

DEPARTMENT OF COMMERCE**National Oceanic and Atmospheric Administration**

RIN 0648-XP00

Small Takes of Marine Mammals Incidental to Specified Activities; Open-water Marine Survey Program in the Chukchi Sea, Alaska, During 2009–2010

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Notice; issuance of an incidental take authorization.

SUMMARY: In accordance with the Marine Mammal Protection Act (MMPA) regulations, notification is hereby given that NMFS has issued an Incidental Harassment Authorization (IHA) to Shell Offshore Inc. and Shell Gulf of Mexico Inc., collectively known as Shell, to take, by harassment, small numbers of 12 species of marine mammals incidental to an open-water marine survey program, which includes shallow hazards and site clearance work and strudel scour surveys, in the Chukchi Sea, Alaska, during the 2009/2010 Arctic open-water season.

DATES: Effective August 19, 2009, through August 18, 2010.

ADDRESSES: A copy of the application containing a list of the references used in this document, two addenda to the application, NMFS' Environmental Assessment (EA) and Finding of No Significant Impact (FONSI), and the IHA may be obtained by writing to the address specified above, telephoning the contact listed below (see **FOR FURTHER INFORMATION CONTACT**), or visiting the Internet at: <http://www.nmfs.noaa.gov/pr/permits/incidental.htm#applications>.

Documents cited in this notice may be viewed, by appointment, during regular business hours, at the aforementioned address.

FOR FURTHER INFORMATION CONTACT: Candace Nachman, Office of Protected Resources, NMFS, (301) 713–2289 or Brad Smith, NMFS, Alaska Region, (907) 271–3023.

SUPPLEMENTARY INFORMATION:**Background**

Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified

geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed authorization is provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s), will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant), and if the permissible methods of taking and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth. NMFS has defined “negligible impact” in 50 CFR 216.103 as “... an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival.”

Section 101(a)(5)(D) of the MMPA established an expedited process by which citizens of the U.S. can apply for an authorization to incidentally take small numbers of marine mammals by harassment. Except with respect to certain activities not pertinent here, the MMPA defines “harassment” 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 [Level A harassment]; 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 [Level B harassment].

Section 101(a)(5)(D) establishes a 45-day time limit for NMFS review of an application followed by a 30-day public notice and comment period on any proposed authorization for the incidental harassment of marine mammals. Within 45 days of the close of the comment period, NMFS must either issue or deny the authorization.

Summary of Request

On December 15, 2008, NMFS received an application from Shell for the taking, by Level B harassment only, of small numbers of several species of marine mammals incidental to conducting an open-water marine survey program during the 2009/2010 Arctic open-water season in the Chukchi Sea. Shell plans to conduct site clearance and shallow hazards surveys and a strudel scour survey in the Chukchi Sea. These surveys are a continuation of those conducted by Shell in the Chukchi Sea in 2008. Shell's December 2008, application also requested MMPA coverage for site

clearance and shallow hazards surveys, an ice gouge survey, and a strudel scour survey in the Beaufort Sea and an ice gouge survey in the Chukchi Sea for the 2009/2010 season. However, in an addendum to the IHA application submitted to NMFS on March 10, 2009, Shell indicated that it cancelled all survey programs for the Beaufort Sea and the ice gouge survey for the Chukchi Sea in 2009. Shell submitted a second application addendum on May 19, 2009, indicating that Shell will utilize an array of 4 x 10 in³ guns (40 in³ total discharge volume) instead of the 2 x 10 in³ array (20 in³ total discharge volume).

Site clearance and shallow hazards surveys will evaluate the seafloor and shallow sub-seafloor at prospective exploration drilling locations, focusing on the depth to seafloor, topography, the potential for shallow faults or gas zones, and the presence of archaeological features. The types of equipment used to conduct these surveys use low level energy sources focused on limited areas in order to characterize the footprint of the seafloor and shallow sub-seafloor at prospective drilling locations.

Description of the Specified Activity*Chukchi Site Clearance and Shallow Hazards Surveys*

Site clearance and shallow hazards surveys of potential proposed locations for exploration drilling will be executed as required by the Minerals Management Service's (MMS) regulations. These surveys gather data on: (1) bathymetry; (2) seabed topography and other seabed characteristics (e.g., boulder patches); (3) potential geohazards (e.g., shallow faults and shallow gas zones); and (4) the presence of any archeological features (e.g., shipwrecks). Site clearance and shallow hazards surveys can be accomplished by one vessel with acoustic sources. A detailed overview of the activities of this survey was provided in the Notice of Proposed IHA (74 FR 26217, June 1, 2009). Since publication of that notice, Shell updated two pieces of information. First, the *R/V Mt. Mitchell* will be utilized as the source vessel for the site clearance and shallow hazards surveys. The *R/V Mt. Mitchell* is a diesel powered vessel, 70 m (231 ft) long, 12.7 m (42 ft) wide, with a 4.5 m (15 ft) draft. Second, the specific prospects within Outer Continental Shelf (OCS) Lease Sale (LS) 193 have been identified. Shell will conduct the surveys at the Burger and Crackerjack prospects and, if time and weather conditions permit, at SW Shobill. Additional information is also

contained in Shell's application and application addenda, which are available for review (see **ADDRESSES**).

Chukchi Strudel Scour Survey

During the early melt, the rivers begin to flow and discharge water over the coastal sea ice near the river deltas. That water rushes down holes in the ice ("strudels") and scours the seafloor. These erosional areas are called "strudel scours". Information on these features is required for prospective pipeline planning. Two proposed activities are required to gather this information: aerial survey via helicopter overflights during the melt to locate the strudels and strudel scour marine surveys to gather bathymetric data. Additional information was provided in the Notice of Proposed IHA (74 FR 26217, June 1, 2009) and Shell's application (see **ADDRESSES**).

Comments and Responses

A notice of receipt of Shell's MMPA application and NMFS' proposal to issue an IHA to Shell published in the **Federal Register** on June 1, 2009 (74 FR 26217). That notice described, in detail, Shell's proposed activity, the marine mammal species that may be affected by the activity, and the anticipated effects on marine mammals. During the 30-day public comment period, NMFS received six comment letters from the following: the Marine Mammal Commission (MMC); Ocean Conservancy and Oceana; the Alaska Eskimo Whaling Commission (AEWC); the Inupiat Community of the Arctic Slope (ICAS); the North Slope Borough (NSB) Office of the Mayor and NSB Department of Wildlife Management (collectively "NSB"); and Alaska Wilderness League (AWL), Center for Biological Diversity, Defenders of Wildlife, Earthjustice, Natural Resources Defense Council, Northern Alaska Environmental Center, Pacific Environment, Sierra Club, The Wilderness Society, and World Wildlife Fund (collectively "AWL"), along with an attached letter from David E. Bain, Ph.D.

Both AEWC and NSB submitted several journal articles as attachments to their comment letters. NMFS acknowledges receipt of these documents but does not intend to address the specific articles themselves in the responses to comments. AEWC also submitted an unsigned, final version of the 2009 Conflict Avoidance Agreement (CAA). However, Shell signed the CAA on June 24, 2009. Some of NSB's comments were specific to the application and do not have a bearing on NMFS' determinations for issuing an IHA. For example, NSB pointed out that

Figure 1 in Shell's application failed to identify the Alaska Maritime National Wildlife Refuge north of Point Lay and asked that the figure be revised. Those comments have been passed on to Shell for consideration in future IHA applications. Any application specific comments that address the statutory and regulatory requirements or findings NMFS must make to issue an IHA are addressed in this section of the **Federal Register** notice. Additionally, some of NSB's comments concerned the Beaufort Sea operations or ice gouge surveys. As noted above and in the Notice of Proposed IHA (74 FR 26217, June 1, 2009), Shell notified NMFS that it did not intend to conduct these activities; therefore, no marine mammals will be taken. Comments on the Beaufort operations and Chukchi ice gouge survey are not addressed in this document.

General Comments

Comment 1: AWL believes that NMFS should not issue incidental take authorizations for oil and gas-related seismic surveying until NMFS and other agencies complete a comprehensive review of both the industrial activities and the marine resources of the Arctic. This review should ensure that critical information gaps relating to the Arctic are filled and that decisions made about Arctic activities are made in the context of a comprehensive plan for the region. In the interim, NMFS should not facilitate further potentially harmful seismic activity.

Response: In order to issue an authorization pursuant to Section 101(a)(5)(D) of the MMPA, NMFS must determine that the authorized activity will take only small numbers of marine mammals, will have a negligible impact on affected species or stocks, and will not have an unmitigable adverse impact on affected species or stocks for subsistence uses. If NMFS is able to make these findings, the Secretary is required to issue an IHA. In the case of Shell's activities for 2009/2010 (as described in the application, the Notice of Proposed IHA (74 FR 26217, June 1, 2009) and this document), NMFS determined that the authorized activity met the requirements of Section 101(a)(5)(D) of the MMPA. Additionally, as described later in this section and throughout this document, NMFS has determined that Shell's activities will not result in injury or mortality of marine mammals.

Comment 2: AWL, ICAS, and Ocean Conservancy and Oceana note that Shell's activities will occur on leases that were acquired in OCS LS 193, which was conducted pursuant to MMS'

2007–2012 Five-Year Leasing Program. This leasing program is part of on-going litigation. NMFS should not issue IHAs for activities on these leases until the litigation is resolved.

Response: NMFS is aware of the litigation in the U.S. Court of Appeals for the D.C. Circuit, but we disagree with the commenter's assertion that NMFS should not issue IHAs for activities on these leases until the litigation is resolved. Although the court issued an opinion vacating and remanding the 5-yr lease program to MMS, it also issued an order (on July 28, 2009) staying its mandate. MMS informed the court that it would complete remand proceedings as soon as possible and that, in the meantime, it would continue to review and act upon exploration plans for Chukchi Sea leases. MMS stated, however, that it would suspend activities under any approved plan pending the Secretary of the Interior's reconsideration decision on the remanded program, thereby halting all but data gathering ancillary activities on Chukchi Sea leases. Shell's 2009 operations are unaffected by the litigation because they are data gathering ancillary activities. Therefore, NMFS has concluded it was appropriate to issue an IHA to Shell for its 2009 seismic operations.

Comment 3: ICAS points out that Native communities in Alaska have long been ignored in the race to find and develop offshore oil and gas resources and that 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.

Response: Regulations at 50 CFR 216.104(a)(12) require applicants for IHAs in Arctic waters to submit a Plan of Cooperation (POC), which, among other things, requires the applicant to meet with affected subsistence communities to discuss the proposed activities. Additionally, for many years, NMFS has conducted the Arctic Open-water Meeting, which brings together the Federal agencies, the oil and gas industry, and affected Alaska Native organizations to discuss the proposed activities and monitoring plans. Local knowledge is considered at these times, and it is not too late for that knowledge to serve a useful purpose.

Comment 4: Executive Order 13175 requires Federal agencies to conduct government-to-government consultation when undertaking to formulate and implement policies that have tribal implications. Despite this explicit requirement, ICAS believes that 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 meet with ICAS and local Native villages on a government-to-government basis to discuss the proposed IHA, as well as appropriate mitigation and monitoring requirements.

Response: NMFS recognizes the importance of the government-to-government relations and has taken steps to ensure that Alaska Natives play an active role in the management of Arctic species. For example, NOAA and the AEWC co-manage bowhead whales pursuant to a cooperative agreement. This agreement has allowed the AEWC to play a significant role in the management of a valuable resource by affording Alaska Natives the opportunity to protect bowhead whales and the Eskimo culture and to promote scientific investigation, among other purposes.

In addition, NMFS works closely with Alaska Natives when considering whether to permit the take of marine mammals incidental to oil and gas operations. NMFS has met repeatedly over the years with Alaska Native representatives to discuss concerns related to NMFS' MMPA program in the Arctic, and has also taken into account recommended mitigation measures to reduce the impact of oil and gas operations on bowhead whales and to ensure the availability of marine mammals for taking for subsistence uses. Finally, NMFS has participated in Alaska Native community meetings in the past and will continue to do so, when feasible. NMFS will continue to ensure that it meets its government-to-government responsibilities and will work closely with Alaska Natives to address their concerns.

Comment 5: Ocean Conservancy and Oceana believe that Shell's activities could substantially affect marine mammals in an area already impacted by climate change and particularly vulnerable to ocean acidification. Approving an IHA in these circumstances would be contrary to NMFS' responsibilities under the law.

Response: NMFS believes that it has made all of the necessary determinations in order to issue an IHA pursuant to Section 101(a)(5)(D) of the MMPA. NMFS has determined that

Shell's activities will affect only small numbers of marine mammals, will have a negligible impact on the affected species and stocks, and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence purposes, provided the mitigation measures described later in this document are implemented. NMFS completed an EA to analyze the impacts of cumulative activities on the affected species in the action area, including climate change.

Comment 6: AEWC and NSB expressed three concerns with the timing of IHA applications. First, they ask that only one authorization be issued per calendar year or per operating season for work associated with a specific project. Secondly, NMFS should ensure that IHA applications are submitted at least 1 month prior to the April Open-water Meeting or comparable peer review meetings that may ultimately replace such meetings. This will allow Native communities to receive draft POCs and proposed mitigation measures sufficiently in advance of these meetings to allow for meaningful discussion of any identified major flaws, evaluation of suggested improvements that draw upon our particular local expertise, and consideration of appropriate peer reviewers. Lastly, they request that NMFS change the expiration date for authorizations so that a single calendar year is authorized rather than activities in the latter part of one calendar year and the early part of the following year.

Response: Regarding the first and third points, Section 101(a)(5)(D) of the MMPA allows NMFS to issue IHAs "for periods of not more than 1 year." There is no requirement that the period of effectiveness of an IHA fall within 1 calendar year or operating season. In instances where the period of effectiveness of an IHA would cover more than one operating season (i.e., there is considerable downtime between the start and finish of the operations), NMFS analyzes impacts for the entire extent of the operations when issuing the IHA. Regarding the second point about distribution of applications, NMFS cannot guarantee that all applications will be submitted to NMFS at least 1 month prior to the meeting. NMFS has a unique relationship with AEWC pursuant to a cooperative agreement. Pursuant to this agreement, NOAA is required to consult with AEWC on any action undertaken or proposed to be undertaken that may affect the bowhead whale and/or subsistence whaling. To that end, NMFS will make every effort to provide the AEWC with as much information as

possible prior to the Open-water Meeting or comparable peer review meeting. However, it is NMFS' practice not to release applications for MMPA authorizations until NMFS deems them complete and a proposed IHA notice or notice of receipt of an application for rulemaking has published in the **Federal Register**.

Comment 7: NSB notes that Shell's application indicates that several vessels will be involved in the 2009–2010 period, involving various transit routes that are to be used to reach the Arctic survey sites. There is an absence of discussion of impacts and "takes" that may occur upon these transit routes. Shell needs to consider and state the impacts sufficiently. Additionally, Shell should consider other stocks of belugas beyond the Beaufort and Chukchi sea stocks, as impacts may occur in Bristol Bay during ship transit.

Response: As has been stated in several **Federal Register** notices in the past, normal shipping and transit operations do not rise to a level requiring an authorization under the MMPA. To require IHAs and Letters of Authorization (LOAs) for standard shipping would reduce the ability of NMFS to review activities that have a potential to cause harm to marine mammal populations. For example, in the Arctic Ocean, NMFS would need to issue authorizations for barging operations that supply the North Slope villages in addition to various onshore and offshore oil and gas projects. However, on this matter, Shell will (in keeping with the CAA signed by Shell) follow transit routes contained in the CAA to avoid conflicts with subsistence hunters.

Comment 8: NSB states that NMFS should not issue Shell an IHA for the strudel scour surveys in 2010, as they are substantially different from the shallow hazards and site clearance surveys. Additionally, it is not clear what other activities might be occurring in 2010, so it is not possible to evaluate the potential cumulative impacts from multiple activities that might occur in 2010. If NMFS does issue Shell an IHA for that survey, estimated takes and monitoring are needed. Additional information is needed from Shell about the possible impacts to marine mammals, monitoring plans, and mitigation measures from helicopter surveys over the sea ice. NMFS needs to make this additional information available to the public and decision makers for review and comment before it issues an IHA to Shell for strudel scour surveys in 2010. NSB also notes that the number of days of operation for

the strudel scour surveys is not consistent throughout the application.

Response: The activities for the strudel scour survey are described in Shell's application and the proposed IHA in order to describe the full scale of Shell's operations. However, NMFS has determined that the activities for the strudel scour survey will not result in take of marine mammals. While the sonar equipment proposed to be used for this project generates high sound energy, the equipment operates at frequencies (>100 kHz) beyond the effective hearing range of most marine mammals likely to be encountered during strudel scour operations. Given the direct downward beam pattern of these sonar systems coupled with the high-frequency characteristics of the signals, the horizontal received levels of 180 and 190 dB re 1 µPa (rms) would be much smaller when compared to those from the low-frequency airguns with similar source levels. Therefore, NMFS has determined that marine mammals will not have a significant behavioral response (i.e., a "take") to the strudel scour surveys. However, Shell needs to coordinate these activities with the Native Alaskan communities to ensure that there is no unmitigable adverse impact to subsistence hunts. As described in the application, two separate activities will occur to complete the strudel scour surveys: helicopter overflights and marine vessel work. The overflights will take approximately 4 days to complete and will occur in mid-May or early June. The marine vessel portion of the survey will take approximately 10 days to complete and will occur sometime in July or early to mid-August.

Comment 9: NSB incorporated by reference a December 18, 2008, letter sent to the Acting Assistant Administrator for Fisheries, as well as NMFS' February 19, 2009, response, asking for suspension and review of Shell's 2008–2009 IHA, wherein Shell was allowed to proceed with seismic activities despite what was acknowledged by NMFS to be a potentially flawed survey design. At that time, NSB asked that no more IHAs be issued until compliance with the MMPA could be demonstrated. Based on NSB's review of NMFS' current proposed IHA, NSB does not see a demonstration of compliance and thus does not support issuance of an IHA at this time.

Response: As was stated in NMFS' February letter responding to NSB's concerns, NMFS determined that Shell was in substantial compliance with their IHA during the 2008 seismic survey season. No additional

information has been provided to NMFS to indicate that Shell was not in compliance with the IHA. Additionally, NMFS believes that Shell will comply with the monitoring and mitigation measures required in the 2009 IHA.

MMPA Concerns

Comment 10: AWL, NSB, and AEWC state that NMFS cannot issue an IHA or a LOA (because NMFS has not promulgated regulations for mortality by seismic activities) to Shell for its activities since they carry the potential for serious injury or death to marine mammals. AEWC also believes that because Level A harassment is possible, an LOA is needed.

Response: Section 101(a)(5)(D) of the MMPA authorizes Level A (injury) harassment and Level B (behavioral) harassment takes. While NMFS' regulations indicate that a LOA must be issued if there is a potential for serious injury or mortality, NMFS does not believe that Shell's surveys will result in serious injury or mortality, thus obviating the need for a LOA. As explained throughout this **Federal Register** Notice, it is highly unlikely that marine mammals would be exposed to sound pressure levels (SPLs) that could result in serious injury or mortality. The best scientific information indicates that an auditory injury is unlikely to occur as apparently sounds need to be significantly greater than 180 dB for injury to occur (Southall *et al.*, 2007). Based on the analysis contained in the "Potential Effects of Survey Activities on Marine Mammals" section in the Notice of Proposed IHA (74 FR 26217, June 1, 2009), NMFS has determined that an IHA can lawfully be issued to Shell for their activities since the already unlikely potential for serious injury or mortality will be reduced even further through the incorporation of the mitigation and monitoring measures described later in this document and required by the IHA.

Comment 11: AEWC notes their disappointment in NMFS for releasing for public comment an incomplete application from Shell that fails to provide the mandatory information required by the MMPA and NMFS' implementing regulations. AEWC requests that NMFS return Shell's application as incomplete, or else the agency risks making arbitrary and indefensible determinations under the MMPA. The following is the information that AEWC believes to be missing from Shell's application: (1) a POC "or information that identifies what measures have been taken and/or will be taken to minimize any adverse effects on the availability of marine

mammals for subsistence uses" (50 CFR 216.104(a)(12)); (2) a scheduled meeting "with the affected subsistence communities to discuss proposed activities and to resolve potential conflicts" (50 CFR 216.104(a)(12)(ii)); (3) a "description of what measures the applicant has taken and/or will take to ensure that proposed activities will not interfere with subsistence whaling or sealing" (50 CFR 216.104(a)(12)(iii)); (4) suggested means of learning of, encouraging, and coordinating any research related activities (50 CFR 216.104(a)(14)); (5) a description of the specified activities and specified geographic region (16 U.S.C. 1371(a)(5)(D)(i)); and (6) a description of the "age, sex, and reproductive condition" of the marine mammals that will be impacted (50 CFR 216.104(a)(6)). AWL and NSB also note their concern about the lack of specificity regarding the timing and location of the site clearance and shallow hazards and strudel scour surveys.

Response: NMFS does not agree that it released an incomplete application for review during the public comment period. After NMFS' initial review of the application, NMFS submitted questions and comments to Shell on its application. After receipt and review of Shell's responses, which were submitted as an addendum to the original application, NMFS made its determination of completeness and released the application, addenda, and the proposed IHA notice (74 FR 26217, June 1, 2009). Regarding the six specific pieces of information believed to be missing by AEWC, Shell's original application included a description of the pieces of information that are required pursuant to 50 CFR 216.104(a)(12). The application noted that Shell was planning to meet with subsistence communities in 2009 and described measures to ensure that the applicant's proposed activities will not interfere with subsistence whaling or sealing. The proposed IHA notice (74 FR 26217, June 1, 2009) also noted meetings that had already taken place in the villages of Barrow, Point Hope, Point Lay, Wainwright, and Kotzebue. Moreover, on May 15, 2009, Shell distributed its draft POC for the 2009 activities to NMFS, other government agencies, and affected stakeholder communities.

Information required pursuant to 50 CFR 216.104(a)(14) was also included in Shell's application. Shell provided a list of researchers who could potentially receive results of their research activities who may find the data useful in their own research. Additionally, Shell and ConocoPhillips will be

working together in 2009 to deploy an intensive array of acoustic recorders around both the Burger and Klondike prospects in the Chukchi Sea.

NMFS also determined that Shell's application provides descriptions of the specified activities and specified geographic region. NMFS defines "specified geographical region" as "an area within which a specified activity is conducted and which has certain biogeographic characteristics" (50 CFR 216.103). In regard to how specific one must be to define a "specific geographic region" within which the activity would take place, House Report 97-228 states:

The specified geographic region should not be larger than is necessary to accomplish the specified activity, and should be drawn in such a way that the effects on marine mammals in the region are substantially the same. Thus, for example, it would be inappropriate to identify the entire Pacific coast of the North American continent as a specified geographic region, but it may be appropriate to identify particular segments of that coast having similar characteristics, both biological and otherwise, as specified geographical regions.

NMFS believes that the U.S. Chukchi Sea meets Congressional intent and NMFS' definition because the region has similar geographic, physiographic (e.g., topography, temperature, sea ice), biologic (e.g., marine fauna (fish and marine mammals)), and sociocultural characteristics. Shell's application noted that the applicant would conduct activities on some of its prospects gained during LS 193, which itself is considered a "specified geographic region." Since that time, Shell has informed NMFS of the specific areas within the lease holdings on which Shell intends to conduct the site clearance and shallow hazards surveys. They are the Burger and Crackerjack prospects, as well as SW Shobill if time and weather conditions allow. At this time, more specificity on the location of the in-water portion of the strudel scour surveys cannot be provided. Until areas with strudel scour are revealed during helicopter overflights, it is uncertain the exact location along the Chukchi Sea coast where marine vessel operations will occur. However, as previously mentioned, the Chukchi Sea itself is considered a "specified geographic region." Shell also provided a description of the types of equipment that would be used and time frame for conducting its activities. Therefore, NMFS believes that Shell's description of the activity and the locations for conducting their surveys meet the requirements of the MMPA.

Lastly, 50 CFR 216.104(a)(6) requires that an applicant submit information on

the "age, sex, and reproductive condition (*if possible*)" (emphasis added) of the number of marine mammals that may be taken. In the application, Shell described the species expected to be taken by harassment and provided estimates of how many of each species were expected to be taken during their activities. In most cases, it is very difficult to estimate how many animals, especially cetaceans, of each age, sex, and reproductive condition will be taken or impacted by seismic or site clearance and shallow hazards surveys. In conclusion, NMFS believes that Shell provided all of the necessary information to proceed with publishing a proposed IHA notice in the **Federal Register**.

Comment 12: AEW and NSB state that Shell did not disclose the full spectrum of activities in which it will engage. For example, Shell mentions support vessels and other equipment in its application but such machinery is not disclosed among Shell's activities. Additionally, Shell changed the airgun array it planned to use after submitting its application but did not conduct any new analysis of the impacts from this change, thus negating its analysis of the impacts from the original airgun array. Shell needs to adequately specify the activities and impacts of all the actions that will be undertaken in the Chukchi. AEW also states that NMFS relied on surveys conducted in 2008 by Shell to calculate the area of "water exposed to received levels at or above 160 dB." The 2008 surveys, however, were based on signals from "four 10 in³ airguns," and not the 40 in³ airguns that Shell now intends to use. Thus, for this reason as well, Shell's application must be returned.

Response: NMFS determined that Shell's application and application addenda fully described the activities in which Shell will engage. In previous years, when Shell conducted its larger, 3D seismic surveys, several support vessels were needed to carry out operations. However, for this smaller survey, all work will be conducted from the single source vessel. All acoustic equipment that will be used to conduct the surveys is listed in the application. Shell did change the number of airguns and submitted this information to NMFS in their second application addendum. In assessing the new airgun array, NMFS determined that the potential impacts to marine mammals would be the same if the total discharge volume was 20 in³ or 40 in³. Shell submitted revised take estimates based on the new discharge volume and ensonified zones. The analysis of impacts from airguns and the revised

take estimates were contained in the proposed IHA notice (74 FR 26217, June 1, 2009). Therefore, NMFS determined that Shell adequately specified the activities and impacts of all the actions that will be undertaken in the Chukchi Sea.

The modeled radii that Shell submitted were from sound source verification tests conducted in the Chukchi Sea during the 2008 open-water season by JASCO. JASCO modeled three different airgun configurations: 4 x 10 in³ airgun array; 2 x 10 in³ airgun array; and 1 x 10 in³ airgun. For 2009, Shell intends to use the 4 x 10 in³ airgun array and not the 40 in³ airguns, as noted by AEW. Therefore, this modeling was accurately used by Shell in its submission to NMFS.

Comment 13: NSB and AWL expressed concern that the IHA will cover a full year, as the assessment of effects on bowhead whales apparently relies in part on the surveys ending before the peak of the bowhead fall migration through the Chukchi Sea. Shell indicates that it will require a maximum of 50 days of active data acquisition, but it is noteworthy that this estimate expressly excludes any unplanned downtime. Consequently, Shell could need to survey well into the month of October, and the IHA as proposed would allow it to do so. A 1-year IHA is clearly not compelled by the MMPA, and an authorization that includes a portion of the next open-water season only invites later confusion. Although NMFS' analysis of impacts to marine mammals appears to consider the entire 50 days of active surveying, the process leaves open the possibility of an unjustifiably segmented evaluation of survey activity, looking only at a portion of the surveying that will take place in a single season. NMFS should take steps to avoid such results.

Response: Section 101(a)(5)(D)(i) of the MMPA states that: "Upon request therefor by citizens of the United States who engage in a specified activity (other than commercial fishing) within a specific geographic region, the Secretary shall authorize, for periods of not more than 1 year, subject to such conditions as the Secretary may specify, the incidental, but not intentional, taking by harassment of small numbers of marine mammals of a species or population stock by such citizens while engaging in that activity within that region...."

As noted, the MMPA does not limit the issuance of an IHA to a single open-water season (approximately July 20 to approximately November 15 in the U.S. Beaufort and Chukchi Seas), a period of less than 4 months, and even less

available time if an applicant's activity is located in an area subject to area closure due to native subsistence hunting. Provided the IHA application includes an analysis of the specified activities during the time frame proposed by the applicant, NMFS will consider issuing an IHA that extends into a portion of the following year. NMFS evaluated the effects of Shell's activities for the full requested time frame, including evaluating effects into the following season. Additionally, NMFS believes that even if Shell must conduct activities into the middle or end of October, the mitigation and monitoring measures required by the IHA (described later in this document) will not increase the level of impact to marine mammals in the area.

Comment 14: AEWC and NSB state that NMFS failed to issue a draft authorization for public review and comment. 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 CFR 216.104(b)(1)(i); 16 U.S.C. 1371 (a)(5)(D)(iii)) and not just on the application itself as NMFS has done here. Without a complete draft authorization and accompanying findings, AEWC and 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. For example, AEWC cannot ensure that the authorization will comport with the requirements of the applicable CAA.

Response: The June 1, 2009 proposed IHA notice (74 FR 26217) contained all of the relevant information needed by the public to provide comments on the proposed authorization itself. The notice contained the permissible methods of taking by harassment, means of effecting the least practicable impact on such species (i.e., mitigation), measures to ensure no unmitigable adverse impact on the availability of the species or stock for taking for subsistence use, requirements pertaining to the monitoring and reporting of such taking, including requirements for the independent peer review of the proposed monitoring plan. The notice provided detail on all of these points, allowing the public to provide meaningful comments. Additionally, the notice contained NMFS' preliminary findings of negligible impact and no unmitigable adverse impact.

The signing of a CAA is not a requirement to obtain an IHA.

Additionally, the CAA is a document that is negotiated between and signed by the industry participant, AEWC, and the Village Whaling Captains' Associations. NMFS has no role in the development or execution (other than, where appropriate, to include marine mammal-related measures from the CAA in the IHA) of this agreement. While signing a CAA helps NMFS to make its no unmitigable adverse impact determination for bowhead and beluga whales, it is not a requirement.

Comment 15: NSB states that based on the limited information provided by NMFS, there is no way to determine whether Shell's monitoring and reporting plans were subjected to independent peer review, as required by the MMPA. Unless NMFS can demonstrate compliance with the MMPA and its own regulations, it cannot issue an IHA to Shell. AEWC also notes that NMFS cannot issue an IHA to any company whose monitoring plan has not been cleared through independent peer review.

Response: On May 6, 2009, NMFS contacted representatives from AEWC, NSB, MMC, and Shell about nominating people to participate in an independent peer review of Shell's monitoring plan. NMFS received nominations from all of the contacted parties and selected and contacted reviewers from these lists. Two of the contacted individuals provided detailed comments on Shell's monitoring and reporting plan. NMFS provided Shell with the comments and recommendations of the reviewers. The reviewers' comments and changes to the monitoring plan are addressed later in this document (see "Monitoring Plan Independent Peer Review" section later in this document). NMFS complied with the requirements under the MMPA and the implementing regulations for issuing IHAs, and therefore can legally issue an IHA to Shell to conduct their operations.

Comment 16: AEWC states that because of the critical information provided through the direct observations of AEWC hunters, the peer review process must include AEWC representatives.

Response: NMFS' proposed rule for implementing the 1994 amendments to the MMPA described the process for conducting an independent peer review of monitoring plans where the proposed activity may affect the availability of a species or stock for taking for subsistence uses (60 FR 28379, May 31, 1995). While panelists for the independent peer review are selected by NMFS in consultation with the MMC, AEWC and/or other Alaska native organizations as appropriate, and the

applicant, selected "panelists are experts who are not currently employed or contracted by either the affected Alaskan native organization or the applicant" (60 FR 28381, May 31, 1995). Therefore, it was NMFS' intent not to include AEWC representatives in the independent peer review process. However, AEWC representatives are afforded the opportunity to provide information based on their direct observations and experiences at the annual Open-water Meeting and through the public comment process on the proposed IHA.

Comment 17: AEWC specifically requests that NMFS release its response to comments at the earliest possible time and that NMFS not allow seismic activities to begin until the whaling captains have had a chance to review NMFS' response. We note that in 2008, NMFS did not publish its response to comments on Shell's IHA for seismic operations in the Beaufort Sea until well after the fall subsistence hunt at Cross Island had concluded and seismic operations had already taken place. There can be no excuse for allowing seismic operations to take place directly within one of the most important subsistence hunting areas in the Arctic Ocean prior to NMFS explaining to the local communities and whaling captains why it was issuing an IHA over their well-reasoned objections, which were presented during the public comment period. 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.

Response: NMFS publishes its responses to public comments in the **Federal Register** notice of issuance or denial. There is no provision requiring an applicant to wait to begin operations until after review of NMFS' responses to comments by members of the public. No public comment period is required on the **Federal Register** notice announcing NMFS' final decision. For the issuance of Shell's 2008 and 2009 IHAs, NMFS reviewed and considered all of the comments submitted before making its final determinations. Additionally, NMFS summarized and presented all of the significant issues raised by the commenters to the decision maker before signing the IHA.

Comment 18: AEWC notes that by regulation, Shell must include with its application a POC that ensures potential conflicts with subsistence uses are resolved/mitigated prior to the issuance of an IHA. It is AEWC's view that

signing and following the CAA meets the POC requirement as it pertains to bowhead whales. AEWC states that Shell must agree to all the terms of the 2009 Open-water CAA in order to mitigate the effects of its proposed operations. In fact, the CAA was in use prior to NMFS' issuance of its regulations, and the POC requirement was included in the regulatory language to point operators to the CAA. In addition to the CAA setting forth mitigation measures agreed to by the operators and hunters, a schedule of meetings in preparation for each upcoming season, and post-season review meetings to evaluate the effectiveness of mitigation measures employed during a certain season, an operator's adherence to the terms of the CAA enables the Secretary to make the no unmitigable adverse impact finding required by Congress in the MMPA. NMFS is well-advised to heed the long-standing practice of relying on the CAA to enable the Secretary to make the required finding, as the agency has no other basis upon which to determine whether a specified set of mitigation measures will enable hunters to retain access to migrating marine mammals without increasing the risks associated with an already high-risk practice.

Response: NMFS believes that the CAA is an important mechanism to ensure that there is not an unmitigable adverse impact on the availability of bowhead whales for taking for subsistence uses. However, the CAA is a document entered into between two entities (industry applicants and native community stakeholders). NMFS is neither a signatory to the CAA, nor does it play any formal role in the development of the CAA other than by requiring industry applicants to develop a POC pursuant to 50 CFR

216.104(a)(12). Moreover, the CAA is only one way to make the no unmitigable adverse impact to subsistence uses finding. Although NMFS has a limited role in this process, NMFS supports the continuation of the CAA process to help ensure that native subsistence harvests are successful.

Comment 19: AEWC and NSB state that the conclusion that Shell's proposed activities will only take small numbers of marine mammals and will have no more than a negligible impact is not justified by the information provided. AEWC believes that without knowing more about the status and number of species present in the Chukchi Sea, this conclusion cannot be supported. NSB believes that NMFS has not adequately considered whether marine mammals may be harassed at received levels significantly lower than

160 dB and has not considered the possible serious injuries associated with authorizing the proposed activities.

Response: NMFS believes that it provided sufficient information in its proposed IHA notice (74 FR 26217, June 1, 2009) to make the small numbers and negligible impact determinations and that the best scientific information available was used to make those determinations. The available information was sufficient to make the necessary findings. While some published articles indicate that certain marine mammal species may avoid seismic vessels at levels below 160 dB, NMFS does not believe that these responses rise to the level of a significant behavioral response. While studies, such as Miller *et al.* (1999), have indicated that some bowhead whales may have started to be deflected from their migratory path 35 km (21.7 mi) from the seismic vessel, it should be pointed out that these minor course changes are during migration and, as described in MMS' 2006 Final Programmatic Environmental Assessment (PEA), have not been seen at other times of the year and during other activities. To show the contextual nature of this minor behavioral modification, recent monitoring studies of Canadian seismic operations indicate that feeding, non-migratory bowhead whales do not move away from a noise source at an SPL of 160 dB. Therefore, while bowheads may avoid an area of 20 km (12.4 mi) around a noise source, when that determination requires a post-survey computer analysis to find that bowheads have made a 1 or 2 degree course change, NMFS believes that does not rise to a level of a "take." NMFS therefore continues to estimate "takings" under the MMPA from impulse noises, such as seismic, as being at a distance of 160 dB (re 1 μ Pa).

NMFS has determined that Shell's activities will not cause serious injury to marine mammals. As explained throughout this **Federal Register** Notice, it is highly unlikely that marine mammals would be exposed to SPLs that could result in serious injury or mortality. The best scientific information indicates that an auditory injury is unlikely to occur, as apparently sounds need to be significantly greater than 180 dB for injury to occur (Southall *et al.*, 2007). The 180-dB radius for the airgun array to be used by Shell is 160 m (525 ft). Therefore, if injury were possible from Shell's activities, the animal would need to be closer than 160 m (525 ft). However, based on the configuration of the airgun array and streamers, it is highly unlikely that a marine mammal would be that close to

the seismic vessel. Mitigation measures described later in this document will be implemented should a marine mammal enter this small zone around the airgun array.

Comment 20: AEWC notes that based on the density estimates, Shell is predicting that an average of 692 and a maximum of 1,078 ringed seals may be exposed to seismic sounds. These are by no means "small numbers" of marine mammals that will be subjected to impacts as a result of Shell's operations. NSB notes that Shell's application states that approximately 2 percent of the Bering-Chukchi-Beaufort stock of bowhead whales will be exposed to sounds greater than or equal to 160 dB (rms). This is a large percentage of the population.

Response: NMFS determined that the small numbers requirement has been satisfied. Shell has predicted that an average of 692 ringed seals will be exposed to SPLs of 160 dB or greater during operations. This does not mean that this is the number of ringed seals that will actually exhibit a disruption of behavioral patterns in response to the sound source; rather, it is simply the best estimate of the number of animals that potentially could have a behavioral modification due to the noise. For example, Moulton and Lawson (2002) indicate that most pinnipeds exposed to seismic sounds lower than 170 dB do not visibly react to that sound, and, therefore, pinnipeds are not likely to react to seismic sounds unless they are greater than 170 dB re 1 μ Pa (rms).

The Level B harassment take estimate of 692 ringed seals is a small number, at least in relative terms, in that it represents only 0.3 percent of the regional stock size of that species (249,000), if each "exposure" at 160 dB represents an individual ringed seal. The percentage would be even lower if a higher SPL is required for a behavioral reaction (as is expected) or, if as expected, animals move out of the seismic area. As a result, NMFS determined that these "exposure" estimates are conservative, and seismic surveys will actually affect less than 0.3 percent of the Chukchi Sea ringed seal population.

Regarding bowhead whales, this percentage is a remnant from when Shell was going to conduct its full suite of surveys in both the Beaufort and Chukchi Seas. As mentioned earlier in this document, the Beaufort Sea surveys and the Chukchi Sea ice gouge survey were cancelled for the 2009/2010 season. Shell's Chukchi Sea site clearance and shallow hazards surveys are estimated to take only one bowhead whale, representing less than 0.01

percent of the Bering-Chukchi-Beaufort stock of bowhead whales.

Comment 21: AEWC states that Shell should be required to engage in monitoring activities that are separate and apart from its oil and gas activities (see 50 CFR 216.104(a)(14)). These activities must be separate from Shell's proposed oil and gas related operations, since any data from such operations is skewed in light of marine mammals' avoidance of the vessels and seismic noise.

Response: In 2009, Shell and ConocoPhillips are jointly funding an extensive acoustic monitoring program in the Chukchi Sea. A total of 44 recorders will be distributed both broadly across the Chukchi lease area and nearshore environment and intensively on the Burger and Klondike lease areas. The broad area arrays are designed to capture both general background soundscape data and marine mammal call data across the lease area. Shell hopes to gain insights into large-scale distribution of marine mammals, identification of marine mammal species present, movement and migration patterns, and general abundance data. Many of these recorders will be placed tens of miles away from the site clearance and shallow hazards surveys. Additionally, these recorders will remain deployed after completion of Shell's survey work in 2009.

Pursuant to 50 CFR 216.104(a)(14), an applicant must include "suggested means of learning of, encouraging, and coordinating research opportunities, plans, and activities relating to reducing such incidental taking and evaluating its effects." There is no requirement that this information or monitoring be conducted separate and apart from the authorized activities, since the research is supposed to evaluate the effects of the taking.

Marine Mammal Impact Concerns

Comment 22: AWL, NSB, and AEWC noted that NMFS has acknowledged that permanent threshold shift (PTS) qualifies as a serious injury. Therefore, if an acoustic source at its maximum level has the potential to cause PTS and thus lead to serious injury, it would not be appropriate to issue an IHA for the activity (60 FR 28381, May 31, 1995). AEWC states that therefore an LOA is required here. 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 radius that extends out to 24 km (15 mi). These groups state that in the proposed

IHA, NMFS did not rule out the possibility of animals incurring PTS (74 FR 26222, June 1, 2009). Although NMFS characterizes the possibility as unlikely, it nevertheless relies on mitigation measures, such as ramp-ups and exclusion zones, to "minimize" the "already-minimal" probability of PTS.

Response: In the proposed rule implementing the process to apply for and obtain an IHA, NMFS stated that authorizations for harassment involving the "potential to injure" would be limited to only those that may involve non-serious injury (60 FR 28380, May 31, 1995). However, NMFS goes on to say that "if the review of an application for incidental harassment indicates there is a potential for serious injury or death, NMFS proposes that it would either (1) determine that the potential for serious injury can be negated through mitigation requirements that could be required under the authorization or (2) deny" (*Ibid*) the IHA and require the applicant to petition for regulations and LOA. As stated several times in this document and previous **Federal Register** notices for seismic activities, there is no empirical evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns (see Southall *et al.*, 2007). PTS is thought to occur several decibels above that inducing mild temporary threshold shift (TTS), the mildest form of hearing impairment (a non-injurious effect). NMFS (1995, 2000) concluded that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μ Pa (rms). The established 180- and 190-dB re 1 μ Pa (rms) criteria are the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. As summarized later in this document, data that are now available imply that TTS is unlikely to occur unless bow-riding odontocetes are exposed to airgun pulses much stronger than 180 dB re 1 Pa rms (Southall *et al.*, 2007). Additionally, while the **Federal Register** notice cited by the commenters states that NMFS considered PTS to be a serious injury (60 FR 28380, May 31, 1995), our understanding of anthropogenic sound and the way it impacts marine mammals has evolved since then, and NMFS no longer considers PTS to be a serious injury. NMFS has defined "serious injury" in

50 CFR 216.3 as "...any injury that will likely result in mortality." There are no data that suggest that PTS would be likely to result in mortality, especially the limited degree of PTS that could hypothetically be incurred through exposure of marine mammals to seismic airguns at the level and for the duration that are likely to occur in this action.

The extent of the 120-dB radius does not indicate that animals may be seriously injured. Additionally, NMFS has required monitoring and mitigation measures to negate the possibility of marine mammals being seriously injured as a result of Shell's activities. In the proposed IHA, NMFS determined that no cases of TTS are expected to result from Shell's activities. Based on this determination and the explanation provided here, PTS is also not expected. Therefore, an IHA is appropriate.

Comment 23: AEWC and NSB state that research is increasingly showing that marine mammals may remain within dangerous distances of seismic operations rather than leave a valued resource such as a feeding ground (see Richardson, 2004). 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.

Response: If marine mammals, such as bowhead whales, remain near a seismic operation to perform a biologically vital activity, such as feeding, depending on the distance from the vessel and the size of the 160-dB radius, the animals may experience some Level B harassment. Depending on the distance of the animals from the vessel and the number of individual whales present, certain mitigation measures are required to be implemented. If an aggregation of 12 or more mysticete whales are detected within the 160-dB radius, then the airguns must be shutdown until the aggregation is no longer within that radius. Additionally, if any whales are sighted within the 180-dB radius of the active airgun array, then either a power-down or shutdown must be implemented immediately. For the reasons stated throughout this document, NMFS has determined that Shell's operations will not injure marine mammals.

Comment 24: AWL and NSB state that the standard for determining whether an IHA is appropriate is exceptionally protective. If there is even the possibility of serious injury, NMFS must establish that the “potential for serious injury can be negated through mitigation requirements” (60 FR 28380, May 31, 1995; emphasis added). Reports from previous surveys, however, indicate that, despite monitored exclusion zones, marine mammals routinely stray too close to the airguns. AEWC states that the safety radii proposed by Shell do not negate injury.

Perhaps, more importantly, the documented exposures were recorded only because conditions were such that the marine mammals could be observed, but this only represents a fraction of the time that airguns are operating. Marine mammal observers (MMOs) cannot see animals at the surface when it is dark or during the day because of fog, glare, rough seas, the small size of animals such as seals, and the large portion 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. AWL, NSB, and AEWC note that although NMFS recognizes that infra-red goggles and night-vision binoculars are of “limited” effectiveness when visibility is low, its only response for Shell’s 2009 surveying is that MMOs are relieved of monitoring the exclusion zones at night, except during periods before and during ramp-ups.

NMFS appears to simply presume that marine mammals will naturally avoid airguns when they are operating at full strength, removing the need for monitoring when conditions prevent MMOs from effectively watching for intrusions into the exclusion zones. That premise is not supported by the survey data, indicating that shutdowns and power-downs have repeatedly proven necessary. The requirement for ramp-up 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 & Technology report noted, although ramp-up is a widely imposed practice, “there has never been a demonstration that it works as intended.” Because NMFS has not negated the possibility of serious injury from Shell’s 2009 seismic surveying, it may not issue an IHA.

Response: As has already been stated several times in this document, recent literature has indicated that sounds need to be significantly higher than 180 dB to cause injury to marine mammals (see Southall *et al.*, 2007). Therefore, the

180- and 190-dB safety zones are conservative. The survey reports indicate that mitigation measures (i.e., power-downs or shutdowns) were implemented, thus preventing the animals from being exposed to more than one or two seismic pulses. Additionally, Shell’s operations will occur in an area where periods of darkness do not begin until early September. Beginning in early September, there will be approximately 1–3 hours of darkness each day, with periods of darkness increasing by about 30 min each day. By the end of the survey period, there will be approximately 8 hours of darkness each day.

The source vessel will be traveling at speeds of about 1–5 knots (1.9–9.3 km/hr). With a 180-dB safety range of 160 m (525 ft), the vessel will have moved out of the safety zone within a few minutes. As a result, during underway survey operations, MMOs are instructed to concentrate on the area ahead of the vessel, not behind the vessel where marine mammals would need to be voluntarily swimming towards the vessel to enter the 180-dB zone. In fact, in some of NMFS’ IHAs issued for scientific seismic operations, shutdown is not required for marine mammals that approach the vessel from the side or stern in order to ride the bow wave or rub on the seismic streamers deployed from the stern (and near the airgun array) as some scientists consider this a voluntary action on the part of an animal that is not being harassed or injured by seismic noise. While NMFS concurs that shutdowns are not likely warranted for these voluntary approaches, in the Arctic Ocean, all seismic surveys are shutdown or powered down for all marine mammal close approaches. Also, in all seismic IHAs, including Shell’s IHA, NMFS requires that the safety zone be monitored for 30 min prior to beginning ramp-up to ensure that no marine mammals are present within the safety zones. Implementation of ramp-up is required because it is presumed it would allow marine mammals to become aware of the approaching vessel and move away from the noise, if they find the noise annoying. Data from 2007 and 2008, when Shell had support boats positioned 1 km (0.62 mi) on each side of the 3D seismic vessel, suggest that marine mammals do in fact move away from an active source vessel. In those instances, more seals were seen from the support vessels than were seen from the source vessels during active seismic operations. Additionally, research has indicated that some species tend to

avoid areas of active seismic operations (e.g., bowhead whales, see Richardson *et al.*, 1999).

NMFS has determined that an IHA is the proper authorization required to cover Shell’s survey. As described in other responses to comments in this document, NMFS does not believe that there is a risk of serious injury or mortality from these activities. The monitoring reports from 2006, 2007, and 2008 do not note any instances of serious injury or mortality (Patterson *et al.*, 2007; Funk *et al.*, 2008; Ireland *et al.*, 2009). Additionally, NMFS is confident it has met all of the requirements of section 101(a)(5)(D) of the MMPA (as described throughout this document) and therefore can issue an IHA to Shell for its survey operations in 2009/2010.

Comment 25: AWL, Dr. Bain, NSB, and AEWC believe that NMFS has not adequately considered whether marine mammals may be harassed at received levels significantly lower than 160 dB. Here, NMFS calculated harassment from Shell’s proposed surveying based on the exposure to marine mammals to sounds at or above 160 dB. This uniform approach to harassment, however, does not take into account known reactions of marine mammals in the Arctic to levels of noise far below 160 dB. These letters state that bowhead, gray, killer, and beluga whales and harbor porpoise react to sounds lower than 160 dB. At least in the case of bowhead whales, a 120-dB level is more appropriate to assess levels of harassment.

Citing several papers on killer whales and harbor porpoise, Dr. Bain states that major behavioral changes of these animals appear to be associated with received levels of around 135 dB re 1 μ Pa, and that minor behavioral changes can occur at received levels from 90–110 dB re 1 μ Pa or lower. He also states that belugas have been observed to respond to icebreakers by swimming rapidly away at distances up to 80 km, where received levels were between 94 and 105 dB re 1 μ Pa. Belugas exhibited minor behavioral changes such as changes in vocalization, dive patterns, and group composition at distances up to 50 km (NRC, 2003), where received levels were likely around 120 dB.

AEWC also states that in conducting scoping on its national acoustic guidelines for marine mammals, NMFS 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 FR 1871, 1873, January 11, 2005). Thus, NMFS itself has recognized that 160 dB (rms) is not an adequate measure.

Response: The best information available to date for reactions by bowhead whales to noise, such as seismic, is based on the results from the 1998 aerial survey (as supplemented by data from earlier years) as reported in Miller *et al.* (1999). In 1998, bowhead whales below the water surface at a distance of 20 km (12.4 mi) from an airgun array received pulses of about 117–135 dB re 1 μ Pa rms, depending upon propagation. Corresponding levels at 30 km (18.6 mi) were about 107–126 dB re 1 Pa rms. Miller *et al.* (1999) surmise that deflection may have begun about 35 km (21.7 mi) to the east of the seismic operations, but did not provide SPL measurements to that distance and noted that sound propagation has not been studied as extensively eastward in the alongshore direction, as it has northward, in the offshore direction. Therefore, while this single year of data analysis indicates that bowhead whales may make minor deflections in swimming direction at a distance of 30–35 km (18.6–21.7 mi), there is no indication that the SPL where deflection first begins is at 120 dB, it could be at another SPL lower or higher than 120 dB. Miller *et al.* (1999) also note that the received levels at 20–30 km (12.4–18.6 mi) were considerably lower in 1998 than have previously been shown to elicit avoidance in bowheads exposed to seismic pulses. However, the seismic airgun array used in 1998 was larger than the ones used in 1996 and 1997. Therefore, NMFS believes that it cannot scientifically support adopting any single SPL value below 160 dB and apply it across the board for all species and in all circumstances. Second, these minor course changes occurred during migration and, as indicated in MMS' 2006 PEA, have not been seen at other times of the year and during other activities.

Third, as stated in the past, NMFS does not believe that minor course corrections during a migration rise to a level of being a significant behavioral response. To show the contextual nature of this minor behavioral modification, recent monitoring studies of Canadian seismic operations indicate that when, not migrating, but involved in feeding, bowhead whales do not move away from a noise source at an SPL of 160 dB. Therefore, while bowheads may avoid an area of 20 km (12.4 mi) around a

noise source, when that determination requires a post-survey computer analysis to find that bowheads have made a 1 or 2 degree course change, NMFS believes that does not rise to a level of a "take." NMFS therefore continues to estimate "takings" under the MMPA from impulse noises, such as seismic, as being at a distance of 160 dB (re 1 Pa). However, monitoring a 120–dB radius in the Chukchi Sea is not practicable and due to safety concerns, NMFS would not require this level of monitoring in the Chukchi Sea.

Although it is possible that marine mammals could react to any sound levels detectable above the ambient noise level within the animals' respective frequency response range, this does not mean that such animals would react in a biologically significant way. According to experts on marine mammal behavior, the degree of reaction which constitutes a "take," i.e., a reaction deemed to be biologically significant that could potentially disrupt the migration, breathing, nursing, breeding, feeding, or sheltering, etc., of a marine mammal is complex and context specific, and it depends on several variables in addition to the received level of the sound by the animals. These additional variables include, but are not limited to, other source characteristics (such as frequency range, duty cycle, continuous vs. impulse vs. intermittent sounds, duration, moving vs. stationary sources, etc.); specific species, populations, and/or stocks; prior experience of the animals (naïve vs. previously exposed); habituation or sensitization of the sound by the animals; and behavior context (whether the animal perceives the sound as predatory or simply annoyance), etc. (Southall *et al.*, 2007).

The references cited in the comment letters address different source characteristics (continuous sound rather than impulse sound that are planned for the proposed shallow hazard and site clearance surveys) or species (killer whales and harbor porpoises) that rarely occur in the proposed Arctic action area. Much research regarding bowhead and gray whales response to seismic survey noises has been conducted in addition to marine mammal monitoring studies during prior seismic surveys. Detailed descriptions regarding behavior responses of these marine mammals to seismic sounds are available (e.g., Richardson *et al.*, 1995; review by Southall *et al.*, 2007), and are also discussed in this document. Additionally, as Shell does not intend to use ice-breakers during its operations, statements regarding beluga reactions to

icebreaker noise are not relevant to this activity.

Regarding the last point raised in this comment by AEWC, NMFS recognizes the concern. Based on the information and data contained in Southall *et al.* (2007), NMFS is moving towards implementing a dual criteria for impacts of noise on marine mammals. However, until guidelines are available, NMFS will continue to use the 160–dB threshold for determining the level of take of marine mammals by Level B harassment for impulse noise (such as from airguns).

Comment 26: NSB and AWL note that this IHA, as currently proposed, is based on uncertainties that are not allowed under the MMPA. Citing comments made by NMFS on recent MMS LS Environmental Impact Statements, they note that NMFS stated that without more current and thorough data on the marine mammals in the Chukchi Sea and their use of these waters, it would be difficult to make the findings required by the MMPA. NMFS also specifically observed that activities "occurring near productive forage areas such as the Hanna Shoal" or "along migratory corridors" are most likely to encounter and impact marine mammals. Shell's proposed surveying for 2009 will likely take place proximate to the Hanna Shoal and within the pathway for migrating bowheads.

It is generally recognized that there is much unknown about the range of potential effects of sound on marine mammals, especially long-term sublethal effects and the impact of exposure to increasing levels of noise year after year. NMFS noted in both sets of LS comments 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." Again, NMFS stressed that additional data should be obtained for the agency to consider authorizing incidental taking under the MMPA and the Endangered Species Act (ESA). AWL also states that the need for more information regarding the effects of sound and the appropriate mitigation measures was emphasized in a recent report issued by an interagency task force led by a representative from NOAA (JSOST, 2009). This lack of information runs up against the precautionary nature of the MMPA. Nor can NMFS claim the lack of available information justifies its decision. NMFS has an affirmative obligation to find that impacts are no more than "negligible"

and limited to the harassment of only "small numbers of marine mammals."

NSB also notes that Shell's application contains several references to the lack of evidence for damage to auditory mechanisms of several marine mammals. A lack of data does not amount to a lack of evidence. Shell needs to provide actual citations that show a lack of damage. These citations must be from studies of baleen whales, belugas, and pinnipeds that were focused on the assessment of this type of damage. But this information does not exist for the noise produced typical of Arctic open-water seismic operations. In fact, the basic anatomy of bowhead whale auditory apparatus has not been investigated.

Response: NMFS agrees that there is some uncertainty on the current status of some marine mammal species in the Chukchi Sea and on impacts to marine mammals from seismic surveys. NMFS is currently proposing to conduct new population assessments for Arctic pinniped species, and current information is available on-line through the Stock Assessment Reports (SARs). In regard to impacts, there is no indication that seismic survey activities are having a long-term impact on marine mammals. For example, apparently, bowhead whales continued to increase in abundance during periods of intense seismic in the Chukchi Sea in the 1980s (Raftery *et al.*, 1995; Angliss and Outlaw, 2007), even without implementation of current mitigation requirements. As a result, NMFS believes that seismic survey noise in the Arctic will affect only small numbers of and have no more than a negligible impact on marine mammals in the Chukchi Sea. However, as NMFS recognizes that there is a lack of information on certain aspects of the marine mammals in the Chukchi Sea and the potential impacts on marine mammal species and stocks from offshore oil exploration, Shell (in collaboration with other offshore companies) has developed and implemented a monitoring program to address data gaps. NMFS used the best scientific information available to make the required findings under the MMPA. As explained in this document, based on that information, NMFS has determined that Shell's activities will affect only small numbers of marine mammals, will have a negligible impact on affected species or stocks, and will not have an unmitigable adverse impact on subsistence uses of the affected species or stocks.

Comment 27: The MMC recommends that the IHA require that operations be suspended immediately if a dead or

seriously injured marine mammal is found in the vicinity of the operations and if that death or injury could be attributable to the applicant's activities. Any suspension should remain in place until NMFS has: (1) reviewed the situation and determined that further deaths or serious injuries are unlikely to occur; or (2) issued regulations authorizing such takes under section 101(a)(5)(A) of the MMPA.

Response: NMFS concurs with the MMC's recommendation and will require the immediate suspension of seismic activities if a dead or injured marine mammal has been sighted within an area where the Holder of the IHA deployed and utilized seismic airguns within the past 24 hours. Additionally, Shell is required to notify the Marine Mammal Stranding Network of stranded marine mammals.

Comment 28: NSB and AEWC note that stranded marine mammals or their carcasses are also a sign of injury. NMFS states in its notice that it "does not expect any marine mammal will...strand as a result of the proposed survey" (74 FR 26222, June 1, 2009). In reaching this conclusion, NMFS claims that strandings have not been recorded for the Beaufort and Chukchi Seas. NSB and AEWC included a paper, which documents 25 years of stranding data, including five whales reported in 2008 alone in comparison with the five dead whales that were reported in the same area over the course of 25 years (Rosa, 2009). NSB also included some stranding reports and newspaper articles for bowhead whales discovered in the last 25 years.

In light of the increase in seismic operations in the Arctic since 2006, NSB's study raises serious concerns about the impacts of these operations and their potential to injure marine mammals. While we think this study taken together with the June 2008 stranding of "melon headed whales off Madagascar that appears to be associated with seismic surveys" (74 FR 26222, June 1, 2009) demonstrate that seismic operations have the potential to injure marine mammals beyond beaked whales (and that Shell needs to apply for an LOA for its operations), certainly NSB's study shows that direct injury of whales is on-going. 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 new information, Shell's application does not have the potential to injure marine mammals. NMFS must also require Shell to report the numbers and species of dead animals it

encounters and require necropsies to be performed on dead marine mammals found during Shell's operations.

Response: NMFS has reviewed the information provided by NSB and AEWC regarding marine mammal strandings in the Arctic. The stranding reports and accompanying newspaper articles for the three bowhead whales discovered in the 1980s and 1990s do not link the deaths to seismic activities. Rather, the two more detailed reports point to entanglement in fishing gear as the possible cause of death in both instances. Additionally, Rosa (2009) does not provide any evidence linking the cause of death for the bowhead carcasses reported in 2008 to seismic operations. Additionally, the increased reporting of carcasses in the Arctic since 2006 may also be a result of increased reporting effort and does not necessarily indicate that there were fewer strandings prior to 2008. MMOs aboard industry vessels in the Beaufort and Chukchi Seas have been required to report sightings of injured and dead marine mammals to NMFS as part of the IHA requirements only since 2006.

Regarding the June 2008 stranding of melon headed whales off Madagascar, information available to NMFS at this time indicates that the seismic airguns were not active around the time of the stranding. While the NSB study (Rosa, 2009) does present information regarding the injury of whales in the Arctic, it does not link the cause of the injury to seismic survey operations. As NMFS has stated previously, the evidence linking marine mammal strandings and seismic surveys remains tenuous at best. Two papers, Taylor *et al.* (2004) and Engel *et al.* (2004) reference seismic signals as a possible cause for a marine mammal stranding.

Taylor *et al.* (2004) noted two beaked whale stranding incidents related to seismic surveys. The statement in Taylor *et al.* (2004) was that the seismic vessel was firing its airguns at 1300 hrs on September 24, 2004, and that between 1400 and 1600 hrs, local fishermen found live stranded beaked whales 22 km (12 nm) from the ship's location. A review of the vessel's trackline indicated that the closest approach of the seismic vessel and the beaked whales stranding location was 18 nm (33 km) at 1430 hrs. At 1300 hrs, the seismic vessel was located 25 nm (46 km) from the stranding location. What is unknown is the location of the beaked whales prior to the stranding in relation to the seismic vessel, but the close timing of events indicates that the distance was not less than 18 nm (33 km). No physical evidence for a link between the seismic survey and the

stranding was obtained. In addition, Taylor *et al.* (2004) indicates that the same seismic vessel was operating 500 km (270 nm) from the site of the Galapagos Island stranding in 2000. Whether the 2004 seismic survey caused the beaked whales to strand is a matter of considerable debate (see Cox *et al.*, 2004). However, these incidents do point to the need to look for such effects during future seismic surveys. To date, follow up observations on several scientific seismic survey cruises have not indicated any beaked whale stranding incidents.

Engel *et al.* (2004), in a paper presented to the IWC in 2004 (SC/56/E28), mentioned a possible link between oil and gas seismic activities and the stranding of 8 humpback whales (7 off the Bahia or Espirito Santo States and 1 off Rio de Janeiro, Brazil). Concerns about the relationship between this stranding event and seismic activity were raised by the International Association of Geophysical Contractors (IAGC). The IAGC (2004) argues that not enough evidence is presented in Engel *et al.* (2004) to assess whether or not the relatively high proportion of adult strandings in 2002 is anomalous. The IAGC contends that the data do not establish a clear record of what might be a "natural" adult stranding rate, nor is any attempt made to characterize other natural factors that may influence strandings. As stated previously, NMFS remains concerned that the Engel *et al.* (2004) article appears to compare stranding rates made by opportunistic sightings in the past with organized aerial surveys beginning in 2001. If so, then the data are suspect.

Moreover, marine mammal strandings do not appear to be related to seismic survey work in the Arctic Ocean. Additionally, NMFS notes that in the Beaufort Sea, aerial surveys have been conducted by MMS and industry during periods of industrial activity (and by MMS during times with no activity). No marine mammal strandings have been observed during these surveys, that appear to be related to seismic survey activity, and none have been reported by NSB inhabitants (although dead marine mammals are occasionally sighted). Finally, if bowhead and gray whales react to sounds at very low levels by making minor course corrections to avoid seismic noise and mitigation measures require Shell to ramp-up the seismic array to avoid a startle effect, strandings, similar to what was observed in the Bahamas in 2000, are unlikely to occur in the Arctic Ocean. Therefore, NMFS does not expect any marine mammals will incur serious injury or mortality as a result of

Shell's 2009/2010 survey operations, so an LOA is not needed.

Lastly, Shell is required to report all sightings of dead and injured marine mammals to NMFS and to notify the Marine Mammal Health and Stranding Response Network. However, Shell is not permitted to conduct necropsies on dead marine mammals. Necropsies can only be performed by people authorized to do so under the Marine Mammal Health and Stranding Response Program MMPA permit. NMFS is currently considering different methods for marking carcasses to reduce the problem of double counting. However, a protocol has not yet been developed, so marking is not required in the IHA.

Comment 29: AWL states that additional mitigation measures are needed to address vulnerable cow/calf pairs. When assessing the potential impacts of noise, NMFS and MMS have recognized that bowhead cow/calf pairs merit special conditions. NMFS acknowledged in 2008 that more information is needed about the potential effects of even a single seismic survey on the health of females and very young calves. Collectively, these factors led NMFS to require a safety zone tailored to protect multiple migrating cow/calf pairs for the surveying that took place in both seas in 2006 and for the subsequent surveying in the Beaufort Sea in 2007 and 2008. These same factors compel a 120-dB safety zone for migrating cow/calf pairs during Shell's proposed surveying in the Chukchi Sea in 2009.

Response: The 120-dB safety zone for migrating bowhead cow/calf pairs was implemented to reduce impacts to the animals as they migrated through the narrow corridor in the Beaufort Sea. However, in the Chukchi Sea, the migratory corridor for bowhead whales is wider and more open, thus the 120-dB ensonified zone would not impede bowhead whale migration. The animals would be able to swim around the ensonified area. Additionally, NMFS has not imposed a requirement to conduct aerial monitoring of the 120-dB safety zone for the occurrence of four or more cow-calf pairs in the Chukchi Sea because it is not practicable. First, NMFS determined that monitoring the 120-dB safety zone was not necessary in the Chukchi Sea because there would not be the level of effort by 3D seismic survey operations found in 2006. This provides cow/calf pairs with sufficient ability to move around the seismic source without significant effort. Second, aerial surveys are not required in the Chukchi Sea because they have currently been determined to be impracticable due to lack of adequate

landing facilities, the prevalence of fog and other inclement weather in that area, potentially resulting in an inability to return to the airport of origin, thereby resulting in safety concerns.

Comment 30: AEWC states the analysis that is provided regarding bowhead whales assumes, without supporting evidence, their migrations through the Chukchi follow a narrow path. AEWC and NSB note that insufficient data exist about bowhead whale and other species' use of the Chukchi, and Shell should not be authorized to operate in this sensitive area until further information has been collected. For this same reason, AEWC asks NMFS to cap the seismic and related activities that it authorizes each year in the Arctic to ensure that we are not damaging sensitive marine resources that are relied on for subsistence in ways that we are unaware of.

Response: NMFS disagrees with the first statement. In fact, in NMFS' Notice of Proposed IHA (74 FR 26217, June 1, 2009), NMFS stated that the bowhead migration pathway is narrower and more well defined in the Beaufort Sea than in the Chukchi Sea. Regarding the comment about insufficient data, please see the response to comment 26 in this document. While NMFS acknowledges that there is some uncertainty about the status of marine mammals in and their use of the Chukchi Sea, population assessments are being conducted. NMFS used the best scientific information available to make the necessary findings required under the MMPA. Using the best available information, NMFS determined that Shell's survey will affect only small numbers of marine mammals, will have a negligible impact on affected species or stocks, and will not have an unmitigable adverse impact on the affected species or stocks for subsistence uses.

NMFS does not authorize the actual seismic and related activities. That authority falls to MMS. Rather, NMFS authorizes the take of marine mammals incidental to a specified activity (in this case, seismic activity) pursuant to sections 101(a)(5)(A) and (D) of the MMPA. While NMFS agrees that limiting the number of geophysical operations in either the Arctic would reduce impacts on marine mammals, this condition is unnecessary for a determination on whether there will be an unmitigable adverse impact on subsistence uses of marine mammals because applicants are required to complete a POC to ensure that their activities will not affect subsistence hunts. As described elsewhere in this document, Shell has incorporated design features into their program,

signed the 2009 CAA, and implemented a POC, and NMFS has included measures in the IHA to ensure no unmitigable adverse impacts to subsistence hunts.

NMFS understands that, under the terms of an OCS lease, the lessee is required to make progress on exploration and development on its leases in order to hold that lease beyond the initial lease term. Ancillary activities (such as seismic and shallow hazard surveys) are those activities conducted on a lease site to obtain data and information to meet MMS' regulations to explore and develop a lease. If a limit is placed by NMFS on the number of ancillary activities authorized for a planning area in a given year, NMFS may preclude the lessee from complying with MMS regulations to proceed in a timely manner on exploring or developing its OCS leases. Therefore, based on both practicability and that it is not necessary, NMFS has not adopted this suggested mitigation measure. However, NMFS encourages industry participants to work together to reduce seismic sounds in the Arctic Ocean through cooperative programs in data collection to reduce impacts on marine mammals.

Comment 31: NSB states that Shell needs to consider impacts on those species that may not occur in the project area in "meaningful numbers."

Response: Although bowhead, beluga, and gray whales and harbor porpoise are more likely to occur in the project area than other cetacean species (i.e., humpback, fin, killer, and minke whale), all of these species were described and analyzed in Shell's application and NMFS' proposed IHA (74 FR 26217, June 1, 2009).

Comment 32: NSB notes that Shell states, "These types of surveys, collectively and individually, have not resulted in impacts of biological significance to marine mammals of the Arctic..." Shell does not have data to support this statement, as Shell and other oil and gas companies have yet to examine whether there have been impacts of biological significance from exploration activities in the Beaufort and Chukchi Seas. Determination of the biological significance of impacts from oil and gas activities (beyond just behavioral deflection) is needed. Further, "biological significance" must be defined. NSB also notes that Shell states, "Any effects would be temporary and of short duration at any one place." It is difficult, if not impossible to judge this statement from the information included in this IHA.

Response: To date, there have not been any reported large scale impacts

attributable to offshore oil and gas development in the Arctic. NMFS would expect that villagers who hunt and fish in the offshore waters would notice changes in marine life. However, NMFS agrees that there is some uncertainty on the current status of some marine mammal species in the Beaufort and Chukchi Seas and on impacts on marine mammals from seismic surveys. NMFS is currently proposing to conduct new population assessments for Arctic pinniped species and current information is available on-line through its SARs program. As stated previously, NMFS determines whether takings by harassment are occurring based on whether there is a significant behavioral change in biologically important activity, such as feeding, breeding, migration or sheltering. All of these activities are potentially important for reproductive success of a marine mammal population (67 FR 46722, July 16, 2002). In regard to impacts, there is no indication that seismic survey activities are having a long-term impact on marine mammals. For example, apparently, bowhead whales continued to increase in abundance during periods of intense seismic in the Chukchi Sea in the 1980s (Raftery *et al.*, 1995; Angliss and Outlaw, 2007), even without implementation of current mitigation requirements. As a result, NMFS has determined that seismic survey noise in the Arctic will have no more than a short-term effect on marine mammals in the Chukchi Sea.

Large-scale impact assessments on marine mammal species from offshore seismic activities have been ongoing since 2006 through the industry's comprehensive monitoring plan. NMFS along with AEWG, NSB, oil exploration companies, and others have developed an off-seismic vessel monitoring program to help address the potential impact of seismic activities on marine mammals and subsistence uses of marine mammals. This program is described later in this document (see "Comprehensive Monitoring Reports"). If NSB wishes to set alternative priorities for this impact assessment program, it should make that concern known to NMFS and Shell as soon as possible.

Comment 33: NSB notes that Shell states, "Excessive amounts of repeated exposure can lead to overestimation of the number of animals potentially exposed through double counting." NSB indicates that this can also cause greater harm in animals exposed multiple times/chronically.

Response: Repeated exposure may cause a marine mammal to exhibit

diminished responsiveness (habituation), or disturbance effects may persist; the latter is most likely with sounds that are highly variable in characteristics, infrequent, and unpredictable in occurrence, and associated with situations that a marine mammal perceives as a threat. Additionally, the relatively short cross-track distance of the 160-dB radius associated with Shell's site clearance and shallow hazards surveys result in little overlap of exposed waters during the survey.

Moreover, as explained in detail elsewhere in this document, marine mammals will need to be significantly closer to the seismic source and be exposed to SPLs greater than 180 dB to be injured or killed by the airgun array. For large airgun arrays (much larger than the array to be used by Shell in 2009/2010), this distance may be within 200 m (656 ft) of the vessel. In order for a marine mammal to receive multiple exposures (and thereby incur PTS), the animal would: (1) need to be close to the vessel and not detected during the period of multiple exposure; (2) be swimming in approximately the same direction and speed as the vessel; and (3) not be deflected away from the vessel as a result of the noise from the seismic array. Preliminary model simulations for seismic surveys in the Gulf of Mexico indicate that marine mammals are unlikely to incur single or multiple exposure levels that could result in PTS, as the seismic vessel would be moving at about 4–5 knots, while the marine mammals would not likely be moving within the zone of potential auditory injury in the same direction and speed as the vessel, especially for those marine mammals that take measures to avoid areas of seismic noise.

Comment 35: Citing research on long term adverse effects to whales and dolphins from whale watching activities (Trites and Bain, 2000; Bain, 2002; Lusseau *et al.*, 2006), Dr. Bain states that Level B behavioral harassment could be the primary threat to cetacean populations.

Response: Although NMFS agrees that long-term, persistent, and chronic exposure to Level B harassment could have a profound and significant impact on marine mammal populations, such as described in the references cited by Dr. Bain, those examples do not reflect the impacts of seismic surveys to marine mammals for Shell's project. First, whale watching vessels are intentionally targeting and making close approaches to cetacean species so the tourists onboard can have a better view of the animals. Some of these whale/dolphin

watching examples cited by Dr. Bain occurred in the coastal waters of the Northwest Pacific between April and October and for extended periods of time (“[r]ecreational and scientific whale watchers were active by around 6 a.m., and some commercial whale watching continued until around sunset”). Thus multiple vessels have been documented to be in relatively close proximity to whales for about 12 hours a day, six months a year, not counting some “out of season” whale watching activities and after dark commercial filming efforts. In addition, noise exposures to whales and dolphins from whale watching vessels are probably significant due to the vessels’ proximity to the animals. To the contrary, Shell’s proposed open-water shallow hazard and site clearance surveys, along with existing industrial operations in the Arctic Ocean, do not intentionally approach marine mammals in the project areas. Shell’s survey locations are situated in a much larger Arctic Ocean Basin, which is far away from most human impacts. Therefore, the effects from each activity are remote and spread farther apart, as analyzed in NMFS’ 2009 EA, as well as the MMS 2006 PEA.

Shell’s site clearance and shallow hazards activities would only be conducted between August and October for 50 days, weather permitting. In addition, although studies and monitoring reports from previous seismic surveys have detected Level B harassment of marine mammals, such as avoidance of certain areas by bowhead and beluga whales during the airgun firing, no evidence suggests that such behavioral modification is biologically significant or non-negligible (Malme *et al.*, 1986, 1988; Richardson *et al.*, 1987, 1999; Miller *et al.*, 1999, 2005), as compared to those exposed by chronic whale watching vessels cited by Dr. Bain. Therefore, NMFS believes that potential impacts to marine mammals in the Chukchi Sea by site clearance and shallow hazards surveys would be limited to Level B harassment only, and due to the limited scale and remoteness of the project in relation to a large area, such adverse effects would not accumulate to the point where biologically significant effects would be realized.

Comment 36: Dr. Bain states that changes in behavior resulting from noise exposure could lead to indirect injury in marine mammals in the wild. He presented several examples to suggest that marine mammals repeatedly exposed to Level B harassment could result in Level A takes: (1) Harbor porpoise were observed traveling at high

speeds during exposure to mid-frequency sonar in Haro Strait in 2003 and that exhaustion from rapid flight could lead to mortality; (2) citing MMS’ (2004) *Environmental Assessment on Proposed Oil and Gas Lease Sale 195 in the Beaufort Sea Planning Area* (OCS EIS/EA MMS 2004–028) that feeding requires a prey density of 800 mg/m³ and his own observation, Dr. Bain is concerned displacement from high productive feeding areas would negatively affect individual whales and that small cetaceans such as harbor porpoise would face a risk of death if they are unable to feed for periods as short as 48–72 hours, or they may move into habitat where they face an increased risk of predation; (3) individual killer whales have been observed splitting from their pod when frightened by sonar and that other killer whales’ separation from their social units has resulted in death; (4) TTS may lead to harm, as a minke whale was nearly struck by a research vessel in the area where one had been observed fleeing mid-frequency sonar, and blunt force trauma was identified as a cause of death in the investigation of harbor porpoise mortalities following exposure to mid-frequency sonar; and (5) impaired auditory ability may increase predation, as white-sided dolphins were attacked by killer whales because the noise of the research vessel caused the approach of the killer whales to go undetected by the dolphins.

Response: NMFS agrees that it is possible that changes in behavior or auditory masking resulting from noise exposure could lead to injury in marine mammals under certain circumstances in the world, such as those examples/hypotheses raised by Dr. Bain. However, it is not likely that received SPLs from the site clearance and shallow hazards surveys would drastically cause changes in behavior or auditory masking in marine mammals in the vicinity of the action area. First, marine mammals in the aforementioned examples and hypotheses were exposed to high levels of non-pulse intermittent sounds, such as military sonar, which has been shown to cause flight activities (e.g., Haro Strait killer whales); and continuous sounds such as the vessel, which could cause auditory masking when animals are closer to the source. The sources produced by the acoustic equipment and airguns for Shell’s site clearance and shallow hazards surveys are impulse sounds used in seismic profiling, bathymetry, and seafloor imaging. Unlike military sonar, seismic pulses have an extremely short duration (tens to hundreds of milliseconds) and

relatively long intervals (several seconds) between pulses. Therefore, the sound energy levels from these acoustic sources and small airguns are far lower in a given time period. Second, the intervals between each short pulse would allow the animals to detect any biologically significant signals, and thus avoid or prevent auditory masking. In addition, NMFS requires mitigation measures to ramp-up acoustic sources at a rate of no more than 6 dB per 5 min. This ramp-up would prevent marine mammals from being exposed to high level noises without warning, thereby eliminating the possibility that animals would dramatically alter their behavior (i.e. from a “startle” reaction). NMFS also believes that long-term displacement of marine mammals from a feeding area is not likely because the seismic vessel is constantly moving, and the maximum 160-dB ensonified radius is about 1.4 km, which would create an area of ensonification of approximately 6 km² at any given moment, which constitutes a very small portion of the Chukchi Sea (0.001 percent). In reality, NMFS expects the 160-dB ensonified zone to be smaller due to absorption and attenuation of acoustic energy in the water column.

Comment 36: AEWC states that NMFS does little to assess whether Level A harassment is occurring as a result of the deflection of marine mammals as a result of 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 Nieukirk *et al.*, 2004). 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. Dr. Bain also states that there are three main ways that minor behavioral changes, when experienced by numerous individuals for extended periods of time, can affect population growth: increased energy expenditure, reduced food acquisition, and stress (Trites and Bain, 2000).

Response: See the response to comment 35 regarding the potential for injury. The paper cited by AEWC (Nieukirk *et al.*, 2004) tried to draw linkages between recordings of fin, humpback, and minke whales and airgun signals in the western North Atlantic; however, the authors note the difficulty in assessing impacts based on the data collected. The authors also state

that the effects of airgun activity on baleen whales is unknown and then cite to Richardson *et al.* (1995) for some possible effects, which AEWC lists in their comment. There is no statement in the cited study, however, about the linkage between deflection and these impacts. While deflection may cause animals to expend extra energy, there is no evidence that this deflection is causing a significant behavioral change to a biologically significant activity. In fact, bowhead whales continued to increase in abundance during periods of intense seismic in the Chukchi Sea in the 1980s (Raftery *et al.*, 1995; Angliss and Outlaw, 2007). Therefore, NMFS does not believe that injury will occur as a result of Shell's activities. Additionally, Shell's total data acquisition activities will occur in an extremely small portion of the Chukchi Sea (0.2 percent). Therefore, based on the smaller radii associated with Shell's site clearance and shallow hazards surveys than the larger 2D or 3D seismic programs and the extremely small area of the Chukchi Sea where Shell will utilize airguns, it is unlikely that marine mammals will need to expend extra energy to locate prey or to have reduced foraging opportunities.

Comment 37: Citing Erbe (2002), AEWC notes that any sound at some level can cause physiological damage to the ear and other organs and tissues. Placed in a context of an unknown baseline of sound levels in the Chukchi Sea, it is critically important that NMFS take a precautionary approach to permitting additional noise sources in this poorly studied and understood habitat. Thus, the best available science dictates that NMFS use a more cautious approach in addressing impacts to marine mammals from seismic operations.

Response: The statement from Erbe (2002) does not take into account mitigation measures required in the IHA to reduce impacts to marine mammals. As stated throughout this document, based on the fact that Shell will be using a small airgun array (total discharge volume of 40 in³) and will implement mitigation measures (i.e., ramp-up, power-down, shutdown, etc.), NMFS does not believe that there will be any injury or mortality of marine mammals as a result of Shell's operations.

Comment 38: AEWC states that in making its negligible impact determination, NMFS failed to consider several impacts: (1) Non-auditory, physiological effects, namely stress; (2) the possibility of vessel strikes needs to be considered in light of scientific evidence of harm from ship traffic to marine mammals; (3) impacts to marine

mammal habitat, including pollution of the marine environment and the risk of oil spills, toxic, and nontoxic waste being discharged; (4) impacts to fish and other food sources upon which marine mammals rely; (5) specific marine mammals that will be taken, including their age, sex, and reproductive condition; and (6) the use of multiple airguns at one time. For this last point, referencing Nieuwkirk *et al.* (2004) and NRC (2003), AEWC states that the impacts from airguns cannot simply be discounted by assuming that most of the energy is focused vertically, and, thus, the impacts horizontally are not great. Dr. Bain also notes that directional sources and arrays produce significant energy in directions other than their primary direction.

Response: NMFS does not agree that these impacts were not considered. First, non-auditory, physiological effects, including stress, were analyzed in the Notice of Proposed IHA (74 FR 26217, June 1, 2009). No single marine mammal is expected to be exposed to high levels of sound for extended periods based on the size of the airgun array to be used by Shell and the fact that an animal would need to swim close to, parallel to, and at the same speed as the vessel to incur several high intensity pulses. This also does not take into account the mitigation measures described later in this document.

Second, impacts resulting from vessel strikes and habitat pollution and impacts to fish were fully analyzed in MMS' 2006 Final PEA and incorporated by reference into NMFS' 2009 EA for Shell's activities. Additionally, the proposed IHA analyzed potential impacts to marine mammal habitat, including prey resources. That analysis noted that while mortality has been observed for certain fish species found in extremely close proximity to the airguns, Saetre and Ona (1996) concluded that mortality rates caused by exposure to sounds are so low compared to natural mortality that issues relating to stock recruitment should be regarded as insignificant. Based on the small portion of the Chukchi Sea that will be ensonified during Shell's activities, less than 0.1 percent of available food resources are anticipated to be impacted, which would have little, if any, effect on a marine mammal's ability to forage successfully.

For the fifth point, please see the response to comment 11. The age, sex, and reproductive condition must be provided when possible. However, this is often extremely difficult to predict. Additional mitigation measures for bowhead cow/calf pairs, such as monitoring the 120-dB radius and

requiring shutdown when 4 or more cow/calf pairs enter that zone, were considered but determined to be impracticable for this survey. As stated elsewhere in this document, due to safety concerns, aerial surveys are not required in the offshore Chukchi Sea environment. Regarding the last point raised by AEWC, NMFS analyzed impacts from the use of an airgun array with a total discharge volume of 40 in³. In its analysis, NMFS did not discount the impacts from airguns by simply assuming that most of the energy is focused downward (i.e., vertically). While the fact that the downward direction of the airguns minimizes sound that is emitted in the horizontal direction, NMFS fully analyzed the impacts of airgun sounds on marine mammals and has required monitoring and mitigation measures to reduce the impacts further. Based on the information contained in this response and the analyses in the proposed IHA and NMFS' EA, NMFS determined that impacts to marine mammals as a result of Shell's action will be negligible.

Comment 39: NSB notes that Shell's application states, "In the absence of important feeding areas, the potential diversion of a small number of bowheads is not expected to have any significant or long-term consequences for individual bowheads or their population. Bowheads, gray, or beluga whales are not predicted to be excluded from any habitat." If these whales are avoiding the 160 dB and potentially the 120 dB isopleths, and the logic that is used for use of the mitigation gun is that the sound "clears" the area, then, yes, they will most certainly be excluded from part of their habitat.

Response: NMFS agrees with NSB's statement that whales will likely be excluded from part of their habitat. However, the exclusion is expected to be temporary and would not affect feeding opportunities because only an extremely small fraction of the Chukchi Sea will be ensonified as a result of Shell's operations (less than 0.2 percent). Implicit in this conclusion, therefore, is that there will be many other areas available to whales for feeding and other biologically important activities.

Acoustic Impacts

Comment 40: Citing studies on noise impacts to chinchillas (Henderson *et al.*, 1991) and human noise exposure standards by the U.S. Occupational Safety Health Administration (OSHA), Dr. Bain states, "[I]n humans, chronic exposure to levels of noise too low to generate a TTS can result in PTS." As OSHA standards require limiting human

exposure to noise at 115 dBA above threshold to 15 minutes per day, Dr. Bain concludes that this level is equivalent to 145 dB re 1 μ Pa for killer whales. Dr. Bain states that although the reference levels for sound in air and water are different, this difference is taken into account when determining thresholds.

Dr. Bain notes that while OSHA's standards are for continuous noise and assume multi-year exposure, surveys employ multiple intermittent sources, which in a reverberant environment, have the potential to become nearly continuous. While individual projects will cause limited exposure to individual marine mammals, these individuals will accumulate exposure from natural sources (e.g., wind) and human activities (e.g., other seismic surveys, vessel traffic) conducted over the course of their lifetime.

Response: Although NMFS agrees that chronic exposure to noise levels that would not cause TTS could result in hearing impairment in the long-term, it is important to understand that such exposure has to be of a chronic and long-term nature. The OSHA standards for permissible exposure are based on daily impacts throughout an employee's career, while the noise exposure to seismic surveys by marine mammals is short-term and intermittent (surveys occur for 2–3 months in a given year), as described in the Notice of Proposed IHA and NMFS' EA. In addition, the reference Dr. Bain cites (Henderson *et al.*, 1991) does not address chronic noise impact to humans. The research by Henderson *et al.* (1991) focused on the applicability of the equal energy hypothesis (EEH) to impact (impulse) noise exposures on chinchillas, and the results indicated that hearing loss resulting from exposure to impact noise did not conform to the predictions of the EEH, which is the basis for OSHA standards for continuous noise exposure.

Most importantly, Dr. Bain's extrapolation of 145 dB re 1 Pa for killer whale hearing safety from OSHA's 115 dBA is fundamentally flawed for three reasons:

(1) The reference points when using decibel units that address sound in air and in water are different. For airborne sounds, such as those by OSHA, the reference point is 20 μ Pa, while for underwater sounds, the reference point is 1 μ Pa. There is a 26 dB difference between the values when different reference points are used for the same sound pressure; therefore, 115 dB re 20 μ Pa is 141 dB re 1 μ Pa for the same sound pressure. So 115 dB re 20 μ Pa in air above human threshold (defined as

0 dB re 20 μ Pa in air) would be 141 dB re 1 μ Pa underwater for the same sound pressure. Using the lowest threshold of 30 dB re 1 μ Pa as the killer whale hearing threshold and assuming that noise impacts to killer whales are the same as for humans, one could extrapolate that continuous noise exposure of 171 dB re 1 μ Pa (141 dB over the 30 dB threshold) for 15 minutes for killer whales would be equivalent to humans exposed to 115 dB re 20 Pa for 15 minutes. Nevertheless, such extrapolation still leaves much uncertainty since marine mammals have a different mechanism for sound reception (Au, 1993; Richardson *et al.*, 1995). Some of the most recent science has shown that for some odontocetes, the onset of TTS when exposed to impulse noise is much higher (Finneran *et al.*, 2002) than NMFS' current thresholds.

(2) The decibel values used by OSHA are expressed as broadband A-weighted sound levels expressed in dBA. This frequency-dependent weighting function is used to apply to the sound in accordance with the sensitivity of the human ear to different frequencies. Thus, it is inappropriate to compare these values to an animal's hearing capability, including how an animal perceives sound in air (Richardson *et al.*, 1995). For marine mammals, M-weighting functions have been suggested based on five different hearing functional groups to address different hearing sensitivities of different frequencies by each of the marine mammal groups (Southall *et al.*, 2007).

(3) Finally, the sound characteristic used in OSHA standards is continuous sound, while the seismic sound from the proposed shallow hazard and site clearance surveys is impulse sound, which by its very nature is not a continuous sound. There are several seconds between each shot, and each shot only lasts for a few milliseconds. Therefore, the amount of time without seismic sound between each shot is greater than 99 percent. As there is a significant period of time between shot events, this does not qualify as a continuous sound source. NMFS' EA assessed the cumulative impacts from all activities in the Chukchi Sea. Based on that assessment, NMFS determined that Shell's activities would not produce any significant cumulative impacts to the human environment (i.e., marine mammals).

Comment 41: Dr. Bain states that sound sources are typically divided into continuous and pulsed categories, and that behavioral effects from pulsed sound are likely to be independent of

the repetition rate and duty cycle and depend primarily on the duration of the survey. Dr. Bain further states that intermittent pulses can result in continuously received noise when sound arrives via multiple paths, which Dr. Bain explains as "sound that bounces between the bottom and the surface will take longer to reach an animal than sound traveling via a direct path," and that "noise can mask signals for a brief period before and after it is received, meaning an almost continuous received noise can mask signals continuously."

Response: NMFS does not agree with Dr. Bain's statement on ocean acoustics and his subsequent analysis and assessment regarding underwater sound propagation and its effects to marine mammals. Within the scientific community on ocean acoustics and bioacoustics, two types of sound are traditionally recognized: transient sounds (sounds of relatively short duration) and continuous sounds (sounds that go on and on). Transient sounds can be further classified into impulsive (such as seismic airguns, explosives, pile driving) and non-impulsive (such as military tactic sonars) sounds (Richardson *et al.*, 1995). Other researchers studying noise impacts on marine mammals classified sound types into a single pulse (a single explosive), multiple pulses (seismic airguns, pile driving), and non-pulses (ships, sonar) (Southall *et al.*, 2007). A simple way to distinguish pulses sound from non-pulses (continuous sound included) is that the former have rapid rise-time in relation to its extremely short duration. As mentioned in the response to comment 25, behavioral responses from marine mammals when exposed to underwater noise is complex and context specific, and often depend on the sound characteristics (such as received levels, duration, duty cycles, frequency, etc.) and other variables.

NMFS agrees that the distinction between transient and continuous sounds is not absolute, as continuous sound from a fast moving vessel is often treated as transient sound in relation to a stationary or slow moving marine mammal. Further, the distinction between pulses and non-pulses is also not always clear, as certain pulsed sound sources (e.g., seismic airguns and explosives) may become non-pulses at greater distances due to signal decay through reverberation and other propagation paths. However, Dr. Bain's statement that intermittent pulses can result in continuously received noise when sound arrives via multiple paths is unfounded. For a marine mammal exposed to noise, multipath propagation

would expose the animal to the noise multiple times, usually each subsequent exposure with lower sound level due to loss of acoustic energy from surface and bottom reflections; however, the noise arriving via multipath propagation would not become continuous sound because the intervals between signals would always exist. In addition, noise cannot mask a signal before or after it is received by the animal. Masking of signals can only occur when the unwanted sound (noise) interferes with the signal when received by the animal, generally at similar frequencies (Richardson *et al.*, 1995). Therefore, Dr. Bain's assessment regarding the potential impact of the acoustic sources to be used during Shell's operations is not supported.

Comment 42: Dr. Bain states that one characteristic of pulsed sources is known as "time-bandwidth" product, and he explains that it is "any sound with a finite duration (that is, any real-world sound) contains additional frequencies to the nominal frequency. That is, pulsed sources that nominally have a frequency that is too high to hear, may, in fact, be audible, as the source will contain lower frequencies that are detectable."

Response: NMFS does not agree with Dr. Bain's statement that high frequency pulsed sources nominally contain additional frequencies that are audible. The high frequency pulsed sources are expected to operate within their frequency range, although some mechanical noise at lower frequencies may be produced as a byproduct during the operation. The mechanical noise associated with acoustic equipment is expected to be low intensity and is not expected to result in harassment of marine mammals. Furthermore, the term "time-bandwidth product" is generally used in signal process, which is irrelevant to the Chukchi Sea site clearance and shallow hazards survey.

Marine Mammal Biology Concerns

Comment 43: NSB states that Table 4-1 in Shell's application should be organized based on the NMFS accepted stocks of marine mammals, which is the appropriate management unit. For example, beluga whales should be evaluated for the Beaufort Sea stock and the eastern Chukchi Sea stock. Population estimates (including nmin, point estimate for stock size, and confidence interval around that point estimate) should be given for each stock. Grouping by species is misleading and inappropriate.

Furthermore, Shell separates out numbers of marine mammals by offshore vs. nearshore/ice edge. This

approach is confusing, inappropriate for the Chukchi Sea, and needs to be refined. Marine mammals occur and migrate across the entire area. Designating a separate abundance for offshore and nearshore is not appropriate and is not helpful for evaluating the potential for small takes of marine mammals.

The pinniped section of Table 4-1 is also misleading. All four species occur in areas other than sea ice. Shell's estimate of the number of spotted seals is incorrect. The provided estimate is from a MMS document and is only for the Beaufort Sea. Thousands of spotted seals use Chukchi Sea haulouts. That information should be provided in the application.

Response: Table 4-1 is meant to provide an overview of the marine mammals that are described in detail in Section 4 of Shell's application. The different stocks that may be encountered during Shell's activities are described in the text portions of the application that follow the table. For example, the discussion for beluga whales describes both the Beaufort Sea stock and the eastern Chukchi Sea stock. Where available, the requested information (e.g., nmin, point estimate for stock size, etc.) was provided; however, that information is not available in the NMFS SARs for all Arctic species. Shell will consider revising this table in future IHA applications. The textual descriptions also provide additional information on the use of the Chukchi Sea by the different species listed in Table 4-1 and a Chukchi Sea specific abundance estimate for spotted seals.

Comment 44: NSB states that the last paragraph in the beluga section of the application (page 16) is incomplete. Decision makers and the public need to be aware that the entire Beaufort and Chukchi populations of belugas migrate through the Chukchi Sea during the autumn. This information is necessary because Shell's proposed work is in the Chukchi Sea and may impact beluga whales. Therefore, appropriate monitoring and mitigation plans are needed for the central Chukchi Sea.

Response: Discussion of the migration patterns of the Beaufort Sea stock of beluga whales is contained earlier in the beluga whale description (page 15 of the application). NMFS considered impacts to beluga whales during Shell's Chukchi operations. The IHA issued to Shell contains appropriate monitoring and mitigation measures (described in detail later in this document) for all marine mammal species under NMFS' jurisdiction.

Comment 45: NSB notes that statements regarding bowheads

summering in the Chukchi Sea and feeding in the Beaufort Sea are incomplete. They provide statements of sightings during the summer months, indicating that not all bowheads migrate to the eastern Beaufort Sea in the summer. This information is needed by decision makers and the public to better assess the potential impacts from oil and gas activities on bowheads.

Response: MMS' 2006 Final PEA contains a discussion about bowhead migration and references scientific literature and accounts from hunters, indicating that some bowheads may summer in the western Beaufort Sea or Chukchi Sea. This information was incorporated by reference into NMFS' 2009 EA for the issuance of an IHA to Shell and was considered in making the necessary MMPA findings.

Comment 46: NSB states that the discussion of results from Shell's aerial surveys regarding gray whales is misleading. Shell states that gray whales were most abundant near shore between Barrow and Wainwright; however, Shell did not conduct aerial surveys in offshore areas, including in the proposed operation area. Shell's visual observations in offshore areas came solely from observers on boats. It is not reasonable to compare aerial and vessel surveys to conclude that gray whales are mostly using nearshore areas. Scientific information on how gray whales are using offshore areas should be considered limited at this time.

Response: Comment noted. In assessing impacts to gray whales, NMFS considered that individuals may occur within the action area. Estimated take numbers for gray whales reflect the fact that the animals may use offshore areas near Shell's operations (see the "Estimated Take of Marine Mammals" section later in this document).

Comment 47: AWL states that there is insufficient information in the proposed IHA **Federal Register** notice related to gray whales to justify NMFS' MMPA conclusions. Gray whales have been shown to abandon habitat in response to anthropogenic noise. It is not clear that NMFS considered the proximity of Shell's proposed survey areas to the Hanna Shoal or other potential eastern gray whale feeding areas.

AWL and Dr. Bain note that gray whale numbers have declined since delisting of the species in 1994. Dr. Bain states that this raises the question of whether gray whales should be re-listed as threatened under the ESA since their population has a negative trend and is at a level that was considered threatened even when it was increasing. One implication of re-listing would be a change in the recovery factor for

calculating Potential Biological Removal (PBR). Using the value for an ESA-listed species would reduce PBR to 42. Subsistence harvest in Russia alone exceeds this number. Thus, additional threats such as habitat loss due to disturbance from seismic surveys would result in further jeopardy to the survival of the species. It is clear that a careful evaluation of this species is needed before activities that disturb gray whales are allowed.

Response: NMFS considered the potential impacts of the site clearance and shallow hazards surveys on gray whales. MMS' 2006 Final PEA contains discussion and analysis of the potential effects of airgun noise on gray whales, including avoidance of habitat when seismic surveys are occurring. This information was considered by NMFS and incorporated by reference into the EA prepared for this action. Through this analysis, NMFS considered the fact that the Chukchi Sea is considered a primary summer feeding ground for the eastern North Pacific stock of gray whales. However, NMFS determined that Shell's surveys will impact only small numbers of gray whales and will have a negligible impact on the affected stock. This determination was made based on several factors: (1) the small size of the airgun array (40 in³); (2) the short duration of the survey (approximately 50 days); and (3) the incorporation of the required mitigation and monitoring measures described later in this document.

Since 1994, NMFS has continued to monitor the status of the population consistent with its responsibilities under the ESA and the MMPA. In 1999, a NMFS review of the status of the eastern North Pacific stock of gray whales recommended the continuation of this stock's classification as non-threatened (Rugh *et al.*, 1999). Workshop participants determined the stock was not in danger of extinction, nor was it likely to become so in the foreseeable future. In 2001 several organizations and individuals petitioned NMFS to re-list the eastern North Pacific gray whale population. NMFS concluded that there were several factors that may be affecting the gray whale population but there was no information indicating that the population may be in danger of extinction or likely to become so in the foreseeable future. Wade and Perryman (2002) and Punt *et al.* (2004) (cited in the 2008 SAR, Angliss and Allen, 2009) found that the stock is within its optimum sustainable population level and that the population is likely close to or above its unexploited equilibrium level. NMFS continues to monitor the

abundance of the stock through the MMPA stock assessment process, especially as it approaches its carrying capacity. If new information suggests a reevaluation of the eastern North Pacific gray whales' listing status is warranted, NMFS will complete the appropriate reviews. Lastly, Shell's surveys are not expected to destroy or result in any permanent impact on habitats used by gray whales or to their prey resources or to jeopardize the continued existence of the species.

Comment 48: AWL, Dr. Bain, and AEWC state that the division of the harbor porpoise population in Alaska is incorrect. Dr. Bain and AEWC cite to the 2008 harbor porpoise Bering Sea stock SAR (Angliss and Allen, 2009):

In cases outside of Alaska, studies have shown that stock structure is more fine-scale than is reflected in the Alaska Stock Assessment Reports. At this time, no data are available to reflect stock structure for harbor porpoise in Alaska. However, based on comparisons with other regions, smaller stocks are likely. Should new information on harbor porpoise become available, the harbor porpoise Stock Assessment Reports will be updated.

That is, the stock to be affected by the survey is likely to be far smaller than currently recognized. The implication is that the population is far less able to tolerate takes than expected based on the current stock definition. AWL states that while NMFS is not required to develop a definitive stock assessment, it cannot rely on concededly inaccurate information in order to comply with its MMPA obligations. AEWC states that without knowing whether a specific stock of harbor porpoise exists in the area that will be impacted by Shell's operations and the population numbers and health of that stock, NMFS cannot determine the level of take and whether such take will be negligible to the stock. Thus, operations in the Chukchi should not proceed until additional studies have been conducted.

Response: Currently, there are insufficient samples to draw conclusions about stock structure of harbor porpoise within Alaska. While NMFS acknowledges that perhaps smaller stocks should be recognized in Alaska, the best science currently available indicates that Shell's activities will potentially impact only small numbers of harbor porpoise and will not have a negligible impact on the affected species or stock. Using the current estimated stock size for the Bering Sea stock, only 0.01 percent is estimated to be taken by harassment. If the number should be something closer to the low 1,000s (as suggested by AWL), this would still represent less than 1 percent

of the stock size. NMFS does not agree that just because a stock contains fewer individuals than originally estimated that it is far less able to tolerate takes than expected. Dr. Bain does not provide any scientific evidence for this statement.

Comment 49: Dr. Bain states that another point of concern regarding the harbor porpoise is that NMFS is reviewing new data on other sources of takes but will not complete the analysis until next year (Allen and Angliss, in prep.). These data are needed to assess the cumulative effects of the proposed survey and other factors that impact the population.

Response: While the draft 2009 SAR (Allen and Angliss, in prep.) states that more current data on fishery-related serious injury and mortality are being analyzed and will be available for inclusion in the 2010 SAR, it also states that in 2001 only one fishery-related harbor porpoise mortality was recorded in 2001, and none were recorded for the period 2002–2006. Although no records are currently available for 2007–2009, the estimated level of human-caused mortality and serious injury is not known to exceed PBR (Allen and Angliss, in prep.). NMFS assessed cumulative impacts to all marine mammals that may occur in the area of Shell's operations in its 2009 EA. Based on that assessment, NMFS concluded that issuance of an IHA to Shell to conduct its open-water marine survey program in the Chukchi Sea during the 2009/2010 Arctic open-water season would not produce any significant cumulative impacts to the human environment.

Comment 50: NSB notes that more information is needed regarding use of the Chukchi Sea and how environmental changes may affect that use for bearded and ringed seals.

Response: As required by the MMPA implementing regulations at 50 CFR 216.102(a), NMFS has used the best scientific information available in making its determinations required under the MMPA. While recent stock assessments are lacking for several species of ice seals, for reasons stated elsewhere in this **Federal Register** Notice, no ice seals are expected to be killed or seriously injured as a result of Shell's site clearance and shallow hazards surveys and the number of takings by Level B harassment will be small relative to the best estimate of population size. Therefore, NMFS has determined that Shell's activity would not result in a decrease in population sizes of any of the ice seal species. As a result of our analysis, NMFS believes that Shell's proposed site clearance and

shallow hazard surveys are not expected to have adverse impacts on ice seals.

Density and Take Estimate Concerns

Several of the comment letters addressed concerns over the species densities used by Shell to calculate take estimates. In general, the commenters believed that Shell used flawed density estimates, which then led to incorrect take estimates. This subsection addresses those concerns and provides further explanation beyond the information and explanations provided in Shell's application and the Notice of Proposed IHA (74 FR 26217, June 1, 2009). Dr. Sue Moore was one of the independent peer reviewers for Shell's 4MP. Those comments are addressed in the "Monitoring Plan Independent Peer Review" subsection later in this document. However, Dr. Moore also provided comments on the density estimates used by Shell, which are more appropriately addressed in this subsection.

Comment 51: NSB states, "Shell contends that 'Animal [marine mammal] densities are generally expected to be lower in deep water, and at locations far-offshore'" (page 13 in Shell's application). Shell does not provide references to support this statement. It is possible that the statement is based on visual surveys in offshore areas conducted from boats during the past 3 years. (Shell's nearshore surveys were conducted by plane.) Because of the impact from boat sounds, including 3D seismic, to marine mammals and the limited efficacy of MMOs, it is inappropriate to compare density estimates from the nearshore and offshore areas using these two different methods. Moreover, Shell's 2008 report on the "Joint Monitoring Program" showed that in some cases the number of marine mammal calls detected was greater in offshore areas compared to nearshore areas.

Response: The statement is a generalization across multiple species and seasons and does not indicate that it applies for all species (use of the word "generally"). Additionally, this statement was written when the application was also considering estimates of marine mammals in the Beaufort Sea. For example, results presented in Moore *et al.* (2000b) for bowhead and beluga whales during the summer months in the Beaufort Sea and to some extent for gray whales in the Chukchi Sea support this statement, as well as statements contained in Bengtson *et al.* (2005) for ringed and bearded seals. However, it is possible that certain species may be encountered in higher densities in offshore areas.

The paragraph from which this statement was taken was merely an introduction. Species specific descriptions are contained in the following pages of the application.

Comment 52: AEWG states that in assessing the level of take and whether it is negligible, NMFS relied on flawed density estimates that call into question all of NMFS' preliminary conclusions. Density data are lacking or outdated for almost all marine mammals that may be affected by Shell's operations in the Chukchi Sea, especially for the fall. A few species specific examples are provided that illustrate NMFS' failure to utilize the best available scientific studies in assessing Shell's application.

NMFS' guess at the number of beluga and bowhead whales in the Chukchi in the summer relies on a study from Moore *et al.* that was published in 2000 based upon information from "industry vessels." The estimate is contrary to the best available scientific information on beluga whale presence in the Chukchi in the SAR from 2005. While more updated information is necessary on beluga presence in the Chukchi during the summer, even the SAR demonstrates the arbitrary nature of NMFS' density calculations and the information upon which these calculations rely. The SAR for bowhead whales cites to a 2003 study that documented bowheads "in the Chukchi and Bering Seas in the summer" that are "thought to be a part of the expanding Western Arctic stock" (Angliss and Allen, 2009). 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 the number of bowhead whales in the Chukchi may be higher than estimated by NMFS.

Response: As required by the MMPA implementing regulations at 50 CFR 216.102(a), NMFS has used the best scientific information available in assessing the level of take and whether it is negligible. The data presented in Moore *et al.* (2000b) was not derived from sightings on industry vessels. The paper relies on data collected over 10 years (1982–1991) from aerial surveys offshore of northern Alaska. AEWG does not provide a citation for the 2005 publication cited in the beluga SAR; however, NMFS assumes it is Suydam *et al.* (2005). This is a more recent paper that provides information on the movements of 23 tagged beluga whales in the Arctic Ocean basin. However, Suydam *et al.* (2005) do not provide any density calculations or information. Shell did reference this publication in section 4 of the IHA application when describing the distribution of beluga

whales. Therefore, although this information was not used when deriving density or take estimates for beluga whales, this information was considered by NMFS in making its MMPA findings. Additionally, the 2003 study noted by AEWG in the bowhead whale SAR discusses distribution, not density (Rugh *et al.*, 2003). This paper is cited in the distribution discussion of bowhead whales in the Chukchi in section 4 of Shell's application. However, it is not useful for deriving density estimates. Therefore, density estimates for bowhead and beluga whales using Moore *et al.* (2000b) are based on the best available science.

Comment 53: Dr. Moore notes that the last paragraph on page 25 of Shell's application states in part that "For the Chukchi Sea, cetacean densities during the summer (July–August) were estimated from effort and sightings data in Moore *et al.* (2000b)." Moore *et al.* (2000b) does provide summer Chukchi transect survey effort and sighting data (stratified by bathymetry) but only for gray whales. However, expected densities are listed for eight cetacean species. Since data for seven of these species cannot be referenced to Moore *et al.* (2000b), they must be calculated (somehow) from "data collected aboard industry vessels in 2006 and 2007." However, to my knowledge, industry vessels never conducted surveys in a manner from which abundance can be estimated. NSB, AEWG, and Dr. Bain echo Dr. Moore's comment about using data from industry vessels for harbor porpoise. AEWG also states that the insufficiency of the harbor porpoise density estimate is compounded by NMFS' decision not to rely on data from "early autumn months" in calculating the "fall period" density of porpoises and to use "minimal values" instead, which is equally arbitrary.

Response: The paragraph noted by the reviewer is meant to indicate to the reader the primary sources from which density information was derived. In the following paragraphs in the application (and in the Notice of Proposed IHA), additional information on the derivation of summer and fall densities for each species is provided. As Dr. Moore suggests, data on the effort and sightings of gray whales during summer surveys are reported in Moore *et al.* (2000b), and these data were used to estimate their expected density. Although not reported in the text or tables in Moore *et al.* (2000b), Figure 6 in the article indicates two on-transect sightings of beluga whales in the Chukchi Sea in the summer. These two sightings along with the survey effort for gray whales were used to calculate a summer beluga

whale density estimate for the Chukchi Sea. As explained in Shell's application, this same method was used to calculate a summer density of bowhead whales by assuming one sighting had occurred (although none were actually reported) during the reported survey effort for gray whales.

No published densities or data on survey efforts or sightings were available for harbor porpoise, but estimates had been calculated from industry survey data in 2006 and 2007, so those densities were used. The commenter is correct that the industry vessels did not conduct standard randomized line-transect surveys while operating (except for short periods in 2006). However, this information was considered the best scientific information available to determine a density estimate for harbor porpoise in the Chukchi Sea. As noted in the subsequent paragraphs in Shell's application, density or survey data for other cetacean species are either not available or have been reported in such low numbers that minimal densities were selected to account for chance encounters of these species that are less frequently observed in the area of Shell's operations in the Chukchi Sea. Additionally, for harbor porpoise, different density estimates were used for the summer and fall periods (see Tables 6-1 and 6-2 in Shell's application).

Comment 54: Dr. Moore also notes that page 25 of Shell's application also states, "Because few data are available on the densities of marine mammals other than large cetaceans in the Chukchi Sea in the fall (Sep-Oct), density estimates from the summer period have been adjusted to reflect the expected ratio of summer-to-fall densities based on the natural history characteristics of each species" (emphasis added by commenter). Moore *et al.* (2000b) provides fall Chukchi data for bowhead, beluga, and gray whales, why is this not used? Even if these data were used, however, there remains the question of using sightings from industry vessels to "calculate densities" for five of the eight cetacean species listed in Table 6-2 of Shell's application. The MMC also recommends that NMFS require Shell to describe in detail how it adjusted the data in Moore *et al.* (2000b) to estimate cetacean densities in the Chukchi Sea in the fall.

Response: Shell used the data from Moore *et al.* (2000b) to calculate densities for beluga and gray whales during the fall period in the Chukchi Sea, which is noted in subsequent paragraphs in the application. However, in order to be consistent with methods used to calculate bowhead densities in

previous years, Moore *et al.* (2000b) was not used, although that data could have been used. See the response to comment 53 regarding deriving densities from industry vessels. In the absence of peer-reviewed literature, this was the best information available. Additional information on the use of correction factors and calculating density estimates is provided in the responses to several of the comments contained in this subsection of the document.

Comment 55: AEWG states that NMFS fails to explain how and why it reaches various conclusions in calculating marine mammal densities and what the densities are actually estimated to be once calculated. One example is NMFS' reliance on Moore *et al.* (2000b) in making its density determinations. This study documented sightings of marine mammals but did not estimate the total number of animals present. NMFS fails to explain the basis for its "conversion" of data on sightings to its density conclusions.

Response: All densities used in calculating estimated take of marine mammals based on the described operations are shown in Tables 6-1 and 6-2 of Shell's application. Moore *et al.* (2000b) provides line transect effort and sightings from aerial surveys for cetaceans in the Chukchi Sea. The kilometers of "on-transect" observer effort and number of sightings were used in the accepted line-transect density estimate equation described in Buckland *et al.* (2001). Species specific correction factors for animals that were not at the surface or that were at the surface but were not sighted [$g(0)$] and animals not sighted due to distance from the survey trackline [$f(0)$] used in the equation were taken from reports or publications on the same species or similar species if no values were available for a given species, that used the same survey platform. Additional explanations regarding the calculations of marine mammal densities are provided in the responses to other comments in this subsection of this document.

Comment 56: NSB indicates that Shell's approach to estimating densities of beluga and bowhead whales is problematic. Shell uses densities from aerial surveys, which would be appropriate if bowheads and belugas were more or less stationary. In reality, the entire bowhead population and both stocks of belugas migrate through the area Shell proposes for its 2009 exploration activities. Thus, many more bowheads and belugas may potentially be taken during Shell's operations than what they have estimated. NMFS should carefully evaluate, and modify as

appropriate, the approach Shell has used for estimating takes.

AWL also questions the use of a "density" measure in determining take in the Chukchi Sea during the bowhead migration. NMFS has recognized in the past that using density is inappropriate for determining bowhead take from seismic activities in the Beaufort Sea during the fall. It is not clear on what basis NMFS abandons an approach that would estimate migrating whales in the Chukchi Sea. Using a density calculation artificially reduces the number of bowheads that will likely be impacted from Shell's surveying and does not represent the best available science.

Response: Shell's density estimates for bowhead and beluga whales are based on the best scientific information available, which is the standard required by the MMPA implementing regulations at 50 CFR 216.102(a). The alternative method referred to by AWL for estimating take of migrating bowhead whales was only used for seismic operations in the Beaufort Sea (and is described in Shell's IHA application in the Beaufort Sea Estimating Take Section; however, Shell cancelled the Beaufort Sea activities). This method has not been applied to activities in the Chukchi Sea. Because the migration corridor is narrower and better defined in the Beaufort Sea than the Chukchi Sea this method was deemed appropriate by NMFS for seismic operations in the Beaufort. However, the migratory path taken by bowhead whales once they enter the Chukchi Sea is not as well understood. Moreover, the migratory route is not as narrowly defined in the Chukchi. Additionally, if these species avoid areas of active seismic operations at levels lower than 160 dB re 1 μ Pa (rms), as noted by several of the commenters, then fewer animals will occur in the area of Shell's operations. After careful evaluation of the methods used by Shell to estimate take, NMFS has determined that Shell used the best scientific information available in calculating the take estimates.

Comment 57: Dr. Bain notes that when estimating number of takes, it is important to consider if the individuals are feeding or migrating. In the case where there is little natural movement, the number of individuals in the ensonified area is an index of the number of takes. Exposed individuals can accumulate noise exposure or move out of the area. Assuming optimal foraging, displaced individuals will move to poorer feeding areas or compete with individuals for food in comparable habitat. When competition outside the

ensonified area occurs, the fitness of all individuals involved will be reduced, although only those exposed to noise are typically counted as taken.

Dr. Bain continues that when individuals are migrating through an area, new individuals are exposed to noise as they approach the noise source. Rather than estimating takes based on density in the ensonified area, it is more appropriate to draw a line across the ensonified area and estimate the number of individuals that would be expected to cross that line during the survey. Using an estimate of bowhead density from Funk *et al.* (2006) of 3/100 km² (3/38.6 mi²) in offshore waters in mid-season and a 120-dB diameter of 46 km (28.6 mi), Dr. Bain presents take numbers during the bowhead migration. Taking into account typical migration speed for bowhead whales (4.5 km reported in Koski *et al.* [2002]), in 24 hours, approximately 144 whales would either enter the ensonified area or be deflected to avoid it. As can be seen, the number of migrating whales exposed is far higher than would be the case if the sound source and whales were relatively stationary. Although not meant to be exact, the numbers used here are well within the range of possibilities and serve to illustrate that far more whales might be exposed during migration than during a feeding season.

Response: Dr. Bain does not provide any scientific support for his theory. The temporary displacement of marine mammals from foraging habitat is not expected to affect individual fitness. For example, apparently, bowhead whales continued to increase in abundance during periods of intense seismic in the Chukchi Sea in the 1980s (Raftery *et al.*, 1995; Angliss and Allen, 2009), even without implementation of current mitigation requirements. NMFS is not certain what Dr. Bain means by “an index of the number of takes.”

NMFS does not agree with Dr. Bain’s method for calculating takes of migrating bowhead whales. First, Dr. Bain uses the 120-dB level to estimate the level of take. For impulse sounds, such as from seismic airguns, NMFS uses the 160 dB re 1 μ Pa (rms) threshold to estimate Level B harassment. NMFS has responded several times over the past few years and elsewhere in this document to the assertion by commenters that Level B harassment takes should be estimated at the 120 dB level and not at the 160 dB level (see response to comment 25). Because Dr. Bain used this lower threshold, the take number presented is much higher than that generated by NMFS and Shell. Second, Dr. Bain uses a density estimate

from Funk *et al.* (2006), which is based on industry monitoring. The public has expressed concern over the use of density estimates derived from industry monitoring (see other comments in this subsection). As explained in the response to comment 53, NMFS uses density estimates from peer reviewed journal articles when they are available. However, in instances when monitoring from industry vessels provide the only information, estimates are derived from those reports. However, in the case of bowhead whales, information is available from non-industry monitoring studies (e.g., Moore *et al.* (2000b)); therefore, the estimate provided in Funk *et al.* (2006) was not used. Additionally, Dr. Bain’s calculation assumes that the whales will continue their entire migration along the same track as the seismic vessel. While some bowhead whales may occur in the action area, the migration corridor in the Chukchi Sea is not well defined. One cannot assume that the entire migration will occur near Shell’s operations. Lastly, Dr. Bain’s calculation also asserts that deflection itself constitutes a take. As explained elsewhere in this document, a minor course correction does not constitute a significant behavioral response rising to the level of a take. Therefore, NMFS does not agree that Dr. Bain’s formula accurately portrays the number of bowhead whale takes during the fall migration period through the Chukchi Sea.

Comment 58: Dr. Bain states that NMFS modeled takes in the Chukchi in September based on sightings in the Beaufort. However, the model is demonstrably inaccurate based on existing data from the Chukchi. Further, NMFS misinterpreted the data that form the basis of their extrapolation. Dr. Bain argues that the three reasons provided by NMFS for believing densities would be 20 times lower in the survey area than in the Beaufort in September are wrong. First, while it may be true to some degree that the migration corridor is narrower in the Beaufort, this is irrelevant. The reported density for the Beaufort depends on how well the survey design identifies the corridor boundary. Regardless of whether the average density is correctly identified, the density will vary across the corridor. That is, when the corridor widens, the average density will decline, but concentrations may still occur, as appears to be the case for the survey area (see plot in Moore *et al.* (2000b)).

Second, NMFS maintains that bowheads are more likely to migrate non-stop through the Chukchi in contrast to the Beaufort where they sometimes linger. As discussed in detail

in Dr. Bain’s letter (and comment 59), this will increase rather than decrease the number of whales taken. Third, NMFS states that most of the whales will migrate north of the survey area. To the contrary, the survey area is in the center of the migration route. Dr. Bain cites Quakenbush (2007), which shows a tagged bowhead whale migrating through Shell’s survey area, and Moore *et al.* (2000b), which plotted bowhead sightings the same distance offshore as the survey area, not north of it. Finally, Funk *et al.* (2006) found many bowheads nearshore, not north of the survey area as anticipated by NMFS.

AWL states even accepting a density approach for the fall, we do not believe that the 95% discount applied by NMFS is appropriate. NMFS’ .05 “correction factor” rests on the three points raised by Dr. Bain in this comment. AWL states that as discussed by Dr. Bain, these assertions do not justify such a severe reduction.

Response: Although it would be preferable to estimate takes of marine mammals migrating through the Chukchi Sea using detailed data on migration location, timing, and rates, as exist for bowhead whales in the Beaufort Sea, no such data exist for any species in the Chukchi Sea. Applying data from the Beaufort Sea without adjustment to the Chukchi Sea, as suggested by the commenter, is also demonstrably inaccurate based on the evidence provided. Because specific migration data are lacking, the more common approach of using expected marine mammal densities to estimate takes in the Chukchi Sea was used. However, even basic density information on many species present in the Chukchi Sea during the open-water season are not available in the published literature.

In the case of bowhead whales, the most well documented density estimates, including $f(0)$ and $g(0)$ correction factors, are given in Richardson and Thomson (2002) for the Beaufort Sea, so this density was chosen as the starting point for estimating an expected density in the Chukchi Sea. The bowhead migration through the Chukchi Sea has been thought to bifurcate after passing Point Barrow. Recent data from the Alaska Department of Fish and Game (ADF&G 2009), which provides updated information of the tagging studies presented in Quakenbush (2007), suggest that a majority of bowheads travel through the northern Chukchi Sea to the Russian coast during the fall migration (approximately 90 percent) while a small number may travel southeast along the U.S. Chukchi Sea coast

(approximately 10 percent). Many of the animals traveling through the northern Chukchi Sea to the Russian coast appeared to travel north of Shell's Burger and Crackerjack prospects (the location for the 2009 site clearance and shallow hazards surveys). Although the sample size in the Beaufort Sea is somewhat smaller, the geographic distribution of migration paths through the Beaufort Sea does appear more restricted than through the northern Chukchi Sea (Quakenbush 2007; ADF&G 2009). Bowhead whale feeding areas have not been identified in or near lease holdings in the Chukchi Sea, so whales are not likely to concentrate at densities as high as those encountered by Richardson and Thomson (2002) in the Beaufort Sea, supporting a further reduction in the density used in the Chukchi Sea. These factors lead to the selection of a density that was 5 percent of the density reported by Richardson and Thomson (2002).

Comment 59: AWL states that equally important is the lack of reasoning to support the final result. Although NMFS has provided some information as to why it applied a discount factor, it has not explained how it arrived at the precise figure. While some adjustment may be appropriate, NMFS does not include adequate information to demonstrate the basis for determining that such a sharp reduction is required. At a minimum, NMFS must reveal how it developed its calculations.

Dr. Bain also notes that it is unclear how corrections were made, as the application indicated species specific values for $g(0)$ and $f(0)$ were used. However, these values are dependent on the species and the observation platform used and sighting conditions involved, not just the species. While no on-effort sightings during surveys were reported for some species, the probability of detecting any individuals given the effort level and assumed density was not reported.

Response: See response to comment 58, which explains how NMFS arrived at a specific discount factor for bowhead whales in the Chukchi Sea. As noted in Shell's application, when densities were provided in publications the $g(0)$ and $f(0)$ correction factors used in density calculations were developed or applied by the original authors in the appropriate manner given the survey platform and conditions. Otherwise, $g(0)$ and $f(0)$ correction factors developed for the same type of survey platform and during on-effort (i.e., good sighting conditions) were used on survey data for which densities had not been explicitly calculated.

Comment 60: Dr. Bain states that while the mean density may be used in some cases to calculate a best estimate of take, maximum estimates should be considered as well to ensure worst case scenarios do not pose an unacceptable threat to a population.

Response: When evaluating the take estimates presented in Shell's IHA application, NMFS took into consideration both the average and maximum estimates. However, as explained in the Notice of Proposed IHA (74 FR 26217, June 1, 2009), since Shell did not provide a rationale regarding the maximum estimate, NMFS decided that the average density data of marine mammal populations would be used to calculate estimated take numbers because these numbers are based on surveys and monitoring of marine mammals in the vicinity of the proposed project area. NMFS only used the "maximum" estimates for marine mammal species that are considered rare in the project area and for which little to no density information exists (i.e., killer, fin, humpback, and minke whales and ringed seals) in order to account for some possibility of these species possibly being taken by Shell's activities. Additionally, using maximum density estimates is problematic as it tends to inflate harassment take estimates to an unreasonably high number and is not based on empirical science.

Comment 61: Dr. Bain states that since the assumptions upon which NMFS based its model are faulty, one would expect available data to contradict the model, and this is, in fact, the case. He notes that Funk *et al.* (2006), using more recent data from the Chukchi than the data in Richardson and Thomson (2002) from the Beaufort Sea used by NMFS, found mid-season offshore densities to be $0.03156/\text{km}^2$, meaning that NMFS' model underestimates density by a factor of almost 30 for the latter part of the survey season. Additionally, Dr. Bain notes that the model used to calculate August densities works a little bit better than the September model, as the early season densities observed by Funk *et al.* (2006) were about 7.5 times higher than predicted by NMFS, using data from Moore *et al.* (2000b). Even if NMFS concluded estimating abundance from missed sightings rather than existing sighting data were the best approach, the assumption of one missed sighting is the wrong methodology. Rather, NMFS should identify the lowest density which would result in a small probability that all whales would be missed (scientists typically use 0.05, 0.01, or 0.001 as the definition of a

"small probability"). In summary, the models used for estimating bowhead density are based on faulty assumptions and underestimate bowhead density by an order of magnitude.

Response: Dr. Bain relies on Funk *et al.* (2006) for validating the applicability of bowhead density estimates derived from Moore *et al.* (2000b) and Richardson and Thomson (2002). However, the density estimates in Funk *et al.* (2006) were calculated from data collected aboard industry vessels during routine operations, not while conducting line-transect surveys and therefore serve as a very poor comparison to data reported by Richardson and Thomson (2002) and Moore *et al.* (2000b) collected from aircraft flying line-transect surveys. Routine industry vessel operations are often conducted in one or more highly localized areas, creating spatial and temporal auto-correlation that likely artificially inflate density estimates calculated from the data. As yet, there are no known or accepted methods to account for these types of auto-correlation in non-randomized survey data.

Dr. Bain also appears to have misunderstood how a "missed" sighting was used to calculate the Chukchi Sea bowhead density estimate. Dr. Bain fails to understand that there were zero reported sightings (i.e., there were no "existing sighting data" to use, as suggested by the commenter), and, therefore, the assumption that there had been one sighting is, in effect, calculating the lowest density which would result in zero sightings. Because the calculation of bowhead density assuming this hypothetical sighting included the $g(0)$ correction factor, animals "missed" by observers, for the various reasons described by Dr. Bain, were taken into account.

Comment 62: NSB quotes a statement from page 29 of Shell's application: "Small numbers of minke and humpback whales were observed during industry activities in 2006 and 2007" (Ireland *et al.*, 2008). NSB notes that if these animals were expected to flee from the industry operations/ disturbance, then the numbers of animals actually seen would likely be a gross underestimate.

Response: The sightings of minke and humpback whales that were reported in Ireland *et al.* (2008) occurred during non-seismic periods (i.e., no airguns firing). Therefore, fleeing would not be expected at those times.

Comment 63: Dr. Moore and NSB note that Shell used Bengtson *et al.* (2005) to estimate pinniped densities; however, this paper only provides information for

springtime estimates of bearded and ringed seals. NSB notes that it is very likely that estimates of seals during open-water periods are much different than spring surveys, and Shell should be required to conduct surveys to appropriately estimate densities of these two seal species that are being considered for listing. Additionally, Shell states that it uses shipboard estimates of some marine mammals to estimate densities for estimating takes in the Chukchi Sea, which is inappropriate because it will underestimate densities. A cursory comparison of Shell's density estimate from shipboard and aerial surveys reveals that shipboard estimates are biased low; therefore, take estimates will be biased low for any time that density estimates from ships are used. NSB also believes that the method used to calculate density estimates for ribbon seals is entirely inappropriate and unacceptable. Dr. Moore asks, "how is it that expected densities are listed for ribbon and spotted seals in Tables 6-1 and 6-2?"

Response: NMFS agrees that densities may be different for ringed and bearded seals during the open-water period than during the spring ice-covered season reported in Bengtson *et al.* (2005). However, estimates for the open-water period are expected to be lower than those reported in the springtime because animals will no longer be concentrated during pupping/breeding season near ice cracks or leads. As mentioned later in the application, densities of seals calculated from industry vessel data were indeed lower than those reported by Bengtson *et al.* (2005). The data were provided merely for comparison purposes within the text. However, the higher densities reported by Bengtson *et al.* (2005) were used to calculate the take estimates. Additionally, as described later in the application, very little information exists on spotted seal densities in the offshore areas of the Chukchi Sea. Therefore, spotted seal densities were estimated by multiplying the bearded seal density provided in Bengtson *et al.* (2005) by 0.2, based on the ratio of abundance estimates of spotted seal to bearded seal. Ribbon seals have been reported in very small numbers within the Chukchi Sea by observers on industry vessels (Ireland *et al.*, 2007a; Patterson *et al.*, 2007) so minimal values have been used for expected densities to account for chance encounters of this species during Shell's operations. The use of minimal values for ribbon seal density estimates is appropriate and actually provides an overestimate of the likelihood of encountering a ribbon seal during

Shell's surveys. Using actual densities of ribbon seals in the project area would result in an estimate of less than one seal being encountered. NMFS has determined that the best scientific information available on the four pinniped species that may occur in the project area was used to calculate density and take estimates.

Comment 64: Page 35 of Shell's application states: "Under this assumption, densities of marine mammals expected to be observed in or near ice margin areas have been applied to 10% of the proposed survey trackline." NSB requests more information on how these estimates were developed.

Response: Survey operations require towing equipment in the water, making it susceptible to damage or loss in the presence of ice. Therefore, survey activities will not occur within pack-ice, and only a small amount of surveying may occur within the vicinity of ice. Densities of some marine mammal species that may occur in the project area are expected to be higher in or near sea ice. In order to avoid underestimating the potential number of takes by harassment if surveying occurs near ice for a short period of time, a small portion (10 percent) of the survey trackline was applied to these densities.

Comment 65: NSB states that Shell must use the 120-dB isopleth for estimating the number of bowheads that might be taken by harassment, not the 160-dB isopleth because of the sensitivity of migrating bowheads to anthropogenic sound. Additionally, allowance for migration of the other marine mammal species is needed. Dr. Bain also states that increased takes due to migration of beluga whales should have been taken into account.

Response: See responses to comments 27 and 31 in this document. Based on the information provided in those responses, NMFS continues to support the use of the 160-dB threshold to estimate take by Level B harassment from impulse sounds, such as seismic airguns.

Comment 66: The AEWC states that ringed seals provide another prime example of NMFS' reliance on industry operations for information on the species (see 74 FR 26224, June 1, 2009). Again, the industry operations obtained far lower numbers than the scientific studies of ringed seals.

Response: The commenter has misunderstood the inclusion of the density estimates obtained from industry operations in the Notice of Proposed IHA and Shell's application for ringed seals. The values were given in the text merely for purposes of

comparison. As stated elsewhere in the application and Notice of Proposed IHA, the values used to calculate ringed seal densities were derived from Bengtson *et al.* (2005), which are higher than the values obtained from industry operations.

Comment 67: NSB notes that Shell provides a take estimate of 283 bowhead whales in the IHA application. NSB states that this would assume that Shell's MMOs would need to visualize 283 bowhead whales in the 160-dB isopleth. Such numbers of whales have not been seen in the past.

Response: First, this number was the combined estimate for surveys that were originally proposed to be conducted in the Beaufort Sea and for operations proposed in the Chukchi Sea. The Beaufort Sea operations were cancelled by Shell and were not analyzed or authorized by NMFS. The average and maximum take estimates for bowheads in the Chukchi Sea are much lower (one and five, respectively). Additionally, NSB has misunderstood the original calculation of 283 whales and the method by which post-season take estimates are calculated. The calculation of 283 whales includes corrections for animals that would not be observed by MMOs on the vessels either because the animals were underwater or because detection is more difficult the farther the animals are from the vessel. These same corrections are applied when estimating post-season take numbers. However, based on the small size of the 160-dB radius for Shell's Chukchi Sea operations (1,400 m [0.87 mi]), it is anticipated that MMOs will be able to better monitor the zone than when monitoring aboard vessels using large airgun arrays.

Comment 68: NSB notes that Shell states in its application that "the number of migrating bowhead whales exposed to sounds ≥ 120 dB by the proposed surveys would be 8.5x the number estimated at ≥ 160 dB." Actual numbers should be included. By our calculation, this is 2,405 whales, almost a fifth of the Bering-Chukchi-Beaufort Sea stock of bowhead whales, exposed at 120 dB. Harassment of this many whales in this stock should not be permissible.

Response: This statement was meant to indicate how many bowhead whales could potentially be exposed to sounds at the 120 dB level. However, as discussed elsewhere in this document, NMFS does not consider exposure to impulse sound at 120 dB to constitute a take. Additionally, as explained in the response to comment 67, the take estimate of 283 whales was when all operations were still planned to occur.

Comment 69: AEWC is opposed to NMFS using “survey data” gathered by industry while engaging in oil and gas related activities and efforts to document their take of marine mammals. NMFS’ methodologies are not adequate for assessing the density or presence of marine mammals that typically avoid such operations. 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.

Response: See the response to comment 53. In making its determinations, NMFS uses the best scientific information available, as required by the MMPA implementing regulations. For some species, density estimates from sightings surveys, as well as from “industry surveys”, were provided in the text of Shell’s application and the Notice of Proposed IHA for purposes of comparison. However, where information was available from sightings surveys (e.g., Moore *et al.*, 2000b, Bengtson *et al.*, 2005), those estimates were used to calculate take. Data collected on industry vessels were only used when no other information was available. Additionally, while some Arctic marine mammal species have shown fleeing responses to seismic airguns, data is also collected on these vessels during periods when no active seismic data collection is occurring.

Comment 70: AEWC states that 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 and Allen, 2009) and the agency is thus unable to reach certain conclusions. Similarly, here, where data are out-dated or non-existent, NMFS should decide it cannot reach the necessary determinations. These flaws in NMFS’ analysis render the agency’s preliminary determinations about the level of harassment and negligible impacts completely arbitrary.

Response: The statements quoted by AEWC from Angliss and Allen (2009) are contained in species SARs where abundance estimates are older than 8 years. However, the full statement reads

as follows: “However, the 2005 revisions to the SAR guidelines (NMFS, 2005) state that abundance estimates older than 8 years should not be used to calculate PBR due to a decline in confidence in the reliability of an aged abundance estimate.” Shell’s activities are not anticipated to remove any individuals from the stock or population. Therefore, a recent estimate of PBR is not needed for NMFS to make the necessary findings under Section 101(a)(5)(D) of the MMPA. Additionally, Shell’s application provides information (including data limitations) and references for its estimates of marine mammal abundance. Because AEWC has not provided information contrary to the data provided by Shell, and NMFS does not have information that these estimates are not reliable, NMFS considers these data to be the best available.

Comment 71: The MMC notes that Shell will base estimates of the minimum number of marine mammals taken by harassment on the numbers of animals directly seen within the relevant safety radii by observers on the vessel during survey activities. The MMC is concerned that this method of estimation may be misleading because (1) the minimum estimate will depend on the portion of time observers are on duty (e.g., operations or observations at night may not be included), (2) it does not account for observer sighting proficiency (e.g., the ability to sight cetaceans versus pinnipeds), and (3) it does not account for behavioral responses of animals outside the so-called safety zones. Shell’s maximum take estimate is likewise problematic because it fails to take into account the movement patterns of these species, which could greatly bias the maximum estimates of take by harassment. Absent reasonable corrections for these factors, the minimum and maximum estimates may be potentially useless or misleading, with potentially adverse consequences. The MMC therefore recommends that NMFS require Shell and other applicants to develop and implement a biologically realistic study design for estimating take levels. Dr. Tim Ragen, one of the independent peer reviewers of Shell’s 4MP, expressed similar concerns. [Dr. Ragen’s comments specific to the contents of the 4MP are addressed later in this document in the “Monitoring Plan Independent Peer Review” subsection.]

Response: In order to account for the concerns expressed by the MMC, Shell provides take estimates in the 90-day report based on several methods of calculation: a minimum; a potential maximum; and a mid-level estimate.

NMFS agrees that all observations are a function of observer effort. The minimum effort is exactly that, a minimum. It is how many animals were actually seen within the specified sound radius (e.g., 160-dB isopleth). NMFS does not assume that the minimum estimate is anything more than what was seen or that this number is the actual number taken. It is not possible to provide a “correction factor” for the minimum take estimate, as it represents the number of animals sighted by the MMOs within a given radius.

A mid-level estimate is made comparing the densities of animals collected during seismic and non-seismic periods. NMFS and Shell recognize that various factors, including those mentioned above create potential variation in these numbers. The third estimate is based on densities reported in the literature during periods when no seismic operations are occurring. Shell uses the numbers that are considered to be the best estimate of density for the area of operations. Depending upon when the densities are measured and when the seismic shoot occurred, such densities may overestimate the number of “takes,” but these are reported as potential maximum levels of “take” assuming that there was no avoidance of the operational area. (However, based on information provided elsewhere in this document, several species, such as bowhead and beluga whales have shown avoidance behavior to airguns.) The actual number of takes most likely lies somewhere between the mid-level estimate and the potential maximum estimate. Calculation methods are described in detail in the 90-day reports submitted by Shell for operations conducted in 2006, 2007, and 2008 (Patterson *et al.*, 2007; Funk *et al.*, 2008; Ireland *et al.*, 2009).

Comment 72: Dr. Bain indicates that NMFS failed to consider the increases in takes of bowhead and beluga whales if there are delays in the work, resulting in its completion at the end of the period covered by the application (end of October) rather than at the time given for the best case scenario (late September).

Response: If Shell encounters several delays in August or September, then animals would not be taken because no active data acquisition would be occurring. Those takes would then potentially occur in October. However, based on the migration patterns for these two species, the density estimates would be nearly the same in early to mid-October as late September (i.e., the beginning of the migratory period). Therefore, these higher densities have

already been taken into account when estimating the level of take.

Comment 73: AEWC states that NMFS failed to account for the impacts from the strudel scour surveys in the spring of 2010, proposing only summer and fall density estimates. These practices 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.

Response: See response to comment 8. NMFS has determined that marine mammals will not have a significant behavioral response (i.e., a “take”) to the strudel scour surveys. Therefore, neither Shell’s application nor the Notice of Proposed IHA provide any take estimates for the strudel scour survey. However, Shell needs to coordinate these activities with the Native Alaskan communities to ensure that there is no unmitigable adverse impact to subsistence hunts.

Habitat Concerns

Comment 74: NSB notes that Shell’s application states, “...concluded that mortality rates caused by exposure to sounds are so low compared to natural mortality that issues relating to stock recruitment should be regarded as insignificant.” NSB asks, “What about these effects in addition to natural mortality?”

Response: The potential for Shell’s activities to affect ecosystem features and biodiversity components, including fish and invertebrates, is analyzed in NMFS’ EA for this action. Shell’s activities would impact less than 0.1 percent of available food resources, which would have little, if any, effect on a marine mammal’s ability to forage successfully. Fish would need to be in very close proximity to the airguns in order to incur mortality. Based on the small scale of effects anticipated on fish, fish eggs, and larvae from the airgun activity, these mortalities are not expected to cumulatively cause significant impacts when added to the natural mortality rates.

Subsistence Use Concerns

Comment 75: The MMC recommends that issuance of the IHA be contingent upon NMFS establishing specific mitigation measures for bowhead and beluga whales that will ensure that the proposed activities do not affect the subject species in ways that will make them less available to subsistence hunters. Such measures should reflect the provisions of any CAA, as well as meet the requirements of the MMPA.

Response: NMFS has required Shell, through the IHA, to implement mitigation measures for conducting seismic surveys that are designed to avoid, to the greatest extent practicable, impacts on coastal marine mammals and thereby, meet the needs of those subsistence communities that depend upon these mammals for sustenance and cultural cohesiveness. For the 2009 season, several of these mitigation measures were taken from the 2009 CAA signed by Shell on June 24, 2009, and include coastal stand-off distances for seismic and vessel transiting activities; a coastal community communication station; and emergency assistance to whalers, among other measures.

Comment 76: NSB and AEWC state that the MMPA requires NMFS to find that the specified activities covered by an IHA “will not have an unmitigable adverse impact on the availability of [marine mammal populations] for taking for subsistence uses” (16 U.S.C. 1371(a)(5)(D)(i)(II)). For the reasons presented herein, such a conclusion cannot be adequately supported. First, in order for impacts to be mitigated, the measures must be “successfully implemented” (50 CFR 216.104(c)) (emphasis added). Thus, Shell cannot on the one hand rely on mitigation to claim its activities will not adversely impact subsistence use but on the other hand fail to commit to mitigating the impacts of its action or ensuring the public has the opportunity to comment on the mitigation measures. For example, Shell acknowledges that there “could be an adverse impact on the Inupiat bowhead subsistence hunt” but claims the impact “is mitigated” despite the fact the mitigation measures upon which Shell relies, such as the POC, have yet to even be established, and Shell makes no definitive commitment to measures to avoid conflicts.

Second, the dates and durations of Shell’s activities are stated in amorphous terms, making it impossible for NMFS to assess whether Shell’s activities will interfere with subsistence hunting, migration, or feeding of marine mammals. Without this detailed information, NMFS is making arbitrary determinations about the actual impacts of Shell’s activities on subsistence uses in the Chukchi Sea.

Response: The MMPA does not prohibit an activity from having an adverse impact on the availability of marine mammals for subsistence uses; rather, the MMPA requires NMFS to ensure the activity does not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence uses. NMFS has

defined “unmitigable adverse impact” in 50 CFR 216.103 as an impact resulting from the specified activity: (1) that is likely to reduce the availability of the species to a level insufficient for a harvest to meet subsistence needs by: (i) causing the marine mammals to abandon or avoid hunting areas; (ii) directly displacing subsistence users; or (iii) placing physical barriers between the marine mammals and the subsistence hunters; and (2) that cannot be sufficiently mitigated by other measures to increase the availability of marine mammals to allow subsistence needs to be met.

Shell signed the 2009 CAA on June 24, 2009. As mentioned in the response to comment 75, NMFS included measures from the 2009 CAA related to marine mammals and avoiding conflicts with subsistence hunts in the IHA. Additionally, NMFS, other government agencies, and affected stakeholder agencies and communities were provided a copy of the draft POC in May 2009, which outlined measures Shell would implement to ensure no unmitigable adverse impact to subsistence uses. The POC specifies times and areas to avoid in order to minimize possible conflicts with traditional subsistence hunts by North Slope villages for transit and open-water activities. Shell waited to begin activities until the close of the spring beluga hunt in the village of Point Lay. NMFS also considered the fact that Shell’s activities will occur more than 113 km (70 mi) offshore. Hunters typically do not travel this far to collect animals. Based on the measures contained in the IHA (and described later in this document), NMFS has determined that mitigation measures are in place to ensure that Shell’s operations do not have an unmitigable adverse impact on the availability of marine mammal species or stocks for subsistence uses.

Comment 77: NSB and AWL state that Shell’s discussion of the impacts to subsistence use is far too limited in scope. Shell looks only at the direct impacts from its activities on active scouting and whaling but does nothing to quantify the overall impacts to subsistence users from on-going oil and gas activities throughout the whales’ migration routes in the Beaufort and Chukchi Seas and beyond. AWL also states that NMFS must also evaluate the following: the susceptibility of bowhead and beluga whales to disturbance from levels of noise below 160 dB; the potential impacts of future activities in both oceans; the acknowledged uncertainty regarding the effects of seismic activity; and the lack of baseline

biological data for the Chukchi Sea. For these reasons, NMFS has not adequately supported its MMPA finding as to subsistence resources (see 50 CFR 216.104(c)) (best available science standard for subsistence finding).

Response: NMFS analyzed the impacts from these additional activities in the cumulative impacts analysis section in the EA for this action. MMS' 2006 Final PEA also contains a full cumulative impacts analysis, which was incorporated into NMFS' 2009 EA by reference. NMFS has responded to the other issues raised by AWL elsewhere in this document. Based on the responses and reasoning provided throughout this document, NMFS has determined that its MMPA finding as to subsistence resources is adequately supported.

Comment 78: NSB states that the MMPA authorizes NMFS to issue a take authorization only if it first finds that there will be adequate monitoring of such taking and that all methods and means of ensuring the least practicable impact have been adopted (16 U.S.C. 1371(a)(5)(D)(ii)(I)). Shell's proposed monitoring and mitigation measures are insufficient to protect against adverse impacts on the availability of the species or stock for subsistence uses. Thus, 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.

Response: First, the section of the statute the discussion the requirement for monitoring measures is 16 U.S.C. 1371(a)(5)(D)(ii)(III), not 16 U.S.C. 1371(a)(5)(D)(ii)(I) as cited by the commenter. Second, NMFS has included measures from the 2009 CAA in Shell's IHA. Measures include: (1) avoiding groups or concentrations of whales; (2) reducing vessel speed when within 300 yards of whales and taking care not to separate members of a group from other members; (3) participating in Communication Centers; (4) planning vessel routes to minimize any potential conflict with subsistence whaling and sealing activities; (5) transiting at least five miles offshore; (6) conducting seismic operations at least 60 miles from shore; (7) providing emergency assistance to whalers; and (8) conducting a post-season review with the communities. Additionally, the following factors (1) Shell's activities will occur more than 113 km (70 mi) offshore where little to no subsistence hunting occurs, (2) activities will not commence before the end of the spring beluga hunt in Point Lay, and, (3) the location of the operational area is 225 km (140 mi) west of Barrow, so whales

will reach Barrow for the fall hunt before being exposed to sounds from the airguns will also ensure no unmitigable adverse impact to subsistence uses in the Chukchi Sea. Therefore, NMFS has determined that the monitoring and mitigation measures required to be implemented by Shell are adequate to ensure no unmitigable adverse impact to subsistence uses.

Comment 79: NSB notes that Shell states in its application that it will work with the communities to "eliminate disturbance to subsistence whaling activities in the Beaufort and Chukchi Seas." Shell needs to provide the details of how it intends to "eliminate disturbance." Shell has expressed increasing unwillingness to sign a CAA with AEWC to protect subsistence hunting of bowheads. If Shell is planning on only using POCs, developed in village meetings that are often poorly attended and without dialogue about details of mitigation measures, then Shell must provide details of the plans to "eliminate disturbance." Additionally, details are needed about how Shell will avoid impacts to hunting of other marine mammals, especially belugas and walrus. NSB also states, "If NMFS is going to rely on a POC so there are no unmitigable adverse impacts to subsistence hunting of marine mammals, there must be some process by which the communities can formally agree and accept the POC." They note that the CAA has worked well over the past 15 years in part because all parties agree to mitigation measures.

Response: It should be understood that the POC is required by NMFS' implementing regulations to be submitted as part of the industry's IHA application; so it is logical that NMFS' MMPA determinations would be made after submission of the POC. The POC is required by NMFS regulations in order to bring industry and the village residents together to discuss planned offshore activities and to identify potential problems. To be effective, NMFS and Shell believe the POC must be a dynamic document, which will expand to incorporate the communications and consultation that will continue to occur throughout 2009. Outcomes of POC meetings are included in updates attached to the POC and distributed to Federal, state, and local agencies, as well as local stakeholder groups.

In its Interim Rule for Arctic Activities (61 FR 1588, April 10, 1996), NMFS clarified that if either a POC or information required by 50 CFR 216.104(a)(12) is not submitted, and, if during the comment period, evidence is

provided indicating that an adverse impact to subsistence needs will result from the activity, an authorization may be delayed in order to resolve this disagreement. The requirements for meeting this requirement are clearly stated in 50 CFR 216.104(12).

In any event, Shell signed a CAA in June 2009, which contains measures agreed to by the parties. Many of these subsistence-related measures (as they pertain to marine mammals and the related subsistence harvests) have been included in the IHA and are enforceable.

Information on how Shell will avoid impacts to subsistence hunts of beluga whales in the Chukchi Sea have been discussed elsewhere in this document. The walrus is managed by the U.S. Fish and Wildlife Service (USFWS), and as such, NMFS does not have jurisdiction over this species.

Comment 80: NSB states that transit of Shell's vessels should not occur before July 15 instead of the stated date of July 1. The villages of Point Lay and Wainwright hunt beluga whales during late June or July (or sometimes early August). Transiting vessels through the Chukchi Sea might cause belugas to avoid their traditional congregation areas nearshore and thus impact subsistence hunting.

Response: Shell's policy has been to communicate with the villages of Point Lay and Wainwright during the spring hunting period in order to ensure that vessel transits will not interfere with the spring beluga hunt. Shell will wait until the completion of the spring hunt before transiting through the Chukchi Sea.

Mitigation and Monitoring Concerns

Comment 81: The MMC notes that NMFS is proposing to include in the IHA the additional mitigation and monitoring measures that were included in IHAs issued to Shell in 2006, 2007, and 2008. The MMC supports these proposed mitigation and monitoring measures and recommends that they be incorporated in the IHA, if issued.

Response: NMFS has included the mitigation and monitoring measures described in the Notice of Proposed IHA (74 FR 26217, June 1, 2009) in the issued IHA. However, for reasons described elsewhere in this document, NMFS has not required a 120-dB shutdown zone for activities in the Chukchi Sea.

Comment 82: NSB notes that it appears Shell wants to survey in areas other than Burger. If this is the case, NMFS needs to require additional and appropriate monitoring.

Response: The monitoring measures contained in the IHA are required at all

site clearance and shallow hazards surveying sites, not just Burger. Therefore, if Shell conducts surveying activities at Crackerjack or SW Shoebill, the same monitoring measures required at Burger will be undertaken at Crackerjack and SW Shoebill.

Comment 83: AWL states that NMFS has proposed an exclusion zone for 12 or more gray or bowhead whales within the 160-dB zone, extending 1,400 m (0.87 mi) from the seismic vessel. AWL and Dr. Bain note that there are serious concerns with the efficacy of mitigation measures such as exclusion zones, particularly when visibility is poor to non-existent. AWL also states that NMFS has not indicated that it will require a fixed number of MMOs to be on duty, and Shell states that the number of MMOs during any period depends on multiple factors, including berthing availability and lifeboat space. If Shell ultimately relies on single observers located on the source vessel only, monitoring the full 1,400 m (0.87 mi) radius for aggregations of whales will present a considerable challenge.

NSB also notes the inadequacies of MMOs to monitor the 160- and 120-dB isopleths. Therefore, MMOs will not provide a reasonable measure of how many marine mammals are exposed to sounds produced by site clearance and shallow hazards surveys. Additional monitoring approaches, such as intensive acoustic arrays, chase vessels, or aerial surveys are needed. NSB also states that Shell is intending to conduct intensive acoustic monitoring near the Burger and Klondike prospects. This will be useful for measuring takes of marine mammals and examining behavioral responses to site clearance and shallow hazards surveys. Other areas that Shell intends to explore with airguns should also be monitored with intensive acoustic arrays or with another suitable monitoring technique, such as aerial surveys. Detailed monitoring of marine mammal behavior and density is needed.

Response: The seismic vessels will be traveling at speeds of about 1–5 knots (1.9–9.3 km/hr). With a 180-dB safety range of 160 m (525 ft) and a 160-dB safety range of 1,400 m (0.87 mi), a vessel will have moved out of the applicable safety zone within a few minutes. As a result, during underway seismic operations, MMOs are instructed to concentrate on the area ahead of the vessel, not behind the vessel where marine mammals would need to be voluntarily swimming towards the vessel to enter the 180- or 160-dB zones. In fact, in some of NMFS' IHAs issued for scientific seismic operations, shutdown is not required for

marine mammals that approach the vessel from the side or stern in order to ride the bow wave or rub on the seismic streamers deployed from the stern (and near the airgun array) as some scientists consider this a voluntary action on the part of an animal that is not being harassed or injured by seismic noise. While NMFS concurs that shutdowns are not likely warranted for these voluntary approaches, in the Arctic Ocean, all seismic surveys are shutdown or powered down for all marine mammal close approaches. Also, in all seismic IHAs, including Shell's IHA, NMFS requires that the safety zone be monitored for 30 min prior to beginning ramp-up to ensure that no marine mammals are present within the safety zones. Implementation of ramp-up is required because it is presumed it would allow marine mammals to become aware of the approaching vessel and move away from the noise, if they find the noise annoying.

Periods of total darkness will not set in during Shell's survey until early September. For the month of September, nighttime conditions will occur for approximately 1–6 hrs. However, during times of reduced light, MMOs will be equipped with night vision devices. During poor visibility conditions, if the entire safety zone is not visible for the entire 30 min pre-ramp-up period, operations cannot begin.

Shell will not be relying on single MMOs aboard the source vessel to monitor the different radii. The IHA requires Shell to have five MMOs on the source vessel at any time, and two MMOs must be on duty during all pre-ramp up and ramp-up periods, as well as for a large fraction of the other operating hours as possible. MMOs are not permitted to work more than 4 consecutive hours and no more than three shifts per day (i.e., no more than 12 hours in a 24 hour period). By requiring five MMOs on the vessel at all times, this will allow for two MMOs to be on-watch for a greater period of time without causing fatigue.

In 2009, Shell and ConocoPhillips are jointly funding an extensive acoustic monitoring program in the Chukchi Sea. A total of 44 recorders will be distributed both broadly across the Chukchi lease area and nearshore environment and intensively on the Burger and Klondike lease areas. The broad area arrays are designed to capture both general background soundscape data and marine mammal call data across the lease area. Shell hopes to gain insights into large-scale distribution of marine mammals, identification of marine mammal species present, movement and

migration patterns, and general abundance data. While intensive arrays will not be deployed at the Crackerjack prospect, the broad array will still collect some of the information suggested by NSB. However, an intensive array is not necessary at every site, as the acoustic monitoring is not used to implement mitigation measures.

Aerial monitoring is not required in IHAs for surveys that occur in the offshore environment of the Chukchi Sea because they have currently been determined to be impracticable due to lack of adequate landing facilities, the prevalence of fog and other inclement weather in that area, potentially resulting in an inability to return to the airport of origin, thereby resulting in safety concerns.

Comment 84: AEWC states that as part of its application, Shell is required to suggest its proposed "means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species" and document "the level of taking or impacts on populations of marine mammals..." (50 CFR 216.104(a)(13)). One of the reasons for this monitoring is for NMFS to "ensure that authorizations over time have only a negligible impact on species or stocks of marine mammals and no unmitigable adverse impact on the availability of species or stocks for taking for subsistence uses (60 FR 28381, May 31, 1995). Thus, monitoring is critical to the proper functioning of the MMPA. For this reason, NMFS has previously explained that a site-specific monitoring plan must be submitted and would have to include information regarding survey techniques and/or other methods to be used to determine whether the behavior of marine mammals near the activity is being affected and how the number of takes would be determined, including the expected precision of that estimated number. However, Shell has failed to adequately describe its monitoring plans. For example, Shell fails to disclose its ethograms for studying marine mammal behavior or describe how data will be collected to "estimate the 'take' of marine mammals by harassment." Without this detailed information, AEWC cannot comment on the adequacy of Shell's monitoring plan or make suggestions for study design so that the data collected can easily be used by AEWC and others.

Response: While a list of the types of animal behaviors that are recorded by the MMOs was not included in the 4MP, MMOs record common behaviors exhibited by cetaceans and pinnipeds. Shell's 2009 monitoring and reporting plan is similar to that used by Shell in

2006, 2007, and 2008. The 90-day reports from those seasons contain descriptions of the types of behaviors that were recorded (Patterson *et al.*, 2007; Funk *et al.*, 2008; Ireland *et al.*, 2009). The 4MP contains a brief description of the methods to calculate take. These are the same methods that have been used by Shell in previous years. The full explanations can be found in the 90-day reports (Patterson *et al.*, 2007; Funk *et al.*, 2008; Ireland *et al.*, 2009). Shell's methods have been described several times, and AEWC and others have had several opportunities over the past few years to comment on the methods for monitoring and reporting behavior and take levels during seismic surveys.

Comment 85: AEWC indicates that Shell's monitoring plan focuses solely on "reporting" the level of take and not "monitoring" marine mammals. The monitoring plan is designed to attempt to document the take of marine mammals and fails to include proactive monitoring beyond that necessary for attempting to assess the level of take that occurs. Especially given the lack of data that exists on marine mammals use of the Chukchi, Shell should be required to conduct basic presence and absence surveys and collect density data utilizing vessels and other tools that will minimally disturb marine life and scientifically recognized data collection techniques.

Response: MMOs record the presence of marine mammals sighted outside of the monitoring zones and note the behaviors exhibited by the animals. Additionally, in 2009, Shell will be deploying an array of 44 acoustic recorders to gain insights into large-scale distribution of marine mammals, identification of marine mammal species present, movement and migration patterns, and general abundance data of marine mammals in the Chukchi Sea. Similar data have been collected in 2006–2008. The data collected during the 2009 season will assist in evaluating changes in the Chukchi Sea ecosystem.

Comment 86: NSB asks how the mitigation measures are being evaluated for efficacy. NSB and AEWC note that Shell asserts that mitigation measures are designed to protect animals from injurious takes, but it is not clear that these mitigation measures are effective in protecting marine mammals or subsistence hunters. 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. NSB states, "In essence the MMOs were not able to

observe marine mammals in the entire safety zone." Thus, the safety zones do not provide adequate mitigation from physical harm to marine mammals.

Response: NMFS believes that the required monitoring and mitigation measures are effective at ensuring the least practicable impact to marine mammals. Moreover, the safety zones for Shell's 2009 surveys are much smaller than those for the larger 3D seismic surveys in past years. The 180- and 190-dB safety zones are 160 m (525 ft) and 50 m (164 ft), respectively. The monitoring reports from 2006, 2007, and 2008 do not note any instances of serious injury or mortality (Patterson *et al.*, 2007; Funk *et al.*, 2008; Ireland *et al.*, 2009). Additionally, the fact that a power-down or shutdown is required does not indicate that marine mammals are not being detected or that they are incurring serious injury. As discussed elsewhere in this document and in the Notice of Proposed IHA (74 FR 26217, June 1, 2009), the received level of a single seismic pulse (with no frequency weighting) might need to be approximately 186 dB re 1 $\mu\text{Pa}^2\text{s}$ (i.e., 186 dB sound exposure level [SEL]) in order to produce brief, mild TTS (a non-injurious, Level B harassment) in odontocetes. Exposure to several strong seismic pulses that each have received levels near 175–180 dB SEL might result in slight TTS in a small odontocete, assuming the TTS threshold is (to a first approximation) a function of the total received pulse energy. For Shell's proposed survey activities, the distance at which the received energy level (per pulse) would be expected to be ≥ 175 –180 dB SEL is the distance to the 190 dB re 1 μPa (rms) isopleth (given that the rms level is approximately 10–15 dB higher than the SEL value for the same pulse). Seismic pulses with received energy levels ≥ 175 –180 dB SEL (190 dB re 1 μPa (rms)) are expected to be restricted to a radius of approximately 50 m (164 ft) around the airgun array.

For baleen whales, there are no data, direct or indirect, on levels or properties of sound that are required to induce TTS. The frequencies to which baleen whales are most sensitive are lower than those to which odontocetes are most sensitive, and natural background noise levels at those low frequencies tend to be higher. As a result, auditory thresholds of baleen whales within their frequency band of best hearing are believed to be higher (less sensitive) than are those of odontocetes at their best frequencies (Clark and Ellison, 2004). From this, it is suspected that received levels causing TTS onset may also be higher in baleen whales.

In pinnipeds, TTS thresholds associated with exposure to brief pulses (single or multiple) of underwater sound have not been measured. Initial evidence from prolonged exposures suggested that some pinnipeds may incur TTS at somewhat lower received levels than do small odontocetes exposed for similar durations (Kastak *et al.*, 1999, 2005; Ketten *et al.*, 2001; cf. Au *et al.*, 2000). However, more recent indications are that TTS onset in the most sensitive pinniped species studied (harbor seal, which is closely related to the ringed seal) may occur at a similar SEL as in odontocetes (Kastak *et al.*, 2004).

NMFS (1995, 2000) concluded that cetaceans and pinnipeds should not be exposed to pulsed underwater noise at received levels exceeding, respectively, 180 and 190 dB re 1 μPa (rms). The established 180- and 190-dB re 1 μPa (rms) criteria are not considered to be the levels above which TTS might occur. Rather, they are the received levels above which, in the view of a panel of bioacoustics specialists convened by NMFS before TTS measurements for marine mammals started to become available, one could not be certain that there would be no injurious effects, auditory or otherwise, to marine mammals. As summarized above, data that are now available imply that TTS is unlikely to occur unless bow-riding odontocetes are exposed to airgun pulses much stronger than 180 dB re 1 μPa rms (Southall *et al.*, 2007).

No cases of TTS are expected as a result of Shell's proposed activities given the small size of the source, the strong likelihood that baleen whales (especially migrating bowheads) would avoid the approaching airguns (or vessel) before being exposed to levels high enough for there to be any possibility of TTS, and the mitigation measures proposed to be implemented during the survey described later in this document.

There is no empirical evidence that exposure to pulses of airgun sound can cause PTS in any marine mammal, even with large arrays of airguns (see Southall *et al.*, 2007). PTS might occur at a received sound level at least several decibels above that inducing mild TTS if the animal is exposed to the strong sound pulses with very rapid rise time.

It is highly unlikely that marine mammals could receive sounds strong enough (and over a sufficient duration) to cause permanent hearing impairment during a project employing the airgun sources planned here (i.e., an airgun array with a total discharge volume of 40 in³). In the proposed project, marine mammals are unlikely to be exposed to

received levels of seismic pulses strong enough to cause more than slight TTS. Given the higher level of sound necessary to cause PTS, it is even less likely that PTS could occur. In fact, even the levels immediately adjacent to the airgun may not be sufficient to induce PTS, especially because a mammal would not be exposed to more than one strong pulse unless it swam immediately alongside the airgun for a period longer than the inter-pulse interval. Baleen whales, and belugas as well, generally avoid the immediate area around operating seismic vessels. The planned monitoring and mitigation measures, including visual monitoring, power-downs, and shutdowns of the airguns when mammals are seen within the safety radii, will minimize the already-minimal probability of exposure of marine mammals to sounds strong enough to induce PTS.

Comment 87: NSB states that Shell needs to include a plan of reporting/communicating the presence of floating dead marine mammals within the zone of industrial exploration. NSB would like to work with industry to determine cause of death and perform other biological sampling from carcasses noted in areas of industrial activity. There are no provisions within the 4MP that facilitate these objectives. Additionally, NSB has asked industry to work with NMFS to develop a plan to mark carcasses so that they are not re-counted and a more definitive count of dead, floating marine mammals within the industry zone of operations can be made. This is not included here.

Response: The IHA requires Shell to notify both NMFS and the Marine Mammal Stranding Network within 24 hours of sighting a stranded marine mammal. The MMOs are also required to complete a Level A Stranding Report Form and to take photographs when possible. However, Shell is not permitted to collect samples or conduct necropsies on dead marine mammals. Necropsies can only be performed by people authorized to do so under the Marine Mammal Health and Stranding Response Program MMPA permit. NMFS is currently considering different methods for marking carcasses to reduce the problem of double counting. However, a protocol has not yet been developed, so marking is neither required nor authorized in the IHA.

Comment 88: The MMC believes that absent an evaluation by the oil and gas industry of its monitoring and mitigation measures, the effects of the industry's activities will remain uncertain. The MMC recommends that NMFS require Shell and other companies conducting seismic work in

the Arctic to undertake the studies needed to verify observer proficiency (including the number of observers needed to monitor entire safety zones and the presence of marine mammals near or within those zones, particularly when operations are being conducted 24 hours a day) and provide additional rationale allowing seismic surveys to continue under nighttime conditions when observer proficiency is severely compromised. AWL also notes that NMFS should prohibit surveying at night and at times of low visibility to achieve the means of effecting the least practicable impact on a species or stock. At a minimum, NMFS must require multiple observers working simultaneously in order to effectively monitor the 160-dB zone. NSB states that with regard to nighttime and poor visibility conditions, Shell proposes essentially no limitations on operations, even though they acknowledge that the likelihood of observers seeing marine mammals in such conditions is low. The obvious solution not analyzed by Shell or NMFS is to simply prohibit seismic surveying when conditions prevent MMOs from detecting all marine mammals in the safety zone.

The MMC, AWL, and Dr. Bain recommend that Shell be required to supplement its mitigation measures by using passive acoustic monitoring (PAM). Such monitoring will enhance marine mammal detection capabilities under all conditions, but particularly at night and when visibility is otherwise poor.

Response: The MMOs hired by Shell are required to complete training courses and exams to verify their proficiency. All MMOs used for the 2009 surveys have at least 2 years of experience working as MMOs for surveys in Arctic waters. Several of the MMOs also have experience working on vessels in other parts of the world as well. Two MMOs are required to be on-duty during all pre-ramp-up and ramp-up periods and for as large a fraction of the active surveying period as possible. MMOs are not required to be on-duty during nighttime periods. However, if the entire safety zone is not visible during the 30 min pre-ramp-up and ramp-up periods, then operations are not permitted to begin.

On the matter of practicability, NMFS has been informed by Shell that requiring a shutdown of the airgun arrays due to inclement weather or darkness in the Arctic would reduce overall effectiveness by about 40 percent. Such a loss in efficiency could increase the potential for Shell and other companies to increase effort by bringing additional seismic vessels into

the Beaufort and/or Chukchi Seas. As a result, implementation of this suggestion as a mitigation measure is considered by NMFS to be impracticable because of economic and practical reasons.

However, an alternative mitigation measure has been identified by NMFS and is being reviewed that could increase detection of marine mammals during darkness. The alternative mitigation measure could involve the use of a high-frequency marine mammal monitoring (HF/M3) sonar, similar to a model used by the U.S. Navy. The HF/M3 sonar is capable of detecting marine mammals out to about 2 km (1.1 mi), with up to 98 percent detection ability (depending upon animal size, distance from sonar and animal depth) (Ellison and Stein, 1999) and has the capability to be ramped up to avoid injury to marine mammals (as it can detect the mammal prior to the HF/M3 sonar reaching levels of auditory injury). It should be noted that this sonar does not require a marine mammal to be vocalizing in order to be detected and has the capability of being ramped-up, ensuring that, once a marine mammal is detected within a 2-km (1.1 mi) radius, powering up the HF/M3 ceases until the marine mammal is no longer detected within the 2-km zone. Once ramp-up of the HF/M3 is complete, seismic surveys can commence. During surveys, the HF/M3 would continue to monitor the area closest to the array where there is a higher potential for injury, if marine mammals were not either deflected by the seismic noise or detected by MMOs, passive acoustics, or active acoustics. NMFS believes that utilizing the HF/M3 with ramp-up would result in the harassment of fewer marine mammals and further ensure that auditory injury does not occur. However, based on the small discharge volume of the airgun array to be used by Shell for its 2009/2010 survey operations and the required mitigation and monitoring measures (described later in this document), NMFS does not believe that marine mammal injury will occur, with or without the use of the HF/M3.

Moreover, as stated in the **Federal Register** Notice of Proposed IHA (74 FR 26217, June 1, 2009), once the safety zones are visually established and pre-survey monitoring has concluded that there are no marine mammals within the safety zones, seismic surveys can commence and continue into low visibility conditions. However, if for any reasons the seismic sources are stopped during low visibility conditions, they are not to be restarted until the conditions are suitable for the marine

mammal visual monitoring so that the safety zones can be re-established.

NMFS' 2009 EA for this action contains an analysis of why PAM is not required to be used by Shell to implement mitigation measures. Shell will deploy acoustic recorders to collect data on vocalizing animals. However, this information will not be used in a real-time or near-real-time capacity. Along with the fact that marine mammals may not always vocalize while near the PAM device, another shortcoming is that it requires a quiet vessel so that vessel noise does not hinder the ability to hear marine mammals. MMS is sponsoring a workshop in November 2009, which will review available acoustic monitoring technology (passive and active), its feasibility and applicability for use in MMS-authorized activities, and what additional developments need to take place to improve its effectiveness. NMFS may consider requirements for PAM in the future depending on information received as the technology develops further.

Comment 89: It is also AEWC's position that independent verification of offshore operators' compliance with IHA provisions must be required as part of the mitigation for the IHAs.

Response: NMFS' implementing regulations at 50 CFR 216.104 require an applicant to submit information about the mitigation, monitoring, and reporting measures that will be implemented to ensure the least practicable impact on the affected species or stock. NMFS reviews these proposed measures, and, after discussion with the applicant, requires mitigation, monitoring, and reporting protocols that NMFS determines will ensure only small numbers of marine mammals will be taken, that those takings will have a negligible impact on the affected species or stock, will not have an unmitigable adverse impact on the affected species or stock for taking for subsistence uses, and will effect the least practicable impact on the affected species or stock. While NMFS recognizes that independent verification of an operator's compliance with the terms of an IHA is generally the best course of action if possible or practicable, in some cases it is not practicable. In this case, and at this time, NMFS does rely on the industry to comply with the measures set forth in the IHA. NMFS continues to review reports submitted by IHA holders to ensure that they comply with the terms contained in the authorization. These reports require, among other things, the holder to supply information regarding sightings of marine mammals and the

implementation of appropriate mitigation measures. NMFS is continually interested, and trying, to develop a monitoring program more independent of the action, but, until such a monitoring plan is implemented, NMFS will rely on the industry to provide assurance that the activity remains in compliance with measures contained in an IHA.

Comment 90: The MMC cannot determine from the information provided in the application whether Shell plans to collect data during ramp-up procedures to test the assumption that animals are able to, and will, move away from an increasingly loud noise to avoid harmful effects. The MMC recommends that NMFS require Shell and other applicant's using ramp-up procedures to collect and analyze data pertaining to the efficacy of ramp-up as a mitigation measure. NSB also states that data need to be collected to better understand the effectiveness of the mitigation measures (i.e., ramp-up, power-down, and shutdown). Dr. Bain stresses the importance of collecting data on animals that are exposed to noise versus those that are not exposed in order to allow for comparisons of population dynamics.

Response: While scientific research built around the question on whether ramp-up is effective has not been conducted, several studies on the effects of anthropogenic noise on marine mammals indicate that many marine mammals will move away from a sound source that they find annoying (e.g. Malme, 1984; Clark *et al.*, 1999; Miller *et al.*, 1999; others reviewed in Richardson *et al.*, 1995). In particular, three species of baleen whales have been the subject of tests involving exposure to sounds from a single airgun, which is equivalent to the first stage of ramp-up. All three species were shown to move away at the onset of a single airgun operation (Malme *et al.*, 1983–1986; BBN Reports 5366, 5586, 6265; Richardson *et al.*, 1986; McCauley *et al.*, 1998, 2000).

From this research, it can be presumed that if a marine mammal finds a noise source annoying or disturbing, it will move away from the source prior to sustaining an injury, unless some other over-riding biological activity keeps the animal from vacating the area. This is the premise supporting NMFS' and others' belief that ramp-up is effective in preventing injury to marine mammals. In addition, observers and power-down/shut-down criteria provide for the protection of non-responding mammals: e.g., those that either do not hear the sounds because of a hearing impairment or because the

sounds are outside the hearing range of the species, or those individuals that do not react to the sounds because of behavioral or other physiological factors. Implementation of these measures would prevent injury to those animals that do not vacate the area. A ramp-up study was first proposed to be conducted by MMS in 1999 (HESS, 1999). While this study has not been funded to date, NMFS believes that a basic difficulty exists for testing ramp-up effectiveness without first establishing some mode of dose-response. As a result, prior to testing ramp-up effectiveness, this type of information is currently being obtained by the Sperm Whales Seismic Study. NMFS believes that this information is a critical component for understanding marine mammal impacts from world-wide operating seismic activities.

Additionally, the IHA requires that MMOs make observations for the 30 min prior to ramp-up, during all ramp-ups, and during all daytime seismic operations and record the following information: (1) the species, group size, age/size/sex categories (if determinable), the general behavioral activity, heading (if consistent), bearing and distance from seismic vessel, sighting cue, behavioral pace, and apparent reaction of all marine mammals seen near the seismic vessel and/or its airgun array (e.g., none, avoidance, approach, paralleling, etc); and (2) the time, location, heading, speed, and activity of the vessel (shooting or not), along with sea state, visibility, cloud cover and sun glare. These requirements should provide information regarding the effectiveness of ramp-up as a mitigation measure, provided animals are detected during ramp-up. This information is also recorded when a power-down or shutdown occurs. Lastly, Shell also documents sightings and behaviors of marine mammals when no active survey operations are occurring (e.g., down due to weather, transiting), allowing for some level of comparison between exposed and non-exposed individuals.

Comment 91: AEWC states that Shell relies on an out-dated Notice to Lessees (NTL 2004–G01) in its proposed mitigation plan to supply some of its mitigation measures. Not only has this notice been superseded (see NTL 2007–G02), but it is based on requirements stemming from a NMFS Biological Opinion for a lease sale in the Gulf of Mexico. The conditions in the Notice are not designed for Alaskan operations or the specific and unique needs of the Arctic. Thus, Shell's reliance on this Notice in crafting its mitigation measures is arbitrary.

Response: The full statement in the 4MP to which AEWC refers reads as follows: "The Program will be operated and administered consistent with MMS NTL 2004-G01 or such alternative requirements as may be specified in the NMFS IHA..." While the 2004 NTL is mentioned in the 4MP, the mitigation measures that are described in the 4MP and Notice of Proposed IHA (74 FR 26217, June 1, 2009) and subsequently required in the IHA are similar to those that have been developed and required by NMFS over the past few years for oil and gas seismic surveys in Arctic waters. Several of the mitigation measures required by NMFS in the IHA are specific to the unique needs of the Arctic. One example is the 160-dB shutdown requirement when an aggregation of 12 or more bowhead are gray whales occur within that isopleth.

Comment 92: AEWC and NSB both state that 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" (50 CFR 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.

Response: Shell's 2006, 2007, and 2008 90-day monitoring reports indicate that the company was able to implement the required mitigation measures (Patterson *et al.*, 2007; Funk *et al.*, 2008; Ireland *et al.*, 2009). Since the measures contained in the 2009 IHA do not differ substantially from those required previously, NMFS does not have any reason to doubt successful implementation during the current site clearance and shallow hazards surveys. NMFS has determined that with the incorporation and implementation of the mitigation measures, impacts to bowheads and other marine mammals will be negligible. Additionally, AEWC and NSB have not provided information indicating that Shell did not successfully implement the required mitigation measures.

Comment 93: NSB states that while there are descriptions of zones of impact within the 4MP, there is no clear statement of mitigation measures associated with these zones of impact. Monitoring does not equate to mitigation. There must be a clear action that results from monitoring, and these actions should go further than just power-downs. Clear indications of when

mitigation measures are triggered and what results will occur are needed in this document.

Response: The Notice of Proposed IHA (74 FR 26217, June 1, 2009) contained a discussion of mitigation measures associated with the different zones of impact. It explained when a power-down or shutdown in required to occur and how long airguns must remain off or used at a reduced level. NMFS has informed Shell that commenters have requested additional detail in the application documents. However, this does not have a bearing on NMFS' required MMPA findings for issuing an IHA.

Comment 94: Dr. Bain questions the effectiveness of marine mammal monitoring with only two MMOs on duty full time. Citing Forney and Barlow (1998) and Dahlheim and Towell (1994), Dr. Bain states that a common work schedule where consistent effort is required would be 40 minutes on, 40 minutes off, 40 minutes on, two hours off, three times a day. Dr. Bain suggests that an observation team of 12 MMOs would be required to cover a 24-hour period. Further, MMOs working shifts longer than 40 minutes cannot be expected to have the same sighting efficiency as those working in dedicated surveys, making it questionable to use sighting efficiencies from dedicated surveys to predict effectiveness of MMOs and to use dedicated survey parameters to extrapolate density estimates from MMO data. Dr. Bain further states that the probability of detecting marine mammals would drop with increased distance from the vessel.

Response: NMFS does not agree with Dr. Bain's assessment and suggestions regarding MMOs and marine mammal monitoring. NMFS reviewed the references (Dahlheim and Towell, 1994; Forney and Barlow, 1998) provided by Dr. Bain, and did not find any type of work schedules described. Unlike observers during marine mammal population surveys who are required to search the entire field for any marine mammals, the primary responsibilities for MMOs are to monitor the safety zones, which in this case are 160 m (525 ft) for the 180-dB isopleth and 50 m (164 ft) for the 190-dB isopleth and to ensure that proper mitigation measures (power-down or shutdown) are implemented if a marine mammal is about to enter or is sighted within these safety zones. NMFS agrees that the detection probability of a marine mammal drops with increased distance from the ship. However, the occurrence of marine mammals outside the safety zones is not a big concern for marine

mammal monitoring during the proposed seismic activity because it is presumed these animals would not be within a zone that could result in injury. Furthermore, MMOs would be on duty for 4 consecutive hours or less to reduce fatigue. Shell will have five MMOs on the vessel at all times so that two MMOs are on duty during all pre-ramp-up and ramp-up periods and for as a large a fraction of other periods as possible. In addition, all MMOs hired for the proposed seismic surveys must be NMFS-approved observers who are qualified to perform the required monitoring tasks. Therefore, NMFS believes that two MMOs are effective for marine mammal monitoring for Shell's shallow hazard and site clearance surveys.

Comment 95: Dr. Bain is concerned that many species that are capable of diving for more than 30 minutes could be missed during the monitoring.

Response: NMFS agrees with Dr. Bain that monitoring for deep diving marine mammals poses a challenge. However, within the proposed survey area, there are no marine mammals that normally dive for more than 30 minutes. However, in the event that a marine would be missed during the initial pre-survey monitoring, ramp-up procedures will be followed when an acoustic source begins to operate, so the undetected animal(s) would have an opportunity to detect the sound as it increases gradually and move away from the source. Please refer to the Mitigation and Monitoring Measures sections later in this document for a detailed description of these measures.

Comment 96: Dr. Bain notes that a fundamental assumption in noise mitigation is that animals will move away from the noise source (horizontal avoidance). Dr. Bain is concerned that many species are sedentary, territorial, or have strong tendencies toward site fidelity, and that these species are unlikely to move away from a noise source. In addition, Dr. Bain is concerned that many predators are used to experiencing pain during feeding, and hence tolerate pain [from being exposed to loud noise] rather than abandoning their prey (e.g., many mammals involved in fishery-interactions).

Response: First, the monitoring and mitigation measures described in this document and contained in Shell's IHA would prevent any marine mammals from being exposed to received levels that could cause onset of injury (180 dB re 1 μ Pa (rms) for cetaceans and 190 dB re 1 μ Pa (rms) for pinnipeds). Second, there are no sedentary marine mammals. The proposed survey is fundamentally

different from commercial fisheries activities in which the appearance of a seismic vessel does not reinforce the marine mammal with food or prey, therefore, it is unlikely that predatory marine mammals would approach the seismic vessel or acoustic source while searching for prey. Even if a marine mammal happens to be in close vicinity of the vessel or source, monitoring and mitigation measures require the crew to power-down or shutdown the acoustic sources so that the animal will not be affected by Level A harassment.

Cumulative Impact Concerns

Comment 97: The MMC continues to be concerned about the potential cumulative impacts of climate-related ecosystem changes occurring in the Arctic and the anticipated increase in the level of seismic and other oil and gas-related activities in the region. The MMC recommends that NMFS conduct a more extensive analysis of the potential or likely effects of currently authorized and proposed oil and gas activities, climate change, and additional anthropogenic risk factors (e.g., industrial operations) and the possible cumulative effects of all of these activities over time. The MMC also recommends that NMFS, together with the applicant and other appropriate agencies and organizations, develop a comprehensive population monitoring and impact assessment program to assess whether these activities, in combination with other risk factors, are individually or cumulatively having any significant adverse population-level effects on marine mammals or having an unmitigable adverse effect on the availability of marine mammals for subsistence uses by Alaska Natives. Such a monitoring program should focus initially on the need to collect adequate baseline information to allow for future analyses of effects. Finally, the MMC recommends that NMFS sponsor a workshop or workshops to facilitate the development of a comprehensive population monitoring and impact assessment program.

Response: A description of the monitoring program submitted by Shell was provided in Shell's application, outlined in the Notice of Proposed IHA (74 FR 26217, June 1, 2009), and posted on the NMFS PR IHA webpage. As a result of a dialogue on monitoring by scientists and stakeholders attending NMFS' public meetings in Anchorage in April, 2006, October, 2006, and April, 2007, the industry has expanded its monitoring program in order to fulfill its responsibilities under the MMPA. Additionally, Shell's 2009 monitoring

plan was subjected to an independent peer review. (See the "Monitoring Plan Independent Peer Review" subsection later in this document for more information.) For the fourth year, Shell has included a marine mammal research component designed to provide baseline data on marine mammals for future operations planning. A description of this research is provided later in this document (see "*Comprehensive Monitoring Reports*" section). Scientists are continuing discussions to ensure that the research effort obtains the best scientific information possible. Finally, it should be noted that this far-field monitoring program follows the guidance of the MMC's recommended approach for monitoring seismic activities in the Arctic (Hofman and Swartz, 1991), that additional research might be warranted when impacts to marine mammals would not be detectable as a result of vessel observation programs.

Comment 98: NSB, AEWC, AWL, and Oceana and the Ocean Conservancy state that NMFS must also consider the effects of disturbances in the context of other activities occurring in the Arctic. NSB notes, as stated previously, the cumulative impacts of all industrial activities must be factored into any negligible impact determination. NMFS has not done so for Shell's activities, and, therefore, the proposed IHA should not be issued until a cumulative impact assessment is conducted.

Response: Under section 101(a)(5)(D) of the MMPA, NMFS is required to determine whether the taking by the applicant's specified activity will take only small numbers of marine mammals, will have a negligible impact on the affected marine mammal species or population stocks, and will not have an unmitigable impact on the availability of affected species or stocks for subsistence uses. Cumulative impact assessments are NMFS' responsibility under the National Environmental Policy Act (NEPA), not the MMPA. In that regard, MMS' 2006 Final PEA, NMFS' 2007 and 2008 Supplemental EAs, and NMFS' 2009 EA address cumulative impacts. The Final PEA's cumulative activities scenario and cumulative impact analysis focused on oil and gas-related and non-oil and gas-related noise-generating events/activities in both Federal and State of Alaska waters that were likely and foreseeable. Other appropriate factors, such as Arctic warming, military activities, and noise contributions from community and commercial activities were also considered. Appendix D of the Final PEA addresses similar comments on cumulative impacts,

including global warming. That information was incorporated into and updated in the NMFS 2008 SEA and into this document by citation. Because these documents are part of NMFS' Administrative Record on this matter, the information contained within them do not need to be repeated. Please refer to these documents for that assessment.

Comment 99: AEWC is concerned that absent 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 ongoing. For this reason, AEWC advocates that NMFS implement a cap on the overall seismic-related activities that can occur in Arctic waters each year.

Response: See the response to comment 98 discussing analysis of cumulative impacts. Regarding the suggestion to cap the number of activities each year, NMFS understands that under the terms of an OCS lease, the lessee is required to make progress on exploration and development on its leases in order to hold that lease beyond the initial lease term. Ancillary activities (such as seismic and shallow hazard surveys) are those activities conducted on a lease site to obtain data and information to meet MMS' regulations to explore and develop a lease. If a limit is placed by NMFS on the number of ancillary activities authorized for a planning area in a given year, NMFS may preclude the lessee from complying with MMS regulations to proceed in a timely manner on exploring or developing its OCS leases. However, NMFS will not issue an IHA for any activity where NMFS is unable to make the necessary findings under section 101(a)(5)(D) of the MMPA. Therefore, based on both practicability and that it is not necessary in this particular instance (because there is only one ancillary activity occurring this season), NMFS has not adopted this suggested mitigation measure. However, NMFS encourages industry participants to work together to reduce seismic sounds in the Arctic Ocean through cooperative programs in data collection to reduce impacts on marine mammals.

ESA Concerns

Comment 100: AEWC and NSB both note that the Notice of Proposed IHA (74 FR 26217, June 1, 2009) states NMFS' determination that "Shell's proposed activities...are adequately analyzed in the 2008 Biological Opinion" and that "NMFS does not plan to conduct a new section 7 consultation." They both state that this is in direct contravention of the ESA. Both Shell and NMFS readily acknowledge that several endangered species will likely be impacted by

Shell's proposed authorizations. Therefore, under the plain language of the statute, the IHA must be consulted on pursuant to section 7 of the ESA. Moreover, in light of our changing climate and the increased activity in the Arctic, it is essential that NMFS continue to *consult on authorized activities* so that the baseline used in making jeopardy/no-jeopardy determinations remains current.

Response: Under section 7 of the ESA, NMFS has completed consultation with the MMS on "*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.*" In a Biological Opinion issued on July 17, 2008, NMFS concluded that the issuance of seismic survey permits by MMS and the incidental take authorizations under the MMPA for seismic surveys are not likely to jeopardize the continued existence of the endangered fin, humpback, or bowhead whale. As no critical habitat has been designated for these species, none will be affected. The 2008 Biological Opinion takes into consideration all oil and gas related activities that are reasonably likely to occur, including exploratory oil drilling activities. This Biological Opinion does not include impacts from production activities, which are subject to a separate consultation.

NMFS has reviewed Shell's proposed action and has determined that the findings in the 2008 Biological Opinion apply to its 2009 Chukchi Sea site clearance and shallow hazards surveys. In addition, NMFS has issued an Incidental Take Statement (ITS) under this Biological Opinion for Shell's survey activities, which contains reasonable and prudent measures with implementing terms and conditions to minimize the effects of take of bowhead, humpback, and fin whales.

Comment 101: AWL notes that NMFS' 2008 programmatic Biological Opinion does not contain an ITS. AWL assumes that NMFS will issue a new ITS in a timely manner.

Response: As indicated in the response to comment 100, after issuance of the IHA, NMFS also issued a new ITS.

NEPA Concerns

Comment 102: AEW and NSB believe that NMFS, in direct contravention of the law, excluded the public from the NEPA process since NMFS did not release a draft EA for the public to review and provide comments prior to NMFS taking its final action.

Response: Neither NEPA nor the Council on Environmental Quality's (CEQ) regulations explicitly require circulation of a draft EA for public comment prior to finalizing the EA. The Federal courts have upheld this conclusion, and in one recent case, the Ninth Circuit squarely addressed the question of public involvement in the development of an EA. In *Bering Strait Citizens for Responsible Resource Development v. U.S. Army Corps of Engineers* (9th Cir. 2008), the court held that the circulation of a draft EA is not required in every case; rather, Federal agencies should strive to involve the public in the decision-making process by providing as much environmental information as is practicable prior to completion of the EA so that the public has a sufficient opportunity to weigh in on issues pertinent to the agency's decision-making process. In the case of Shell's 2009 MMPA IHA request, NMFS involved the public in the decision-making process by distributing Shell's IHA application and addenda for a 30-day notice and comment period. However, at that time, a draft EA was not available to provide to the public for comment. The IHA application and NMFS' Notice of Proposed IHA (74 FR 26217, June 1, 2009) contained information relating to the project. For example, the application included a project description, its location, environmental matters such as species and habitat to be affected, and measures designed to minimize adverse impacts to the environment and the availability of affected species or stocks for subsistence uses.

Comment 103: AEW notes that Shell's IHA application warrants review in an environmental impact statement (EIS) given the potential for significant impacts.

Response: NMFS' 2009 EA was prepared to evaluate whether significant environmental impacts may result from the issuance of an IHA to Shell, which is an appropriate application of NEPA. After completing the EA, NMFS determined that there would not be significant impacts to the human environment and accordingly issued a FONSI. Therefore, an EIS is not needed for this action.

Comment 104: AEW, AWL, and NSB note the release of the MMS/NMFS Draft Programmatic EIS (PEIS; MMS, 2007) in the summer of 2007. To date, a Final PEIS has not been completed. The commenters believe that all public comments submitted on the Draft PEIS must be answered and the Final PEIS released before NMFS can issue new IHAs for seismic activities in the Chukchi and Beaufort Seas. AWL states

that CEQ regulations limit new activities that are otherwise covered by a PEIS during the period in which the environmental review is in progress. Allowing surveying to continue avoids the broader look at potential impacts and could prejudice the agency's decision making.

Response: While the Final PEIS will analyze the affected environment and environmental consequences from seismic surveys in the Arctic, the analysis contained in the Final PEIS will apply more broadly to Arctic seismic operations. NMFS' issuance of an IHA to Shell for the taking of several species of marine mammals incidental to conducting its open-water marine survey program in the Chukchi Sea in 2009, as analyzed in the EA, is not expected to significantly affect the quality of the human environment. Shell's surveys are not expected to significantly affect the quality of the human environment because of the limited duration and scope of Shell's operations. Additionally, the EA contained a full analysis of cumulative impacts.

Marine Mammals Affected by the Activity

Marine mammals that occur in the proposed survey areas belong to three taxonomic groups: (1) odontocetes (toothed cetaceans), (2) mysticetes (baleen whales), and (3) carnivora (pinnipeds and polar bears). Cetaceans and pinnipeds (except walrus) are the subject of this IHA. In the U.S., the walrus and polar bear are managed by the USFWS. USFWS issued a LOA to Shell on July 16, 2009, for incidental "takes" specific to walruses and polar bears.

Marine mammal species under the jurisdiction of NMFS which are known to or may occur in the open-water marine survey area of the Chukchi Sea include eight cetacean and four pinniped species (see Table 4-1 in Shell's application). Three of these species, the bowhead, humpback and fin whales, are listed as "endangered" under the ESA. Bowhead whales are more common in the survey area than other ESA species. Based on a small number of sightings, fin whales are unlikely to occur along the planned trackline in the Chukchi Sea. Humpback whales normally are not found in the Chukchi Sea; however, several humpback sightings were recorded during vessel-based surveys in the Chukchi Sea in 2007 (Reiser *et al.*, 2008).

The marine mammal species under NMFS jurisdiction that are most likely to occur in the survey area include:

beluga, bowhead, and gray whales, harbor porpoise, and ringed, bearded, and spotted seals. The marine mammal species likely to be encountered most widely (in space and time) throughout the survey period is the ringed seal. Encounters with bowhead and gray whales are expected to be limited to particular regions and seasons, as discussed in Shell's application.

Four additional cetacean species and one pinniped species—the killer, minke, humpback, and fin whales and ribbon seals—could occur in the project area, but each of these species is uncommon or rare in the survey area and relatively few encounters with these species are expected during Shell's operations. Descriptions of the biology, distribution, and population status of the marine mammal species under NMFS' jurisdiction can be found in Shell's application and the NMFS SARs. The Alaska SAR is available at: <http://www.nmfs.noaa.gov/pr/pdfs/sars/ak2008.pdf>. Please refer to those documents for information on these species.

Potential Effects of Survey Activities on Marine Mammals

The only anticipated impacts to marine mammals associated with Shell's proposed activities (primarily resulting from noise propagation) are from vessel movements and airgun operations. Aircraft may provide a potential secondary source of sound. The physical presence of vessels and aircraft could also potentially lead to non-acoustic effects on marine mammals involving visual or other cues.

The effects of sounds from airguns might include one or more of the following: tolerance, masking of natural sounds, behavioral disturbance, and temporary or permanent hearing impairment or non-auditory effects (Richardson *et al.*, 1995). As outlined in previous NMFS documents, the effects of noise on marine mammals are highly variable, and can be categorized as follows (based on Richardson *et al.*, 1995):

(1) The noise may be too weak to be heard at the location of the animal (i.e., lower than the prevailing ambient noise level, the hearing threshold of the animal at relevant frequencies, or both);

(2) The noise may be audible but not strong enough to elicit any overt behavioral response;

(3) The noise may elicit reactions of variable conspicuousness and variable relevance to the well being of the marine mammal; these can range from temporary alert responses to active avoidance reactions such as vacating an area at least until the noise event ceases;

(4) Upon repeated exposure, a marine mammal may exhibit diminishing responsiveness (habituation), or disturbance effects may persist; the latter is most likely with sounds that are highly variable in characteristics, infrequent, and unpredictable in occurrence, and associated with situations that a marine mammal perceives as a threat;

(5) Any anthropogenic noise that is strong enough to be heard has the potential to reduce (mask) the ability of a marine mammal to hear natural sounds at similar frequencies, including calls from conspecifics, and underwater environmental sounds such as surf noise;

(6) If mammals remain in an area because it is important for feeding, breeding, or some other biologically important purpose even though there is chronic exposure to noise, it is possible that there could be noise-induced physiological stress; this might in turn have negative effects on the well-being or reproduction of the animals involved; and

(7) Very strong sounds have the potential to cause temporary or permanent reduction in hearing sensitivity. In terrestrial mammals, and presumably marine mammals, received sound levels must far exceed the animal's hearing threshold for there to be any TTS in its hearing ability. For transient sounds, the sound level necessary to cause TTS is inversely related to the duration of the sound. Received sound levels must be even higher for there to be risk of permanent hearing impairment. In addition, intense acoustic or explosive events may cause trauma to tissues associated with organs vital for hearing, sound production, respiration and other functions. This trauma may include minor to severe hemorrhage.

The Notice of Proposed IHA (74 FR 36217, June 1, 2009) included a discussion of the effects of sounds from airguns on mysticetes, odontocetes, and pinnipeds, including tolerance, masking, behavioral disturbance, hearing impairment and other physical effects, as well as a discussion on stranding and mortality events. The initial discussion of the potential effects of airguns on marine mammals presented in the Notice of Proposed IHA were presented without consideration of the mitigation measures proposed by Shell and required by NMFS. However, NMFS' preliminary determinations were made only after evaluation of Shell's proposed mitigation measures. When these measures are taken into account, it is unlikely that this project would

result in temporary, or especially, permanent hearing impairment or any significant non-auditory physical or physiological effects.

The Notice of Proposed IHA also included a discussion of the potential effects of the sonar equipment (e.g., multi-beam bathymetric sonar) to be used by Shell during the surveys. While the sonar equipment proposed to be used for this project generates high sound energy, the equipment operates at frequencies (≤ 100 kHz) beyond the effective hearing range of most marine mammals likely to be encountered during the proposed activities (Richardson *et al.*, 1995). Therefore, NMFS believes that effects of signals from sonar equipment to marine mammals will be negligible.

Estimated Take of Marine Mammals

The anticipated harassments from the activities described above may involve temporary changes in behavior. There is no evidence that the planned activities could result in serious injury or mortality, for example due to collisions with vessels or strandings. Disturbance reactions, such as avoidance, are very likely to occur among marine mammals in the vicinity of the source vessel. The required mitigation and monitoring measures (described later in this document) will result in, at most, Level B harassment and will reduce even further the already minimal potential for the risk of injury.

The Notice of Proposed IHA (74 FR 26217, June 1, 2009) included an in-depth discussion of the methodology used by Shell to estimate incidental take by harassment by its seismic activities and the numbers of marine mammals that might be affected during the site clearance and shallow hazards surveys in the Chukchi Sea. Additional information was included in Shell's IHA application and application addenda. Moreover, further explanations have been provided in the "Comments and Responses" section earlier in this document based on comments received during the 30-day public comment period. A summary is provided here.

The estimates are based on data obtained during marine mammal surveys in and near the proposed survey area and on estimates of the sizes of the areas where effects could potentially occur. In some cases, these estimates were made from data collected in regions, habitats, or seasons that differ from those in the proposed survey areas. Adjustments to reported population or density estimates were made to account for these differences insofar as possible.

Although several systematic surveys of marine mammals have been

conducted in the southern Beaufort Sea, few data (systematic or otherwise) are available on the distribution and numbers of marine mammals in the Chukchi Sea beyond the 200 m (656 ft) bathymetry contour. The main sources of distributional and numerical data used in deriving the estimates are described below and in Shell's application. While there is some uncertainty related to the use of regional population densities for applications that are local in focus, these estimates are based on the best available scientific data and represents standard practice.

Marine Mammal Density Estimates

This section provides estimates of the number of individuals potentially exposed to sound levels at or above 160 dB re 1 Pa (rms). The estimates are based on a consideration of the number of marine mammals that might be disturbed appreciably by operations in the Chukchi Sea.

For the Chukchi Sea, cetacean densities during the summer (July-August) were estimated from effort and sightings data in Moore *et al.* (2000b) while pinniped densities were estimated from Bengtson *et al.* (2005). Because few data are available on the densities of marine mammals other than large cetaceans in the Chukchi Sea in the fall (September-October), density estimates from the summer period have been adjusted to reflect the expected ratio of summer-to-fall densities based on the natural history characteristic of each species. Alternatively, some densities from data collected aboard industry vessels in 2006 and 2007 in the Chukchi Sea have been used.

As noted above, there is some uncertainty about the representativeness of the data and assumptions used in the calculations. To provide some allowance for the uncertainties, "maximum estimates" as well as "average estimates" of the numbers of marine mammals potentially affected have been derived and provided by Shell in their application. For a few marine mammal species, several density estimates were available, and in those cases, the average and maximum estimates were calculated from the survey data. In other cases, only one, or no applicable estimate was available so correction factors were used to arrive at "average" and "maximum" estimates. These are described in detail in Shell's application and the Notice of Proposed IHA (74 FR 26217, June 1, 2009). Except where noted, the "maximum" estimates have been calculated as twice the "average" estimates. The densities presented are believed to be similar to, or in most cases higher than, the

densities that will actually be encountered during the survey.

Detectability bias, quantified in part by $[f(0)]$, is associated with diminishing sightability with increasing lateral distance from the survey trackline. Availability bias $[g(0)]$ refers to the fact that there is less than 100 percent probability of sighting an animal that is present along the survey trackline. These correction factors were applied to the data from Moore *et al.* (2000b) and were already included in data provided by Richardson and Thompson (2002) on beluga and bowhead whales, and where possible were applied to the available data for other species.

Estimated densities of marine mammals in the Chukchi Sea during the "summer" (July and August) site clearance and shallow hazards survey are presented in Table 6-1 of Shell's application. Densities of marine mammals estimated for the "fall" period of Shell's proposed activities in the Chukchi Sea (September and possibly October) are presented in Table 6-2 of the application. Both "average" and "maximum" densities are provided in the tables. Unless otherwise noted by Shell in the application, maximum densities are twice the average densities. However, since Shell did not provide a rationale regarding the maximum estimate, NMFS has decided that the average density data of marine mammal populations will be used to calculate estimated take numbers because these numbers are based on surveys and monitoring of marine mammals in the vicinity of the proposed project area. NMFS only used the "maximum" estimates for marine mammal species that are considered rare in the project area and for which little to no density information exists (i.e., killer, fin, humpback, and minke whales and ringed seals).

(1) Cetaceans

Nine species of cetaceans are known to occur in the Chukchi Sea project area. Only four of these (bowhead, beluga, and gray whales and harbor porpoise) are expected to be encountered in meaningful numbers during the proposed survey. Densities of bowhead and beluga whales are expected to be lower in the summer when the majority of the stocks are in the Canadian Beaufort Sea. Later in the season, as the animals begin their westward migration through the Alaskan Beaufort and Chukchi Seas, densities of these species will increase in the survey area. Species specific information for bowhead, beluga, and gray whales and harbor porpoise was contained in the Notice of Proposed IHA.

The remaining four cetacean species that could be encountered in the Chukchi Sea during Shell's proposed open-water marine survey include the humpback, killer, minke, and fin whales. Although there is evidence of the occasional occurrence of these species in the Chukchi Sea, it is unlikely that individuals will be encountered during the proposed survey.

(2) Pinnipeds

Four species of pinnipeds may be encountered in the Chukchi Sea area of Shell's proposed shallow hazards and site clearance program: ringed, bearded, spotted, and ribbon seals. Each of these species, except the spotted seal, is associated with both the ice margin and the nearshore area. Ribbon seals have been reported in very small numbers within the Chukchi Sea by observers on industry vessels (Ireland *et al.*, 2007a; Patterson *et al.*, 2007) so minimal values have been used for expected densities. Additional information for ringed, bearded, and spotted seals can be found in the Notice of Proposed IHA.

Exposure Calculations of Marine Mammals

Numbers of marine mammals that might be present and potentially disturbed as a result of the site clearance and shallow hazards surveys are estimated below based on available data about mammal distribution and densities at different locations and times of the year, as described previously. Shell's survey would take place in the Chukchi Sea over two different seasons (i.e., summer, August, and fall, September and possibly October). The estimates of marine mammal densities have therefore been separated both spatially and temporally in an attempt to represent the distribution of animals expected to be encountered over the duration of the survey.

The number of individuals of each species potentially exposed to received sound levels at or above 160 dB re 1 μ Pa (rms) within the survey region, time period, and habitat zone was estimated by multiplying:

- The expected species density (as provided in Tables 6-1 and 6-2 of Shell's application); by
- The anticipated area to be ensounded to the specified level in the survey region (900 km²), time period, and habitat zone to which that density applies.

The numbers of potential individuals exposed were then summed for each species across the survey region, seasons, and habitat zones. Some of the animals estimated to be exposed,

particularly migrating bowhead whales, might show avoidance reactions before being exposed to 160 dB re 1 μ Pa (rms). Thus, these calculations actually estimate the number of individuals potentially exposed to sound at or above 160 dB (rms) that would occur if there were no avoidance of the area ensonified to that level.

The area of water potentially exposed to received levels at or above 160 dB (rms) by the proposed operations was calculated by multiplying the planned trackline distance by the cross-track distance of the sound propagation measured during previous field seasons. For site clearance and shallow hazards surveys in 2008 in the Chukchi Sea, the 160 dB radius from the *Cape Flattery's* four 10 in³ airguns measured in 2008 was 1,400 m (0.87 mi), and the single 10 in³ airgun was 440 m (0.27 mi).

Closely spaced survey lines and large cross-track distances of the 160 dB radii can result in repeated exposure of the same area of water. Excessive amounts of repeated exposure can lead to overestimation of the number of animals potentially exposed through double counting. However, the relatively short cross-track distances of the 160 dB radii associated with the site clearance and shallow hazards surveys result in little overlap of exposed waters during the survey, so multiple exposures due to overlap of ensonified areas have not been removed from the area calculations.

Shallow hazards and site clearance surveys in the Chukchi Sea are planned to occur along approximately 480 km (298 mi) of survey lines (plus approximately 120 km (74.6 mi) of mitigation gun activity between survey lines) from August-September (and possibly early to mid-October) exposing approximately 900 km² (347.5 mi²) of water to sounds at or above 160 dB re 1 Pa (rms). Additional information on the calculations for estimating take can be found in Shell's application and the Notice of Proposed IHA.

Based on the operational plans and marine mammal densities described above, the estimates of marine mammals potentially exposed to sounds at or above 160 dB (rms) in the Chukchi Sea are presented in Table 6–7 of Addendum 2 to Shell's application. A discussion of the number of potential exposures is summarized by species in the following subsections.

(1) Cetaceans

Based on density estimates, one ESA-listed cetacean species (the bowhead whale) is expected to be exposed to received sound levels at or above 160 dB (rms) unless bowheads avoid the

survey vessel before the received levels reach 160 dB. Migrating bowheads are likely to avoid the survey vessel, though many of the bowheads engaged in other activities, particularly feeding and socializing may not. Using average density estimates, Shell estimates that one bowhead whale may potentially be exposed to sounds at or above 160 dB (rms) in the Chukchi Sea project area during the site clearance and shallow hazards survey (see Table 6–7 of Addendum 2 to Shell's application). Two other cetacean species listed as endangered under the ESA that may be encountered in the project area (fin and humpback whales) are unlikely to be exposed given their low "average" density estimates in the area. However, Shell has estimated that a "maximum" of five humpback whales and five fin whales may be exposed to sound levels at or above 160 dB (rms) during the proposed survey (see Table 6–7 in Addendum 2). NMFS' reasoning for using the "maximum" estimate for these species was explained earlier in this document.

Most of the cetaceans exposed to survey sounds with received levels greater than or equal to 160 dB (rms) would involve bowhead, gray, and beluga whales and harbor porpoise. Average and maximum estimates of the number of exposures of cetaceans other than bowheads are: beluga whale (10 and 19, respectively), gray whale (19 and 37, respectively), and harbor porpoise (6 and 11, respectively). Average estimates for the other cetacean species are zero (see Table 6–7 in Addendum 2 to Shell's application) since accurate density estimates are not possible given the paucity of sightings. However, maximum estimates are provided for these species (Table 6–7). For the common species, the requested numbers are calculated as described previously in this document and based on the average densities from the data reported in the different studies mentioned previously.

(2) Pinnipeds

The ringed seal is the most widespread and abundant pinniped in ice-covered Arctic waters, and there is a great deal of annual variation in population size and distribution of these marine mammals. Ringed seals account for the vast majority of marine mammals expected to be encountered and hence exposed to airgun sounds with received levels greater than or equal to 160 dB re 1 μ Pa (rms) during the site clearance and shallow hazards survey. The average (and maximum) exposure estimate is that 692 (1,078) ringed seals might be exposed to marine survey

sounds with received levels at or above 160 dB (rms).

Two additional pinniped species (other than Pacific walrus) are expected to be encountered. They are the bearded seal (31 and 43, average and maximum estimates, respectively) and the spotted seal (6 and 11, average and maximum estimates, respectively; Table 6–7 in Addendum 2 to Shell's application). The ribbon seal is unlikely to be encountered. Therefore, only a maximum estimate (5) has been provided for this species based on the minimal density data and extremely low density estimates for this species in the Chukchi Sea. NMFS' reasoning for using the "maximum" estimate for this species was explained earlier in this document.

Conclusions

(1) Cetaceans

Most of the bowhead whales encountered during the summer will likely show overt disturbance (avoidance) if they receive airgun sounds with levels at or above 160 dB re 1 Pa (rms). The small airgun array proposed for use in this survey greatly limits the size of the 160 dB zone around the ship (1,400 m (0.87 mi)). The use of this smaller array will result in fewer bowhead whales being disturbed by the survey when compared to the use of larger arrays.

Seismic operators sometimes see dolphins and other small toothed whales near operating airgun arrays, but in general, there seems to be a tendency for most dolphins to show some limited avoidance of operating seismic vessels (Stone, 2003; Moulton and Miller, 2005; Holst *et al.*, 2006; Stone and Tasker, 2006). Studies that have reported cases of small toothed whales close to the operating airguns include Duncan (1985), Arnold (1996), Stone (2003), and Holst *et al.* (2006). However, at least when in the Canadian Beaufort Sea in summer, belugas appear to be fairly responsive to seismic energy, with few being sighted within 10–20 km (6.2–12.4 mi) of seismic vessels during aerial surveys. These results were consistent with the low number of beluga sightings reported by observers aboard the seismic vessel, suggesting that some belugas might be avoiding the seismic operations at distances of 10–20 km (6.2–12.4 mi; Miller *et al.*, 2005). The study conducted by Miller *et al.* (2005) was aboard a vessel conducting a 3D seismic survey, utilizing two identical 2,250 in³ airgun arrays with each array containing 24 guns. Since the acoustic sources to be used during Shell's survey are significantly smaller

(total discharge volume of 40 in³) than the ones described in the Miller *et al.* (2005) study, deflections of that magnitude are not expected.

Taking into account the mitigation measures that are planned, effects on cetaceans are generally expected to be restricted to avoidance of a limited area around the survey operation and short-term changes in behavior, falling within the MMPA definition of "Level B harassment". Furthermore, the estimated numbers of animals potentially exposed to sound levels sufficient to cause appreciable disturbance are relatively low percentages of the population sizes in the Bering-Chukchi-Beaufort seas, as described next.

Based on the 160 dB (rms) disturbance criterion, the best (average) estimates of the numbers of cetacean exposures to sounds at or above 160 dB re 1 μ Pa (rms) represent varying proportions of the populations of each species in the Chukchi Sea and adjacent waters (cf. Table 6–1 in Shell's application). For species listed as endangered under the ESA, Shell's estimates suggest it is unlikely that fin or humpback whales will be exposed to received levels greater than or equal to 160 dB rms, but that approximately one bowhead may be exposed at this level. The latter is less than 0.01 percent of the Bering-Chukchi-Beaufort population of greater than 13,779 individuals assuming 3.4 percent annual population growth from the 2001 estimate of 10,545 animals (Zeh and Punt, 2005).

Beluga whales may be exposed to sounds produced by the airgun arrays during the survey, and the numbers potentially affected are small relative to the population size (Table 6–7 in Addendum 2 to Shell's application). The best estimate of the number of belugas that might be exposed to sounds at or above 160 dB (10) represents 0.27 percent of the eastern Chukchi Sea population of approximately 3,710 individuals (Angliss and Allen, 2009).

Gray whales and harbor porpoise may also be exposed to sounds produced by the airguns. The best (average) estimate of the number of gray whales and harbor porpoise that might be exposed to sounds at or above 160 dB (rms) represents 0.11 percent of the Eastern North Pacific stock of gray whales and less than 0.01 percent of the Bering Sea stock of harbor porpoise.

In addition, killer, fin, humpback, and minke whales could also be taken by Level B harassment as a result of the survey. However, the possibility is low. The numbers of "average" estimated take of these species are not available because they are rare in the project area

and little density data exist for these species in the project area. Since the Chukchi Sea represents only a small fraction of the North Pacific and Arctic basins where these animals occur, and these animals do not regularly congregate in the vicinity of the project area, NMFS has determined that only relatively small numbers, if any, of these marine mammal species would be potentially affected by Shell's activities.

Varying estimates of the numbers of marine mammals that might be exposed to sounds from the airgun array during the 2009 Shell shallow hazards and site clearance surveys have been presented (average vs. maximum). The relatively short-term exposures that will occur are not expected to result in any long-term negative consequences for the individuals or their populations.

The many reported cases of apparent tolerance by cetaceans of seismic exploration, vessel traffic, and some other human activities show that co-existence is possible. Mitigation measures such as controlled vessel speed, dedicated MMOs, non-pursuit, shutdowns or power-downs when marine mammals are seen within defined ranges, and avoiding migration pathways when animals are likely most sensitive to noise will further reduce short-term reactions and minimize any effects on hearing sensitivity. In all cases, the effects are expected to be short-term, with no lasting biological consequence. Subsistence issues are addressed later in this document.

Potential Bowhead Disturbance at Lower Received Levels – Aerial surveys during fall seismic surveys in the Beaufort Sea showed that migrating bowhead whales appeared to avoid seismic activities at distances of 20–30 km (12.4–18.6 mi) and received sound levels of 120–130 dB rms (Miller *et al.*, 1999; Richardson *et al.*, 1999). Therefore, it is possible that a larger number of bowhead whales than estimated above may be disturbed to some extent if reactions occur at or near approximately 130 dB (rms). Using the same method of calculation as described earlier in this document for estimating take, the number of migrating bowhead whales exposed to sounds greater than or equal to 120 dB by the proposed survey would be approximately 8.5 the number estimated at 160 dB. (It should be noted though that this calculation is more accurate for the Beaufort Sea where the bowhead whale migration pathway is narrower and more clearly defined than in the Chukchi Sea.) However, acoustic data collected in the vicinity of seismic surveys in the Beaufort Sea in 2007 indicated that bowhead whales did not avoid the

sound source at distances equivalent to 120 dB (rms) and instead tolerated sounds at higher levels while likely changing their calling behavior (Blackwell *et al.*, 2008).

Reducing operations during the bowhead whale subsistence harvest is meant to accomplish two mitigation objectives. It greatly reduces the potential for conflicts with subsistence hunting activities, and it allows a large proportion of the bowhead population to migrate past the survey area without being exposed to survey sounds at or above 160 dB (rms) or 120 dB (rms).

The western Arctic stock of bowhead whales usually begins its westward migration through the Beaufort Sea in late August. Westbound bowheads typically reach the Barrow area in mid-September and remain in that area until late October (Brower, 1996). Therefore, migrating bowhead whales are not expected in the proposed Chukchi Sea survey area until the second half of the survey, as the project is expected to occur for approximately 50 days between August and September, not including weather delays. Shell's seismic vessel left Dutch Harbor on July 27, 2009. Through September 30, 2009, Shell had completed 34 days of active data acquisition. Also during this period, Shell experienced 13 down-days due to weather, and there were 19 days of transit to both Nome and Dutch Harbor for crew transfers and resupplying the vessel. Shell expects to complete active seismic operations on October 10, 2009, and to return to Dutch Harbor on October 15 (G. Horner, 2009, Shell, pers. comm.).

(2) Pinnipeds

A few pinniped species are likely to be encountered in the study area, but the ringed seal is by far the most abundant marine mammal species in the survey area. The best (average) estimates of the numbers of individual seals likely to be exposed to airgun sounds at received levels at or above 160 dB re 1 μ Pa (rms) during the open-water marine survey in the Chukchi Sea are as follows: ringed seals (692), bearded seals (31), and spotted seals (6), (representing 0.3 percent, 0.6 percent, and 0.01 percent, respectively, of the Bering-Chukchi-Beaufort populations for each species). It is probable that only a small percentage of the animals exposed to sound levels at 160 dB would actually be disturbed. For example, Moulton and Lawson (2002) indicate that most pinnipeds exposed to seismic sounds lower than 170 dB do not visibly react to that sound, and, therefore, pinnipeds are not likely to react to seismic sounds unless they are

greater than 170 dB re 1 μ Pa (rms). Consequently, the take estimates presented in this document may be an overestimation. The short-term exposures of pinnipeds to airgun sounds are not expected to result in any long-term negative consequences for the individuals or their populations, as observations have shown pinnipeds to be rather tolerant of (or habituated to) underwater seismic sounds.

Potential Impacts on Habitat

Shell's activities will not result in any permanent impact on habitats used by marine mammals or to their prey sources. Any effects would be temporary and of short duration at any one place. The primary potential impacts to marine mammals are associated with acoustic sound levels from the site clearance and shallow hazards surveys discussed earlier in this document.

The Notice of Proposed IHA (74 FR 26217, June 1, 2009) contained a discussion of the potential impacts to the marine mammal habitat in the survey area. The activities are not expected to have any habitat-related effects that would produce long-term impacts to marine mammals or their habitat due to the limited extent of the acquisition areas and timing of the activities.

Effects of Seismic Noise and Other Related Activities on Subsistence

The disturbance and potential displacement of marine mammals by sounds from seismic activities are the principal concerns related to subsistence use of the area. Subsistence remains the basis for Alaska Native culture and community. Marine mammals are legally hunted in Alaskan waters by coastal Alaska Natives. In rural Alaska, subsistence activities are often central to many aspects of human existence, including patterns of family life, artistic expression, and community religious and celebratory activities. The main species that are hunted include bowhead and beluga whales, ringed, spotted, and bearded seals, walruses, and polar bears. The importance of each of these species varies among the communities and is largely based on availability.

Communities that participate in subsistence hunts that have the potential to be affected by Shell's open-water marine survey program in the Chukchi Sea survey areas are Point Hope, Point Lay, Wainwright, Barrow and possibly Kotzebue (however, this community is much farther to the south of the project area).

Point Hope residents subsistence hunt for bowhead and beluga whales, polar bears, and walrus. Bowhead and beluga whales are hunted in the spring and early summer along the ice edge. Beluga whales may also be hunted later in the summer along the shore. Walrus are harvested in late spring and early summer, and polar bears are hunted from October to April (MMS, 2007). Seals are available from October through June, but are harvested primarily during the winter months, from November through March, due to the availability of other resources during the other periods of the year (MMS, 2007).

With Point Lay situated near Kasegaluk Lagoon, the community's main subsistence focus is on beluga whales. Each year, hunters from Point Lay drive belugas into the lagoon to a traditional hunting location. The belugas have been predictably sighted near the lagoon from late June through mid- to late July (Suydam *et al.*, 2001). Seals are available year-round, and polar bears and walruses are normally hunted in the winter. Hunters typically travel to Barrow, Wainwright, or Point Hope to participate in bowhead whale harvest, but there is interest in reestablishing a local Point Lay harvest. Shell's activities are scheduled to avoid the traditional subsistence beluga hunt, which annually occurs in July, and Shell will not begin data acquisition until the close of the hunt.

Wainwright residents subsist on both beluga and bowhead whales in the spring and early summer. During these two seasons the chances of landing a whale are higher than during other seasons. Seals are hunted by this community year-round, and polar bears are hunted in the winter.

Barrow residents' main subsistence focus is concentrated on biannual bowhead whale hunts. They hunt these whales during the spring and fall. Westbound bowheads typically reach the Barrow area in mid-September and are in that area until late October (e.g., Brower, 1996). Autumn bowhead whaling near Barrow normally begins in mid-September to early October but may begin as early as late-August if whales are observed and ice conditions are favorable (USDI/BLM, 2005). Whaling near Barrow can continue into October, depending on the quota and conditions. Other animals, such as seals, walruses, and polar bears are hunted outside of the whaling season, but they are not the primary source of the subsistence harvest (URS Corporation, 2005).

There could be an adverse impact on the Inupiat bowhead subsistence hunt if the whales were deflected seaward (further from shore) in traditional

hunting areas. The impact would be that whaling crews would have to travel greater distances to intercept westward migrating whales thereby creating a safety hazard for whaling crews and/or limiting chances of successfully striking and landing bowheads. This potential impact is mitigated by application of the procedures established in the 4MP. Adaptive mitigation measures may be employed during times of active scouting and whaling within the traditional subsistence hunting areas of the potentially affected communities. Shell did not begin activities until the close of the spring bowhead hunts. However, there is a possibility that their data acquisition will not be completed prior to the start of the fall bowhead hunt in Barrow. However, it is not expected that the whales will be deflected further offshore before reaching Barrow since Shell's survey will occur approximately 225 km (140 mi) west of Barrow. The whales will be traveling westward through the Beaufort Sea from Canada and will reach Barrow before entering the survey area in the Chukchi Sea. Based on these factors, Shell's Chukchi Sea survey is not expected to interfere with the fall bowhead harvest in Barrow. In recent years, bowhead whales have occasionally been taken in the fall by coastal villages along the Chukchi coast, but the total number of these animals has been small.

Shell has adopted a spatial and temporal operational strategy for its Chukchi Sea operations that should minimize impacts to subsistence hunters. Operations will not begin prior to the close of the spring bowhead hunt in the Chukchi coastal villages and will closely coordinate with and avoid impacts to beluga whale hunts and walrus hunts through subsistence advisors.

The timing (late summer and fall after many of the Chukchi Sea communities have harvested sizeable portions of their marine mammal quota) and distance (approximately 113 km (70 mi) or more) from shore, as well as the low volume airguns to be used and the required mitigation measures described later in this document, are expected to mitigate any adverse effects of the surveys on the availability of marine mammals for subsistence uses. NMFS does not expect subsistence users to be directly displaced by the surveys because subsistence hunters usually do not travel this far (113 km [70 mi]) offshore to harvest marine mammals. Also, because of the significant distance offshore and the lack of hunting in these areas, there is no expectation that any physical barriers would exist between

marine mammals and subsistence users. Based on this information, as well as the fact that Shell signed the 2009 Open-water CAA, NMFS has determined that Shell's site clearance and shallow hazards surveys in the Chukchi Sea in 2009/2010 will not have an unmitigable adverse impact on subsistence uses.

Plan of Cooperation (POC) and Conflict Avoidance Agreement (CAA)

Regulations at 50 CFR 216.104(a)(12) require IHA applicants for activities that take place in Arctic waters to provide a POC or information that identifies what measures have been taken and/or will be taken to minimize adverse effects on the availability of marine mammals for subsistence purposes. Shell has prepared and will implement a draft POC for its 2009 activities. The POC also describes concerns received during 2008. Shell developed the POC to mitigate and avoid any unreasonable interference from their planned activities with North Slope subsistence uses and resources. The POC is, and has been in the past, the result of numerous meetings and consultations between Shell, affected subsistence communities and stakeholders, and Federal agencies. The POC identifies and documents potential conflicts and associated measures that will be taken to minimize any adverse effects on the availability of marine mammals for subsistence use. The Draft POC document was distributed to the communities, subsistence users groups, NMFS, and USFWS on May 15, 2009. To be effective, the POC must be a dynamic document which will expand to incorporate the communications and consultation that will continue to occur throughout 2009 and 2010. Outcomes of POC meetings are typically included in updates attached to the POC as addenda and distributed to Federal, state, and local agencies as well as local stakeholder groups that either adjudicate or influence mitigation approaches for Shell's open-water programs.

Shell has held and plans to hold additional community meetings in Barrow, Wainwright, Point Hope, Point Lay, and Kotzebue regarding its 2009 Chukchi open-water marine survey program. Some of the community POC meetings that have already occurred include: February 2, 2009, in Barrow; March 24, 2009, in Point Hope; March 25, 2009, in Kotzebue; March 26, 2009, in Wainwright; April 22, 2009, in Point Lay, and April 23, 2009, in Kivalina. Shell plans to focus on lessons learned from the 2008 open-water program to avoid potential conflicts. During 2009, Shell will continue to meet with the

marine mammal commissions and committees including the AEWC, Eskimo Walrus Commission (EWC), Alaska Beluga Whale Committee (ABWC), Alaska Ice Seal Committee (AISC), and the Alaska Nanuq Commission (ANC). Throughout 2009, Shell anticipates meeting with the marine mammal commissions and committees active in the subsistence harvests and marine mammal research.

Also during 2009, Shell will meet at least twice with the commissioners and committee heads of ABWC, ANC, EWC, and AISC jointly in co-management meetings. During a pre-season co-management meeting Shell presented pre-season planning to the commissioners and committee leads in order to gather their input on subsistence use concerns, consider their traditional knowledge in the design of project mitigations, and to hear about their involvement in research on marine mammals and/or traditional use. Following the season, Shell will have a post-season co-management meeting with the commissioners and committee heads to discuss results of mitigation measures and outcomes of the preceding season. The goal of the post-season meeting is to build upon the knowledge base, discuss successful or unsuccessful outcomes of mitigation measures, and possibly refine plans or mitigation measures if necessary.

In addition, Shell will meet with North Slope officials and community leaders on an as-requested basis before the 2009 open-water season in order to discuss the proposed activities. Lastly, Shell intends to discuss adaptive conflict avoidance mechanisms to address concerns expressed by subsistence users in the North Slope communities.

The POC also specifies times and areas to avoid in order to minimize possible conflicts with traditional subsistence hunts by North Slope villages for transit and open-water activities. As mentioned elsewhere in this document, Shell waited to begin its 2009 activities until the close of Point Lay's spring beluga hunt. Additionally, Shell has stated that vessel transits in the Chukchi Sea spring lead system will not occur prior to July 1, 2009, and July 1, 2010.

In regard to the CAA, the AEWC submitted a draft CAA to the industry earlier this spring and was signed by Shell on June 24, 2009. The 2009 CAA incorporated all appropriate measures and procedures regarding the timing and areas of the Shell's planned activities (e.g., places where seismic operations will be curtailed or moved in order to avoid potential conflicts with

active subsistence whaling and sealing); a communications system between Shell's vessels and whaling and hunting crews (i.e., the communications center will be located in strategic areas); provision for MMOs/Inupiat communicators aboard all project vessels; conflict resolution procedures; and provisions for rendering emergency assistance to subsistence hunting crews. If requested, post-season meetings will also be held to assess the effectiveness of the 2009 CAA between Shell, the AEWC, and the Whaling Captains Associations, to address how well conflicts (if any) were resolved; and to receive recommendations on any changes (if any) that may be needed in the implementation of future CAAs. In addition, NMFS has included in Shell's IHA, those mitigation and monitoring measures contained in the CAA that it determined would ensure that Shell's activities will not have an unmitigable adverse impact on subsistence uses of marine mammals.

Based on the signed CAA, the mitigation and monitoring measures included in the IHA (see next sections), and the project design itself, NMFS has determined that there will not be an unmitigable adverse impact on subsistence uses from Shell's activities.

Mitigation and Monitoring

As part of its application, Shell has implemented a 4MP that will consist of monitoring and mitigation during their open-water shallow hazards data acquisition activities in the Chukchi Sea during the 2009/2010 open-water season. The program consists of monitoring and mitigation during Shell's various activities related to survey data acquisition, including transit and data acquisition. This program will provide information on the numbers of marine mammals potentially affected by the survey program and real-time mitigation to prevent possible injury or mortality of marine mammals by sources of sound and other vessel-related activities. Monitoring efforts will be initiated to collect data to address the following specific objectives: (1) improve the understanding of the distribution and abundance of marine mammals in the Chukchi Sea project areas; and (2) assess the effects of sound and vessel activities on marine mammals inhabiting the project areas and their distribution relative to the local people that depend on them for subsistence hunting. These objectives and the monitoring and mitigation goals will be addressed through the utilization of vessel-based MMOs on the survey source vessels. Additional

information can be found in Shell's application.

Mitigation Measures

The survey program incorporates both design features and operational procedures for minimizing potential impacts on cetaceans and pinnipeds and on subsistence hunts. The design features and operational procedures are described in the IHA application submitted to NMFS summarized here. Survey design features include:

- Timing and locating survey activities to avoid interference with the annual fall bowhead whale and other marine mammal hunts;
- Selecting and configuring the energy source array in such a way that it minimizes the amount of energy introduced into the marine environment and, specifically, so that it minimizes horizontal propagation;
- Limiting the size of the acoustic energy source to only that required to meet the technical objectives of the survey; and
- Early season field assessment to establish and refine (as necessary) the appropriate 180 dB and 190 dB safety zones, and other radii relevant to behavioral disturbance.

The potential disturbance of cetaceans and pinnipeds during survey operations will be minimized further through the implementation of several ship-based mitigation measures, which include establishing and monitoring safety and disturbance zones, speed and course alterations, ramp-up (or soft start), power-down, and shutdown procedures, and provisions for poor visibility conditions.

(1) Safety and Disturbance Zones

Safety radii for marine mammals around airgun arrays are customarily defined as the distances within which received pulse levels are greater than or equal to 180 dB re 1 μ Pa (rms) for cetaceans and greater than or equal to 190 dB re 1 μ Pa (rms) for pinnipeds. These safety criteria are based on an assumption that seismic pulses at lower received levels will not injure these animals or impair their hearing abilities, but that higher received levels might have such effects. It should be understood that marine mammals inside these safety zones will not be seriously injured or killed as these zones were established prior to the current understanding that significantly higher levels of impulse sounds would be required before injury or mortality could occur (see Southall *et al.*, 2007).

Monitoring similar to that conducted in the Chukchi Sea in 2007/2008 is required in 2009/2010. Shell is required

to use MMOs onboard the survey vessel to monitor the 190 and 180 dB (rms) safety radii for pinnipeds and cetaceans, respectively, and to implement appropriate mitigation as discussed in this document.

In addition, a 160-dB (rms) vessel monitoring zone for bowhead and gray whales shall be established and monitored during all survey activities. Whenever an aggregation of 12 or more bowhead or gray whales are observed during a vessel-monitoring program within the 160-dB zone around the source vessel, the survey will not commence or will shutdown until MMOs confirm they are no longer present within the 160-dB safety radius of surveying operations (see the "Power-downs and Shutdowns" subsection later in this document). The radius of the 160-dB isopleth based on modeling is 1,400 m (0.87 mi).

During previous survey operations in the Chukchi Sea, Shell utilized early season sound source verification (SSV) to establish safety zones for the previously mentioned sound level criteria. As the equipment being utilized in 2009 is similar to that used in 2008, Shell will initially utilize the derived (i.e., measured) sound criterion distances from 2008. An acoustics contractor performed the direct measurements of the received levels of underwater sound versus distance and direction from the energy source arrays using calibrated hydrophones. The acoustic data was analyzed and used to verify (and if necessary adjust) the safety distances.

(2) Ramp-up

A ramp-up of an energy source array provides a gradual increase in energy levels, and involves a step-wise increase in the number and total volume of energy released until the full complement is achieved. The purpose of a ramp-up (or "soft start") is to "warn" cetaceans and pinnipeds in the vicinity of the energy source and to provide the time for them to leave the area and thus avoid any potential injury or impairment of their hearing abilities.

During the survey program, the operator is required ramp up energy sources slowly, if the energy source being utilized generates sound energy within the frequency spectrum of cetacean or pinniped hearing. Full ramp-ups (i.e., from a cold start after a shut down, when no airguns have been firing) shall begin by firing one small airgun. Ramp-ups are required at any time electrical power to the airgun array has been discontinued for a period of 10 min or more and the MMO watch has been suspended

Ramp-up, after a shutdown, will not begin until there has been a minimum of a 30 min period of observation by MMOs of the safety zone to assure that no marine mammals are present. The entire safety zone must be visible during the 30 min lead-in to a full ramp-up. If the entire safety zone is not visible, then ramp-up from a cold start cannot begin. If a marine mammal(s) is sighted within the safety zone during the 30-min watch prior to ramp-up, ramp-up will be delayed until the marine mammal(s) is sighted outside of the safety zone or the animal(s) is not sighted for at least 15 min for small odontocetes and pinnipeds or 30 min for baleen whales (large odontocetes do not occur within the project area).

During periods of turn around and transit between survey transects, at least one airgun (or energy source) shall remain operational. The ramp-up procedure still must be followed when increasing the source levels from one gun to the full array. Keeping air gun firing, however, avoids the prohibition of a cold start during darkness or other periods of poor visibility. Through use of this approach, survey operations can resume upon entry to a new transect without a full ramp-up and the associated 30-min lead-in observations. MMOs must be on duty whenever the airguns are firing during daylight and during the 30-min periods prior to ramp-ups as well as during ramp-ups. Daylight will occur for 24 hr/day until mid-August, so until that date, MMOs will automatically be observing during the 30-min period preceding a ramp-up. Later in the season, MMOs will be called out at night to observe prior to and during any ramp-up. The vessel operator and MMOs shall maintain records of the times when ramp-ups start and when the airgun arrays reach full power.

(3) Power-downs and Shutdowns

A power-down is the immediate reduction in the number of operating energy sources from all firing to some smaller number. A shutdown is the immediate cessation of firing of all energy sources. The arrays shall be immediately powered down whenever a marine mammal is sighted approaching near or close to the applicable safety zone of the full arrays but is outside the applicable safety zone of the single source. If a marine mammal is sighted within the applicable safety zone of the single energy source, the entire array will be shut down (i.e., no sources firing). Although MMOs will be located on the bridge ahead of the center of the airgun array, the shutdown criterion for animals ahead of the vessel will be

based on the distance from the bridge (vantage point for MMOs) rather than from the airgun array a precautionary approach. For marine mammals sighted alongside or behind the array, the distance is measured from the array.

Following a power-down or shutdown, operation of the airgun array will not resume until the marine mammal has cleared the applicable safety zone. The animal will be considered to have cleared the safety zone if it:

- (1) Is visually observed to have left the safety zone;
- (2) Has not been seen within the zone for 15 min in the case of small odontocetes and pinnipeds; or
- (3) Has not been seen within the zone for 30 min in the case of mysticetes.

For the aggregation of 12 or more mysticete whales, the acoustic equipment will not be turned back on or return to full power until the aggregation has left the 160-dB isopleth or the animals forming the aggregation are reduced to fewer than 12 mysticete whales.

In the unanticipated event that an injured or dead marine mammal is sighted within an area where the operator deployed and utilized airguns within the past 24 hours, the airguns must be shutdown immediately and the Marine Mammal Stranding Network notified.

(4) Operations at Night and in Poor Visibility

Shell plans to conduct the site clearance and shallow hazards survey 24 hr/day. Regarding nighttime operations, note that there will be no periods of total darkness until mid-August. When operating under conditions of reduced visibility attributable to darkness or to adverse weather conditions, infra-red or night-vision binoculars will be available for use. It is recognized, however, that their effectiveness is limited. For that reason, MMOs will not routinely be on watch at night, except in periods before and during ramp-ups. As stated earlier, if the entire safety zone is not visible for at least 30 min prior to ramp-up, then ramp-up may not proceed. It should be noted that if one small energy source has remained firing, the rest of the array can be ramped up during darkness or in periods of low visibility. Survey operations may continue under conditions of darkness or reduced visibility.

(5) Speed and Course Alterations

If a marine mammal (in water) is detected outside the safety radius and, based on its position and the relative motion, is likely to enter the safety radius, the vessel's speed and/or direct

course shall be changed in a manner that does not compromise safety requirements. The animal's activities and movements relative to the source vessel shall be closely monitored to ensure that the individual does not approach within the safety radius. If the mammal is sighted approaching near or close to the applicable safety radius, further mitigative actions must be taken, i.e., either further course alterations or power-down or shutdown of the airgun(s).

(6) Determination on Mitigation

NMFS has determined that the combination of the use of the mitigation gun, ramp-up of the airgun array, and the slow vessel speed (to allow marine mammals sufficient time to take necessary avoidance measures), the use of trained MMOs, shutdown procedures (to avoid potential injury if the animal is close to the vessel), and the behavioral response of marine mammals (especially bowhead whales) to avoid areas of high anthropogenic noise all provide protection to marine mammals from serious injury or mortality. As a result, NMFS has determined that it is not necessary to require termination of survey activities during darkness or reduced visibility and that the current level of mitigation will achieve the least practicable impact on marine mammal species or stocks.

Marine Mammal Monitoring

Vessel-based monitoring for marine mammals shall be conducted throughout the period of survey operations. The 4MP is required to be implemented by a team of experienced MMOs, including both biologists and Inupiat personnel. All MMOs must be approved by NMFS prior to the start of operations. At least one observer on the survey vessel will be an Inupiat who will have the responsibility of communicating with the Inupiat community and (during the whaling season) directly with the Subsistence Advisors in coastal villages.

The MMOs shall be stationed aboard the survey source vessel throughout the active field season. The duties of the MMOs include watching for and identifying cetaceans and pinnipeds; recording their numbers, distances, and reactions to the survey operations; initiating mitigation measures when appropriate; and reporting the results. MMOs aboard the survey source vessel must be on watch during all daylight periods when the energy sources are in operation and when energy source operations are to start up at night. Each MMO shift shall not exceed more than 4 consecutive hours, and no MMO shall work more than 3 shifts in a 24 hr

period (i.e., 12 hours total per day) in order to avoid fatigue. Shell is required to have five MMOs on-board the source vessel at any one time during all survey operations.

Crew leaders and most other biologists serving as observers in 2009 are individuals with experience as observers during one or more of the 1996–2008 monitoring projects for Shell, WesternGeco, or BP and/or subsequent offshore monitoring projects for other clients in Alaska, the Canadian Beaufort, or other offshore areas. Biologist-observers have previous marine mammal observation experience and field crew leaders are highly experienced with previous vessel-based monitoring projects. Qualifications for those individuals have been provided to NMFS for review and acceptance. Inupiat observers shall be experienced in the region and familiar with the marine mammals of the area. An MMO handbook, adapted for the specifics of the survey programs from the handbooks created for previous monitoring projects were prepared and distributed to all MMOs (see Shell's 4MP for additional details on the handbook). All observers completed a 2-day training and refresher session on marine mammal monitoring shortly before the start of the 2009 open-water season.

(1) Monitoring Methodology

The observer(s) shall watch for marine mammals from the best available vantage point on the operating source vessel, which is usually the bridge or flying bridge. The observer(s) will scan systematically with the naked eye and 7 x 50 reticle binoculars, supplemented with 20 x 50 image stabilized binoculars, and night-vision equipment when needed. Personnel on the bridge will assist the MMOs in watching for pinnipeds and cetaceans.

The observer(s) will give particular attention to the areas within the "safety zone" around the source vessel. These zones are the maximum distances within which received levels may exceed 180 dB re 1 μ Pa (rms) for cetaceans or 190 dB re 1 μ Pa (rms) for pinnipeds. MMOs shall also monitor the 160 dB re 1 μ Pa (rms) radius for Level B harassment takes, as this radius is expected to be a maximum of 1,400 m (0.87 mi). The 160-dB isopleth (1,400 m [0.87 mi]) will also be monitored for the presence of aggregations of 12 or more bowhead or gray whales.

Information required to be recorded by MMOs includes the same types of information that were recorded during previous monitoring programs (1998–2008) in the Chukchi and Beaufort seas

(Moulton and Lawson, 2002; Patterson *et al.*, 2007). When a mammal sighting is made, the following information about the sighting shall be recorded:

(1) Species, group size, age/size/sex categories (if determinable), behavior when first sighted and after initial sighting, heading (if consistent), bearing and distance from the source vessel, apparent reaction to the source vessel (e.g., none, avoidance, approach, paralleling, etc.), closest point of approach, and behavioral pace;

(2) Time, location, heading, speed, activity of the vessel, and operational state (e.g., operating airguns, ramp-up, etc.), sea state, ice cover, visibility, and sun glare; and

(3) The positions of other vessel(s) in the vicinity of the source vessel. This information will be recorded by the MMOs at times of whale (but not seal) sightings.

The ship's position, heading, and speed, the operational state (e.g., number and size of operating energy sources), and water temperature (if available), water depth, sea state, ice cover, visibility, and sun glare shall also be recorded at the start and end of each observation watch and, during a watch, every 30 min and whenever there is a change in one or more of those variables.

Distances to nearby marine mammals, e.g., those within or near the 190 dB (or other) safety zone applicable to pinnipeds, will be estimated with binoculars (7 x 50) containing a reticle to measure the vertical angle of the line of sight to the animal relative to the horizon.

Observers will use a laser rangefinder to test and improve their abilities for visually estimating distances to objects in the water. Previous experience showed that this Class 1 eye-safe device was not able to measure distances to seals more than about 70 m (230 ft) away. (Previous SSV measurements indicate that the 190-dB safety radius for the 4 x 10 in³ airgun array proposed for use during Shell's site clearance and shallow hazards survey is approximately 50 m (164 ft), well within the range of 70 m (230 ft)). However, it was very useful in improving the distance estimation abilities of the observers at distances up to about 600 m (1968 ft)-the maximum range at which the device could measure distances to highly reflective objects such as other vessels.

When a marine mammal is seen within the safety radius applicable to that species, the geophysical crew shall be notified immediately so that the required mitigation measures described previously in this document can be

implemented. As in 1996–2001 and in 2006–2008, it is expected that the airgun arrays will be shut down within several seconds-often before the next shot would be fired, and almost always before more than one additional shot is fired. The MMO shall then maintain a watch to determine when the mammal(s) is outside the safety zone such that airgun operations can resume.

Night vision equipment ("Generation 3" binocular image intensifiers or equivalent units) will be available for use when needed. Prior to mid-August, there will be no hours of total darkness in the project area. The operators shall provide or arrange for the following specialized field equipment for use by the onboard MMOs: reticle binoculars, 20 x 50 image stabilized binoculars, "Big-eye" binoculars, laser rangefinders, inclinometer, laptop computers, night vision binoculars, and possibly digital still and digital video cameras.

(2) Field Data-recording and Verification

The observers shall record their observations onto datasheets or directly into handheld computers. During periods between watches and periods when operations are suspended, those data will be entered into a laptop computer running a custom computer database. The accuracy of the data entry will be verified in the field by computerized validity checks as the data are entered and by subsequent manual checking of the database printouts. These procedures allow initial summaries of data to be prepared during and shortly after the field season and will facilitate transfer of the data to statistical, graphical, or other programs for further processing. Quality control of the data will be facilitated by the start-of-season training session, subsequent supervision by the onboard field crew leader, and ongoing data checks during the field season.

(3) Acoustic Sound Source Verification Measurements

As part of the IHA application process for similar shallow hazards and marine survey acquisition in 2006–2008, Shell contracted JASCO Research Ltd. to conduct acoustic measurements of vessel and energy source arrays on source and support to broadband received levels of 190, 180, 170, 160, and 120 dB re 1 μ Pa (rms; see Table 1 of Attachment A in Shell's application).

The radii measured by these previous SSV tests will be utilized as temporary safety radii until current SSV measurements of the actual airgun array sound are available as mentioned earlier in this document. The measurements were made at the beginning of the field

season and the measured radii are to be used for the remainder of the survey period.

The objectives of the SSV tests planned for 2009 in the Chukchi Sea and the methods used to conduct the tests were described in Shell's 4MP and the Notice of Proposed IHA (74 FR 26217, June 1, 2009).

(4) Chukchi Sea Acoustic Arrays

Shell and ConocoPhillips are jointly funding an extensive acoustic monitoring program in the Chukchi Sea in 2009. This program incorporates the acoustic programs of 2006–2008 with a total of 44 recorders distributed both broadly across the Chukchi lease area and the nearshore environment and intensively on the Burger and Klondike lease areas. The broad area arrays are designed to capture both general background soundscape data and marine mammal call data across the lease area. From these recordings, it is anticipated that Shell (and others) may be able to gain insights into large-scale distribution of marine mammals, identification of marine mammal species present, movement and migration patterns, and general abundance data.

The intense area arrays are designed to support localization of marine mammal calls on and around the leasehold areas. In the case of the Burger prospect, where Shell intends to conduct shallow hazards data acquisition, localized calls will enable investigators to understand response of marine mammals to survey operations both in terms of distribution around the operation and behavior (i.e., calling behavior).

(5) Aerial Surveys

No manned aerial overflights are anticipated during the 2009 shallow hazards and marine survey activities. In the Chukchi Sea, all shallow hazards activities will be conducted beyond 113 km (70 mi) from shore and well away from coastal communities or nearshore concentrations of subsistence resources. The strudel scour survey will be conducted beyond 8 km (5 mi) from shore and will utilize sources of low energy and frequencies outside the hearing ranges of cetacean and pinniped species in the area. Additionally, the energy source to be utilized by Shell for the survey operations is minimal by comparison to larger scale seismic operations. It is not anticipated that manned overflights would accomplish any direct mitigative effects or monitoring purpose. Additionally, aerial surveys are not required in the Chukchi Sea because they have currently been

determined to be impracticable due to lack of adequate landing facilities, the prevalence of fog and other inclement weather in that area, potentially resulting in an inability to return to the airport of origin, thereby resulting in safety concerns. Although no manned aerial surveys are planned as part of the 4MP, NMFS has determined that the monitoring and mitigation measures proposed by Shell in its 4MP and required in the IHA will be sufficient to reduce impacts on marine mammals to the lowest level practicable.

(6) Monitoring Plan Independent Peer Review

The MMPA requires that monitoring plans be independently peer reviewed “where the proposed activity may affect the availability of a species or stock for taking for subsistence uses” (16 U.S.C. 1371(a)(5)(D)(ii)(III)). Regarding this requirement, NMFS’ implementing regulations state, “Upon receipt of a complete monitoring plan, and at its discretion, [NMFS] will either submit the plan to members of a peer review panel for review or within 60 days of receipt of the proposed monitoring plan, schedule a workshop to review the plan” (50 CFR 216.108(d)). Shell’s 4MP was discussed by meeting participants at the Arctic Stakeholder Open-water Workshop in Anchorage, Alaska, on April 6–8, 2009. On April 24, 2009, NMFS received a letter from the AEWC, which noted that while there was discussion of the 4MP at the workshop, they do not believe that there was ample review of the plan and wanted to know NMFS’ plans to hold an independent peer review in order to meet its statutory requirement.

NMFS established an independent peer review panel to review Shell’s monitoring plan for the 2009/2010 open-water season activities. NMFS asked the AEWC, the Marine Mammal Commission, and Shell to recommend independent subject matter experts to take part in the panel. NMFS selected and contacted the panelists from the names submitted by the aforementioned organizations. NMFS received comments from two of the reviewers. NMFS considered the recommendations of the reviewers and modified the monitoring plan, as appropriate.

The comments from the independent peer reviewers focused on the following: (1) the number of MMOs; (2) qualifications and training of MMOs; (3) standardization of methods and gear; (4) the inability of MMOs to monitor at night; (5) the efficacy of ramp-up and the minimum period for shutdowns; and (6) acoustic monitoring. The reviewers also addressed concerns

similar to those raised by the public about the density estimates and take calculations and estimates. Those concerns are addressed in the “*Density and Take Estimate Concerns*” subsection of the “Comments and Responses” section earlier in this document.

Shell has clarified some of the ambiguities in the 4MP, which address some of the concerns of the reviewers. Five MMOs will be on-board the site clearance and shallow hazards vessel for the duration of the survey. This will allow for two MMOs to be on duty during all pre-ramp-up and ramp-up periods and for as large a portion of active surveying during daylight hours for no more than 12 hours per day. Clarification has also been provided on the training and qualifications of the MMOs. The MMO handbook contains information on all species expected to occur in the project area, and post-training exams are required to verify proficiencies. Concerns regarding monitoring at night and the efficacy of ramp-up were addressed in the responses to the public comments. Ramp-up must occur if the airguns have been shutdown for 10 minutes or more. The reviewers also suggested the use of PAM as an alternate monitoring measure at night and in poor visibility conditions. The explanation for not requiring PAM was discussed earlier in this document and NMFS’ EA.

Reporting

SSV Report

A report on the preliminary results of the acoustic verification measurements, including as a minimum the measured 190-, 180-, and 160-dB (rms) radii of the airgun sources, shall be submitted within 120 hr after collection and analysis of those measurements at the start of the field season. This report will specify the distances of the safety zones that were adopted for the survey.

Technical Reports

The results of the 2009 Shell vessel-based monitoring, including estimates of “take” by harassment, shall be presented in the “90-day” and Final Technical reports, as required by NMFS in the IHA. The Technical Reports shall include: (1) summaries of monitoring effort (e.g., total hours, total distances, and marine mammal distribution through study period versus operational state, sea state, and other factors affecting visibility and detectability of marine mammals); (2) summaries of the occurrence of power-downs, shutdowns, ramp-ups, and ramp-up delays; (3) analyses of the effects of various factors,

influencing detectability of marine mammals (e.g., sea state, number of observers, and fog/glare); (4) species composition, occurrence, and distribution of marine mammal sightings, including date, water depth, numbers, age/size/gender categories (if determinable), group sizes, and ice cover; (5) sighting rates of marine mammals versus operational state (and other variables that could affect detectability); (6) initial sighting distances versus operational state; (7) closest point of approach versus operational state; (8) observed behaviors and types of movements versus operational state; (9) numbers of sightings/individuals seen versus operational state; (10) distribution around the acoustic source vessel versus operational state; and (11) estimates of take by harassment. The take estimates will be calculated using two different methods to provide both minimum and maximum estimates. The minimum estimate will be based on the numbers of marine mammals directly seen within the relevant radii (160, 180, and 190 dB (rms)) by observers on the source vessel during survey activities. The maximum estimate will be calculated using densities of marine mammals determined for non-acoustic areas and times. These density estimates will be calculated from data collected during (a) vessel based surveys in non-operational areas, or (b) observations from the source vessel or supply boats during non-operational periods. The estimated densities in areas without data acquisition activity will be applied to the amount of area exposed to the relevant levels of sound to calculate the maximum number of animals potentially exposed or deflected. This report shall be due 90 days after termination of the 2009 open-water season and shall include the results from any seismic work conducted in the Chukchi/Beaufort Seas in 2009 under the previous IHA, which expired on August 19, 2009.

Comprehensive Monitoring Reports

In November, 2007, Shell (in coordination and cooperation with other Arctic seismic IHA holders) released a final, peer-reviewed edition of the 2006 Joint Monitoring Program in the Chukchi and Beaufort Seas, July–November 2006 (LGL, 2007). This report is available on the NMFS Protected Resources website (see **ADDRESSES**). In March, 2009, Shell released a final, peer-reviewed edition of the Joint Monitoring Program in the Chukchi and Beaufort Seas, Open Water Seasons, 2006–2007 (Ireland *et al.*, 2009). This report is also available on the NMFS

Protected Resources website (see **ADDRESSES**). A draft comprehensive report for 2008 (Funk *et al.*, 2009) was provided to NMFS and those attending the Arctic Stakeholder Open-water Workshop in Anchorage, Alaska, on April 6–8, 2009. The 2008 report provides data and analyses from a number of industry monitoring and research studies carried out in the Chukchi and Beaufort Seas during the 2008 open-water season with comparison to data collected in 2006 and 2007. Once Shell is able to incorporate reviewer comments, the final 2008 report will be made available to the public.

Following the 2009 open-water season, a comprehensive report describing the acoustic and vessel-based monitoring programs will be prepared. The comprehensive report will describe the methods, results, conclusions and limitations of each of the individual data sets in detail. The report will also integrate (to the extent possible) the program into an assessment of 2009 industry activities and their impacts on marine mammals. The report will help to establish long term data sets that can assist with the evaluation of changes, if any, in the Chukchi Sea ecosystem. The report will attempt to provide a regional synthesis of available data on industry activity in offshore areas of northern Alaska that may influence marine mammal density, distribution, and behavior.

This report will consider data from many different sources including differing types of acoustic systems for data collection (net array and OBH systems) and vessel based observations. Collection of comparable data across the wide array of programs will help with the synthesis of information and allow integration of the data sets over a period of years. Data protocols for the acoustic operations will be similar to those used in 2006–2008 to facilitate this integration.

Endangered Species Act

NMFS previously consulted under section 7 of the ESA on the issuance of IHAs for seismic survey activities in the Beaufort and Chukchi Seas. In a Biological Opinion issued on July 17, 2008, NMFS concluded that the issuance of seismic survey permits by MMS and the issuance of the associated IHAs for seismic surveys are not likely to jeopardize the continued existence of threatened or endangered species (specifically the bowhead, humpback, and fin whales) under the jurisdiction of NMFS or destroy or adversely modify any designated critical habitat. The 2008 Biological Opinion takes into

consideration all oil and gas related activities that are reasonably likely to occur, including exploratory (but not production) oil drilling activities. NMFS has reviewed Shell's proposed activities in light of the 2008 Biological Opinion and believes that Shell's 2009/2010 open-water season activities and their effects are adequately analyzed in the 2008 Biological Opinion. NMFS has issued an ITS under this Biological Opinion which contains reasonable and prudent measures with implementing terms and conditions to minimize the effects of take of listed species.

National Environmental Policy Act (NEPA)

NMFS prepared an EA that includes an analysis of potential environmental effects associated with NMFS' issuance of an IHA to Shell to take marine mammals incidental to conducting its open-water marine survey program in the Chukchi Sea during 2009–2010. NMFS has finalized the EA and prepared a FONSI for this action. Therefore, preparation of an EIS is not necessary.

Determinations

Based on the information provided in Shell's application, Shell's application addenda, this document, Shell's 2009 4MP, the 2006 and 2007 Final Comprehensive Reports, the 2008 Draft Comprehensive Report, NMFS' 2009 EA, and other relevant documents, NMFS has determined that the impact of Shell conducting its proposed open-water marine survey program (site clearance and shallow hazards and strudel scour surveys) in the Chukchi Sea during the 2009/2010 open-water season may result, at worst, in a temporary modification in behavior (Level B Harassment) of small numbers of 12 species of marine mammals, will have no more than a negligible impact on the affected species or stocks, and will not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence purposes, provided the mitigation measures described previously in this document are implemented.

While the number of potential incidental harassment takes will depend on the distribution and abundance of marine mammals (which vary annually due to variable ice conditions and other factors) in the area of survey operations, the number of potential harassment takings is estimated to be small (less than one percent of any of the estimated population sizes) and has been mitigated to the lowest level practicable through incorporation of the measures

mentioned previously in this document. NMFS anticipates the actual take of individuals to be lower than the numbers presented in the analysis because those numbers do not reflect either the implementation of the required mitigation measures or the fact that some animals will avoid the sound at levels lower than those expected to result in harassment.

In addition, no take by death and/or serious injury is anticipated, and the potential for temporary or permanent hearing impairment will be avoided through the incorporation of the mitigation and monitoring measures described earlier in this document. This determination is supported by the fact that: (1) given sufficient notice through slow ship speed and ramp-up of acoustic equipment, marine mammals are expected to move away from a sound source prior to it becoming potentially injurious; (2) TTS is unlikely to occur, especially in odontocetes and pinnipeds, until sound levels above 180 dB re 1 μ Pa (rms) and 190 dB re 1 μ Pa (rms), respectively, are reached; and (3) animals are unlikely to be exposed to potentially injurious levels of sound unless they get very close to the vessel (approximately 160 m (525 ft) for the 180 dB (rms) radius and 50 m (164 ft) for the 190 dB (rms) radius). However, as stated earlier in this document, based on the configuration of the airgun array and streamers, it is highly unlikely that a marine mammal would approach within 160 m (525 ft) of the seismic vessel. No rookeries, mating grounds, areas of concentrated feeding, or other areas of special significance for marine mammals occur within the area of operations during the season of operations.

NMFS has determined that Shell's open-water marine survey program in the Chukchi Sea in 2009/2010 will not have an unmitigable adverse impact on the subsistence uses of bowhead whales and other marine mammals. This determination is supported by the information in this **Federal Register** Notice, including: (1) Survey activities will not begin prior to the closure of the spring bowhead hunt in Chukchi coastal villages; (2) Shell will closely coordinate with and avoid impacts to beluga whale hunts through subsistence advisors; (3) activities are scheduled to avoid the traditional subsistence beluga hunt, which annually occurs in July in the community of Point Lay; (4) Barrow is east of the project area, so the animals will reach Barrow before entering the project area on their fall westward migration through the Beaufort and Chukchi Seas; (5) the fact that survey activities will occur more than 113 km

(70 mi) or more from shore, and most cetaceans and pinnipeds are hunted much closer to the shore; and (6) that several of the required mitigation and monitoring conditions in the IHA (described earlier in this document) are designed to ensure that there will not be

an unmitigable adverse impact on subsistence uses of marine mammals.

Authorization

As a result of these determinations, NMFS has issued an IHA to Shell for conducting an open-water marine survey program in the Chukchi Sea

during the 2009/2010 Arctic open-water season.

Dated: October 19, 2009.

James H. Lecky,

*Director, Office of Protected Resources,
National Marine Fisheries Service.*

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