effecting the least practicable impact on such species," measures to "ensure no unmitigable adverse impact on the availability of the species or stock for taking for subsistence use," requirements pertaining to "monitoring and reporting" and for "independent peer review" of such monitoring and reporting if the taking may affect subsistence use. 16 U.S.C. § 1371(a)(50(D)(ii). Indeed, NMFS's regulations further provide that "[a]ny preliminary finding of 'negligible impact' and 'no unmitigable adverse impact' shall be proposed for public comment along with [] the proposed incidental harassment authorization . . .." 50 C.F.R. § 216.104(c).

Given Shell's refusal to sign the CAA, without a complete draft authorization and accompanying findings, AEWC cannot provide meaningful comments on Shell's proposed activities, ways to mitigate the impacts of those activities on marine mammals, and measures that are necessary to protect subsistence uses and sensitive resources. We are aware that NMFS takes the position that the Federal Register notice provides information equivalent to a draft of the IHA itself, however that position is both contrary to the plain language of the law and common sense. In particular, the language of the IHA governs the specific mitigation, monitoring and reporting requirements, and Shell's ultimate legal obligations will be interpreted based not on what is in the Federal Register notice but what is in the authorization itself. Only by reviewing the specific language governing Shell's activities can the AEWC provide meaningful input into the IHA process.

IV. Shell's Application Is Not Ripe for Approval Until The Following Substantive Requirements Are Met.

A. The Likely Take Of Marine Mammals Due To Shell's Operations Exceeds The Limits Set By Congress In Allowing The Incidental Take Exception To the United States' Moratorium On All But Subsistence Takes Of Marine Mammals.

With respect to the "take" of marine mammals, NMFS may only issue an IHA if the activity will result in only incidental take by "harassment of small numbers of marine mammals," 16 U.S.C. § 1371(a)(5)(D), and that "based on the best scientific evidence available, that the total taking by the specified activity during the specified time period will have a negligible impact on the species or stock . . .." 50 C.F.R. § 216.102(a).

Harassment is defined under the MMPA as "any act of pursuit, torment, or annoyance which (i) has the potential to injure a marine mammal or marine mammal stock in the wild; or

(ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." 16 U.S.C. § 1362(18)(A).

1. Shell's Proposed Activities Carry the Potential to Cause Level A Take And Serious Injury.

Take as the result of airgun use and other seismic operations are the focal point for both NMFS and Shell. In terms of assessing the impacts of airgun use on marine mammals, there are two basic reactions that must be addressed: threshold shifts from exposure to sound and deflection of marine mammals from the ensonified area.

With respect to sound exposure, NMFS has previously explained in enacting the Arctic specific MMPA regulations that:

> if an application indicates that an acoustic source at its maximum output level has the potential to cause a temporary threshold shift in a marine mammal's hearing ability, that taking would constitute a 'harassment' take, since the animal's hearing ability would recover and the section 101(a)(5)(D) application would be appropriate. However, if the acoustic source at its maximum level had the potential to cause a permanent threshold shift in a marine mammal's hearing ability, that activity would be considered to be capable of causing serious injury to a marine mammal and would therefore not be appropriate for an incidental harassment authorization.

60 Fed. Reg at 28,381 (May 31, 1995). Since Shell's operations at their maximum level have the "*potential to cause permanent threshold shift*" if marine mammals did not leave the ensonified area, an LOA and not an IHA is required here.

Additionally, research is increasingly showing that marine mammals may remain within dangerous distances of seismic operations rather than leaving a valued resource such as a feeding ground. *See* (Richardson, 2004) (Attachment 2) ("For Bowhead whales, a recent LGL Ltd. study of migrating animals showed that deflection began at lower received levels than had been previously documented, with most individuals remaining >20 km from the airguns." And more recent data showed that "bowheads are more tolerant of airgun pulses when feeding in summer than when migrating in autumn."). The International Whaling Commission ("IWC") scientific committee has indicated that the lack of deflection by feeding whales in Camden Bay (during Shell seismic activities) likely shows that whales will tolerate and expose themselves to potentially harmful levels of sound when needing to perform a biologically vital activity, such as feeding (mating, giving birth, etc.).

Thus, the noise from Shell's proposed operations could injure marine mammals if they are close enough to the source. Shell intends to employ marine mammal observers ("MMO") and a "190 and 180 dB safety radii for pinnipeds and cetaceans, respectively, and the 160 dB disturbance radii" to mitigate these effects. *See* Shell 4MP at 18. However, the safety radii proposed by Shell do not negate these impacts. The safety radii only function as well as the

observers on the vessels can see and report marine mammals within the radii or the general vicinity of the vessel. MMOs are human and suffer from human flaws. Not only does Shell admit that observes are bad at judging distances in the water – i.e., whether a marine mammal is within the radii are, *see* Shell 4MP at 9 (discussing use of lasers for "visually estimating distances to objects in the water" and a human's trained ability to estimate distances plus or minus 20%), but that at night and during storms MMO are particularly ineffective. *See* Shell 4MP at 9 (night vision devices "are not nearly as effective as visual observation during daylight hours"). Thus, Shell's proposed MMO program is not sufficient mitigation to prevent Shell from engaging in Level A harassment.

a. Shell's proposed activities create the potential for injury due to deflection.

NMFS does little to assess whether Level A harassment is occurring as a result of the deflection of marine mammals due to Shell's proposed operations. Deflected marine mammals may suffer impacts due to masking of natural sounds including calling to others of their species, physiological damage from stress and other non-auditory effects, harm from pollution of their environment, tolerance, and hearing impacts. *See* (Nieukrik, 2004) (Attachment 3) ("Airgun activity . . . effect on the baleen whales studied here is unknown; possible effects include masking of conspecific sounds, increased stress levels, changing vocalizations, and ear damage (Richardson et al., 1995)."). Thus, movement of marine mammals away from noise in the marine environment is common, and constitutes take because it "disturb[s]" marine mammals "by causing disruption of behavioral pattern[s]" such as feeding and migrating. *See* 16 U.S.C. § 1362(18) (defining "harassment"). Not only do these operations disrupt the animals' behavioral patterns, but they also create the potential for injury by causing marine mammals to miss feeding opportunities, expend more energy, and stray from migratory routes when they are deflected.

Moreover, these impacts cannot be assessed in the isolation of one proposed project but must be placed in the larger context of what these animals are experiencing throughout their *ranges in Arctic waters. See* Angliss, R. P., and B. M. Allen. BOWHEAD WHALE (Balaena mysticetus): Western Arctic Stock Assessment (4/1/2008) NOAA-TM-AFSC-193. (last visited June 14, 2010: http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2008whbh-arw.pdf) ("since 2006 there has been elevated interest in exploiting petroleum reserves in the seas around Alaska, including most areas where bowheads feed and migrate. The accumulation of impacts from vessels, seismic exploration, and drilling are of concern across the North Slope of Alaska.").

For example, Shell's proposal is only one of the oil industry activities recently occurring, planned, or ongoing in the U.S. portions of the Chukchi and Beaufort seas. NMFS's website reveals the following additional MMPA IHA and LOA requests that were approved in the range of the species at issue here over the past few years, and those applications for the present and future seasons: 2006 LOA issued - BP, Operation of Northstar Oil and Gas Facility in the Beaufort Sea, AK; 2007 IHA approved - Shell Offshore, Inc. and WesternGeco, Inc., seismic survey program in the Chukchi and Beaufort Seas, AK; 2009 IHA approved - Shell Offshore, Inc. and Shell Gulf of Mexico, Inc., site clearance and shallow hazards surveys in the Chukchi Sea, AK; 2010 IHA applied for - Statoil 3D, marine seismic survey in the Chukchi Sea, AK; 2011-2016 LOA applied for - BP, Operation of Northstar Oil and Gas Facility in the Beaufort

Sea, AK. *See* NMFS, Incidental Take Authorizations (last visited June 14, 2010: HYPERLINK http://www.nmfs.noaa.gov/pr/permits/incidental.htm). Moreover of additional geophysical work planned in the Russian far east and the Canadian Beaufort, which could similarly impact the Western Beaufort Stock of bowhead whales. The United States Geological Service has also released a draft environmental assessment and applied for an IHA for its own geophysical work during this upcoming open water season. NMFS must determine whether level A take is likely to result from multiple harassing events within the same year or season, which could result in whales being deflected at multiple points throughout their migration routes.

Each of these operations may deflect marine mammals altering their behavior and setting them off migratory courses or feeding grounds on numerous occasions. Each such deflection can cause the animals to expend additional energy, miss feeding opportunities, or stray from its intended course and when this occurs repeatedly, it certainly has the potential to injure marine mammals. Without an analysis of the effects of all of the planned operations on marine mammals, it is impossible to assess the level of take of these animals that is on-going. It is for this reason that we advocate NMFS implement a cap on the overall seismic related activities that can occur in Arctic waters each year.

b. Increases in carcasses/stranding also indicate the potential for injury.

Stranded marine mammals or their carcasses are also a sign of injury. NMFS states in its notice that the Agency "does not expect any marine mammals will . . . strand as a result of proposed seismic survey." 75 Fed. Reg. at 27714. NMFS also states that "to date, there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays." *Id.* In reaching this conclusion, NMFS claims that strandings have not been recorded for the Beaufort and Chukchi Seas. Had NMFS consulted with native groups it would have learned this is in fact false. The Department of Wildlife Management of the North Slope Borough has completed a study documenting twenty-five years worth of stranding data and showing that five dead whales were reported in 2008 alone in comparison with the five dead whales that were reported in the same area over the course of twenty-five years. (Rosa, 2009) (Attachment 4). Indeed, the study points to "[a]nthropogenic activities such as oil and gas development, commercial fishing, and shipping" which "create disturbance, noise, and chemical pollution, all of which have been shown to have detrimental effects on wildlife, including whales" as a potential cause for the recent increase in stranded whales documented by the Borough. *Id.*

In light of the increase in seismic operations in the Arctic since 2006, the Borough's study raises serious concerns about the impacts of these operations and their "potential to injure a marine mammal." *See* 16 U.S.C. § 1362(18)(A)(i). While we think this study taken together with the "May- June 2008, stranding of 100–200 melon- headed whales (Peponocephala electra) off Madagascar that appears to be associated with seismic surveys" 75 Fed. Reg. at 27,714, demonstrate that seismic operations have the potential to injure marine mammals beyond beaked whales, certainly the Borough's study shows that direct injury of whales is an ongoing risk. While NMFS acknowledges the strandings in Madagascar and their apparent association with seismic surveys, it does only that. Although it has been two years since the incident, NMFS

merely notes that it is currently under investigation. These direct impacts must be analyzed and explanations sought out before additional activities with the potential to injure marine mammals are authorized.

Thus, NMFS must explain how, in light of this information, Shell's application does not have the potential to injure marine mammals.

2. NMFS Failed To Use The Best Scientific Evidence Available In Assessing The Level Of Take From Shell's Operations.

In assessing "the total taking by the specified activity" and whether it will have a negligible impact, NMFS must use the "best scientific evidence available." *See* 50 C.F.R. § 216.102(a). It has not done so here.

a. NMFS did not use the best scientific evidence in setting the sound levels against which take was assessed.

NMFS uses exposure to sound levels ≥160 dB re 1 µPa (rms) as the measure in assessing the impacts from Shell's proposal. 75 Fed. Reg. at 27,712; Shell Application at 24. We disagree that 160 dB remains an appropriate measure for take of marine mammals for several reasons.

First, in conducting scoping on its national acoustic guidelines for marine mammals, NFMS noted that the existing system for determining take – *i.e.*, the 160 dB mark – "considers only the sound pressure level of an exposure but not its other attributes, such as duration, frequency, or repetition rate, all of which are critical for assessing impacts on marine mammals" and "also assumes a consistent relationship between rms (root-mean-square) and peak pressure values for impulse sounds, which is known to be inaccurate under certain (many) conditions." 70 Fed. Reg. 1871, 1873 (Jan. 11, 2005). Thus, NMFS itself has recognized that 160 dB (rms) is not an adequate measure.

Second, current scientific research establishes that 120 dB (rms) is a more appropriate measure for impacts to marine mammals. Using baleen whales as an example, studies suggest that seismic frequencies may be more damaging than originally anticipated. For example, a literature review of baleen whale sound sensitivity determined that bowhead whale vocalizations ranged from 129 to 189 dB, *see* Erbe (Attachment 5). This study concluded that

> Inferring from their vocalizations, bowheads should be most sensitive to frequencies between 20 Hz-5 kHz, with maximum sensitivity between 100-500 Hz. The lowest reported 3rd octave band level causing a behavioral response was **84dB, followed by 87, 90 and 94 dB**.

(Erbe 2002) (Attachment 5) (emphasis added). Moreover, "Richardson et al. (1999) reported that sighting rates of bowhead whales during aerial surveys in the Beaufort Sea were lower when the whales were exposed to seismic survey sounds of 120–130 dB re 1 µPa (rms), indicating a movement response at sound levels lower than had previously been reported for bowhead whales (Richardson et al. 1986; Richardson and Würsig 1997)." (Gailey 2007) (Attachment 6). Thus, if

the ensonified zone around seismic operations is dropped down to 120 dB for purposes of impacts analysis, it is likely that many more bowheads will be deemed harassed by Shell's proposed activities.

These studies and others like them are significant because research on anthropogenic sound is also showing that such noises "mask sounds associated with foraging" and "can decrease an animal's ability to find and capture food" and make communication sounds which "can decrease the ability of individuals to establish or maintain contact with group members or potential mates." (ICES 2005) (Attachment 7).

Moreover, the Erbe study also concluded that "[i]t is generally agreed that any sound at some level can cause physiological damage to the ear and other organs and tissues." (Erbe 2002) (Attachment 5). Placed in the context of an unknown baseline of sound levels in the Beaufort and Chukchi Seas, it is critically important that NMFS take a precautionary approach to permitting additional noise sources in this poorly studied and understood habitat. See Shell 4MP at 19 (regarding the proposed Acoustic Study of Bowhead Deflections - "The purpose of the array [of acoustic recorders] will be to further understand, define, and document sound characteristics and propagation resulting from site clearance and shallow hazards surveys that may have the potential to cause deflections of bowhead whales from their migratory pathway. "). Thus, the best available science dictates that NMFS use a more cautious approach in addressing impacts to marine mammals from seismic operations.

b. NMFS did not use the best scientific evidence in assessing the impacts of Shell's operations.

In assessing the level of take and whether it is negligible, NMFS relied on flawed density estimates that call all of NMFS's preliminary conclusions into question. Density data are lacking or outdated for almost all of the marine mammals that may be affected by Shell's operations in the Beaufort Sea and Chukchi Sea especially for the fall. When discussing marine mammal densities, NMFS speaks in very uncertain terms. NMFS notes, for example, that "densities of marine mammals are *likely* to vary with the presence or absence of sea ice." 75 Fed. Reg. at 27,723 (emphasis added). NMFS casually dismisses this gap in knowledge, however, because "survey activities will *generally* avoid sea-ice." *Id.* (emphasis added). Therefore, Shell is allowed to make the assumption "that only 10% of the area exposed to sounds ≥160 dB by the survey will be near ice margin habitat." *Id.* In the case of some marine mammal species, "no applicable estimate (or perhaps a single estimate) was available" in regards to density. *Id.* In those instances, "correction factors were used." *Id.* A couple species specific examples are provided below that illustrate NMFS's failure to utilize the best available scientific studies in assessing Shell's application.

Beluga Whales: NMFS's guess regarding the density of beluga whales was derived from data published ten years ago in a study from Moore *et al.* (2000). *See* 75 Fed. Reg. at 27,723. The estimate is contrary to the best available scientific information on beluga whale presence in the Beaufort and Chukchi Seas. Although Shell submitted a revised version of its application as recently as April 2010, it relies upon the 2008 Alaska Marine Mammal Stock Assessment. *See* Shell's IHA Application at 54 (Angliss, R.P., and B.M. Allen. 2009. Alaska Marine Mammal

Stock Assessments, 2008. U.S. Dep. Commer., NOAA Technical Memorandum NMFS-AFSC-193, 258 p.) The most recent Alaska Marine Mammal Stock Assessment dates from 2009 and was issued in February 2010. *See* Angliss, R.P., and B.M. Allen. 2010. Alaska Marine Mammal Stock Assessments, 2009. U.S. Dep. Commer., NOAA Technical Memorandum NMFS-AFSC-206, 276 p. (last visited June 14, 2010: http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2009.pdf). This report cites "increased human activity in the Arctic, including increasing oil and gas exploration and development" as a few of the current concerns related to negative impact on beluga habitat. *Id.* at 71, 75 (citing (Moore et al 2000, Lowry et al 2006)).

Bowhead Whales: NMFS's guess regarding the density of bowhead whales was derived from limited aerial surveys conducted by industry operators, some of which occurred several years ago, and the same ten year old report as was used to calculate beluga densities. *See* 75 Fed. Reg. at 27,724. NMFS makes no mention of the most recent Alaska Marine Mammal Stock Assessment which was released this year. The Assessment cites to a 2003 study that documented bowhead whales in the "Chukchi and Bering Seas in summer" that are "are thought to be a part of the expanding Western Arctic stock. Angliss, R.P., and B.M. Allen. 2010. Alaska Marine Mammal Stock Assessments, 2009. U.S. Dep. Commer., NOAA Technical Memorandum NMFS-AFSC-206, 276 p. (last visited June 14, 2010: http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2009.pdf). While a study published in 2003 still is not a sufficient basis for a 2009 density analysis, this study does show that additional information is available that indicates that number of bowhead whales in the Chukchi may be higher than estimated by NMFS.

As a general matter, when it comes to NMFS assessing the various stocks of marine mammals under the MMPA it cannot use out-dated data – i.e., "abundance estimates older than 8 years" - because of the "decline in confidence in the reliability of an aged abundance estimate," Angliss, R. P., and B. M. Allen. 2008. HARBOR PORPOISE (Phocoena phocoena): Bering Sea Stock Assessment. (3/31/2008) (last visited June 14, 2010: http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2008poha-be.pdf) – and the agency is thus, unable to reach certain conclusions. Similarly here, where data is out-dated or non-existent NMFS should decide it cannot reach the necessary determinations. These flaws in NMFS's analysis render the agency's preliminary determinations about the level of harassment and negligible impacts completely arbitrary.

Additionally, we are opposed to NMFS utilizing "survey data" gathered by industry while engaging in oil and gas related activities and efforts to document their take of marine mammals. Such industry "monitoring" – like that proposed by Shell – is designed to document the level of take occurring from the operations. *See 75* Fed. Reg. at 27,724, Shell 4MP. Putting aside whether the methodologies employed are adequate for this purpose, they certainly are not adequate for assessing the density or presence of marine mammals that typically avoid such operations. Research has documented that

> In general, bowheads react strongly and rather consistently to approaching vessels of a wide variety of types and sizes. Bowheads interrupt their normal behavior and swim rapidly away. Surfacing, respiration, and diving cycles are affected.

Richardson, W.J. *et al.* Marine Mammals and Noise. Academic Press. 1995: 268-270; *id.* ("Bowheads can be displaced by as much as a few kilometers while fleeing.") Thus, it is *completely arbitrary* to rely on data collected from the very vessels that marine mammals avoid in making density arguments and it is not surprising that such industry information consistently reports lower numbers for this reason. For these reasons, NMFS cannot rely on such industry information in calculating the density of marine mammals or determining whether certain species are present in the area without running afoul of the law.

Furthermore, NMFS fails to explain how and why it reaches various conclusions in calculating the marine mammal densities. One example is NMFS's reliance on Moore *et al.* 2000 in making its density determinations. This study documented sightings of marine mammals but did not estimate the total number of animals present. In all, the practices discussed above have resulted in entirely arbitrary calculations of the level of take of marine mammals and whether such takes constitute "small numbers" or a "negligible impact" as a result of Shell's proposal.

3. NMFS's Preliminary "Small Takes" and "Negligible Impact" Determinations Are Arbitrary.

An authorization of incidental take of marine mammals from specified activities can only be issued if such take will be limited to "small numbers" and have a "negligible impact" on the species or stock. 16 U.S.C. § 1371(a)(5)(D)(i)(I); 50 C.F.R. § 216.107. These are separate and distinct statutory requirements. *Id.* However, NMFS has adopted a regulatory definition of "small numbers" that conflates it with the "negligible impact" determination and impermissibly renders it meaningless. Thus, NMFS's implementation of the MMPA fails to comport with the plain language of the Act.

Moreover, despite NMFS assurances otherwise, Shell's IHA application does not meet either the "small numbers" or "negligible impact" requirements. NMFS has preliminarily determined that the impact of Shell conducting seismic surveys in the Beaufort and Chukchi Seas will have no more than a negligible impact on marine mammals. Neither the Federal Register notice nor Shell's application provides any support whatsoever for this "conclusion." Indeed, without knowing more about the status and number of species present in the Chukchi this conclusion cannot be supported.

Based on the density estimates, Shell is predicting that an average of 381 and a maximum of 394 bowhead whales may be exposed to sound levels of 160 dB and above in the Beaufort Sea between July and October, 2010. *see* table 6-7, Shell IHA Application at 32. This example shows numbers of marine mammals that will be subjected to impacts as a result of Shell's operations that are by no means "small."

In terms of negligible impacts, NMFS has failed to fully consider several impacts in its *Negligible Impact and Small Numbers Analysis and Preliminary Determination.* 75 Fed. Reg. at 27,726, 27,727.

First, the Agency acknowledged that Shell's activities may cause marine mammals to leave their customary feeding areas. However, it simply dismissed this concern by stating that "based on the vast size of the Arctic Ocean where feeding by marine mammals occurs versus the localized area of the marine survey activities, any missed feeding opportunities in the direct project area would be minor based on the fact that other feeding areas exist elsewhere." *Id.* at 27,727.

Second, while NMFS mentioned physiological stress as a potential concern, it responds in a conclusory fashion, stating that extreme physiological stress is not anticipated. *Id.* at 27,726.

Third, the possibility of marine mammals being struck by the many vessels that will be involved in Shell's operations needs to be considered in light of scientific evidence of harm from ship traffic to marine mammals, *see, e.g.*, (George, 1994) (Attachment 8).

Fourth, the very real impacts to marine mammal habitat, including pollution of the marine environment and the risk of "oil spills, toxic, and nontoxic waste" being discharged, Western Arctic stock. Angliss, R.P., and B.M. Allen. 2010. Alaska Marine Mammal Stock Assessments, 2009. U.S. Dep. Commer., NOAA Technical Memorandum NMFS-AFSC-206, 276 p. (last visited June 14, 2010: http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2009.pdf)., all must be taken into account. NMFS cannot simply rely on the Environmental Protection Agency to regulate air and water pollution. NMFS is charged with protecting both marine mammals and subsistence use of them under the MMPA and must ensure marine resources and those who rely on them are not adversely impacted by pollution from oil and gas related activities.

Fifth, impacts to fish and other marine mammal food sources upon which marine mammals rely must also be analyzed. *See* (Nieukrik, 2004) (Attachment 3) ("Airgun activity in shallow water has been shown to significantly damage the ears of fish (McCauley et al., 2000)"). NMFS recognizes that little is known about the effects of geophysical activities on fish and invertebrates but illogically still determines that there will only be a negligible impact on these resources. In particular, the effects of the project on fish, zooplankton, krill, and other aspects of the marine food chain needs to be studied and assessed before a finding of only negligible impacts can be justified. Many local hunters have expressed concerns about the effects of seismic work on fish and lower-level animals – for both nearshore and offshore operations – and the ramifications to the ecosystem as a whole.

Sixth, impacts about the specific marine mammals that will be taken – including their "age, sex, and reproductive condition," 50 C.F.R. § 216.104(a)(6), needs to be accounted for. Again, this information is necessary because for example, baleen whale calves and their mothers are more sensitive to ocean noise and may suffer greater adverse impacts from vessel traffic and seismic operations. *See* (McCauley 2000) (Attachment 1) ("Cow/calf pairs are in the author's experience more likely to exhibit an avoidance response to man-made sounds they are unaccustomed to. Thus any management issues relating to seismic surveys should consider the cow/calf responses as the defining limits.").

For all these additional reasons, NMFS's preliminary negligible impacts determination is arbitrary.

B. Shell's Proposed Mitigation And Monitoring Are Not Sufficient.

Shell is once again relying on Marine Mammal Observers ("MMOs") to detect marine mammals that may pass within safety zones and therefore be harmed by geophysical activities. Data previously presented by Shell and ConocoPhillips from their seismic activities made clear that MMOs failed to detect many marine mammals that encroached within the designated safety zones. Indeed, Shell admits that night vision devices "are not nearly as effective as visual observation during daylight hours." Shell 4MP at 9.

If NMFS relies on mitigation included in an IHA to find an activity will have only a negligible level of impact, that finding is "subject to such mitigating measures being *successfully* implemented." *See* 50 C.F.R. § 216.104 (emphasis added). The simple existence of a measure is not enough. Shell must be able to demonstrate that measures will and can be implemented, thus, ensuring that impacts to bowheads remain "negligible." As Shell's proposed mitigation currently stands, this is a difficult if not impossible determination for NMFS to make.

Finally, as we stated above, we request that NMFS review and incorporate the mitigation measures in the final 2010 CAA, in particular the measure contained in Section 401, 402, 403, 501 and 502. These measures have been developed over many years by our whaling captains in cooperation with offshore operators and represent defensible and reasonable provisions for the protection of subsistence activities.

IV. Other Legal Violations That Warrant Denial Of Shell's Application

A. NMFS Must Undertake Sufficient Review Of The Impacts Of Seismic Operations In The Chukchi Under The National Environmental Policy Act.

With respect to the National Environmental Policy Act ("NEPA"), NMFS simply states that it is "currently preparing an Environmental Assessment" and that this "analysis will be completed prior to the issuance or denial of" Shell's application. 75 Fed. Reg. at 27,731. It would appear from these statements that NMFS has decided to entirely cut the public out of the NEPA process, which is in direct contravention of the law. One of the express purposes of NEPA is to ensure that "environmental information is available to public officials and citizens *before decisions are ma*de and before actions are taken . . . [because] public scrutiny [is] essential to implementing NEPA." 40 C.F.R. § 1500.1(b) (emphasis added).

In addition, in light of the impacts discussed above it is clear that Shell's IHA application warrants review in an Environmental Impact Statement ("EIS") given the potential for significant impacts. *See* 40 C.F.R. § 1508.27. In particular, NMFS must give close scrutiny to the potential cumulative impacts of Shell's proposed geophysical work in combination with: 1) geophysical activities in the Russian far east; 2) geophysical activities in the Canadian Beaufort Sea; 3) geophysical activities proposed by the USGS; 4) geophysical activities proposed by Statoil; and 5) all other present and reasonably foreseeable activities that could impact the bowhead whales or other subsistence resources. Thus, a draft EIS must be put out for public comment and the

comments must be analyzed and the EIS finalized before NMFS makes it final decision on Shell's application.

B. Shell Failed To Provide Plans For Community Engagement.

Shell is required to include in its application a "schedule for meeting with affected subsistence communities to discuss proposed activities and to resolve potential conflicts regarding any aspects of either the operation or the plan of cooperation." *See* 50 C.F.R. § 216.104(a)(12)(ii). In its application, Shell only just mentions that it held a few meetings and "anticipates continued engagement." *See* Shell IHA App. at 51. This vague intention to participate in more meetings with the affected communities is insufficient and does not satisfy the regulatory requirement. Shell is also required to provide its plans for continuing to meet with communities. *See* 50 C.F.R. § 216.104(a)(12)(iv). While Shell mentions communicating with communities via its SA and Com and Call Center program, which allows for the availability of back and forth communication, the company has described no actual, planned communication with the affected communities. *See* Shell IHA App. at 52.

C. Suggested Means Of Learning Of, Encouraging, And Coordinating Research Opportunities, Plans, And Activities Relating To Reducing Such Incidental Taking And Evaluating Its Effects.

Shell is required to "suggest means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects." *See* 50 C.F.R. § 216.104(a)(14). Shell only mentions that other research is occurring and that Shell will share its data. *See* Shell IHA Application at 53. This lack of cooperation clearly violates Shell's duties under regulation.

CONCLUSION

Thank you again for the opportunity to comment. It is our hope that due to the lack of compliance with NMFS's regulatory requirements for IHA applications as well as the serious concerns Shell's activities raise for marine mammals that NMFS will deny Shell's application. Please feel free to contact my staff or me if you would like clarification of any of our comments.

Sincerely,

/s/ Jessica Lefevre

Jessica Lefevre
Counsel for AEWC

North Slope Borough

OFFICE OF THE MAYOR

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Edward S. Itta, Mayor

June 17, 2010

Sent Via Email to PR1.0648-XV09@noaa.gov

P. Michael Payne
Permits, Office of Protected Resources
National Marine Fisheries Service
1315 East-West highway
Silver Spring, MD 20910-3225

Re: RIN 0648–XV09, Taking Marine Mammals Incidental to Open Water Marine Survey Programs in the Beaufort and Chukchi Seas, Alaska.

Dear Mr. Payne:

Thank you for the opportunity to comment on the National Marine Fisheries Service's ("NMFS") proposed authorization of incidental take of marine mammals from open water surveying in the Beaufort and Chukchi Seas by Shell Offshore Inc. ("Shell").

The North Slope Borough (NSB or Borough) has the largest territorial and coastal jurisdiction of any municipal government in the United States—an area larger than the State of Minnesota. We have multiple interests at stake in the Arctic Ocean Outer Continental Shelf (OCS).

First and foremost are our interests in the health and welfare of our residents, who are rightfully concerned about potential health impacts associated with offshore oil and gas development on the North Slope. Activities allowed by the proposed authorization pose direct, indirect, and cumulative impacts on species that are critical to our people's subsistence harvest. Although many of our residents are engaged in wage employment, we continue to depend heavily on the subsistence harvest for maintaining our cultural and nutritional needs. Traditional foods are far more nutritious than many types of imported "store-bought" food, and their

continued consumption has repeatedly been shown to be critical to the health of our people.[1] Subsistence activities also provide spiritual and cultural affirmation, and are crucial for passing skills, knowledge and values from one generation to the next, thus ensuring cultural continuity and vibrancy.

Second, we are concerned that NSB communities are being overwhelmed by multiple planning processes, both in terms of lack of time and expertise on community and individual levels and in terms of a seeming inability to meaningfully influence the decisions being made.

As evidenced by the ongoing disaster in the Gulf of Mexico, it is no longer debatable that our people's concerns are founded. The potentially significant impacts of industrial activities and environmental changes offshore—both individually and cumulatively—demand comprehensive environmental analysis and proven mitigation prior to the issuance of additional incidental take authorization.

I. The proposed authorization must be revised to comply with the Marine Mammal Protection Act.

A. Background

The Marine Mammal Protection Act ("MMPA") recognizes the central role of subsistence hunting by specifically exempting the activities of the Inupiat Eskimos and other coastal dwelling Alaska Natives from its general prohibitions against take of marine mammals.[2] Other forms of take and harassment[3] are allowed only under narrow circumstances.

To receive an authorization for an action that may harass marine mammals (an "incidental harassment authorization" or "IHA"), the activity (i) must be "specified" and limited

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[1] The subsistence diet protects against obesity and diabetes, and associated problems such as hypertension and cardiovascular disease. Restricted access to subsistence foods therefore places the community at increased risk for these problems. If subsistence use in the region is reduced, very significant increases in obesity and diabetes in the impacted communities would predictably ensue. *See*

Ebbesson SO, Kennish J et al. Diabetes is Related to Fatty Acid Imbalance in Eskimos. *International Journal of Circumpolar Health.* 58: 108-119. 1999.

Shephard R and Rode A. The Health Consequences of Modernization: Evidence from Circumpolar Peoples. Cambridge University Press. 1996

Curtis T, Kvernmo S et al. Changing Living Conditions, Lifestyle, and Health. *International Journal of Circumpolar Health.* 64(5) 442-450

Jorgensen M, Bjerregaard P et al. Diabetes and impaired glucose tolerance among the Inuit of Greenland. *Diabetes Care.* 26: 1766-1771. 2002.

Ebesson S, Schraer C et al. Diabetes and impaired glucose tolerance in three Alaskan Eskimo Populations. *Diabetes Care.* 21: 563-569. 1998.

Hogan P et al. Economic Costs of Diabetes in the U.S. in 2002. *Diabetes Care.* 2003. 26: 917- 932.

[2] 16 U.S.C. § 1371(b); *see also* 16 U.S.C. 1362 (13): "The term 'take' means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal."

[3] See 16 U.S.C. 1362 (18)(A): "The term 'harassment' means any act of pursuit, torment, or annoyance which—(i) has the potential to injure a marine mammal or marine mammal stock in the wild; or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering."

to a "specified geographical region," (ii) must result in the incidental take of only "small numbers of marine mammals of a species or population stock" and can have no more than a "negligible impact" on species and stocks, and (iii) will not have "an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses."[4] Also, NMFS must provide for the monitoring and reporting of such takings and must prescribe methods and means of causing the "least practicable impact" on the species or stock and its habitat.[5]

MMPA and NMFS regulations require NMFS to provide an opportunity for public comment and review on proposed incidental harassment authorizations ("IHAs").[6] IHAs must indicate "permissible methods for taking by harassment," "means of effecting the least practicable impact on such species," measures to "ensure no unmitigable adverse impact on the availability of the species or stock for taking for subsistence use," requirements pertaining to "monitoring and reporting" and for "independent peer review" of such monitoring and reporting if the taking may affect subsistence use.[7] NMFS's regulations further provide that "[a]ny preliminary finding of 'negligible impact' and 'no unmitigable adverse impact' shall be proposed for public comment along with [] the proposed incidental harassment authorization[.]"[8]

But here, NMFS only allowed for review of Shell's *application* for an IHA—not the IHA actually proposed. The application offered for public review lacked a Plan of Cooperation containing identifying measures to minimize adverse effects on the availability of marine mammals for subsistence uses.[9]

Without a complete draft authorization and accompanying findings, NSB cannot provide meaningful comments on Shell's proposed activities, ways to mitigate the impacts of those activities on marine mammals, and measures that are necessary to protect subsistence uses and sensitive resources. The limited information NMFS has provided does not allow us to determine whether Shell's monitoring and reporting plans were subjected to independent peer review as required by the MMPA. Unless NFMS can demonstrate compliance with the MMPA and its own regulations, it cannot issue an IHA to Shell.

B. The specified activities are inadequately identified.

We are concerned about the lack of specificity regarding the timing and location of the proposed surveys, as well as the lack of specificity regarding the surveys themselves. MMPA allows take authorization only for "specified activities" within a "specified geographic region."[10]

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[4] 16 U.S.C. 1371(5)(A).

[5] 16 U.S.C. § 1371(a)(5)(D); 50 C.F.R. § 216.107.

[6] 50 C.F.R. § 216.104(b)(1)(i) (emphasis added); 16 U.S.C. § 1371(a)(5)(D)(iii).

[7] 16 U.S.C. § 1371(a)(5)(D)(ii).

[8] 50 C.F.R. § 216.104(c).

[9] *See* 50 C.F.R. § 216.104(a)(12).

[10] 16 U.S.C. § 1371(a)(5)(D)(i).

But Shell's application fails to provide any information on location other than stating that activities will take place on its existing leases in Harrison Bay.[11]

We estimate that the total amount of time needed for Shell's activities (including down time for weather contingencies) adds up to 140 days. But the time frame for the proposed plans is only from July to October (about 120 days). Thus, it appears that Shell will not be able to complete all of its proposed activities. Also, it is not clear whether Shell will conduct activities in the Chukchi Sea or the Beaufort Sea first. This information is critical for ensuring that Shell's proposed activities do not conflict with hunting for beluga, walruses, or seals that takes place at set times each year.

C. Shell has not demonstrated that its proposed activities would take only "small numbers of marine mammals of a species or population stock," resulting no more than a "negligible impact" on a species or stock.

The conclusion that Shell's proposed seismic surveying will take only small numbers of marine mammals and will have no more than a negligible impact is not justified by the information provided in the Federal Register notice.

1. The proposed IHA would be issued in the face of many uncertainties regarding the impacts of Shell's activities.

In its comments on the proposed Lease Sale 193 in the Chukchi Sea, NMFS stated that without "current and thorough data which describe the habitat use and function of these waters," and without information on the distribution patterns of marine mammals, the agency would find it challenging to meet its obligations under the MMPA. NMFS explained that, lacking such information, "[I]t will be very difficult to permit and conduct seismic surveys in a manner that has no more than a negligible impact to the stock and minimizes disturbance and harassment to the extent practicable."[12]

NMFS also noted that the "continued lack of basic audiometric data for key marine mammal species" that occur throughout the Chukchi Sea inhibits the "ability to determine the nature and biological significance of exposure to various levels of both continuous and impulsive oil and gas activity sounds."[13]

MMS agreed in its final Environmental Impact Statement (EIS) that much remains unknown. Information is limited on the bowhead fall migration through the Chukchi and the feeding that takes place during that time.[14] Basic data are still needed for other species as well, including gray whales, beluga whales, and harbor porpoises. Yet NMFS is now prepared to issue an IHA despite these unknowns.

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[11] *See* 75 Fed. Reg. at 27709 ("Actual locations of site clearance and shallow hazards surveys within Harrison Bay have not been definitively set as of this date . . .").

[12] NMFS Comments on MMS's Draft EIS for Chukchi Sea Lease Sale 193 (Jan. 30, 2007).

[13] *Id.*

[14] *See* LS 193 EIS at III-51-52.

2. NMFS has not adequately analyzed harassment associated with noise.

MMPA defines harassment to mean any act of pursuit, torment or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering.[15] An activity constitutes harassment if it has even the "potential" to affect marine mammal behavior.

In a previous Environmental Assessment, NMFS made clear the potential for harassment from seismic surveying and the need for mitigation that includes a protective 120-dB exclusion zone:

> NMFS considers the feeding, socializing and migration of bowhead whales during the fall westward migration to be critical to bowhead whale survival. The reason for the 120-dB-related conditions and the requirement for two aerial surveys is that preliminary information from a Canadian seismic survey in 2006 indicates that a tagged bowhead whale migrating westward ceased its migration until the seismic survey ended. This reaction is of concern to NMFS principally because one animal's response to seismic sounds is a likely indicator that a larger population of bowheads could exhibit the same reaction to seismic sound and possibly even drilling noise.[16]

But here, NMFS calculated harassment from Shell's proposed surveying based on the exposure of marine mammals to sounds at or above 160 dB.[17] This uniform approach to harassment does not take into account known reactions of marine mammals in the Arctic to levels of noise far below 160 dB.

In determining the impacts on marine mammals, Shell and NMFS have only considered limited sources of sounds. Shell's application focuses on airgun sounds for its estimates of take. Activities that use equipment other than airguns are mentioned, but then ignored in the assessment of impacts. Nor are ship sounds considered.[18] The Federal Register Notice[19] indicates only that source levels from various vessels "would be empirically measured before the start of the marine surveys," but there is no indication how the impacts of this noise, combined with Shell's actual survey sounds, would be reviewed and considered prior to operations—which are scheduled to occur in the next couple months.

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[15] 16 U.S.C. § 1362(18)(A)(ii).

[16] NMFS, Environmental Assessment for the Shell Offshore, Inc. Incidental Harassment Authorization to Take Marine Mammals Incidental to an Offshore Drilling Program in the U.S. Beaufort Sea Under the Marine Mammal Protection Act, at 9 (October 2007).

[17] *See* 74 Fed. Reg. at 27,712

[18] *See* Application at Section 5.

[19] 75 Fed. Reg. at 27714

Finally, NMFS should also consider global warming-induced changes relating to the oceanic acoustical environment, such as the relationship between acidification and oceanic sound absorption.

3. NMFS has not adequately analyzed the potential for serious injury.

An IHA pursuant to 16 U.S.C. § 1371(a)(5)(D) is only available if the activity has no potential to result in serious injury or mortality to a marine mammal.[20] In promulgating the regulations that govern IHAs in the Arctic, NMFS acknowledged that permanent hearing loss – or permanent threshold shift ("PTS") – qualifies as serious injury:

> Serious injury for marine mammals, such as permanent hearing or eyesight loss, or severe trauma, could lead fairly quickly to the animal's death. NMFS does not believe that Congress intended to allow "incidental harassment" takings to include injuries that are likely to result in mortality, even where such incidental harassment involves only small numbers of marine mammals.[21]

Therefore, "if the acoustic source at its maximum level had the potential to cause a permanent threshold shift in a marine mammal's hearing ability," that activity would be considered "capable of causing serious injury to a marine mammal and would therefore not be appropriate for an incidental harassment authorization."[22]

In this instance, while the airguns proposed by Shell are smaller than those associated with typical 2D / 3D deep marine surveys, the noise they produce is still considerable, as evidenced by the estimated 120 dB radii that extends out to 14,900 meters.[23]

If there is even the possibility of serious injury, NMFS must establish that the "potential for serious injury can be *negated* through mitigation requirements[.]"[24] While monitored exclusion zones have been proposed, they are likely insufficient to negate serious injury. Reports from previous surveys indicate that even where there are monitored exclusion zones, marine mammals routinely stray too close to the airguns.[25]

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[20] 50 C.F.R. § 216.107 ("Except for activities that have the potential to result in serious injury or mortality, which must be authorized under § 216.105, incidental harassment authorizations may be issued[.]").If such injury or mortality is possible, take can only be authorized pursuant to a Letter of Authorization ("LOA") consistent with regulations promulgated pursuant to 16 U.S.C. § 1371(a)(5)(A) and 50 C.F.R. § 216.105. Because NMFS has not promulgated any such regulations related to seismic surveys, and because such surveys and associated activities carry the potential for serious injury or death to marine mammals, neither an IHA nor an LOA can be issued for Shell's proposed activities.

[21] 60 Fed. Reg. 28,379, 28,380 (May 31, 1995).

[22] *Id.* at 28,381.

[23] 75 Fed. Reg. at 27,710.

[24] 60 Fed. Reg. at 28,380 (emphasis added).

[25] *See, e.g.* Marine Mammal Monitoring and Mitigation During Open Water Seismic Exploration by ConocoPhillips Alaska, Inc. in the Chukchi Sea, July-October 2006, at 5-11-5-12 (January 2007) (identifying 50 marine mammals

The requirement for ramp ups rests on the same foundation – that marine mammals will leave an affected area as a result of increasing noise. Yet, as the Joint Subcommittee on Ocean Science and Technology report notes, "there has never been a demonstration that [ramp ups] work[] as intended."[26]

It is notable that the above marine mammal behavior was recorded only because conditions were such that the marine mammals could be observed. Such conditions occur only a fraction of the time that airguns are operating. Observers cannot see animals at the surface when it is dark, and even during the day, visually detecting marine mammals from the deck of a seismic vessel may be inhibited due to glare, fog, rough seas, the small size of animals such as seals, and the large proportion of time that animals spend submerged. Shell has acknowledged that reported sightings are only "minimum" estimates of the number of animals potentially affected by surveying, as compromised visibility and high seas "are often significant limiting factors."[27]

The shortcomings of monitoring were reiterated by the interagency task force:

> [V]isual monitoring under the best of conditions may detect less than 50 percent of most marine mammals and only 1-10 percent of some deep-diving mammals . . . In poor weather and at night those percentages are reduced to effectively zero.[28]

Because NMFS has not negated the possibility of serious injury from Shell's 2010 surveying, it should do so prior to issuance of an IHA.

4. NMFS has not adequately demonstrated that the proposed activities will not have "an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses."

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likely exposed to potentially injurious sound levels); Marine Mammal Monitoring and Mitigation During Open Water Seismic Exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July-September 2006: 90-Day Report, at 6-13 (January 2007) (identifying 24 seals likely exposed to potentially injurious sound levels); Marine Mammal Monitoring During Open Water Seismic Exploration by Shell Offshore in the Chukchi and Beaufort Seas, July –November 2007, at 5-43 (January 2008) (identifying 26 sightings of 50 walrus within the exclusion zone); Marine Mammal Monitoring and Mitigation During Open Water Seismic Exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July –October 2008: 90-Day Report, at 7-14 (January 2009) ("Shell 2008 90-day Report") (identifying 44 powerdowns involving 45 marine mammals).

[26] Joint Subcommittee on Ocean Science & Technology, "Addressing the Effects of Human-Generated Sound on Marine Life: An Integrated Research Plan for U.S. Federal Agencies," at 58 (Jan. 2009) ("JSOST"). Also, in the Lease Sale 193 EIS, MMS – with NMFS as a cooperating agency – acknowledged that measures such as ramp ups are "not empirically proven"; its value instead relies on "anecdotal evidence" and "professional reasoning." LS 193 EIS at II-25. The EIS does not expressly consider the industry survey results.

[27] Shell 2008 90-Day Report at 5-17.

[28] Joint Subcommittee on Ocean Science & Technology, "Addressing the Effects of Human-Generated Sound on Marine Life: An Integrated Research Plan for U.S. Federal Agencies," at 58 (Jan. 2009) ("JSOST").

NMFS acknowledges that "Shell's proposed open water marine surveys have the potential to impact marine mammals hunted by Native Alaskans."[29] As such, NMFS must ensure that the surveys will not have "an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses" by Alaska Natives.[30]

As discussed above, Shell's application is far too amorphous for NMFS to be able to actually determine the impacts to subsistence uses—let alone whether they can be mitigated. This falls short of the requirement that mitigation measures be "successfully implemented."[31] We have no way of assuring that measures will be successfully implemented if they are not even revealed to the public. One of the primary proposed mitigation tools, the Plan of Cooperation (POC), has yet to even be established.

NMFS also requires IHAs to provide for adequate monitoring of takes, and to ensure that all methods and means of ensuring the least practicable impact have been adopted.[32] Again, lack of details regarding the activities and their impacts impedes our analysis of whether monitoring and mitigation are appropriate.

While it is unclear what aerial survey will be conducted in the Chukchi Sea during the described activities, it is apparent that the aerial survey approach needs to be modified in order to adequately survey calves. Shell will need to break off transect to take a careful look for calves. This change in methods is especially important since cow calves are part of the mitigation measures.

NMFS should not issue an IHA for the proposed activities until adequate monitoring and mitigation techniques for avoiding adverse impacts to the marine mammals and subsistence hunting are developed.

II. NMFS Should Review the Cumulative Impacts of Shell's Activities in Combination with All Other Past, Present and Reasonably Foreseeable Future Activities.

In the Federal Register Notice, NMFS states that it is "currently preparing and Environmental Assessment" to determine whether Shell's activities may have a significant impact on the environment.[33] Pursuant to the National Environmental Policy Act[34] and its accompanying regulations,[35] NMFS will need to adequately consider the cumulative impacts of

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[29] FR Notice at 27729.

[30] 16 U.S.C. § 1371(a)(5)(D)(i)(II).

[31] *See* 50 C.F.R. § 104(c) (emphasis added).

[32] 16 U.S.C. § 1371(a)(5)(D)(ii)(I).

[33] 75 Fed. Reg. at 27731.

[34] *See* 42 U.S.C. 4321-4347.

[35] For specific regulatory guidance on making a significance determination, *see* 40 C.F.R. § 1508.27.

Shell's proposed activities combined with all other past, present and reasonably foreseeable future activities.[36]

Specifically, NMFS should ascertain the significance of multiple exposures to underwater noise, ocean discharge, air pollution, and vessel traffic—all of which could impact bowhead whales and decrease survival rates or reproductive success. NMFS should consider how many bowhead whales would be exposed to underwater noise, where those exposures could take place, what impact the noise could have on bowhead whale behavior, and the biological significance of these impacts. NMFS should also consider the cumulative impact of discharge and whether bioaccumulation of contaminants could have lethal or sub-lethal effects on bowhead whales and other marine mammals. NMFS should then synthesize that information into a health impact assessment looking at the overall combined effect to the health of the Inupiat people.

Reasonably foreseeable activities for the 2010 open water season include the following:

1) GX Technology's Beaufort Sea seismic surveys.
2) Statoil's Chukchi Sea seismic surveys.
3) Seismic surveys planned in the Canadian Arctic.
4) U.S. Geological Survey's seismic surveys.
5) BP's production operations at Northstar.
6) Dalmorneftegeophysica (DMNG) Russian Far East Offshore Seismic surveys.

NMFS is currently in the process of preparing an EIS, in partnership with MMS, to assess the potentially significant impacts of oil and gas exploration activities in the Arctic. In choosing this course, NMFS has recognized that these activities can have significant impacts on marine mammals and that a longer term, more comprehensive review needs to be taken of these activities. It would be regretful for Shell to proceed on a one-year IHA when the impact of those activities could have a catastrophic impact on Arctic resources and foreclose management options to be developed in the forthcoming EIS. As a policy matter, NMFS should allow exploration-related activities to proceed only after it has the opportunity to develop a robust long-term plan for balancing the needs of industry with Congress's mandate in the Marine Mammal Protection Act to prioritize the protection of our subsistence resources.

III. NMFS Should Consider and Address Disproportionate Impacts in Analyzing the IHA Application.

Federal agencies must "make achieving environmental justice part of ... [their] mission[s]."[37] Compared to many United States residents, our residents face significant impacts from oil and gas activities in the OCS. NMFS should thus specifically address issues of

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[36] 40 C.F.R. § 1508.7. NSB requests that in conducting any review of reasonably foreseeable exploration drilling that NMFS review NSB's comments and attachments, specifically the Declaration of NSB biologist Robert Suydam, PhD, relating to Shell's now withdrawn Camden Bay Exploration Drilling IHA application (delayed until 2011 at the soonest).

[37] Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations."

environmental justice in considering this application. NMFS must also work to ensure effective public participation and access to information, and must "ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public."

In conclusion, based on our review of NMFS' current proposed authorization of incidental take of marine mammals from its contemplated surveying in the Beaufort and Chukchi Seas during 2010 by Shell, we do not yet see a demonstration of compliance with the MMPA and thus do not support issuance of an IHA at this time.

Thank you for your consideration of these comments.

Sincerely,

Acting Mayor

Edward S. Itta
Mayor

cc:

Bessie O'Rourke, NSB Attorney
Dan Forster, Director, NSB Department of Planning and Community Services
Taqulik Hepa, Director, NSB Department of Wildlife Management
Andy Mack, NSB Mayor's Office
Karla Kolash, NSB Mayor's Office

IÑUPIAT COMMUNITY of the ARCTIC SLOPE

an IRA Regional Tribal Government

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June 17, 2010

Via Electronic Mail to PR1.0648-XV09@noaa.gov

Michael Payne
Chief, Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West highway
Silver Spring, MD 20910-3225

Re: Take of Marine Mammals During Open-water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska between July and October 2010. 75 Fed. Reg. 27,708 (May 18, 2010).

Dear Mr. Payne:

The Inupiat Community of the Arctic Slope (ICAS) writes in support of the comments submitted by the Alaska Eskimo Whaling Commission (AEWC) regarding the application submitted by Shell Offshore Inc. (Shell) for an Incidental Harassment Authorization (IHA) for an open-water marine survey program in the Beaufort and Chukchi Seas this summer. See 75 Fed. Reg. 27,708 (May 18, 2010). Thank you for the opportunity to provide input on Shell's application.

As you know, ICAS is a regional tribal government for eight villages on the North Slope that depend upon marine mammals that live and migrate through the Chukchi and Beaufort Seas. ICAS has a long history of opposition to offshore oil and gas activities in the Arctic because of the well-documented threats to our subsistence activities and the resources that have sustained us since time immemorial. In light of the current events in the Gulf of Mexico and President Obama's decision to suspend Shell's exploratory drilling program in the Arctic, NMFS and the Administration should not be allowing Shell to move forward with additional seismic work until we know whether, and how, Shell will be allowed to move forward with an exploratory drilling program. As we have stated many times in the past, seismic activities carry with them a serious risk of harming the marine mammals that we depend on for our subsistence way of life. Until such time as the Administration completes its review of Shell's drilling program and provides that information to the public, it is inappropriate to allow Shell to continually put our subsistence resources at risk of greater harm.

We also make this recommendation in light of NMFS and the Minerals Management Service's (MMS) decision to undertake a comprehensive environmental review of the site-specific impacts of oil and gas activities in the Beaufort and Chukchi Seas to determine how many, if any, such activities can be authorized during a given open water season. As discussed below, allowing Shell's seismic activities to proceed this summer is irresponsible given the known threats posed by such activities and the fact that NMFS is in the process of developing a more comprehensive approach to regulation. NMFS would be authorizing activities under the MMPA before it has given full consideration to the cumulative impacts to marine life. The cart should not be put before the horse in this manner, especially when the unstudied and un-quantified impacts to marine life threaten the ability of North Slope residents to sustain themselves.

In addition to the concerns raised by AEWC, we also question NMFS's ability to determine that Shell's proposed activities "will not have an unmitigable adverse impact on the availability" of the species or stock "for subsistence uses," 16 U.S.C. § 1371(a)(5)(D), in light of the other activities that will occur this summer and impact marine life. These activities include

- 4D surveys in Russian waters where we are learning from telemetry data that many bowhead whales migrate to in the fall;
- 2D and 3D surveys in the Canadian Beaufort sea where many bowhead whales can be found during the summer;[1]
- The State Department (along with other U.S. agencies including NMFS/NOAA and MMS) and the Canadian government's seismic surveying to determine the extent of the Arctic continental shelf;
- Statoil's planned seismic suveys.

We ask that NMFS explain how it can conclude that Shell's exploration activities "will not have an unmitigable adverse impact on the availability" of the species or stock "for subsistence uses," 16 U.S.C. § 1371(a)(5)(D), when the impacts of all these activities are added together. Our communities have experienced the dire consequences to marine life from Shell's seismic operations alone. The community at Point Hope noted that for the last two years Tom cod disappeared from the waters around their village. While the fish have returned this year, they are too small to feed their community. Community members saw beached fish after seismic operations occurred and heard reports of regions in the sea where krill had all died. The fish and krill support marine mammals and all of this marine life sustains our people. We recommend against approving all of these activities for one summer especially since earlier seismic surveys alone impacted our communities and their ability to feed themselves.

Additionally, ICAS points out that Native communities in Alaska have long been ignored in the race to find and develop offshore oil and gas resources. Despite a multitude of local

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[1] ICAS has documented at least twenty-five applications for seismic in these areas during an eleven year period.

knowledge of marine species gained from both subsistence users (such as whaling crews) and local scientists and wildlife departments, the U.S. government has consistently failed to comply with legal requirements that require consultation with local Native communities *as* proposals are being developed that affect native environments. Instead, both federal agencies and the entities they permit make only token gestures at consultations with Native groups offering them only the opportunity for involvement *after* proposals are developed and *after* local knowledge would serve a useful purpose.

It is the policy of the United States that "[w]hen undertaking to formulate and implement policies that have tribal implications, agencies shall . . . consult with tribal officials as to the need for Federal standards and any alternatives that would limit the scope of Federal standards or otherwise preserve the prerogatives and authority of Indian tribes." Executive Order 13175 § 3(c)(3). Despite this explicit government-to-government consultation requirement, NMFS has failed to consult with governing bodies of Native people who will be and have been affected by the decisions NMFS is making under the MMPA. NMFS must explain why it has neglected to sit down with Native governing bodies when making decisions that directly impact the ability of communities to sustain themselves. NMFS must meet with ICAS and local Native villages on a government-to-government basis to discuss IHA applications as well as appropriate mitigation and monitoring requirements well before notice is provided of the applications so we can play a role in developing the agency's proposal.

ICAS incorporates by reference the comments submitted by the Alaska Eskimo Whaling Commission (AEWC) with respect to the rest of the issues raised by Shell's IHA application and NMFS's preliminary findings. Thank for your consideration of these comments. Please contact me if you have any questions or are willing to meet with ICAS on a government-to-government basis.

Sincerely,

George Edwardson

George Edwardson

ALASKA WILDERNESS LEAGUE – AUDUBON ALASKA
CENTER FOR BIOLOGICAL DIVERSITY – DEFENDERS OF WILDLIFE
EARTHJUSTICE – GREENPEACE – NATURAL RESOURCES DEFENSE COUNCIL
NORTHERN ALASKA ENVIRONMENTAL CENTER – OCEAN CONSERVANCY
OCEANA – PACIFIC ENVIRONMENT – SIERRA CLUB
WORLD WILDLIFE FUND

June 17, 2010

VIA E-MAIL

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Re: Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Open Water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska 75 Fed. Reg. 27,708 (May 18, 2010)

Dear Mr. Payne:

The undersigned groups submit the following comments on the National Marine Fisheries Service's (NMFS) May 18, 2010, proposed incidental harassment authorization (IHA) issued pursuant to the Marine Mammal Protection Act (MMPA). NMFS has proposed allowing the incidental take of eight marine mammal species resulting from Shell Offshore Inc.'s marine surveying activities in the Chukchi and Beaufort seas that are scheduled to begin in July 2010. 75 Fed. Reg. 27,708 (May 18, 2010). NMFS should deny Shell's application.

The ongoing tragedy in the Gulf has brought to light the many problems with regard to effective planning, regulation, and oversight for offshore oil and gas activities. As Congress and the Obama administration evaluate the failures that led to the blowout and put in place the necessary science and safeguards, we should take the opportunity to address all decisions about offshore activities – not just drilling, but seismic activities and other surveys. We have the opportunity to do this right, and there is no reason to rush ahead to approve proposals like the ones under consideration here.

As an initial matter, in light of its recognition that a programmatic Environmental Impact Statement (EIS) is needed for oil and gas activities in the Arctic and its current steps to develop a draft, NMFS should not authorize the marine mammal harassment incident to Shell's surveying. The National Environmental Policy Act (NEPA) prohibits piecemeal approvals while a programmatic EIS process is ongoing, except under strictly prescribed circumstances not found

here. If it were to allow these activities, NMFS risks undermining the overarching review contained in the EIS that will establish appropriate standards for future oil and gas activities. Moreover, incorporating all seismic activities into that process will reinforce NMFS's commitment to create a five-year Arctic Action Plan that will include efforts to improve the management of ocean and coastal resources.

In addition, the impacts of the proposed surveying on bowhead, beluga, and gray whales, along with harbor porpoises and the concomitant effects on Alaska Native communities exceed the protective standards imposed by the MMPA. The proposed IHA ignores the best available science by setting a generic 160-dB harassment threshold for all species and excluding entirely the potential effects of three surveys, two ice gouge surveys and one strudel scour survey. The decision to ignore the full scope of Shell's activities is compounded by the failure to consider how the effects of Shell's surveying will combine with other surveys planned in the Arctic this year. The proposed IHA also does not reduce impacts to the "least practicable" as NMFS has not evaluated limitations that would avoid disturbing the peak of the bowhead migration.

Finally, should it choose to allow Shell to proceed, NMFS must first address the full scope of Shell's activities pursuant to the Endangered Species Act (ESA) while using an appropriate baseline for future activities. As part of its ESA obligations, NMFS previously issued successive regional, programmatic biological opinions examining the effects of exploration activities on endangered whales in the Arctic. The broad scope of those opinions – considering activities through actual production – is equally applicable to the seismic activity at issue this year. The opportunity for future exploration and production is the only reason that Shell is conducting its surveys, and indeed, drilling may not proceed without the information to be gathered by the shallow hazard surveying. If Shell's surveys are to take place this summer, the ESA requires that NMFS update its existing analysis, evaluating exploration and production, in light of the best information currently available.

I. NATIONAL ENVIRONMENTAL POLICY ACT

NMFS and the Minerals Management Service (MMS) have acknowledged the potential for significant, longer-term impacts to marine mammals resulting from expanded oil and gas activity. The agencies first addressed this problem in the context of a projected increase in seismic activity and now must address the potential increase in exploratory drilling. As a result, the cumulative, long-term effects of increased noise and other impacts from oil and gas activity must be properly addressed before further activity is authorized. A number of the undersigned groups raised this issue to NMFS previously, including in a letter dated February 12, 2010. We repeat the main points here.

Although NMFS and MMS have begun a comprehensive analysis of oil and gas activities in the Arctic, they have not yet finished the job. In 2006, the agencies published a notice of intent to prepare a programmatic EIS in order to assess the entire program of seismic survey permitting throughout the Beaufort and Chukchi Seas. 71 Fed. Reg. 66,912 (Nov. 17, 2006). According to the notice, the agencies determined that a programmatic EIS was necessary because of an anticipated increase in permitting and the determination that impacts needed to be analyzed over "a longer time frame" than had been addressed in previous single season assessments. *Id.* at 66,913. In spring 2007, the agencies issued a draft programmatic EIS that reinforced their earlier

conclusions. NMFS and MMS continued to recognize that seismic surveys have "potential significant impacts on marine mammals, other Arctic marine life, and native subsistence lifestyles" due to the "reasonably foreseeable proposed offshore oil and gas seismic surveys off Alaska." 72 Fed. Reg. 17,117, 17,117 (Apr. 6, 2007).

The agencies did not complete the programmatic EIS. In October 2009, NMFS published a notice along with MMS, announcing that new information had become available since the DPEIS was published – in particular, "renewed interest in exploratory drilling in both the Chukchi and Beaufort Seas " – and that therefore the agencies were "withdrawing the 2007 DPEIS" and initiating a new process that will consider and incorporate this new information. 74 Fed. Reg. 55,539, 55,539 (Oct. 28, 2009). On February 8, 2010, NMFS published a second notice announcing its intent to prepare an EIS "to analyze the environmental impacts of issuing Incidental Take Authorizations (ITAs) . . . to the oil and gas industry for the taking of marine mammals incidental to offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas off Alaska" and opening the official scoping period for this EIS. 75 Fed. Reg. 6,175, 6,175 (Feb. 8, 2010). According to the notice:

> For the purposes of complying with NEPA and to achieve greater administrative efficiency in its ITA program, NMFS has determined the need to prepare an EIS that will analyze a range of oil and gas exploratory actions and that will satisfy the requirements of the [CEQ]'s NEPA regulations and the NOAA NEPA administrative order 216-6. The proposed EIS would cover known and reasonably foreseeable projects requiring ITAs in the U.S. Arctic regions for future years, until such time that a revision of the document is necessary.

Id. at 6,176. The factors that contributed to NMFS's decision that a programmatic EIS is needed include the receipt of applications for exploratory drilling, as well as anticipated future applications, that were not analyzed in the withdrawn DPEIS, and the need to analyze a longer timeframe "in order to most effectively and fully evaluate the potential for cumulative impacts." *Id.*

In short, the agencies have reaffirmed their previous determination that a programmatic EIS process is necessary to address the overall, cumulative impacts of increased oil and gas activity in the Arctic Ocean and intend to incorporate into that analysis new scientific information as well as new information about projected seismic and exploratory drilling activity in both seas.

This approach is consistent with the mandate of NEPA. NEPA "emphasizes the importance of coherent and comprehensive up-front environmental analysis to ensure informed decision making" so that "'the agency will not act on incomplete information, only to regret its decision after it is too late to correct.'" *Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1216 (9th Cir. 1998) (quoting *Marsh v. Oregon Natural Res. Council*, 490 U.S. 360, 371 (1989)). Conducting an upfront, "coherent and comprehensive" analysis of the environmental impacts of expanded seismic *and* drilling activities – now that proposals for

drilling are increasing as well – in the Alaskan Arctic Ocean will enable the agencies to make informed decisions and provide adequate protection for the affected resources.

NEPA regulations make clear that NMFS should not proceed with authorizations for individual projects like Shell's surveying until its programmatic EIS is complete. Specifically, agencies are explicitly prohibited from undertaking any major action covered by a programmatic EIS that is underway:

> While work on a required program environmental impact statement is in progress and the action is not covered by an existing program statement, agencies shall not undertake in the interim any major Federal action covered by the program which may significantly affect the quality of the human environment . . .

40 C.F.R. § 1506.1(c).[1] NMFS and MMS have made it clear that the programmatic EIS is necessary for an adequate evaluation of the environmental impacts of approving currently proposed and reasonably foreseeable oil and gas exploration activity in the Beaufort and Chukchi Seas. Work on that EIS, moreover, has been in progress since 2006. The primary effect of the recent notices withdrawing the 2007 draft and initiating a new EIS process is to expand the scope of that process to reflect the "renewed interest in exploratory drilling" along with other relevant new information. 74 Fed. Reg. at 55,539. In light of this ongoing programmatic EIS process, it would be unlawful for NMFS to authorize marine mammal harassment associated with new seismic activity. Only by evaluating the cumulative, long-term impacts of noise associated with expanding levels of seismic exploration and exploratory drilling can the full and potentially synergistic effects of the various individual projects be understood and adequately protective mitigation measures put in place.

The programmatic EIS should complement NMFS's commitment to create a five-year Arctic Action Plan that will include efforts to improve management of ocean and coastal resources. 75 Fed. Reg. 25,843 (May 10, 2010). We encourage NMFS to take the opportunity to thoroughly review both the industrial activities and the marine resources of the Arctic. Ultimately, the Action Plan and the EIS should ensure that widely acknowledged information gaps relating to the Arctic are filled and that all decisions are made in the context of a comprehensive plan for the region. Given these important plans, it is premature to issue IHAs that commit to a path of increasing exploitation of the Arctic.

[1] The regulation requires any activity covered by the program to meet a stringent three-part test in order to qualify for an exception to the general rule. It must be: justified independently of the program; accompanied by an adequate environmental impact statement; and not prejudicial to the ultimate decision on the program. 40 C.F.R. § 1506.1(c). The proposed seismic surveying does not meet all of the requirements. Shell's plans are inseparable from the issues to be addressed in the programmatic EIS and must be considered in the larger context to avoid compromising future options for protecting vulnerable resources in the Arctic.

II. MARINE MAMMAL PROTECTION ACT

NMFS's proposed authorization to Shell does not comply with the requirements of the MMPA. Congress enacted the MMPA in 1972 in response to widespread concern that "certain species and population stocks of marine mammals are, or may be, in danger of extinction or depletion as a result of man's activities[.]" 16 U.S.C. § 1361(1). The legislative history states that the purpose of the MMPA is to manage marine mammals "for their benefit and not for the benefit of commercial exploitation." H. Rep. No. 92-707 (1972), *reprinted in* 1972 U.S.C.C.A.N., pp. 4144, 4154. The primary mechanism by which the MMPA protects marine mammals is through the implementation of a "moratorium on the taking" of marine mammals. 16 U.S.C. § 1371(a). Under the MMPA, the term "take" is broadly defined to mean "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." *Id*. § 1362(13). "Harassment" is further defined to include acts of "torment" or "annoyance" that have the "potential" to injure a marine mammal or marine mammal stock in the wild or have the potential to "disturb" them "by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." *Id*. § 1362(18); *see also* 50 C.F.R. § 216.3 (defining "Level A" and "Level B" harassment).

The MMPA provides several narrow exceptions to the moratorium on take. Relevant here, NMFS may, upon request, authorize take in the form of harassment by an IHA for a period of not more than one year, provided certain conditions are met. An activity: (i) must be "specified" and limited to a "specific geographical region," (ii) must result in the incidental take of only "small numbers of marine mammals of a species or population stock," (iii) can have no more than a "negligible impact" on species and stocks, and (iv) cannot have "an unmitigatable adverse impact on the availability of such species or stock for taking for subsistence uses" by Alaska Natives. 16 U.S.C. § 1371(a)(5)(D). In issuing an authorization, NMFS must provide for the monitoring and reporting of such takings and must prescribe methods and means of effecting the "least practicable impact" on the species or stock and its habitat. *Id*. Finally, an activity in the Arctic cannot have the "potential to result in serious injury or mortality[.]" 50 C.F.R. § 216.107. As discussed below, NMFS has not demonstrated that the proposed IHA will meet the standards imposed by the MMPA and its governing regulations.

A. The 160-db harassment threshold is arbitrary

The MMPA prohibits NMFS from authorizing the take of more than "small numbers" of marine mammals. 16 U.S.C. § 1371(a)(5)(D)(i). Critically, the MMPA definition of harassment is focused on "potential harassment," which supports the conclusion that all of the animals in a population are harassed "if there is the *potential* for the act to disrupt the behavioral patterns of the most sensitive individual in the group." *Natural Res. Def. Council v. Evans*, 279 F. Supp. 2d 1129, 1157 (N.D. Cal. 2003) (emphasis added; in dicta); *see also* 16 U.S.C. § 1362(18)(A)(ii) (defining harassment to include any act of pursuit, torment, or annoyance that "has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns"). Recent amendments to the MMPA emphasize this point because they require a more specific showing of disturbance – beyond "potential" – for only two specified categories of activities. *See* 16 U.S.C. § 1362(18)(B)(ii) (defining harassment for a military readiness activity or scientific research activity as one that "disturbs or is likely to disturb"

marine mammals to a point that natural behavioral patterns are "abandoned or significantly altered").

NMFS underestimated the number of animals that will be harassed because it calculated harassment from Shell's proposed surveying based on the exposure of marine mammals to sounds at or above 160 dB. *See* 75 Fed. Reg. at 27,712. This uniform approach to harassment, however, does not take into account known reactions of marine mammals in the Arctic to levels of noise well below 160 dB and avoids the MMPA injunction to consider even the "potential" for harassment.

Harbor porpoises have been shown to be particularly responsive to sound. For harbor porpoises, behavioral changes, including exclusion from an area, can occur at received levels from 90-110 dB or lower. Porpoises avoid pingers with source levels of about 130 dB at distances of from 100-1000 meters (with received levels around 70-90 dB), depending on experience with the noise source and environmental context. *See* David Bain, *A Model Linking Energetic Effects of Whale Watching to in Killer Whale (Orcinus orca) Population Dynamics* (2002) (contract report, on file with Orca Relief Citizens' Alliance); Barlow, J. and G. A. Cameron, *Field Experiments Show That Acoustic Piingers Reduce Marine Mammal Bycatch in the California Drift Gillnet Fishery,* Paper IWC SC/S1/SM2 (1999); Cameron, G., *Report on the Effect of Acoustic Warning Devices (Pingers) on Cetacean and Pinniped Bycatch in the California Drift Gillnet Fishery,* NMFS Contract Report No. 40JGNF900207 (1999); Cox, T. M., A. J. Read, A. Solow and N. J. C. Tregenza, *Will Harbour Porpoises (Phocoena phocoena) Habituate to Pingers?* JOURNAL OF CETACEAN RESEARCH AND MANAGEMENT 3(1): 81-86 (2001); Gearin, P. J., M. E. Gosho, L. Cooke, R. Delong, J. Laake and D. Greene, *Acoustic Alarm Experiment in the 1995 Northern Washington Marine Setnet Fishery,* NMML AND MAKAH TRIBAL FISHERIES MANAGEMENT DIVISION (1996); Kraus, S. D., A. J. Read, A Solow, K. Baldwin, T. Spradlin, E. Anderson & J. Williamson, *Acoustic Alarms Reduce Porpoise Mortality,* 388 Nature 525 (1997); Laake, J. L., P. J. Gearin, M. E. Gosho and R. L. DeLong, *Evaluation of Effectiveness of Pingers to Reduce Incidental Entanglement of Harbor Porpoise in a Set Gillnet Fishery*, *in* MMPA AND ESA IMPLEMENTATION PROGRAM, 1996 (P. S. Hill and D. P. DeMaster, eds.), AFSC Processed Report 97-10, 75-81 (1997); Laake, J., D. Rugh and L. Baraff, *Observations of Harbor Porpoise in the Vicinity of Acoustic Alarms on a Set Gill Net,* NOAA Tech. Memo. NMFS-AFSC-84 (1998); Laake, J. L., P. J. Gearin and R. L. DeLong,

Further Evaluation of Harbor Porpoise Habituation to Pingers in a Set Gillnet Fishery, AFSC Processed Rep. 99-08 (1999).[2]

Similarly, as NMFS is aware, multiple studies confirm the sensitivity of beluga whales. Belugas are known to alter their migration paths in response to ice breaker noise at received levels as low as 80 dB. *See, e.g.*, 75 Fed. Reg. 25,730, 25,737 (May 7, 2010). Belugas have shown avoidance of icebreakers at distances of 35-50 kilometers, with some fleeing at distances of up to 80 kilometers. *Id*. Elsewhere, NMFS has taken notice of data suggesting that some belugas "might be avoiding the seismic operations" at distances of 10–20 kilometers. 74 Fed. Reg. 26,217, 26,226 (June 1, 2009). *See also* Sounding the Depths at 38 (noting that belugas in the Arctic have responded "dramatically" to ships and icebreakers).

In the past, NMFS has found the potential for behavioral disturbance to endangered bowhead whales based on exposures to sound levels significantly lower than 160-dB, referencing studies that found migrating bowheads avoided seismic activities at distances of 20-30 kilometers. 74 Fed. Reg. at 26,226. In the Environmental Assessment prepared to evaluate the impacts of noise from Shell's previous plans for offshore drilling, NMFS took note that

> preliminary information from a Canadian seismic survey in 2006 indicates that a tagged bowhead whale migrating westward ceased its migration until the seismic survey ended. This reaction is of concern to NMFS principally because one animal's response to seismic sounds is a likely indicator that a larger population of bowheads could exhibit the same response to seismic sound and possibly even drilling noise.

NMFS, Environmental Assessment for the Shell Offshore, Inc. Incidental Harassment Authorization to Take Marine Mammals Incidental to Conducting an Offshore Drilling Project in the U.S. Beaufort Sea Under the Marine Mammal Protection Act, at 9 (October 2007). This protective approach is entirely consistent with the need to consider the potential for an activity to disrupt the behavioral patterns of the most sensitive individual in the group. *See Natural Res. Def. Council*, 279 F. Supp. 2d at 1157.

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[2] Indeed, studies have found behavioral responses from harbor porpoise at even lower levels. Kastelein, R. A., D. de Hahn, A. D. Goodson, C. Staal and N. Vaughan, *The Effects of Various Sounds on a Harbour Porpoise (Phocoena phocoena), in* THE BIOLOGY OF THE HARBOUR PORPOISE (1997); Kastelein, R. A., D. de Hahn, N. Vaughan, C. Staal and NM Schooneman, *The Influence of Three Acoustic Alarms on the Behaviour of Harbour Porpoises (Phocoena phocoena) in a Floating Pen*., 52 MAR. ENVIRO. RES. 351-371 (2001). *See also* Natural Resources Defense Council, *Sounding the Depths II: The Rising Toll of Sonar, Shipping, and Industrial Ocean Noise on Marine Life*, at 5-6 & 30 (Nov. 2005) ("Sounding the Depths") (noting that harbor porpoises are "notoriously sensitive" to sound and will flee tens of miles to escape, endangering themselves in the process), available at http://www.nrdc.org/wildlife/marine/sound/contents.asp.

Moreover, recent research on cetaceans' reactions to noise in the marine environment indicates that most species are much more sensitive than previously understood. Dr. David Bain, a biologist who specializes in the behavioral ecology of marine mammals and has focused a substantial portion of his work on audition, sound production, and other aspects of the acoustic ecology, has reviewed the proposed IHA and provided a statement, attached as Exhibit 1. Based on the new data, Dr. Bain recommends a threshold for harassment of bowhead and beluga whales as well as harbor porpoise significantly lower than 120-dB. Ex. 1 at 2-5. If NMFS applies this more appropriate threshold, it will find that many more whales are likely to be harassed by Shell's proposed surveying. *See id*. at 4 (noting over 1,500 bowhead whales potentially affected). A draft version of the recent study – currently submitted for publication – is attached as Exhibit 3.

B. The effects of ice gouge and strudel scour surveying should be considered

NMFS's proposed IHA underestimates the number of marine mammals to be taken and the impact on the affected species by failing to include animals exposed to ice gouge and strudel scour surveying. NMFS excludes these sources on the grounds that much of the noise associated with the strudel scour and ice gouge surveys will occur at frequencies beyond the range of marine mammal hearing. Although the dual-frequency sub-bottom profiler for the ice gouge surveying does produce sounds within that range, NMFS dismisses any effects based on what it considers to be the low source levels. *See* 75 Fed. Reg. at 27,711. Consequently, the notice finds that neither the strudel scour nor ice gouge surveys would result in the take of any marine mammals.

The Federal Register notice's dismissal of potential effects based on marine mammal hearing is not adequately supported. First, NMFS's approach fails to take into consideration the fact that juvenile whales, based on their smaller size, likely hear sounds of higher frequencies than adults of the same species. *See* Ex. 1 at 1. Accordingly, even if NMFS is correct that most whales will not be disturbed by the noise of these activities, it should have considered whether young animals will be disturbed. Second, sound sources contain frequencies beyond the "nominal" frequency in the form of undertones, overtones, distortion, or noise. *See id*. at 1-2. Third, NMFS failed to consider the beat frequency. *Id*. at 2. When a source simultaneously emits sound of more than one frequency, it will also emit energy at the difference between the two frequencies. *Id.* Fourth, NMFS fails to take into account the fact that information about the hearing abilities of bowhead whales is based on estimates since bowheads have not been the subject of direct testing and there is inherent uncertainty in these estimates. *Id.* Finally, the notice does not address the fact that toothed whales have are sensitive to high-frequency sounds, including those over 100 kHz. MMS, Final EIS Chukchi Sea Planning Area, Oil and Gas Lease Sale 193 and Seismic Surveying Activities in the Chukchi Sea, at IV- 149 (OCS EIS/EA 2007-026).

As to the claim that the ice gouge sub-bottom profiler does not produce sufficient noise, NMFS does not give sufficient consideration to effects at lower noise thresholds. *See* 75 Fed. Reg. at 27,722 (noting that the dual-frequency sub-bottom profiler 120-dB range extends to 456 meters). The issue of appropriate thresholds is discussed in more detail, *supra*.

The peer review panel created for this years Open Water meeting similarly took issue with NMFS's decision, concluding that Shell's activities "will create a complex sound field with potential effects beyond those that the applicant proposes to monitor." Expert Panel Review of Monitoring and Mitigation Protocols in Applications for Incidental Take Authorizations Related to Oil and Gas Exploration, Including Seismic Surveys, in the Chukchi and Beaufort Seas (Panel Review), at 19 (March 2010). In sum, NMFS has not justified its decision to remove entirely three of Shell's surveys from the ambit of the MMPA.

C. The effects of other activities in the Arctic should be considered

NMFS cannot ensure that permitted activities will have no more than negligible impacts on the stock of bowhead whales without looking at all of the oil activities scheduled to take place this summer in the Arctic Ocean, including an extensive seismic survey planned for the Chukchi Sea Lease Sale 193 this summer, and exploration activities in the Canadian Beaufort as well. As a result of its failure to look beyond Shell's proposed activities, NMFS understates the potential effect on bowhead whales. The Western Arctic population of bowhead whales relies on habitat in both the Chukchi and the Beaufort seas and is particularly susceptible to disturbance from industrial activity.

1. Other surveys in the Arctic

NMFS must consider the cumulative impacts of Statoil's seismic surveying in the Chukchi. The Statoil proposal includes both 3D and 2D surveying for 60 days in the Chukchi sometime between July and November 2010. 75 Fed. Reg. 32,379 (June 8, 2010). The 3D survey will consist of two towed airgun array consisting of 26 active airguns with a maximum discharge volume of 3,000 cubic inches and will take place in a 915 square mile survey area. *Id*. Statoil will follow this up with additional 2D survey work. Statoil and NMFS estimate that the surveying will harass 158 bowhead whales, 184 beluga whales, and 144 gray whales, among others. *Id*. at 32,395. As in this case, however, those numbers likely represent an underestimate of potentially affected animals. In addition, NMFS should consider seismic surveys that will take place in whale habitat outside of US waters. Four seismic surveys are planned in the Canadian Beaufort, which provides important summer feeding habitat for the bowhead whale.[3]

NMFS cannot accurately assess the potential for harm from Shell's proposed marine mammal harassment without considering effects in the context of the other activities occurring in the Arctic. *See* Ex. 1 at 5-7. Without taking this into account, NMFS's estimates of take are inaccurate. According to NMFS's Alaska Stock Assessment Report, the "accumulation of impacts from vessels, seismic exploration, and drilling are of concern across the North Slope of Alaska," R. P Angliss and B. M. Allen, *Alaska Marine Mammal Stock Assessments*, 2008, U.S. Dep. Commerce., NOAA Tech. Memo, NMFS AFSC-193, at 198 (2009). The National Research Council (NRC) has advised agencies to assess cumulative effects to the population from multiple

[3] Canadian Environmental Assessment Registry, Geographic View Northwest Territories Search Results, available at http://www.ceaa.gc.ca/050/output-eng.cfm?nav=3&evaluations=54749,54752,55407,55408

effects to multiple individuals:

> At the individual level, the biological significance of an effect must be judged by changes in the ability of an animal to grow, survive, and reproduce. The population effect involves the cumulative impact on all individuals affected. … Population consequences of behavioral change result from the accumulation of responses of individuals.

NRC, Marine Mammal Populations and Ocean Noise, Determining When Noise Causes Biologically Significant Effects, at 19-20 (2005). The Open Water peer review panel agreed that there is a need "for better analysis of the potentially interacting influences of multiple oil and gas activities co-occurring in time and space[.]" Panel Review at 9.

2. An alternative approach

One alternative approach to NMFS's piecemeal consideration of IHAs would be to create a sound budget for the Arctic, limiting the total amount of sound introduced into the water. Doing so would ensure that the effects of multiple noise sources do not create impacts that exceed the thresholds established by the MMPA. The sound budget could include any noise source that could contribute to a potential take, not just other seismic activities. Other oil and gas activities, such as overflights and support vessel traffic, could contribute to an overall sound level that has the potential to adversely affect marine mammals. This point was emphasized in the peer review comments for the 2010 Open Water meeting:

> Panel members emphasized the need for more "comprehensive ecosystem assessments" and they used that term to refer to the interaction and collective impact of all human activities and environmental phenomena to which an individual or population is exposed in a well-defined spatial region during a specific period of time.

Panel Review at 9.

Instead of dismissing the impacts of relatively smaller sources of sound, NMFS should account for and regulate those sources, and a sound budget may be the most appropriate tool for doing so. Establishing a sound budget that places an overall limit on noise would assist NMFS in reducing the potential for unanticipated harm. Development of this budget could be undertaken as part of the programmatic EIS process described above, which is another reason not to move forward until that EIS is complete.

Even without a comprehensive sound budget, NMFS could impose limits on the total number of activities permitted in the Arctic during the open-water season. Allowing only one or two noise generating activities each year could reduce the potential for take and would facilitate additional monitoring of the impacts of noise, since multiple noise sources make it very difficult to study the effect of specific sound sources.

D. Additional measures are required to achieve the "least practicable" impact

Pursuant to the MMPA, an IHA must prescribe "means of effecting the least practicable impact" on a species or stock and its habitat. 16 U.S.C. § 1371(a)(5)(D)(ii)(I). As is clear from the language chosen by Congress, the emphasis is on reducing the impact to the lowest level possible. NMFS has previously recognized that "practicable" qualifies "impact" not "means." When defending the conditions of an IHA against an industry challenge, the agency argued that the emphasis of the inquiry, thus, is on "the practicability of further reductions in harm (*i.e.*, can the reductions be achieved) rather than the economic costs of the 'means' used to obtain those reductions." Defendants' Opposition to Plaintiff's Motion to Stay at 22, *ConocoPhillips v. NMFS*, Case 3:06-cv-00198-RRB (D. AK).

NMFS should consider time and space limitations on surveying in order to reduce harm. There is general consensus that spatial-temporal avoidance of high value habitat represents one of the best means to diminish potential impacts. *See, e.g.*, Agardy, T., Aguilar Soto, N., Cañadas, A., Engel, M., Frantzis, A., Hatch, L., Hoyt, E., Kaschner, K., LaBrecque, E., Martin, V., Notarbartolo di Sciara, G., Pavan, G., Servidio, A., Smith, B., Wang, J., Weilgart, L., Wintle, B., and Wright, A., *A Global Scientific Workshop on Spatio-Temporal Management of Noise*, Report of workshop held in Puerto Calero, Lanzarote, June 4-6, 2007 (2007); ECS Working Group: Dolman, S., Aguilar Soto, N., Notabartolo di Sciara, G., Andre, M., Evans, P., Frisch, H., Gannier, A., Gordon, J., Jasny, M., Johnson, M., Papanicolopulu, I., Panigada, S., Tyack, P., and Wright, A., *Technical Report on Effective Mitigation for Active Sonar and Beaked Whales* (2009) (working group convened by European Cetacean Society); OSPAR Commission, *Assessment of the Environmental Impact of Underwater Noise*, OSPAR BIODIVERSITY SERIES (2009).

In this case, NMFS must evaluate the possibility of avoiding activities during the peak of the bowhead migration within the Beaufort migratory before issuing an IHA. According to the Federal Register notice, only 10 days of surveying will overlap with the bowhead's fall migration. 75 Fed. Reg. at 27,724. Even this short period of time results in the potential exposure of approximately 400 bowheads to sound levels of 160 dB or greater. *Id*. at 27,726. Although it is unclear on what basis the 10-day assumption is made, the MMPA mandate to reduce impacts to the "least practicable" requires NMFS to at least consider issuing an IHA that attempts to avoid exposing hundreds of bowheads to elevated sound levels. Shell's shallow hazard surveying will require 30 days of active surveying, yet NMFS proposes to issue an IHA that will allow activity for approximately 120 days, from July through October. NMFS should instead require Shell to complete its 30 days of shallow hazard surveying in July and August in an effort to avoid – as much as possible – the bulk of the bowhead migration. *See* NMFS, Biological Opinion for Oil and Gas Leasing and Exploration Activities in the U.S. Beaufort and Chukchi Seas, Alaska and Authorization of Small Takes Under the Marine Mammal Protection Act (2008 BiOp), at 13-14 (July 2008) (finding that "in some years bowheads are present in substantial numbers in early September"). At a minimum, NMFS should impose specific requirements to ensure that the surveying remains within the 10-day limit.

E. More analysis is required on the effects to subsistence hunting

The MMPA also requires that any incidental take authorized will not have "an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses" by Alaska Natives. 16 U.S.C. § 1371(a)(5)(D)(i)(II). NMFS must ensure that Shell's activities do not reduce the availability of any affected population or species to a level insufficient to meet subsistence needs. 50 C.F.R. § 216.103.

In addition to the other issues already noted in these comments, NMFS should also, as part of its MMPA review, evaluate the potential impacts of future activities in both seas and the acknowledged uncertainty regarding the effects of noise in the marine environment. The importance of bowhead and beluga whales to coastal communities and their acknowledged sensitivity to noise impacts strongly favor a precautionary approach. To do so, NMFS should first undertake a comprehensive assessment of traditional ecological knowledge. For these reasons, NMFS has not adequately supported its MMPA finding as to subsistence resources. *See* 50 C.F.R. § 216.104(c) (best available science standard for subsistence finding).

III. ENDANGERED SPECIES ACT

Although NMFS states in the Federal Register that it has begun ESA consultation on the issuance of the authorization for Shell's marine seismic activities, 75 Fed. Reg. at 27,731, it is not clear how the self-consultation will proceed. Since at least 1988, multiple agencies have relied on NMFS's regional biological opinions when considering the impacts of oil and gas activities throughout the Arctic. For this consultation, NMFS is likely to consider a number of options, including updating the most-recent 2008 regional biological opinion or issuing a wholly new decision based on this specific action. Regardless of the path NMFS chooses, however, it must address Shell's future drilling in the Arctic through an appropriate baseline analysis as well as part of a comprehensive look at the "agency action" under review.

A. NMFS's consultation must consider the potential impact of potential future oil and gas activities

When considering whether an action "may affect" a listed species, NMFS must consider all of the "effects of the action." 50 C.F.R. §§ 402.02; 402.14(a). Those effects are then added to the "environmental baseline," which consists of the past and present impacts of activities in the action area as well as "the anticipated impacts of all proposed Federal projects that have already undergone formal or early section 7 consultation." *Id*. at § 402.02. The analysis requires that agencies determine what jeopardy might result "from the agency's proposed actions in the present and future human and natural contexts." *Pac. Coast Fed'n of Fishermen's Ass'n v. United States Bureau of Reclamation*, 426 F.3d 1082, 1093 (9th Cir. 2005).

Shell has proposed exploration plans for the Chukchi and Beaufort seas, and MMS has approved them. Those approvals relied on NMFS's 2008 regional biological opinion. *See* MMS, Environmental Assessment, Shell Offshore, Inc., 2010 Outer Continental Shelf Lease Exploration Plan, Camden Bay, Alaska, at 74 (OCS EIS/EA MMS 2009-052) ("Consultation with NMFS for Shell's proposed exploration activities is covered by the July 17, 2008, BO[.]"). These drilling plans are "proposed Federal projects" that have completed formal section 7

consultation and must be added to the baseline when evaluating the effects of Shell's seismic activity. Doing otherwise would ignore the mandate of the ESA to consider proposed activities in their appropriate context.

Moreover, NMFS must take a forward-looking approach to Shell's 2010 proposed seismic activity in order to capture the full scope of its potential effects. Shell's application includes: 1) strudel scour and ice gouge surveying to enable pipeline construction for production on its proposed Chukchi and Beaufort drill sites; and 2) a shallow-hazard survey in Harrison Bay to allow for later exploration drilling. In both instances, NMFS must consider the effects of the "*entire* agency action." *Conner v. Burford*, 848 F.2d 1441, 1453 (9th Cir. 1988) (emphasis in original).

The Ninth Circuit interprets the term "agency action" broadly. When evaluating lease sales, this requires ESA consultations to consider all post-leasing oil and gas activities, including exploration and production. *Conner*, 848 F.2d at 1453. As explained by one court,

> any course of agency action could ultimately be divided into multiple small actions, none of which, in and of themselves, would cause jeopardy. Moreover, such impermissible segmentation would allow agencies to engage in a series of limited consultations without ever undertaking a comprehensive assessment of the impacts of their overall activity on protected species. The ESA requires more; it "requires that the consulting agency scrutinize the total scope of agency action."

American Rivers v. United States Army Corps of Eng'rs, 271 F. Supp. 2d 230, 255 (D.D.C. 2003) (quoting *North Slope Borough v. Andrus*, 486 F. Supp. 332, 353 (D.C.C. 1980)). The decision in *Conner* favorably quotes the D.C. Circuit for the recognition that "pumping oil" not "leasing tracts" is the aim of congressional mineral leasing policy. *Conner*, 848 F.2d at 1453 (alterations and quotation marks omitted). Similar reasoning applies here. The surveys are taking place in furtherance of Shell's undeniable intent to facilitate pumping oil out of the ground. *See* 30 C.F.R. § 250.214(e) (noting that exploration plans must include a shallow hazards report); Shell Exploration and Production, Application for Incidental Harassment Authorization for the Non-Lethal Taking of Whales and Seals in Conjunction with a Proposed Open Water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska, During 2010, at 5 (April 2010) (stating that ice gouge information "is required for the design of potential pipelines"); *id*. at 7 (stating that strudel scour information is "required for prospective pipeline planning").[4]

Moreover, when specifically evaluating the shallow hazard surveying, subsequent exploration drilling should be considered an "interrelated" action. Interrelated actions are those

[4] In the past, NMFS has maintained that an IHA authorizes only the harassment of marine mammals and not the underlying action. This distinction is overly formalistic. Shell's seismic activity would be illegal absent NMFS'S authorization, and stripping the IHA of its context would undermine the operation of the ESA. *Cf. Ramsey v. Kantor*, 96 F.3d 434, 444 (9th Cir. 1996) (noting that the issuance of an incidental take statement that allows an activity to take place that would otherwise be illegal is a federal "action" for NEPA purposes).

that "are those that are part of a larger action and depend on the larger action for their justification." 50 C.F.R. § 402.02. The Ninth Circuit has found that that the test for interrelatedness "is 'but for' causation: but for the federal project, these activities would not occur." *Sierra Club v. Marsh*, 816 F.2d 1376, 1387 (9th Cir. 1987) (quoting 51 Fed. Reg. 19,932 (1986)); *see also* Fish and Wildlife Service and National Marine Fisheries Service, Endangered Species Consultation Handbook (ESA Handbook) at 4-27 (March 1998). Because MMS regulations require a shallow hazards report as a prerequisite to exploration drilling, the effects of drilling in Harrison Bay must be evaluated as an "interrelated" action as well.[5]

Because Shell has existing proposals for drilling in the Arctic and because Shell's proposed surveying is part of longer-term plans that potentially culminate in production wells, a comprehensive assessment of impacts on endangered species should take place now, before resources are committed to an effort that may ultimately jeopardize listed species.

B. NMFS's existing regional biological opinion is inadequate

To satisfy the requirements of the ESA, NMFS's consultation for Shell's surveying must go beyond the analysis in 2008 regional biological opinion to consider probable impacts based on the best information available, including both the site-specific details of Shell's exploration drilling plans and what is known about the potential for oil spills and oil spill response capabilities.

1. The 2008 biological opinion does not adequately consider site-specific information related to Shell's proposed drilling

Whether noise disturbances from oil and gas activities result in a biologically significant impact depends on the "timing, location, and number" of the disturbances. 2008 BiOp at 86. Concentrations of loud noise and disturbance activities during the open water period "have the potential to cause large numbers of [bowhead] whales to avoid using areas for resting and feeding for long periods of time (days to months) while the noise producing activities continue." *Id*. at 89. The consequences of this avoidance "would be of particular concern if [inaccessible] areas included those used for feeding or resting by large numbers of individuals or by females and calves." *Id*. at 86; *see also id.* at 47 ("Increased noise levels could . . . alter normal behavior, such as causing avoidance behavior that keeps animals from an important area or displace a migration route farther from shore."). Due to the "potential for noise disturbance to displace whales from important feeding areas," NMFS has advised that "special scrutiny should be given to seismic and drilling operations which may impact these areas." *Id*. at 99; *see also id.* at 68 (stating that "[s]mall deflections in individual bowhead-swimming paths and a reduction in use of possible bowhead-feeding areas near exploration units may result in adverse effects on the species").

[5] The Handbook also provides examples to illuminate the fact that the term "larger action" is more appropriately viewed shorthand for the action under consultation. If , for example, a statute requires a dam operator to construct a "fuse plug" on the spillway of an existing dam, construction of the fuse plug is the proposed "larger action" that interrelated actions – such as a larger spillway for the dam – are then measured against. ESA Handbook at 4-27.

Shell has proposed exploration drilling in Camden Bay in the Beaufort Sea. Camden Bay has been repeatedly identified as a resting and feeding area for migrating bowheads. *See* Donald K. Ljungblad, Sue E. Moore, and Janet T. Clarke, *Assessment of Bowhead Whale (Balena mysticetus) Feeding Patterns in the Alaskan Beaufort and Northeastern Chukchi Seas via Aerial Surveys, Fall 1979-84*, 36 Rep. Int. Whal. Comm'n 265, 270 (1986) (feeding whales seen in "four of the six years north of Camden Bay and Prudhoe Bay"); Donald K. Ljungblad, Sue E. Moore, and Janet T. Clarke, *Bowhead Whale (Balaena mysticetus) Spatial and Temporal Distribution in the Central Beaufort Sea During Late Summer and Early Fall 1979-86*, 39 Rep. Int. Whal. Comm'n , 283, 289 (1989) (feeding bowheads seen north of Camden Bay in 1982 and 1984). Whaling captains from Nuiqsut and Kaktovik "consistently report bowhead whales feeding, resting, and caring for young in Camden Bay waters." Alaska Eskimo Whaling Commission, *Summary of Key Research on Bowhead Whale Impacts Due to Offshore Oil and Gas Activity During the Beaufort Sea Fall Open Water Season and Bowhead Whale Use of the Alaskan Beaufort Sea During Fall Westward Migration*, at 1 (Aug. 2009), (attached as Exhibit 2).

Recent monitoring has reaffirmed the past usage. In 2008, Shell conducted aerial surveys in support of seismic activities at its Torpedo and nearby Masva prospects. LGL, Marine Mammal Monitoring and Mitigation During Open Water Seismic Exploration by Shell Offshore Inc. in the Chukchi and Beaufort Seas, July-October 2008: 90-Day Report, at 9-3 (Jan. 2009). Based on those whales whose activity could be characterized, just over 75% were determined to be feeding, with 15% resting. *Id*. at 9-51. In 2007, Shell conducted aerial surveys associated with seismic activity on its Sivilluq prospect. LGL, 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, at 5-92 (Jan. 2008). It estimated that just over 50% of the bowheads were feeding, with approximately 13% resting. *Id.* at 5-109. Based on the number of observed whales, as many as 4,826 whales may have been present in the Camden Bay area in mid-September. *Id*. at 5-100. *See* Shell Offshore Inc., 2010 Outer Continental Shelf Lease Exploration Plan Camden Bay, Alaska, Appendix H, at 130 (June 2009) (Shell's Environmental Impact Analysis noting that in "2007 and 2008 bowhead whales also used areas near Camden Bay to feed during the migration"). The industry's joint monitoring report for activities in 2006 noted more than a third of the whales in Camden Bay were using the area for resting. LGL, Joint Monitoring Program in the Chukchi and Beaufort Seas, July-November 2006, at 8-14 (Table 8.3) (Nov. 2007).

The biological opinion's concern with limiting the number of displaced whales – and the elevated concern for cow-calf pairs – is consistent with the agency's past regulatory decisionmaking in the Arctic. In 2006, NMFS issued a finding of no significant impact for multiple seismic operations in the Arctic based on the imposition of a 120-dB safety zone for 4 or more cow-calf pairs and a 160-dB safety zone for aggregations of feeding whales. *See* 71 Fed. Reg. 66,912, 66,913 (Nov. 17, 2006) (noting that the 120-dB requirement was "essential" to NMFS's finding of no significant impact). As NMFS has recognized, "protective measures should be designed to reduce the potential for disruption of biologically significant behaviors or help ensure that whales do not avoid important key habitat areas (*and thus potentially negate a negligible impact finding under the MMPA*)[.]" 73 Fed. Reg. 49,421, 49,429 (Aug. 21, 2008) (emphasis added); *see also* MMS, Final Programmatic Environmental Assessment, Arctic Ocean

Outer Continental Shelf Seismic Surveys – 2006, at 111 (OCS EIS/EA MMS 2006-038) ("To the extent that information exists, we have highlighted potential effects that could affect the use of areas used for calving, feeding, resting, and breeding by large numbers of whales."). NMFS should re-examine the potential impacts of Shell's proposed drilling in light of its long-standing policy and the cautionary language contained in its 2008 opinion.[6]

2. The 2008 biological opinion does not adequately consider oil spills

In the 2008 biological opinion, NMFS recognized the potential dangers of a large oil spill. Whales contacting oil, particularly freshly- spilled oil, "could be harmed and possibly killed." 2008 BiOp at 99. This is especially problematic were aggregations of whales or females and newborns/young calves exposed, in which case "highly significant effects could occur[.]" *Id*. at 113; *see also id*. at 103 (potential for population-level effects "may exist" if females and newborn / young calves are exposed). Overall, however, NMFS found that several "coincidental events" would have to take place for such harm to occur: 1) a spill; 2) that coincides with the whales' seasonal presence; 3) that is "transported to the area the whales occupy (e.g. the migrational corridor or spring lead system)"; and 4) is not successfully cleaned up. *Id*. at 99 (reviewing oil spill effects at the exploration stage); *see also id*. at 115 (reviewing oil spill effects at the production stage and finding that significant adverse effects would only be expected "if all of the low probability events occurred at the same time").

Existing circumstances demonstrate that this combination of events is not as remote as NMFS appears to have assumed. First, NMFS's analysis of whether a spill may occur relies in part on statistical probabilities based on past incidents. 2008 BiOp at 90-91 (exploration drilling). The ongoing disaster in the Gulf of Mexico, however, has revealed that current regulatory safeguards are insufficient to prevent large-scale spills from happening. There appears to have been a significant breakdown in the system that was intended to both prevent spills from occurring and require adequate oil spill response capabilities to limit the harm.[7] Moreover, problems with the adequacy of MMS's environmental reviews have been previously documented. According to a GAO report, the Alaska office of MMS has been subject to allegations by former MMS scientists that it suppressed or altered work. Government Accounting Office, GAO-10-276, *Offshore Oil and Gas Development: Additional Guidance Would Help Strengthen the Minerals Management Service's Assessment of Impacts in the North Aleutian Basin*, at 24 (March 2010). NMFS must take into account that there are likely gaps in the current regulatory regime. Given those flaws, an analysis that relies on the safety record of previous drilling is doubtful as a predictive tool.

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[6] Although NMFS downplayed the potential effects of missed feeding and resting opportunities in its proposed IHA for Shell's Camden Bay drilling, its dismissal runs counter to the agency's long-standing practice and ignores existing science.

[7] *See, e.g., Tracking down Minerals Management Service's dysfunctional history of drilling oversight*, available at http://www.denverpost.com/headlines/ci_15236764; *U.S. agency overseeing oil drilling ignored warnings of risks*, available at http://www.washingtonpost.com/wp-dyn/content/article/2010/05/24/AR2010052401974_pf.html.

As for the second and third contingencies, Shell's future pipelines would support production from two areas in the Beaufort and Chukchi seas where it is currently pursuing exploratory drilling. Both are located within the bowhead whales' migration corridor. The Beaufort Sea drilling is proposed for an established feeding and resting area in Camden Bay, and the Chukchi drilling is proximate to the historical spring lead system. Shell's Harrison Bay shallow hazard surveying will also take place within the migratory corridor. In all, the drill sites present scenarios in which the probability of spilled oil reaching areas utilized by bowhead whales is 100%. *See* 2008 BiOp at 114 (recognizing that depending on the location of the drilling "many scenarios" will present a 100% probability).

Finally, the recent events in the Gulf of Mexico also underscore the fact that cleaning up a large-scale oil spill is exceptionally difficult, and this is especially true were a spill to occur in the Arctic. Even the biological opinion observes that spill response drills in the Beaufort had "failed to demonstrate industry can adequately respond under [broken or newly formed ice] conditions[.]." 2008 BiOp at 100. In the Chukchi, spill response protocols, technologies, plans, and infrastructure at the time of the opinion were either not fully developed or are untested. *Id*. NOAA reiterated its concerns last year in its comments to MMS regarding the draft 2010-2015 leasing plan. NOAA, Comments on the U.S. Department of the Interior / Minerals Management Service Draft Proposed Outer Continental Shelf Oil and Gas Leasing Program for 2010-2015, at 5 (September 9, 2009). The inability to effectively clean up spills weighs on the other factors as well – oil remaining in and around an area like the spring lead system at the end of the season could freeze in the ice, only to return to the open water during spring thaw. The biological opinion does not, however, adequately consider the possibility that oil will carry over from season to season.

CONCLUSION

For the above reasons, Shell's request for an IHA for marine mammal harassment incident to its 2010 seismic surveying should be denied. Thank you for your consideration of these comments.

Respectfully,

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Comments of Dr. David E. Bain on Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Open Water Marine Survey Program in the Beaufort and Chukchi Seas, Alaska, 75 Fed. Reg. 27,708 (May 18, 2010)

I am submitting this statement regarding the proposed Incidental Harassment Authorization (IHA) for Shell's seismic project in the Beaufort and Chukchi Seas. I am currently a contracting scientist for the National Marine Fisheries Service. I received my B.A. with majors in Biology and Psychobiology with Physics in 1980 and Ph.D. in Biology in 1989 from the University of California at Santa Cruz. I have authored over 30 peer-reviewed papers and reports on the behavioral ecology of marine mammals, especially of killer whales (*Orcinus*). A substantial portion of this work has been concerned with audition, sound production, and other aspects of the acoustic ecology of these species. I have conducted studies for the National Marine Mammal Laboratory and other branches of the National Marine Fisheries Service, Minerals Management Service, and U.S. Geological Survey on the impacts of acoustic disturbance on individuals and populations of marine mammals. Reports based on these and other disturbance related studies have been published in books and peer-reviewed journals and presented at scientific meetings of the International Whaling Commission, the Society for Marine Mammalogy, and the Acoustical Society of America.

I have reviewed the National Marine Fisheries Service's ("NMFS") proposed IHA, the Statoil 2010 Chukchi Seismic IHA Application, the July 2008 Bowhead Biological Opinion, "An Update on Feeding by Bowhead Whales near an Offshore Seismic Survey in the Central Beaufort Sea" (IWC SC/61/BRG3), and key papers cited by these documents. The conclusions I draw and the opinions I express are supported by texts and research that are generally accepted as reliable by experts in my field.

I will address three inadequacies in the proposed IHA regarding the effects of seismic survey noise on marine mammals. First, the potential for effects from high frequency sources was not adequately considered. Second, the best available science was not used to determine the threshold for harassment of marine mammals. Third, the potential for cumulative effects with other seismic survey work was not considered.

Effects of high frequency sources

Although some sources were dismissed as too high in frequency for marine mammals to hear, this is not necessarily the case. In mammals generally, the upper limit of hearing is correlated with the maximum sound arrival-time difference between the ears (Heffner and Heffner 1982). That is, smaller mammals hear higher frequencies than larger mammals, and marine mammals hear higher frequencies than terrestrial mammals of the same size. An implication of this is that young mammals will hear higher frequencies than adults of the same species, so hearing ability based on measurements of adults cannot be assumed to apply to juveniles.

Second, sound sources contain frequencies beyond the "nominal" frequency. This is especially true of brief signal sources, as the time-bandwidth product minimum requires brief pulses to be broadband (Gabor 1947). Even long duration signals may contain other frequencies in the form of undertones, overtones (harmonics), distortion, or noise. It is important to measure the complete

spectrum of a signal source, not simply consider the frequencies the manufacturer indicates are the most powerful.

Third, a source that simultaneously puts out more than one frequency will also put out energy at the difference between frequencies (the beat frequency, Watkins 1967). For example, a source that puts out 190 and 240 kHz will also put out a beat frequency at 50 kHz, and hence will be audible to species capable of hearing 50 kHz (this principle is used to allow people to "hear" the ultrasonic clicks of bats, for example). They can also put out frequencies that differ from the main frequencies by the beat frequency and its harmonics. In this example, 190 ±50, ±100, ±150, and 240 ± 50, ±100, ±150, ±200, etc. That is, there is likely to be energy audible at 40 kHz as well as 50 kHz.

Fourth, there is uncertainty about the hearing ability of many species. E.g., while it is possible to estimate hearing ability based on anatomy (e.g., Ketten 2007), the actual hearing ability of a bowhead whale has never been tested.

In the past, such errors have led NMFS to erroneously conclude that noise sources would have no impact. For example, a sonar designed to detect gray whales while being inaudible to them, in fact deflected them from their migration route (Frankel 2005).

Even without such errors, the single beam echosounder contains frequencies (24-50 kHz) known to be audible to odontocetes and pinnipeds, and likely to be audible to bowhead calves. The dual frequency side scan sonar is likely to be audible to porpoises.

Thus NMFS should require the applicant to submit complete, measured spectra of all noise sources, model the propagation of all noise sources which may be audible to any marine mammal species in the region, and consider the potential impact of these sources on protected species. Special consideration should be given to noise sources that may be audible to calves but not adults, as these could result in separation of mothers and calves, or calves receiving injurious levels of noise if they remain with their mothers near a noise source the mother is unaware of.

Threshold for behavioral effects

Estimating the number of individuals likely to be affected by anthropogenic noise (takes) is an important step in the permitting process. However, biases in estimates of the number of takes due to the use of biased data and biases in estimates from unbiased data due to uncertainty in sound propagation and species-typical and individual-specific thresholds can lead to underestimation of number of takes. Sources of biased data include observations limited to locations near the noise generator (Bain and Williams in review) and hence only of the subset of the population most tolerant to noise, and extrapolation of laboratory values for behavioral thresholds from individuals trained to ignore noise and pain to wild animals. The non-linear decline of received level with distance results in asymmetrical differences in zones of influence due to uncertainty. For example, with an uncertainty of ±3dB, the average of the area within the 117dB and the 123 dB contour is greater than the area within the 120 dB contour, and the bias increases with increasing uncertainty. Failure to correct for this results in the use of the best estimate of take threshold leading to an underestimate of takes. Uncertainty in source level and sound propagation itself can lead to bias. A consequence of sociality is that all individuals in a group must move similarly to maintain group cohesion, contrary to a model

incorporating individual variation. This analysis has important management implications. Incorporating uncertainty shows takes may occur at far greater distances than predicted based on best estimates alone. This implies takes of specific individuals will be of greater duration and be repeated more often than modeled, resulting in unexpectedly large cumulative effects. The greater range at which takes may occur requires more careful consideration of habitat-specific risks and fundamentally different approaches to mitigation.

Changes in behavior resulting from noise exposure could result in indirect injury in the wild. A variety of mechanisms for Level B harassment to potentially lead to Level A takes have been identified.

Flight may lead to injury in some species. Exhaustion from rapid flight leading to heart or other muscle damage (Williams and Thorne 1996) could also account for increased mortality such as was observed in harbor porpoises following sonar exercises in Juan de Fuca and Haro Straits in April and May of 2003. Harbor porpoises, in contrast to Dall's porpoises, rarely engage in sustained high energy activities such as rapid swimming or bow riding, and hence are less adapted to long distance flight responses.

Even successful flight may have negative survival consequences. Although many noise exposure protocols consider movement of animals out of the area an acceptable outcome, as the animals are not exposed to high levels of noise, such movement requires expenditure of significant amounts of energy. Assuming animals were in optimal habitat, moving out of that habitat is likely to have consequences such as reduced foraging efficiency. This is of particular importance in the Arctic, where nutrients from fresh water sources, ice cover, bottom topography, currents, and other factors influence prey density (NRC 2003a, MMS 2004). Such factors vary temporally, resulting in the location of patches of high quality habitat varying through time. Feeding studies noted that prey density averaged 230 mg/m^3, while feeding appears to require a density of 800 mg/m^3 for bowheads (MMS 2004). Such highly productive patches are likely to be rare, so displacement from these areas would negatively affect individuals. Although some large whales can go extended periods of time without eating much, juveniles, lactating females and individuals in poor condition cannot go as long. In the case of small cetaceans (e.g., harbor porpoises), there is a risk of death if they are unable to feed for periods as short as 48-72 hours (personal observation). They may also move into habitat where they face increased risk of predation.

Separation of individuals from social units is another consequence of noise exposure that may lead to mortality. In 2003 in Haro Strait, some killer whales responded to mid-frequency sonar by seeking shelter behind a reef. Others chose to flee, resulting in splitting of a pod that historically spent all of its time together as a single unit. While no deaths resulted from this particular incident, other killer whales have been observed separated from their social units resulting in death prior to reunion or requiring human intervention to restore the individual to its social unit (Schroeder *et al.* 2007).

Relationship of Noise Level to Impact. NMFS uses different thresholds for continuous and pulsed sounds. The motivation for this was to tie impact to SEL measurements of sound (as opposed to RMS or peak-to-peak measurements), which correlated well with TTS. However, there is no evidence linking SEL to behavioral changes. In contrast, Bain and Williams (in review) found peak-to-peak level measurements correlated best with behavioral changes. The extremely good temporal resolution of the cetacean auditory system (e.g., Szymanski et al. 1998) may explain this relationship.

Major behavioral changes appear to be associated with received levels of around 135 dB in killer whales. Bain and Dahlheim (1994) observed major behavioral changes in a captive killer whale exposed to 135 dB (in a band below 5 kHz), and Bain (1995) used noise with a received level of around 135 dB (with a predominant frequency at 300 Hz) to drive killer whales from Barnes Lake, where two individuals in the group had previously died rather than leave. Killer whale watching guidelines prohibit close approaches that would result in received levels exceeding approximately 135 dB (Bain 2001). Olesiuk *et al.* (2002) found noise from acoustic harassment devices with a source level of 195 dB excluded harbor porpoises within a radius of 3 km (individuals may have been kept farther away, but porpoises are difficult to see at all beyond that range), where received levels probably dropped below 135 dB. Belugas have been observed to respond to icebreakers by swimming rapidly away at distances of up to 80 km, where received levels were between 94 and 105 dB. Bowheads appeared to be displaced to distances of about 20-30 km when seismic devices were inactive, and distances of 30-40 km when airguns were active (Miller *et al.*1999), suggesting major behavioral effects to noise in the 105-125 dB range (NRC 2003b). Morton and Symonds (2002) found the same type of acoustic harassment devices as studied by Olesiuk *et al.* (2002) not only excluded killer whales from the area around the devices, they kept them from accessing the area beyond the devices. It is reasonable to conclude that site clearance surveys could similarly prevent various whale species from accessing areas around the surveys.

More subtle behavioral changes can occur at received levels from 90-110 dB re 1 µPa or lower. Porpoises avoid pingers with source levels of about 130 dB at distances of from 100-1000 m, depending on experience and environmental context (Bain 2002b, Barlow and Cameron 1999, Cameron 1999, Cox *et al.* 2001, Gearin *et al.* 1996 and 2000, Kraus *et al.* 1997, Laake *et al.* 1997, 1998, 1999). Kastelein *et al.* (1997, 2001) found behavioral responses to even lower levels. Bain *et al.* (2006ab) and Williams *et al.* (2002ab, 2009) found killer whales exhibited behavioral changes in the presence of a single vessel producing a received level in the neighborhood of 105-110 dB re 1 µPa. Belugas exhibited minor behavioral changes such as changes in vocalization, dive patterns and group composition at distances up to 50 km (NRC 2003b), where received levels were likely around 120 dB. It should be further noted that these behavioral responses occurred where noise was barely detectable above ambient noise, suggesting that noise whose total level is below ambient but occurs at a frequency where ambient noise is low may have effects. In addition, the range at which effects are observed would be expected to vary with natural ambient noise, with effects occurring at greater ranges on quiet days and shorter distances on noisy days.

The 105 dB contour is likely to occur on the order of 7 to 30 times farther out than the 120 dB contour (depending on the propagation model used). The potential for marine mammal occurrence in the project area is severely underestimated given that the ensonified area is proportional to the square of the distance to the threshold received levels for effects.

It is likely that many bowheads will change significant behaviors such as migration and resting or avoid potential feeding areas in response to received noise at 120 dB or lower. NMFS estimated the 120 dB contour is more than 12 times as distant from the source as the 160 dB contour, increasing the area where takes are likely to occur by 150 times over that used in the proposed IHA. Taking this larger area into account for non-migrating bowheads, and the larger diameter of the ensonified area migrating whales would otherwise cross, suggests that the number of bowheads affected using 120db as the threshold will be well over 1500 (>10% of the population) using the densities and migration rates employed in the IHA. The number could approach 3000 if the offshore portion of the work coincides

with the peak of the migration, as the 120 dB contour would extend into the high density core of the migration corridor from the northern part of the survey area.

It is clear from the above review that marine mammals respond to noise at levels far below 160 dB. Thus implications of takes must be considered at far lower received levels of noise, which will occur over much larger areas, and hence affect much greater numbers of individuals than when 160 dB or higher is set as the threshold for concern. There are three main ways that minor behavioral changes, when experienced by numerous individuals for extended periods of time, can affect population growth. These include increased energy expenditure, reduced food acquisition, and stress (Trites and Bain, 2000).

Whales typically are active part of the time and rest part of the time. Traveling around a noise source replaces resting with active time. Marine mammals typically have a metabolic scope of about 6. That is, energy consumption at rest is about 6 times lower than fast travel. In killer whales, travel at moderate speeds requires expenditure of about twice the energy as resting (Kriete 1995).

When whales are displaced from optimal habitat, rates of energy acquisition are reduced. As noted above, whales typically forage where prey density is at least four times higher than average prey density. Thus displacement from optimal foraging habitat may result in a four-fold reduction in food intake.

The actual situation may be worse, as foraging may be abandoned altogether when conditions are poor. For example, killer whales are 40% less likely to forage at all when vessels are nearby (Lusseau *et al.* 2009), perhaps because vessel noise masks echoes from prey, making the probability of foraging successfully negligible (Bain and Dahlheim 1994). This likely reduction in food intake is significant to food limited populations (e.g., killer whales: Ford *et al.* 2005, Olesiuk *et al.* 2005, Fisheries and Oceans Canada 2008).

These energetic consequences are most significant to a population approaching carrying capacity, as bowheads are (Angliss and Allen 2009). The increased competition with conspecifics that consume more energy than they would if undisturbed, and reduced effective carrying capacity due to inaccessibility of prey protected by anthropogenic noise could be used in conjunction with population dynamics models to calculate the net change in population growth rate resulting from reduced fecundity and increased mortality (Bain 2002a).

In addition to energetic consequences, stress can increase mortality rates through impairing the immune system and reduce calf production through abortion of fetuses or prevention of conception (Rolland *et al.* 2006).

Cumulative effects

The consideration of cumulative effects is inadequate. Migratory species will experience effects of human activities well beyond the project areas, such as shipping, oil industry activities in the Canadian Arctic, the Chukchi, and other waters, and other human activities. All these activities need to be weighed when considering effects on a species' status (NRC 2003).

In addition to this project, it is particularly important to consider cumulative effects with other seismic surveys proposed for 2010. Further, since the purpose of these surveys is to make subsequent oil production possible, it is important to consider whether the cumulative effects with impacts of oil production would pose a threat to the species in the region.

Of particular relevance is the proposed Statoil seismic surveys in the Chukchi. There are a number of ways these two projects could interact.

One, if the same individuals are exposed to both projects, this would increase the duration of exposure beyond those considered in this application. Further, individuals would potentially be exposed multiple times. Multiple exposures are likely to result in increased stress levels.

Second, if both projects operate in the Chukchi at the same time, individuals would be forced to simultaneously respond to both noise sources. Avoidance of one noise source could result in approach to the other, resulting in unexpectedly high noise exposure. This negates the safety assumption that animals will move away prior to receiving harmful exposure.

Third, different individuals may be exposed to the two projects. This puts NMFS' assumption that its policies only allow small takes to occur into question. That is, the absolute number of individuals to be taken, and hence the fraction of the population, would be higher when both projects are considered than when either is considered alone.

The MMPA attaches special significance to disruption of foraging. The Harrison Bay area is a feeding area for bowheads at times (Koski et al. 2009 , SC/61/BRG3). The Chukchi is a significant feeding area for gray whales, of which several emaciated individuals have stranded in Washington state already this year.

One approach to modeling cumulative effects from disturbance is to weigh the energetic consequences. For example, when the migration is route is lengthened, more energy will be required to swim the additional distance. When feeding areas are avoided, energy acquisition will be reduced. This is equivalent to additional whales competing for resources. The minimum population dynamics implications can be calculated using standard equations (Bain 2002a, Olesiuk *et al.* 2005).

Other mechanisms of impact, such as stress or exposure to toxic chemicals, are less easily addressed through an energetic model, but require consideration.

Exclusion from feeding areas by disturbance will have stronger consequences for cow calf pairs than other whales. Lactating female bottlenose dolphins and killer whales require 2-4 times the food intake of non-lactating females to nurture their calves (Bain and Olhiser 1994). Mysticetes are also estimated to need twice the calories to nurse calves than when they are pregnant (Lockyer 1984).

Thus displacement from feeding areas poses a threat to successful recruitment. In the case of odontocetes, displacement of mothers from feeding grounds is likely to result in increased neonatal mortality. In the case of mysticetes, displacement from feeding grounds may delay reproduction rather than result in calf loss (Oftedal 1997).

Stress is likely to result when ice prevents marine mammals from passing a comfortable distance away (Romano *et al.* 2004).

Summary

NMFS has likely underestimated the effects of the proposed seismic for several reasons. First, the agency has ignored the potential for some of the noise sources to cause takes, and therefore ignored the potential for impact in the area where only those sources will be used. Second, and likely most important, it has ignored the potential for sound well below 160 dB to result in takes. Using a lower threshold for estimation purposes based on species-specific data would result in takes over a much larger area, and hence a much larger number of individuals being effected. Third, the potential for cumulative effects have been ignored. Collectively, this could have resulted in the number of takes being underestimated by two or three orders of magnitude, and hence the potential for population level effects has been underestimated as well.

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SUMMARY OF KEY RESEARCH ON BOWHEAD WHALE IMPACTS
DUE TO OFFSHORE OIL AND GAS ACTIVITY DURING THE
BEAUFORT SEA FALL OPEN WATER SEASON
AND
BOWHEAD WHALE USE OF THE ALASKAN BEAUFORT SEA DURING FALL
WESTWARD MIGRATION
August 2009

NOTE: All results corroborate observations reported by AEWC whaling captains prior to research being conducted. Whaling captains' observations are used by the North Slope Borough, NMFS, and operators to identify research needs related to offshore impacts. While not exhaustive, the information here provides a summary of key research results regarding fall bowhead whale use of the Alaskan Beaufort Sea and offshore oil and gas development impacts. The very small number of research citations provided here demonstrates the very limited amount of baseline research available on bowhead whale use of the Beaufort Sea habitat.

BOWHEAD WHALE USE OF THE BEAUFORT SEA DURING FALL WESTWARD MIGRATION.

CAMDEN BAY: Whaling captains from Nuiqsut and Kaktovik consistently report bowhead whales feeding, resting, and caring for young in Camden Bay waters. Aerial surveys have also documented feeding in Camden Bay (Moore et al. 1989).

EASTERN, MIDDLE, AND WESTERN BEAUFORT: Bowhead whales feed regularly in the nearshore waters of the eastern, central and western Alaskan Beaufort Sea during September-October. This entire region should be considered an integral part of the summer- autumn feeding range of bowhead whales (Lowry, et al., 2004, p. 221; Conclusion).

BOWHEAD WHALE DISTURBANCE EFFECTS DUE TO OFFSHORE DRILLING AND ICE MANAGEMENT IN THE BEAUFORT SEA, CAMDEN BAY (See NRC, 2003, p. 100; Richardson, et al., 1995, p. 276.; *Attachment 1*) .

HAMMERHEAD/SIVULLIQ 1986 (with little ice management): "Zone of avoidance" by fall migrating bowhead whales appeared to extend 15-25 km (9-15 mi) from the drill ship. No whales were detected closer than 9.5 km (6 mi) from the drillship (received sound at 15 km was 105-130 dB), few were seen closer than 15 km (9 mi),

and one whale was observed for 6.8 hours as it swam in an arc of about 25 km (15 mi) around the drillship (LGL and Greeneridge 1987).

CORONA 1986 : Received sound levels at 15 km (9 mi) were reported to be 105-125 dB (LGL and Greeneridge 1987).

KUVLUM 1992 (with daily ice management): Whales began to deflect at about 32 km (19 mi) away from the drill rig (Brewer et al. 1993). Whaling captains reported behavioral changes (swimming patterns and respiratory rates) at 20+ miles. (See Attachment 1).

KUVLUM 1993: The whales were nearly excluded from an area within 20 km (12 mi) of the drilling platform (Davies 1997, Hall et al. 1994).

BOWHEAD WHALE DISTURBANCE EFFECTS DUE TO OFFSHORE GEOPHYSICAL ACTIVITY IN THE BEAUFORT SEA, CAMDEN BAY (See LGL Ltd., et al., 1999, pp. 5-60, F-7; Attachment 2.)

In 1996, 1997, and 1998, bowhead whales were rarely seen within 20 km of an active seismic operation. Near total avoidance extended to 15-20 km in two years, with substantial avoidance extending out to 30 km in the third year. Significantly elevated sighting rates at 20-30 km during seismic activity the first year and 30-40 km during seismic activity in the third year are consistent with the interpretation that whales concentrated at those distances while avoiding the areas closer to the seismic operations.

BOWHEAD WHALE DISTURBANCE DUE TO VESSEL TRAFFIC (See Richardson, et al., 1995, p. 270). Bowheads react strongly and consistently to approaching vessels of a wide variety of types and sizes; interrupt normal behavior and swim rapidly away; surfacing, respiration, and diving cycles are affected. Research at BP's Northstar Island, where oil production is occurring, also showed bowheads deflecting away from the island at very low levels of received sounds (Richardson 2008).

RESEARCH AND MITIGATION RELYING SOLELY ON MARINE MAMMAL OBSERVERS (MMOs) (See Richardson, et al., 1995, p. 268). Some bowhead whales begin to avoid approaching diesel-powered vessels 4 km or more away -- too far away

to be observed from the vessel. Therefore, MMOs are not an appropriate means of documenting disturbance.

ACTIVITIES MOST LIKELY TO AFFECT BOWHEAD WHALES. These include marine seismic exploration, exploratory drilling, ship and aircraft traffic, discharges into the water, dredging and island construction, and production drilling (NRC, 2003, p. 100).

Marine seismic exploration produces the loudest industrial noise in the bowhead whale habitat (NRC, 2003, p. 100). Aside from seismic vessels, the strongest noise sources known to occur near bowhead whales are icebreakers (Burns, et al., 1993, p. 639).

CONSEQUENCES OF DISTURBANCE._"The significance of short-term behavioral responses to the long-term well-being of individuals and populations is rarely known. Most brief interruptions of normal behavior may have little affect on overall energy balance and reproductive performance. However, physiological reactions may occur even if no overt behavioral response is evident (e.g., MacArthur, et al. 1979; Section 11.8.4). Uncertainties about physiological, long-term, and population consequences are common for all types of marine mammals and all sources of disturbance." (Richardson, et al., 1995, p. 242, citing, MacArthur, R.A., V. Geist and R.H. Johnston. 1979. *Factors influencing heart rate in free-ranging bighorn sheep: A physiological approach to the study of wildlife harassment. Can. J. Zool.* 57(10):2010-2021).

In most studies, little or no information has been obtained about the duration or biological significance of altered behavior after disturbance (Richardson, et al., 1995, p. 242). This is a very serious base line research need in the Arctic. The AEWC has requested support for this research for more than 20 years.

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Responses of marine mammals to airgun noise at long range in coastal waters of British Columbia and Washington State

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Running title: Long-range responses of marine mammals to airgun noise

Abstract

Effects of seismic survey noise on marine mammals must be understood to ensure appropriate mitigation. This study examined effects of large airgun arrays on behaviour of marine mammals in the waters of British Columbia, Canada and Washington State, USA, using a small boat to monitor out to long ranges (1 to > 70 km from the source vessel). The survey was scheduled to minimise probability of marine mammal presence, which mitigated environmental impacts but also limited sample size. Received noise levels near marine mammals were measured rather than predicted, to reflect levels actually received in these geographically complex, near-shore waters. Although airguns concentrate energy at low frequencies, noise was detectable above ambient to at least 100 kHz. A significant relationship was observed between the magnitude of behavioural response and peak-to-peak received level. Response appeared to vary by species, but sample size prevented rigorous comparison among all species. Species with similar audiograms exhibited markedly different response patterns, suggesting that audiograms alone will not predict which species are most disturbed by acoustic stimuli. The long distances at which behavioural responses were observed (>60 km for harbour porpoises), along with counter-productive behaviour that occasionally brought individuals into higher-intensity acoustic zones, indicate that long ramp-up times would be required to prevent harmful exposure. Scheduling surveys around seasonal distribution patterns of marine mammals, limiting exposure periods, and routing airguns to minimise risk of stranding may be more important than monitoring safety zones to prevent injuries and death.

KEYWORDS: AIRGUN, BEHAVIOUR, CETACEAN, MARINE MAMMAL, NOISE, SEISMIC SURVEY

INTRODUCTION

High intensity sound is a useful tool in marine geophysical research. It has been used in seismic surveys to map sub-seafloor structures (e.g. Brocher et al. 1999), to perform acoustic tomography, and to communicate among marine equipment (Elisseeff et al. 1999). Richardson et al. (1995) reviewed the effects of noise on marine mammals, and more recent updates that focus on cetaceans have been reported by Nowacek et al. (2007), Southall et al. (2007) and Weilgart (2007). Recent work has quantified the extent to which cetacean communication may be masked by chronic noise (Clark et al. 2009), but much of the concern about intense, pulsed sounds has to do with their ability to generate behavioural responses or more serious effects (Southall et al. 2007). Ongoing concern about the effects that noise could have on protected species such as marine mammals led to efforts to establish safety standards. Such efforts have focused on the potential for noise to cause acoustic trauma leading to immediate injury or death (Federal Register 2005). However, behaviourally-mediated effects of noise, including seismic survey noise (IWC 2004, Taylor et al. 2004, Hildebrand 2005), may lead to injury or death through other mechanisms such as stranding (e.g. Frantzis 1998, NOAA & US Navy 2001, Brownell et al. 2004) and decompression sickness (Jepson et al. 2003, Fernández et al. 2005, Cox et al. 2006). These consequences sometimes occur at much lower exposure levels than are thought to cause temporary threshold shifts ('TTS', Hildebrand, 2005). Still lower levels of noise may cause effects that, while not directly resulting in injury, can contribute to harm to marine life through indirect mechanisms such as stress (Romano et al. 2004), displacement from habitat (Morton & Symonds 2002, Olesiuk et al. 2002), and potential energetic consequences of disrupting whales' feeding activities or movement patterns (Williams, Lusseau & Hammond 2006). For highly social odontocetes, even small levels of anthropogenic mortality can affect the functioning of the social network

as a whole (Williams & Lusseau 2006) and may threaten the viability of small populations (Wade & Angliss 1997).

Southall et al. (2007) proposed a scale for scoring behavioural responses to facilitate a more nuanced consideration of their biological significance. The ordinal scale goes from 0 (no visible response) to 9 (for the strongest response). Levels of noise sufficient to cause responses high on the scale are more likely to interact with environmental factors to result in increased rates of serious injury or death.

Stone & Tasker (2006) performed an analysis of over 200 studies of marine mammal behaviour in the presence of airguns in the North Atlantic. Direction of movement relative to the noise source is one of the behavioural endpoints they analysed. The authors noted stronger responses in small odontocetes than large mysticetes. This was unexpected, as mysticetes are thought to be better specialised than odontocetes to hear the low frequencies at which airgun noise is most intense. Stone & Tasker (2006) hypothesised the presence of high frequencies in airgun blasts to help explain the unexpected responses of odontocetes, and postulated that effects might extend well beyond the 8 km observation range limit in their study. Unfortunately, all of the observations in the Stone & Tasker (2006) report were made from the seismic survey (source) vessel itself, so little information was available on the stimulus (i.e., the received level) to which the animals were responding and no observations could be made at very large distances. In fact, a recurring theme in the literature on responses of cetaceans to anthropogenic noise is an absence of quantitative data on the received levels of noise (Nowacek et al. 2007). Certainly, having information on received noise level is crucial to plotting dose-response curves (Nowacek et al. 2007), but it is also important to have information on the tolerance of various species to noises of different intensity (Weilgart

2007). Some gaps in the literature to date include studies in which exposure to high frequency noise could be detected and behavioural responses at long distances were recorded.

In March 1998, the United States Geological Survey (USGS), in collaboration with a number of other government and academic institutions, conducted seismic surveys in the Strait of Juan de Fuca, Strait of Georgia, Puget Sound, Hood Canal, and other marine waters in British Columbia and Washington to investigate earthquake hazards. The project was named SHIPS (Seismic Hazards Investigations in Puget Sound) and employed an array of airguns with a total capacity of up to 110 L. Prior to scheduling the survey, USGS consulted with marine biologists to evaluate the biological implications of alternative timings and routes to determine the one likely to result in the least impact. Baseline condition of the habitat was determined in the course of long-term projects in the region (e.g., Bigg et al. 1990 and long-term field research conducted by Center for Whale Research, Cascadia Research Collective and others). In addition to monitoring marine mammals from the seismic survey vessel from which possible responses to high-intensity noise could be observed, the monitoring protocol also called for observations from other platforms to allow marine mammal monitoring up to tens of kilometers distant from the airgun array where responses to lower levels of noise might occur. Post-exposure monitoring was also planned to determine whether any effects occurred that were not apparent during the survey itself through continuation of long-term studies and consultation with the regional stranding network (J. B. Norberg, personal communication). This process was considered by the participants as a model that could be used for planning future seismic surveys and accompanying mitigation, monitoring, and noise impact studies.

The topographic complexity of the inshore waters was expected to result in a complex relationship between received level and distance. Therefore, received sound levels and

spectra were measured where possible, and this allowed measuring deviation of measured sound levels from a best-fit spreading loss model.

The study area is inhabited by a variety of marine mammal species, including: pinnipeds, such as harbour seals *Phoca vitulina*, California sea lions *Zalophus californianus* and Steller sea lions *Eumetopias jubatus*; odontocetes, such as killer whales *Orcinus orca*, harbour *Phocoena phocoena* and Dall's porpoises *Phocenoides dalli*; and mysticetes, such as gray *Eschrictus robustus* and common minke whales *Balaenoptera acutorostrata*. Each of these taxa has different auditory sensitivities, and thus expected to have different sensitivities to airgun noise (Richardson et al. 1995). The presence of this variety of species therefore presented the opportunity to conduct a taxonomically diverse study of the effects of airgun noise on marine mammals. However, by scheduling the survey when marine mammal presence was at a minimum, the number of groups of each species exposed to airgun noise was expected to be low.

In some respects, this situation forms a conundrum. The permitting procedure under the US Marine Mammal Protection Act led to a paradigm shift occurring in the policy and science arenas surrounding marine mammals and noise, in which reduced power sources and non-lethal end points are used for research directly on marine mammals. Further, researchers conducting geophysical studies are required to minimise 'incidental takes' of marine mammals, both in terms of the number of animals exposed and in terms of the intensity of exposure. From an impact-assessment standpoint, though, this limits the statistical power to detect effects of intense noise on marine mammals during monitoring of such studies. A consequence is that simplifying assumptions have been made by management agencies, such as the National Marine Fisheries Service's assumption that species with similar phylogenetic

history and hearing ability will respond to noise in similar ways (Southall et al. 2007), but these assumptions need to be tested as new data become available.

It is important to identify the received noise levels at which marine mammals do not show obvious responses, show responses that are only likely to result in harm with chronic exposure or short-term exposure in a limited set of conditions, as well as those levels of intense noise that unconditionally cause serious harm, such as temporary or permanent threshold shifts, stranding or death. While ongoing government and industry efforts, including control-exposure experiments attempt to estimate the points along the noise spectrum at which lethal takes and serious injuries occur for various species, the goal of our study was to provide information on long-range responses of multiple marine mammal species to relatively low received levels at long ranges.

METHODS

Seismic Survey

Two vessels, the *R.V. Thomas Thompson* ('TT'), which towed the airgun array, and the *R.V. John P. Tully* ('JPT'), which towed a receiving streamer, were involved in the seismic research (see Brocher et al. 1999, Ramachandran et al. 2004) and were platforms for observations of marine mammal behaviour. In addition, a smaller vessel served as a platform for some more detailed observations well beyond the field of view of the ship, and allowed measurement of actual received sound levels near marine mammals. This paper describes the observations recorded from that smaller vessel.

Approximately 33,000 airgun blasts were generated, typically at 20- or 40-second intervals, from 10 to 24 March 1998. The survey consisted of generating shots, which were relatively omni-directional in the horizontal plane, with a towed array of 13 or 16 air guns with a total volume of 79 or 110 L, respectively. Maximum theoretical source level for the larger array was calculated to be on the order of 260 dB (re 1 µPa at 1m), and signals could be recorded up to 370 km away. The seismic survey methods are described in detail in Brocher et al. (1999). The seismic survey vessel that towed the array was a platform for observing marine mammals close to the airgun array. Observers aboard the seismic survey vessel used binoculars to assist with observation by day and an AN/KAS-1A chemical weapons detector to observe thermal infrared images at night. The infrared gear was also used outside the survey period to test its effectiveness when marine mammal encounter rate was high. Methods and results of this research component are detailed elsewhere (Calambokidis, Bain & Osmek 1998).

Acoustical Monitoring

Two sampling regimes were used. The first involved measuring ambient noise and received sound levels at selected distances and orientations from the airgun array, and at locations of interest in the study of sound propagation, such as on banks to examine upslope enhancement and nearshore shadow zones, and beyond reefs to examine high-pass filtering by shallow water. The second regime involved measuring ambient noise and sound levels from locations near marine mammals to produce a best estimate of actual noise exposure. Due to complicated sound propagation in inshore waters, measurements of the actual sound field near marine mammals were used rather than modelled levels. Measurements were based on two-minute recordings to allow both determination of received level and ambient noise. These recordings provided an opportunity to try to detect marine mammals using passive acoustic monitoring.

The recording system consisted of a Bruel & Kjaer 8105 hydrophone connected to a B&K 2635 charge amplifier. The output of the charge amplifier was connected a Tucker-Davis Technologies AD2 digitising module, which was connected to a TDT AP2 signal processing board. The waveform was digitised at a sample rate of 200kHz, yielding a maximum analysed frequency of 100 kHz, and stored directly to disk on an IBM PC-compatible notebook computer with docking station. In parallel to the input to the analog-digital converter, the signal was also sent to an oscilloscope, to allow monitoring of signal quality. The oscilloscope was used to amplify the signal and output it to an amplified speaker to allow auditory monitoring of the signal. A sine-wave inverter was used to power the analog signal processing equipment, and a modified sine-wave inverter was used to power the computer. The recording depth was 7 m.

The digitised waveform was read from disk and analysed using custom software. Blasts were reviewed aurally and in time-frequency amplitude mode to identify the most intense portion. Then a 10.24 msec segment was selected to be Fourier transformed to determine the frequency spectrum, and for calculation of peak-to-peak and RMS sound levels.

The acoustics vessel was a launch carried aboard the *Tully*. The launch was placed in the water and a sound level measurement was performed. The launch then travelled along a line at approximately 20 km/h until either marine mammals were closely approached, or the launch had travelled 10 km. Then the next acoustic measurement was made. When marine mammals were sighted, behavioural observations were made in as much detail as possible. In many cases, this was minimal (species, group size, behaviour state, location, and direction of travel). In others, what appeared to be the same individuals were followed for tens of minutes

(allowing notation of behavioural events and narrative comments in addition to the basic information), and multiple sound level measurements were obtained in their vicinity.

The goal was to observe marine mammals exposed to sounds across as wide a range as possible of received levels, in order to identify a threshold above which groups of individuals in each species behaved in a consistent fashion. Thus, the launch travelled ahead of the seismic survey vessel and then turned to approach the seismic survey vessel and passed behind it, before returning to a position near the seismic survey vessel at the end of the observation period. This allowed observing marine mammals exposed to low but increasing levels noise while ahead of the airguns, and low and decreasing levels of noise while behind the airguns. In addition, marine mammals were observed while exposed to moderate levels of noise as the launch moved between the endpoints of its route.

Position of the recording vessel was determined using differential GPS. Position of the airguns was approximated by the DGPS position of the *Thomas Thompson*. The distance between these two locations was calculated to determine the distance between the source and the recording vessel. When possible, the recording vessel was positioned near marine mammals, to determine actual noise exposure.

A regression line for received level as a function of distance was calculated. Points that deviated from this line by about 6 dB or more were analysed for possible propagation anomalies due to factors such as poor shallow water propagation, reflections off sides of channels, and diffraction.

Scoring behaviour

Field notes described behaviour when marine mammals were first observed. These notes included time, location, species, group size, behaviour state, and direction of travel. The observations continued during approach to the sound measurement location, sound recording, and initial travel to the next observation station, allowing several minutes to review the accuracy of behavioural classification. Observations were subsequently assigned a score based on a response severity scale (Southall et al. 2007). Pinnipeds that were hauled out were not included in the statistical analysis of data in Table 1. Other observations excluded from the analysis were 3 cases in which species identity was uncertain.

By scoring behaviour out to distances of tens of kilometres from the noise source, responses were evaluated to determine their magnitudes at a variety of received levels. While the sample sizes within species were generally small (reflecting the success of scheduling the seismic survey at the time of year when marine mammal densities were likely to be minimal), a response score at an intermediate received level suggests that a response at least as strong would be expected at all higher received levels but would be no stronger at all lower received levels. Thus observations at maximal and minimal levels provided a check on the interpretation of observations at intermediate levels.

Behavioural studies face methodological concerns due to the subjectivity of observers. The same observer (D.E.B.) scored each observation, so inter-observer reliability was not a concern. Secondly, the observer was unaware of the received level when recording field notes, because the measurement of the stimulus (the received level) was made in the laboratory, long after the behavioural observations were recorded.

Behavioural data were analysed in R using a proportional odds logistic regression[1] (Venables and Ripley 2002), which is well suited to an ordered factor response like the 0-9 severity scale (Southall et al. 2007). Candidate explanatory variables were: species, range (km); peak-to-peak received level (referenced to 1 μPa); and RMS received level.

RESULTS

Received sound level as a function of distance

Approximately one-third of the sound level measurements deviated by 6 dB or more from values predicted by simple spreading loss models. Values lower than expected could be attributed to shadow zones. Shallow water was sufficient to reduce sound levels, and land formed an effective barrier to direct propagation. Most cases of higher-than-expected levels might be attributed to upslope enhancement. In addition, long-range propagation through the Strait of Juan de Fuca was better than expected, resulting in the airguns being clearly audible at ranges of 60-70 km, the maximum distance at which signal measurement was attempted in the biological component of the study (Fig.1).

The airguns produced energy above ambient levels at all frequencies up to 100 kHz (the highest frequency measured), although the peak frequency was quite low. Low frequencies were filtered out by propagation through shallow water, and high frequencies attenuated faster with distance. A sample spectrum is shown in Fig. 2.

[1] http://pbil.univ-lyon1.fr/library/MASS/html/polr.html

Marine mammals sighted from the recording vessel

Marine mammal sighting locations and the track line of the vessel towing the airgun array are shown in Fig. 3. RMS levels were generally 9-14 dB lower than peak-to-peak levels. Peak-to-peak received levels explained more of the residual deviance in response severity in the proportional odds logistic regression model, but had only marginally lower AIC than models that contained RMS level (ΔAIC=0.51) or range (ΔAIC=0.11). A model that used an interaction term of Species*ReceivedLevel failed to converge.

Marine mammals exhibited a variety of responses to airgun noise that generally declined with received level, according to the proportional odds logistic regression model. At the highest noise levels at a which marine mammals of a given species were observed, all individuals moved away from the noise source, but at lower noise levels orientation was less consistent. However, the threshold at which orientation became variable appeared to differ among species.

Responses of six species of marine mammals for which received sound levels were measured are summarised in Table 1 and Fig. 4.

Harbour Seal. Although this species was observed at received levels up to approximately 190 dB re 1 µPa p-p, individuals were generally moving away from the airguns at exposure levels above 170 dB re 1 µPa p-p. A common behavioural change noted was floating at the surface and visually orienting toward the airguns. Individuals were sometimes observed closer together in the water than is typically the case. These behaviours were counted as

responses because harbour seals orienting randomly were unlikely to orient toward the seismic survey vessel and they are rarely gregarious except when hauled out on land.

California Sea Lion. This species was observed at received levels up to approximately 180 dB re 1 µPa p-p. All individuals were moving away from the airguns at the lowest exposure levels observed.

Steller Sea Lion. This species was recorded at received levels up to about 170 dB re 1 µPa p-p, but all individuals were moving away from the airguns at this level. One group moved away at normal swimming speed, one moved away rapidly, and one displayed behaviour typical when searching for a haul-out site, although none was available in the steep-walled location.

Gray Whale. This species was observed at received levels up to approximately 170 dB re 1 µPa p-p, but no behavioural response was obvious at this level. Most individuals milled with variable orientation relative to the airgun array. Although one individual was moving away from the airguns, it was actually moving toward higher exposure levels (that is, moving into deeper water outside the near-shore shadow zone).

Dall's Porpoise. This species was observed at received levels up to approximately 180 dB re 1 µPa p-p. Individuals were moving away from the airguns at the highest exposure levels. This species initially responded by moving away while travelling in the same direction as the seismic survey vessel, but as the airguns got closer (the towing speed exceeded the sustained swimming speed of this species), individuals changed direction to move at right angles to the path of the airguns. Once the airguns passed the porpoises, they turned again and moved in

the opposite direction to the seismic survey vessel's path. Travel speed was higher during the orthogonal and reverse movements than during the initial avoidance response.

Harbour Porpoise. This species was recorded at received levels up to 155 dB re 1 µPa p-p, and all individuals were moving away at this level. Although the number of independent groups observed was small, these groups were unusually large, synchronous in their surfacings, and consistently directional in their travel, suggesting these individuals were responding to the airguns at distances over 60 km. Harbour porpoises normally travel singly or in small groups in this location. When in groups, it is rare for many individuals to surface at the same time, and direction changes are frequent.

Statistical comparison of species pairs. An unpaired t-test with Welch's correction showed a significant difference between Dall's and harbour porpoises in the received level at which they were observed ($p<0.05$, $t=2.80$, d.f.=7). This is consistent with the qualitative observation that all harbour porpoises showed strong responses at received levels at which Dall's porpoises showed no observable response. While a similar qualitative pattern was also observed for the California and Steller sea lion species pair, the sample was too small for a quantitative analysis.

Acoustic detections. None of the marine mammals observed visually was detected acoustically, even at close range, indicating that passive acoustic monitoring alone would have been inadequate to reliably detect the species of marine mammals encountered in this study. Although the hydrophone was only monitored for a few minutes at a time, rather than continuously, it was monitored cumulatively for hours over the course of the study when marine mammals were known to be present.

Efficacy of survey timing. Survey timing was chosen to minimise impact on marine mammals in general and killer whales in particular. No killer whales were observed during the seismic survey.

DISCUSSION

This study has generated several results that can be used to inform ongoing efforts to predict impacts of noise on marine mammals. These include: 1) airguns generated substantial noise at high frequencies; 2) complex propagation pathways between source and receiver confound the ability to predict received levels as a function of distance; 3) passive acoustic monitoring offered limited utility in detecting marine mammals; 4) species with similar phylogenetic history and hearing ability responded differently to received noise; 5) responses were detected to low received levels and at long range; and 6) not all species responded to noise by avoiding it upon first exposure.

This study found that while airguns concentrated their sound output at low frequencies, substantial high frequency energy (to at least 100 kHz) was also present. Detection of high frequencies was facilitated by using equipment designed to record ultrasonic vocalizations, large dynamic range of the recording, and making some measurements in shallow water where low frequencies were filtered out by the environment, increasing the relative strength of the high frequency end of the spectrum.

Long-distance propagation in narrow channels was more efficient than would be expected from simple spreading and absorption loss models, suggesting the sides of channels served as something of a waveguide rather than allowing all sound to spread into the substrate.

Barlow and Gisiner (2006) also concluded that passive acoustic monitoring alone would have limited value.

It is important that Dall's and harbor porpoises, species with similar hearing ability, differed in the noise level tolerated and the noise level at which strong behavioural changes were observed. Parallel observations of Steller and California sea lions suggest a larger sample is likely to show similar differences between that species pair. California sea lions and Dall's porpoises are known for their tolerance of human activities (Richardson et al. 1995). Similarly, Stone & Tasker (2006) reported that white-beaked dolphins *Lagenorhynchus albirostris* were more than four times as likely to move away than toward shooting airguns, while Atlantic white-sided dolphins *L. acutus* exhibited no difference in direction of movement relative to shooting airguns.

Gray whales were expected to be the most responsive to airgun noise, because they are believed to have the best sensitivity to low frequency sound among the species observed (Richardson et al. 1995). However, gray whales appeared to be more tolerant of airgun noise than harbour porpoises, the species with the highest frequency of best sensitivity observed in this study, and Steller sea lions (Figure 4). Similarly, Stone & Tasker (2006) reported mysticete responses to airguns were less obvious than responses of small odontocetes. That is, behavioural responses to noise did not correlate well with expectations based on estimated hearing sensitivity to low frequency sound for the species studied. Au (1993) reviewed odontocete hearing and found some audiograms appeared to be limited by ambient noise, so ambient noise may offset low-frequency hearing superiority at times.

For reasons stated above, use of smaller safety zones for species believed to have poor low-frequency hearing does not appear to be well founded. In fact harbour porpoises appeared to be the species least tolerant of airgun noise (Figure 4). It is worth noting that harbour porpoises were the only species in Stone & Tasker's (2006) study that were never reported moving toward shooting airguns. While "…one of the most important aspects to assess the effects of high intensity sounds on marine mammals is to understand their hearing sensitivity" (Federal Register 2007), our results suggest that other aspects of behavioural ecology may be more important. Behavioural responses are not just a function of hearing ability, but rather are mediated by tolerance, sensitisation and habituation (Bejder et al. 2009).

Strong behavioural changes occurred at long ranges (>60 km in harbour porpoises). This is consistent with recent information that low-frequency, pile-driving noise caused habitat displacement in harbour porpoise at ranges exceeding 20km (Tougaard et al. 2009). The

potential for strong behavioural changes to lead to injury or death (Jepson et al. 2003, Fernández et al. 2005) suggests that safety zones when behavioural implications are considered need to be far larger than the size thought to be necessary to prevent hearing loss. For some species, that safety zone will need to be larger than the range at which animals can be seen from seismic survey vessels. Even with a 180 dB safety zone, this could require observing marine mammals on the order of 3 km or more from the seismic survey vessel.

The long range at which some species appeared to show evasive behaviour suggests that displacement from habitat and the duration of that displacement need to be considered when estimating cumulative effects (Tougaard et al. 2009). Further, habitat can be significantly degraded before marine mammals will leave it for alternate habitat that is poorer in quality (Morton & Symonds 2002). In other words, population-level effects could occur in the absence of displacement, and displacement to poorer quality alternate habitat could result in population-level effects in the absence of immediate injury or death.

Dall's porpoises observed in this study followed curved paths rather than moved directly away from the source. Harbour seals commonly stopped to orient visually rather than moving continuously away. Bain (cited in US Navy 2004) observed killer whales remaining in a shadow zone rather than moving away while being approached by a vessel emitting mid-frequency sonar. That is, avoidance tactics adopted by marine mammals were not optimal for limiting the maximum exposure received as noise sources passed by. Direct movement away from noise sources may not occur until it is too late to limit received noise to safe levels. The fjord habitat where this study took place also restricted movements perpendicular to the array's path, and prevented individuals from moving as far away as conspecifics might in open water.

The long range at which strong behavioural changes were observed indicates that 20-30 minute ramp-up procedures are inadequate, because marine mammals cannot sustain swimming speeds sufficient to leave the area before the noise source reaches full power. Species swimming at 6-10 km/h would require roughly 2-3 hours to travel a distance of 20 km.

Southall et al.'s (2007) response severity scale provides a useful framework for classifying behavioural responses, but few statistical models cope well with ordinal response variables. The proportional odds logistic regression approach offers a useful framework that retains information in the rank of the response variable, but large sample sizes will be needed to fit models that allow interactions between species and received level. In the future, modifications to multinomial families of generalised linear or additive models could be developed to allow more flexible analyses that are robust to missing values or small sample size that will always hinder studies of this kind.

Although strong behavioural changes were observed even at long distances, the precautions utilised in the SHIPS survey were sufficient to prevent any detectable marine mammal mortalities during the survey, and none were reported subsequently by the regional marine mammal stranding network (Norberg, personal communication). Scheduling surveys at a time when protected species are minimally present is an important mitigation step that contributed to the success of SHIPS and could contribute to the success of future surveys. The availability of baseline data from many long-term studies in the region made such

scheduling possible. The results of this and similar studies provide a partial basis for establishing relationships between received level and species-typical response patterns. In turn, these relationships can be used to estimate the likelihood that behavioural changes will ultimately lead to physical harm depending on geographic setting and whether exposure is scheduled to last hours, days, or months.

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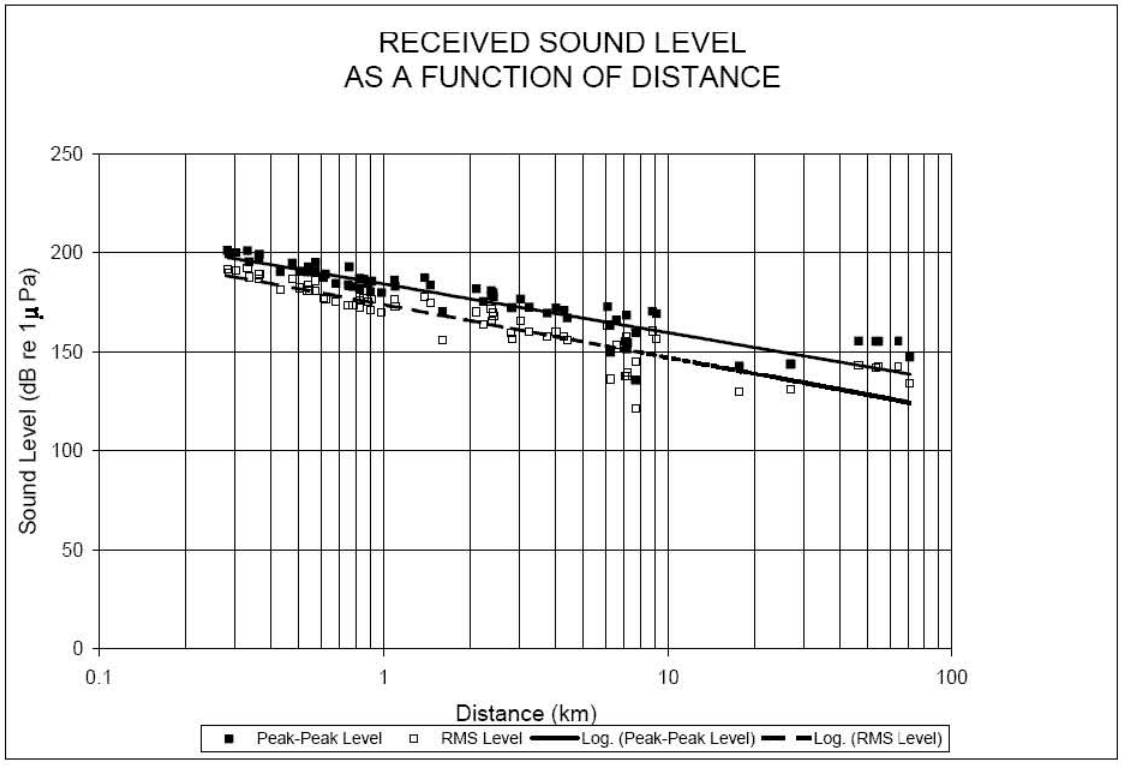
641Table 1.

Time	Species	Group Size (min. est.)	RMS	P-P	Range (km)	Response Score	Corresponding Behaviour
1117	Harbour seal	1	121.3	135.5	7.7	n/a	hauled out
1421	Harbour seal	1	129.8	142.8	17.8	0	no observable response
1349	Harbour seal	1	131	143.5	26.9	1	brief orientation response
1711	Harbour seal	2	136	149.5	6.3	n/a	hauled out
1111	Harbour seal	41	137.3	151.3	7.2	n/a	hauled out
751	Harbour seal	1	143.2	155.3	46.5	3	prolonged orientation behaviour
1659	Harbour seal	1	145	159.3	7.7	6	minor individual avoidance
1717	Harbour seal	1	149.5	162.9	6.2	3	prolonged orientation behaviour
1027	Harbour seal	1	153.1	165.9	6.6	3	prolonged orientation behaviour
1624	Harbour seal	1	155.6	166.9	4.4	3	prolonged orientation behaviour
1457	Harbour seal	43	156.1	169.1	9.1	3	prolonged orientation behaviour and hauled out
1204	Harbour seal	2	157.5	169.3	3.8	3	minor change in locomotion
1131	Harbour seal	2	157.8	170.7	4.3	6	minor group avoidance
1510	Harbour seal	1	159.5	172.1	2.8	6	no observable response
1150	Harbour seal	1	160	172.4	3.2	6	minor individual avoidance
1645	Harbour seal	1	163.5	175.4	2.2	3	prolonged orientation behaviour
1643	Harbour seal	2	177.5	187.4	1.4	6	minor group avoidance
956	Harbour seal	2	183.2	192.7	0.8	6	minor group avoidance
1441	Harbour seal	1	185.8	194.9	0.6	3	prolonged orientation behaviour

1726	California SL	1	170	181.8	2.1		0	no observable response
1435	California SL	1	172.8	182.9	1.1		6	minor individual avoidance
1452	California SL	1	176.4	186.1	1.1		6	minor individual avoidance
956	California SL	1	183.2	192.7	0.8	n/a		no record
1117	Steller SL	100	121.3	135.5	7.7	n/a		hauled out
1349	Steller SL	1	131	143.5	26.9		0	no observable response
1111	Steller SL	100	137.3	151.3	7.2	n/a		hauled out
1707	Steller SL	1	155.6	170.2	1.6		7	clear anti-predator response
1039	Steller SL	3	160.1	171.9	4.0		6	minor individual avoidance
1210	Gray whale	1	139.3	154.3	7.2		0	no observable response
1012	Gray whale	1	137.7	155	7.0		0	no observable response
1039	Gray whale	1	160.3	170.3	8.8		0	no observable response
1257	Gray whale	1	163.4	172.5	6.1		0	no observable response
1349	Dall's porp.	3	131	143.5	26.9		0	no observable response
1649	Dall's porp.	2	157.4	168.3	7.1		0	no observable response
1340	Dall's porp.	4	156.6	172.2	2.8		6	minor group avoidance
1311	Dall's porp.	4	165.4	176.5	3.0		6	minor group avoidance
1445	Dall's porp.	4	169.5	179.8	2.4		6	minor group avoidance
1314	Dall's porp.	4	171.3	180.8	2.4		6	minor group avoidance
1349	Harbour porp.	3	131	143.5	26.9		0	no observable response
726	Harbour porp.	7	142.5	155.2	54.7		7	severe and sustained avoidance
734	Harbour porp.	7	142	155.2	53.5		7	severe and sustained avoidance
702	Harbour porp.	1	142.4	155.3	64.8		7	severe and sustained avoidance
758	Unid. porp.	3	167.9	177.8	2.4	n/a		no record

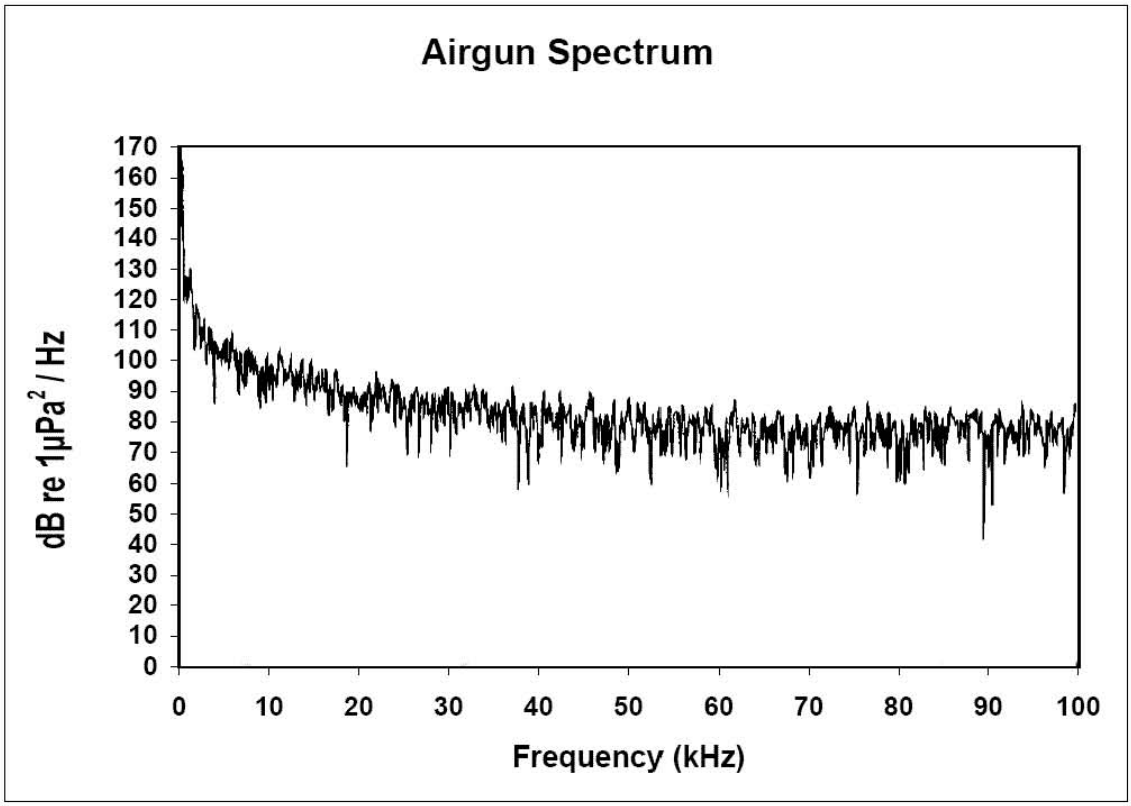
1305	Unid. porp.	3	165.6	178.4	2.4	0	no observable response

642Figure 1



643

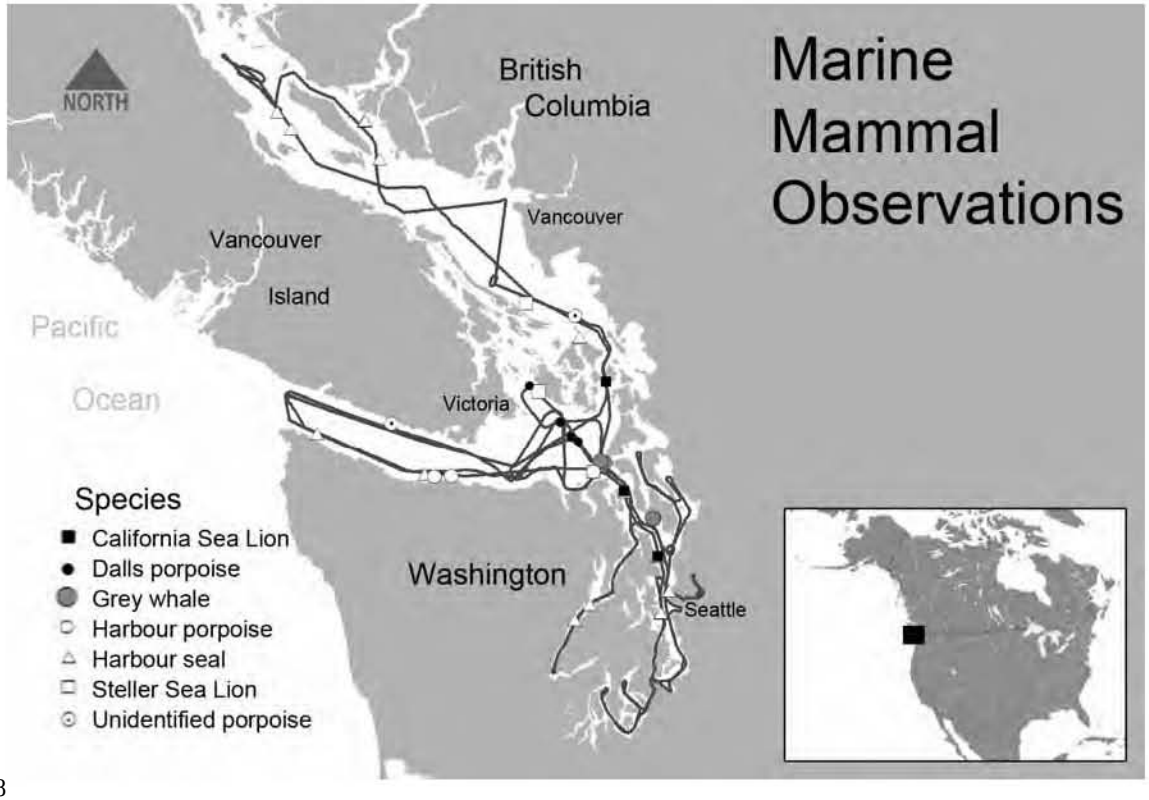
644Figure 2



645

646Figure 3.

647



648

649Figure 4

651