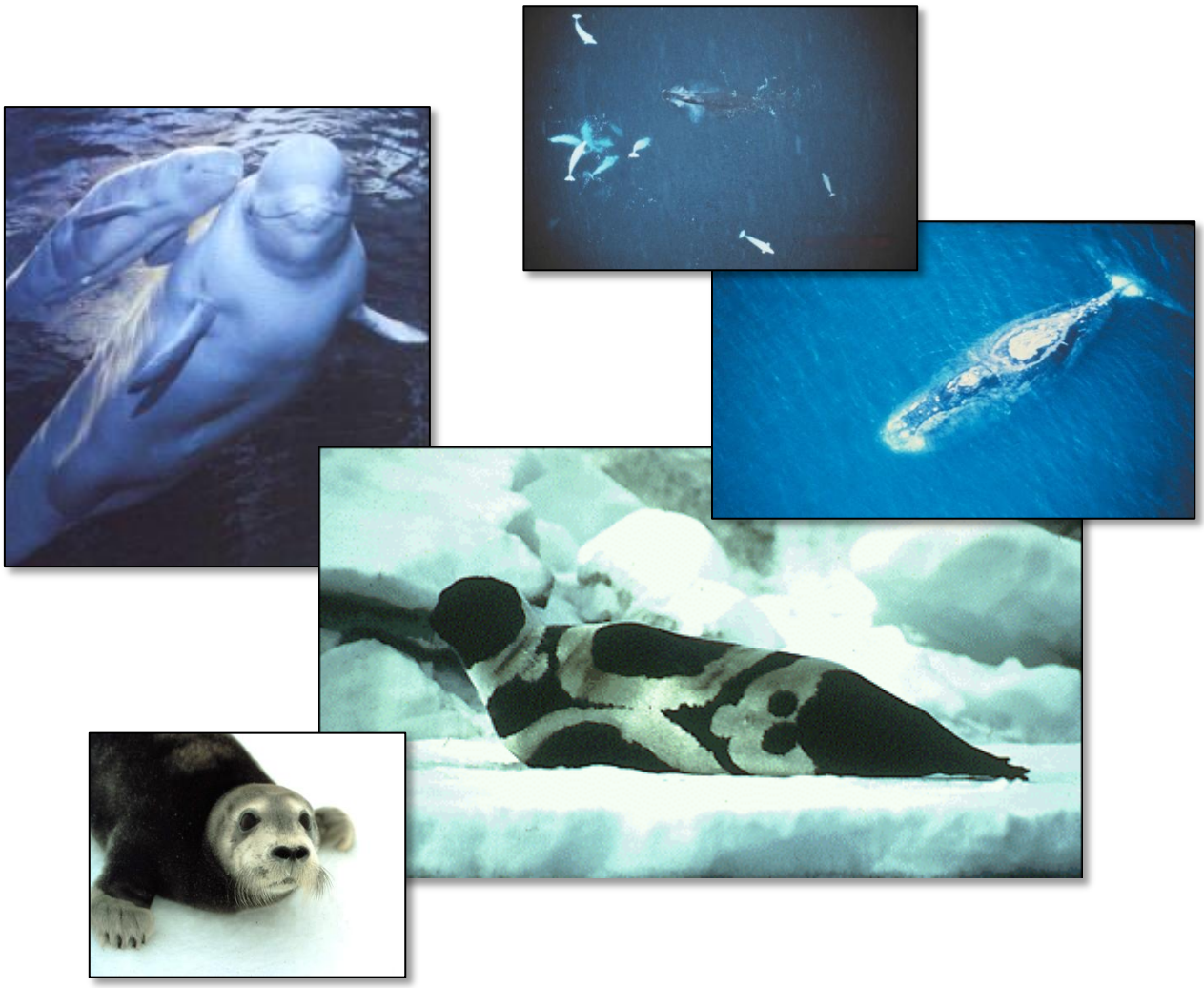
Effects of Oil and Gas Activities in the Arctic Ocean

Final Environmental Impact Statement

Volume 3: Figures and Appendices



October 2016

United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Protected Resources

Effects of Oil and Gas Activities in the Arctic Ocean

Final Environmental Impact Statement

October 2016

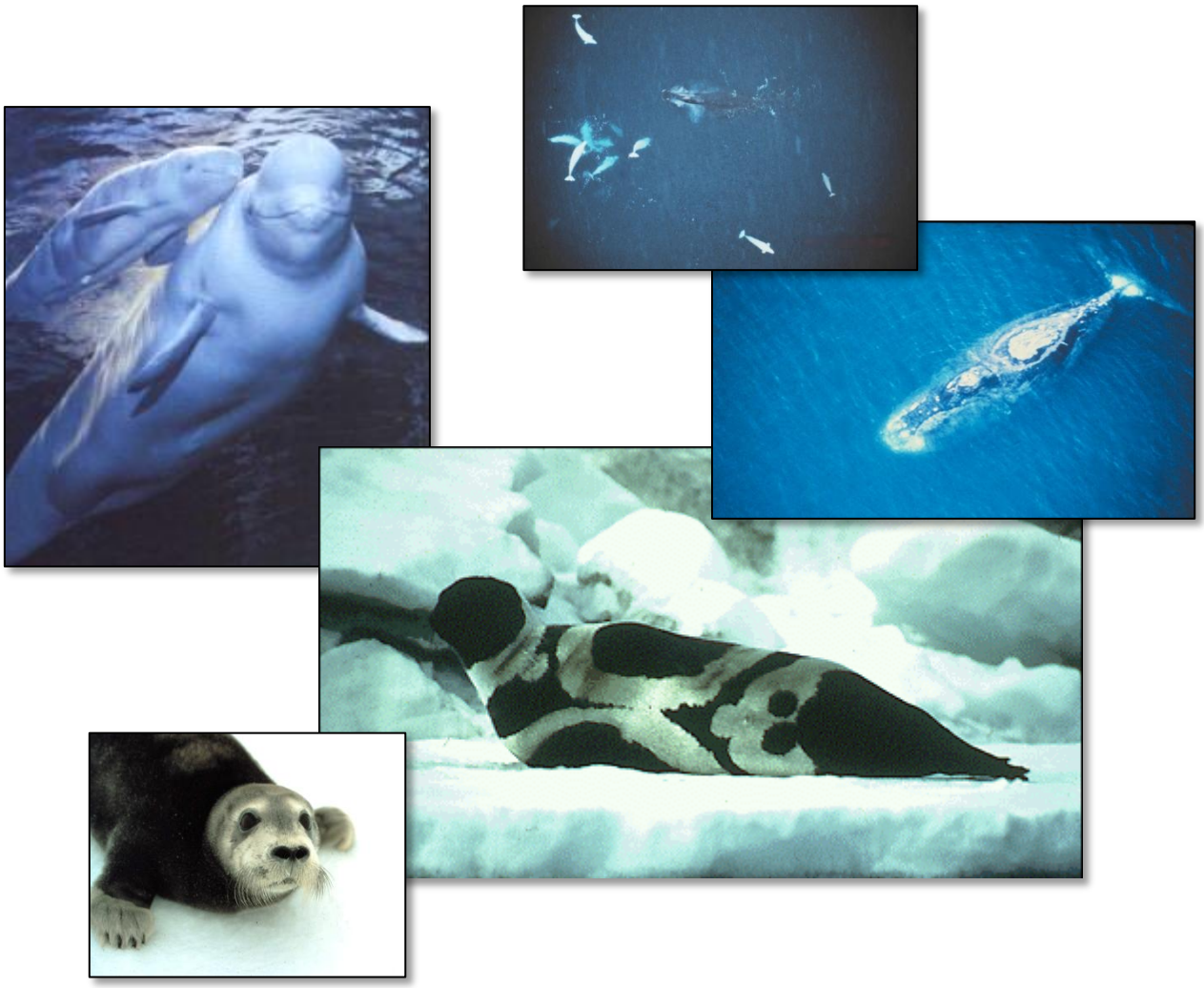
Prepared by:
U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Protected Resources

APPENDIX A

Comment Analysis Report that summarizes comments and responses received on the 2011 DEIS and the 2013 SDEIS

Effects of Oil and Gas Activities in the Arctic Ocean

Comment Analysis Report



October 2016

United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Protected Resources

TABLE OF CONTENTS

INTRODUCTION 1
ISSUE #1. PUBLIC PARTICIPATION AND REVIEW PROCESS 2
ISSUE #2. NEPA COMPLIANCE 6
Issue 2A - Need for an EIS 6
Issue 2B - Programmatic EIS 7
Issue 2C - Limitation on NMFS Actions during Preparation of the EIS 8
Issue 2D - Pre-decisional 9
Issue 2E - Scope of Analysis 9
Issue 2F - Jurisdictional Overreach 11
Issue 2G - 5-Year Incidental Take Regulations 13
Issue 2H - Scoping Process 13
Issue 2I - Impact Criteria 15
Issue 2J - Significance Thresholds 21
Issue 2K - Selecting Alternatives and Mitigation Measures 21
Issue 2L – Incomplete or Unavailable Information 22
Issue 2M - Cooperating Agencies 25
Issue 2N - New Approach 27
ISSUE #3. COMPLIANCE WITH OTHER LAWS AND REGULATIONS 28
Issue 3A - General 28
Issue 3B - Marine Mammal Protection Act 30
Issue 3C - International Treaties and Conventions 35
Issue 3D - Outer Continental Shelf Lands Act 35
Issue 3E - Contractual Outer Continental Shelf Lease Agreements 36
Issue 3F - Air Quality Jurisdiction 36
Issue 3G - Government-to-Government Consultation 37
Issue 3H - Executive Orders 38
Issue 3I - Coordination with Other Agencies/Stakeholders 38
ISSUE #4. ALTERNATIVES 41
Issue 4A - Expression of Preferred Alternative 41
Issue 4B - The No Action Alternative 41
Issue 4C - Range of Alternatives Inadequate 42
Issue 4D - Improper Dismissal of Alternatives 43
Issue 4E - Limit on Activities 43
Issue 4F - Unprecedented Level of Activities 45
Issue 4G - Alternative Flaws 45
Issue 4H - Additional Alternatives Suggested 47
ISSUE #5. SCENARIO, ASSUMPTIONS, AND ACOUSTIC CRITERIA 49
Issue 5A - Proposed Action 49
Issue 5B - Spatial Scope 50

Issue 5C - Temporal Scope 51
Issue 5D - Analytical Assumptions 52
Issue 5E – Acoustic Criteria 54
ISSUE #6. PHYSICAL ENVIRONMENT 58
Issue 6A - Air Quality and Emissions 58
Issue 6B - Water Quality and Discharges 61
Issue 6C - Climate Change 63
ISSUE #7. BIOLOGICAL RESOURCES 65
Impacts on Marine Mammals 65
Issue 7A - Introduced Sound (Includes Bowhead Whales) 65
Issue 7B - Beluga Whales 71
Issue 7C - Gray Whales 73
Issue 7D - Direct Injury 74
Issue 7E - Walrus, Seals and Polar Bears 77
Issue 7F - Impacts on Fish and Invertebrates 81
Issue 7G - Impacts on Birds 83
Issue 7H - Impacts on Habitat (Special Areas, Protected Areas /Ecosystems) 84
ISSUE #8. SOCIOCULTURAL ISSUES 86
Issue 8A - Subsistence 86
Issue 8B - Environmental Justice and Public Health Effects 89
Issue 8C - Human Health and Safety 90
Issue 8D - Cultural Resources 91
Issue 8E - Visual Resources 91
ISSUE #9. ECONOMIC EFFECTS 93
Issue 9A - General 93
Issue 9B - Socioeconomic 94
ISSUE #10. CUMULATIVE EFFECTS 97
ISSUE #11. SCIENCE-BASED DECISION MAKING 100
Issue 11A - Additional Information Warranting Consideration 100
Issue 11B - Traditional Knowledge 102
Issue 11C - Data Gaps 103
Issue 11D - Needed Research and Studies 104
ISSUE #12. MITIGATION AND MONITORING 107
Issue 12A - General 107
Issue 12B - Effectiveness of Mitigation Measures 109
Issue 12C - Implementation 113
Issue 12D - Time/Area Restrictions 114
Issue 12E - Acoustic Restrictions 121
Issue 12F - Vessel Restrictions 125
Issue 12G - Aerial Surveys 126

Issue 12H - Subsistence Mitigation 127
Issue 12I – Monitoring and Reporting 128
Issue 12J - Adaptive Management 132
Issue 12K - Standard Mitigation Measures 133
Issue 12L - Additional Mitigation Measures 135
Issue 12M - New Mitigation 144
ISSUE #13. OIL SPILLS 149
Issue 13A - Occurrence 149
Issue 13B - Scenario 149
Issue 13C - Effects 151
Issue 13D - Spill Response 152
ISSUE #14. OTHER COMMENTS 155
Issue 14A – Other Comments 155
Issue 14B – Editorial, Out of Scope, Comment Noted 156
Issue 14C – Requests to Incorporate Specific Studies 157

LIST OF APPENDICES

APPENDIX 1 SUBMISSION INDEX

INTRODUCTION

On December 30, 2011, the National Marine Fisheries Service (NMFS) published a Notice of Availability (NOA) for the *Effects of Oil and Gas Activities in the Arctic Ocean Draft Environmental Impact Statement* in the *Federal Register* (76 FR 82275). The public was afforded 60 days to comment on that document. Consistent with comments on the Draft EIS (DEIS), NMFS and the Bureau of Ocean Energy Management (BOEM) determined that the environmental analysis would benefit from the inclusion of additional alternatives for analysis that covered a broader range of potential levels of exploratory drilling, including scenarios in the Beaufort and Chukchi seas that were more reflective of the levels of activity that oil and gas companies have indicated may be pursued in the region within the coming years. The alternatives are based upon the agencies' analysis of additional information, including the comments and information submitted by stakeholders during the DEIS public comment period. For this reason, the agencies determined it appropriate to prepare a Supplemental DEIS (SDEIS) and allow for an additional public comment period before releasing the Final EIS (FEIS) and Record of Decision (ROD). On January 30, 2013, NMFS published a Notice of Intent (NOI) in the *Federal Register* informing the public of its determination to prepare a SDEIS (78 FR 6303).

During the public comment periods, various government agencies, organizations, and individuals provided comments through oral testimony, in writing, or electronically. This appendix and specific revisions to the FEIS provide a comprehensive response to these comments.

NMFS' response to the comments involved a thorough review of both oral testimony received at public meetings and each written and electronic comment NMFS received. NMFS grouped all relevant, substantive comments into particular ***issue categories*** identified during this review. NMFS grouped comments as they pertain to specific issues or impacts to resource areas that could result from the full range of activities analyzed in the EIS.

To assist in identifying how a submission was coded within the Issue Categories, a Submission and Comment Index (Appendix 1) was created. The index is a list of all submissions received, presented alphabetically by the last name of the commenter and identifies which issue responds to their specific comments. To identify the specific issues contained in an individual submission, search for the submission of interest in Appendix 1, note which issue category is listed under the submissions and read the issue summary and response to comments.

A great number of the comments NMFS received via e-mail or compact disk were identical form letters or slight variations of those form letters. NMFS provided responses for relevant and substantive comments. Responses are not always provided in instances where a submittal does not comment on the content of the EIS but instead offers a general opinion or simply recommends a specific decision that is not delegated to NMFS. In some instances, NMFS provides responses to some recurring issues—even when not directly relevant to the EIS—to better communicate the nature of the Marine Mammal Protection Act (MMPA) process.

NMFS received and considered many comments of an editorial nature; for example: suggested word changes and corrections, request for clarification, questions regarding citations, and similar. Where appropriate, NMFS made these suggested revisions in the FEIS, and these revisions constitute NMFS' response to those editorial comments.

All comments received became part of the public record and can be viewed at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm. These comments are available to the decision maker during the deliberation process when deciding between the alternatives analyzed in the 2011 DEIS, the 2013 SDEIS, and the FEIS.

ISSUE #1. PUBLIC PARTICIPATION AND REVIEW PROCESS

In general, there were comments on the process and effectiveness of public participation activities.

Summary of Comments:

Commenters explained that Native communities are overwhelmed with the number and length of documents to review related to various oil and gas activities. Comments further suggested that while public meetings are important, the system of commenting on EISs should be revised to alleviate the burden on communities. Concerns were stated that the comment process is disproportionately difficult for poor or rural residents. Several other comments went on to suggest actions NMFS can take to encourage more public participation or improve its review process:

- Inform local city councils, the elected representatives of the communities, of all public meetings.
- Provide more transparency in the scoping process.
- Schedule or reschedule public meetings and comment periods such that people have adequate time to review such a large document and provide informed feedback. Additional reasons for an extended comment period were:
    - It is difficult to download a 1,500 page document from the internet in rural Alaska and mail delivery has been taking longer in recent years. Ensure that hard copies of the EIS and associated materials are available to communities; access to internet is often slow or unavailable.
    - There are many other proposed activities and government actions that request input from rural Alaska residents.
- Accommodate postponed public meetings in Kaktovik and Nuiqsut.
- Conduct public meetings in more communities to afford more people the chance to comment and learn about the proposed activities. This would alleviate some of the inconvenience and financial burden placed on individuals who want to participate in these meetings. Locations specifically mentioned included Point Hope, Savoonga and communities in the Northwest Arctic Borough such as Kivalina, Noatak, and Selawik.
- Consult with other groups of subsistence hunters in the affected area, including the Village of Noatak, the communities of the Bering Strait (such as Gambell and Savoonga), and indigenous people in Canada.
- Extend public outreach to the Lower 48 since the proposed activity would be on federal property. Doing so would help fulfill the National Environmental Policy Act (NEPA) requirement for broad outreach to the public.
- Commenters pointed out flaws with NMFS' handling of public comments:
    - Previous comments are not adequately addressed in the SEIS.
    - NMFS is not providing a response to comments until after the FEIS is published.
    - NMFS does not specify how individual comments from the 2011 DEIS are incorporated into the SEIS document. This should have been released prior to the SEIS.
    - To address these problems, commenters advised:
        - Return to communities after the comments have been received on the EIS and provide a presentation or summary document that shows how communities' comments were incorporated.

- Create and release to the public, a comment table that aggregates the 2011 DEIS comments by theme and provides the response from the cooperating agencies. The table should also specify where in the new document changes that resulted from individual comments were made.
- Issue revised SEIS containing specific responses to previous comments on both the SEIS and the 2011 DEIS.

- BOEM should partner with tribal, state, and local governments to educate the public about the NEPA process. This should occur well in advance of the scoping period and include instructions on how to prepare substantive comments and how to deliver public testimony.
- Make a conscious effort to enable effective participation from people that depend on the affected resources for subsistence needs. These people cannot afford to wait years for these vital resources to be adequately protected.
- The public needs an opportunity to comment on drilling activities, which were not included in the SEIS.
- NMFS should ensure that surveys, permits, research, and monitoring are transparent and peer reviewed.
- Public comments are gathered in an anonymous and piecemeal process. Public meetings should allow for dialogue between community members and comments should be weighed according to the experience of the person commenting.
- This EIS is an important opportunity for NMFS to assess the efficacy of these proposed measures with the full input of the scientific community before making a decision on overall levels of industrial activity in the Beaufort and Chukchi Seas. NMFS should, therefore, amend the DEIS to include such an analysis, which can then be subject to further public review and input pursuant to a renewed public comment period.
- NMFS should contract with smaller village corporations to contract biological studies. This would help communities feel their local expertise is being utilized.

Commenters expressed other concerns and requests including:

- The public is at an unfair disadvantage because average people cannot afford to fund expensive and time consuming unbiased scientific studies that can be incorporated into the process during evaluation of potential impacts.
- BOEM should increase transparency regarding government oversight of Arctic drilling operations by releasing public information before and after Arctic drills, require equipment and management system inspections, and releasing detailed incident reports and near-miss data.

Response to Comments:

In accordance with 40 CFR 1506.6, NMFS has made every effort to keep our stakeholders informed of the NEPA process schedules and to provide multiple opportunities for public and stakeholder input. Hard copies of the EIS were sent to an extensive list of Alaska Native organizations, Tribal and local governments, and libraries in the potentially affected communities, as well as to private citizens who requested copies. Public review of the EIS afforded an opportunity to provide input on the need for and expected effectiveness of each standard and additional mitigation measure, as well as provide input on the potential effects to be mitigated. NMFS has used this input to provide an analysis of the standard and additional mitigation measures in the FEIS.

Public outreach efforts, as well as public commenting opportunities, were designed in accord with applicable NEPA requirements and to maximize opportunities for public input. Yet NMFS also

understands that participating in public review processes can be very burdensome. In order to foster efficient and effective public participation, NMFS staff members are available to summarize important aspects of the document and answer any questions from stakeholders and community members. Additionally, NMFS prepared a summary document that outlines the primary differences between the 2011 DEIS and the 2013 SEIS, which was posted on the project website in conjunction with release of the 2013 SEIS and provided at the public meetings.

Public meetings were announced in the *Federal Register*, on the project website, and in the *Arctic Sounder* and *Nome Nugget* (advertisements and news releases), through flyers send to communities, public service announcements on the radio, as well as over the local CB radios in the native communities the day of the meeting. The original deadline to submit comments for the DEIS was February 13, 2012. In response to stakeholder requests, the public comment period on the DEIS was extended by 15 days, and the comment period concluded on February 28, 2012. For the SEIS, the original deadline to submit comments was May 28, 2013. In response to stakeholder requests, the public comment period on the SEIS was extended by 30 days, and the comment period concluded on June 27, 2013. The public meetings were announced broadly through the *Federal Register* and the project website, and meetings were then held with stakeholders located in the affected regions.

Public hearings on the DEIS and SEIS were held in North Slope and Northwest Arctic Borough communities in late January and early February 2012 and April 2013, respectively. Public hearing dates were coordinated with the Alaska Native communities to avoid conflict with community activities. Meetings in Nuiqsut, Kaktovik, and Point Lay originally scheduled for January/February 2012 were cancelled due to extreme weather conditions. Transcripts of the public hearings were made available on the project website (http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm).

In a separate but parallel process, government-to-government meetings were held in conjunction with meetings in Wainwright, Barrow, Kivalina, Kotzebue, and Point Hope. Follow-up letters requesting teleconference meetings were sent to the communities NMFS was unable to visit. Government-to-government consultation was conducted with the Native Village of Point Lay via teleconference; the Native Village of Nuiqsut did not participate in the scheduled teleconference, and the Native Village of Kaktovik did not respond to the teleconference request. NMFS also coordinated with the Alaska Eskimo Whaling Commission pursuant to the co-management agreement under the MMPA and also contacted the Alaska Beluga Whale Committee and Ice Seal Committee for their input and participation pursuant to co-management agreements under the MMPA with those organizations as well. Input from the Alaska Eskimo Whaling Commission represents the views and knowledge of bowhead whales from 11 hunting communities in the Beaufort, Chukchi, and Bering seas.

BOEM sees public input as a critical component of the safe and responsible exploration and development of offshore resources. The issues are complex and the better all parties are able to understand these issues and participate in the process, the better the resulting decisions are likely to be. BOEM provides explanatory materials and, in response to similar comments in the past, has given instructions orally and in writing about how to provide public comments. We conduct public meetings with appropriate key communities and meet with local governmental representatives while visiting these communities. Teleconferences are sometimes conducted as well, when community activities conflict with the timing of BOEM's visits. BOEM also has a dedicated Tribal and Community Liaison who is in touch with communities and is available to discuss such concerns and ideas about how to improve our public processes. See http://www.boem.gov/About-BOEM/BOEM-Regions/Alaska-Region/Community-Liaison/Index.aspx to read about upcoming hearings or meetings, and to find contact information for the Tribal and Community Liaison. BOEM remains open to suggestions about how to improve the public input process within time and budget constraints.

The FEIS summarizes the comments received on the 2011 DEIS and 2013 SEIS and provides responses to broad issue categories. The FEIS has been corrected, revised, and updated, as needed, in response to

comments on the DEIS and SEIS. This response to comment appendix provides the public with the agencies' rationale for how we accepted and rejected the numerous comments. NEPA regulations only require agencies to publish this information in a Final EIS. Time and money restraints preclude NMFS from engaging in another round of public meetings to explain how comments were incorporated into the FEIS. However, NMFS staff members remain available to answer specific questions about the document or process.

Chapter 2 of the EIS contains a robust discussion of seismic surveys, ancillary activities, and exploratory drilling. The science that was used in the analysis of this EIS has been peer reviewed. For those studies that have not yet been peer reviewed, the public was afforded the opportunity to comment on the science used in the EIS during the two public comment periods noted above. Additionally, public comment is a vital component of the MMPA Incidental Take Authorization (ITA) process, and the monitoring plans of activities in Arctic waters are peer reviewed pursuant to the MMPA and its implementing regulations. We rely on the best available science, which includes peer reviewed data and articles, as well as traditional knowledge.

Additionally, NMFS hosted annual Open Water Meetings through 2013 to inform and seek input from stakeholders on proposed offshore activities, potential MMPA authorizations, and mitigation requirements. BOEM also provides opportunities for stakeholder input on preparation of NEPA documents and on proposed exploration activities.

NMFS does not plan to meet with the Village of Noatak or indigenous people in Canada. The scoping process for this EIS did not indicate that these groups would experience adverse impacts from the proposed action, and no request from these groups has been received.

Transparency regarding permitted drilling operations or other actions authorized by BOEM is one of the purposes of the NEPA process. This EIS analysis combined with the project specific NEPA analyses to be developed in later stages of the process under the Outer Continental Shelf Lands Act (OCSLA) are part of efforts to make BOEM's actions and the potential effects of those actions transparent and readily available to the public and decision makers. As part of this process, BOEM releases public documents, including industry applications and plans for Geological and Geophysical (G&G) activities, industry applications for permits to drill and associated exploration plans, and all subsequent NEPA analyses pertaining to these and other Federal permitting actions—these documents are available through the BOEM Alaska Region website at http://www.boem.gov/Alaska-Region/. Further, following the Deepwater Horizon event and the reorganization of the Minerals Management Service into three new and separate agencies, the Bureau of Safety and Environmental Enforcement established the Workplace Safety Rule (30 CFR Subpart S), including its Safety and Environmental Management Systems Program (SEMS) designed to reduce the risks of accidents, injuries, and spills that occur in connection with offshore oil and gas exploration and development activities on the Outer Continental Shelf. Operators were required to complete audits under this regulation by November 15, 2013. More information about safety programs is available on the Bureau of Safety and Environmental Enforcement (BSEE) website at www.bsee.gov.

ISSUE #2. NEPA COMPLIANCE

The majority of comments received conveyed arguments regarding how well the EIS is in accord with the intent and requirements of NEPA and its implementing regulations. Many suggested modifications to NMFS' current approach. Comments addressed a variety of issues related to NEPA compliance.

Issue 2A - Need for an EIS

Summary of Comments:

Several comments challenged the need for NMFS to prepare an EIS in the first place. The EIS, it was asserted, duplicates existing NEPA documents, particularly those prepared by BOEM. Further, an EIS is not required because the types of activities analyzed are limited in scope and duration and do not have the duration to significantly affect the environment. NMFS should clarify that its action to undertake an EIS does not mean that it has made an implicit determination that the activities analyzed would result in a significant impact to the human environment. Nor does it necessitate that the agency undertake an EIS in the future, as opposed to a lesser level of NEPA analysis, if activity levels in the EIS are exceeded.

Another comment stated that BOEM is the only agency qualified to lead such a broad analysis of oil and gas activities in the OCS, as the ability to authorize, prescribe or limit oil and gas activities are within BOEM's authority alone. One commenter questioned the federal decision to use one EIS to meet NEPA planning and activities comparison for two different departments with uniquely different jurisdictions, missions, statutes, and regulations. Additional clarification is requested about the resolution process when a conflict of jurisdiction arises. The EIS should definitively clarify which agency has primacy for specific issues of conflict between NMFS and BOEM.

Other comments questioned the propriety of an EIS but for different reasons. NMFS' decision to prepare an EIS, it was argued, implies that significant effects are likely to occur. However, since the MMPA prohibits NMFS from issuing an Incidental Harassment Authorizations (IHAs) where impacts would exceed negligible, NMFS should not prepare an EIS for the action of issuing take authorizations.

Some commenters question the need for the EIS when the existing MMPA regulatory process is working well as an effective tool in balancing and justifying oil and gas activities with the conservation of marine mammals. The EIS does not explain why NMFS could not continue to issue IHAs and promulgate Incidental Take Regulations (ITRs) supported by Environmental Assessments, which has been the usual approach.

Response to Comments:

NMFS has prepared this EIS to determine if the projected rise in oil and gas activity levels in the project area would cause significant cumulative impacts to the human environment. NMFS' decision to prepare an EIS should not be construed as an assumption that significant adverse effects would occur from all levels of activities analyzed. Federal agencies may employ the EIS process to aid in their decision-making, whether the contemplated action would have significant effects or not. However, in this case, one of the main drivers for preparing an EIS was, in fact, that the higher levels of activity predicted by the oil and gas industry to likely occur in the near future could potentially have significant cumulative impacts. Based on the industry's prediction of increased activities, NMFS and BOEM wanted to ensure that appropriate NEPA analysis was pre-emptively conducted instead of waiting until the first year that anticipated cumulative impacts from industry activities exceed the significance threshold, which would result in a delay of activities while an EIS was written.

NMFS determined that a robust EIS process (i.e., identifying issues through scoping, examining a reasonable range of alternatives, engaging stakeholders through public meetings and two comment periods, and creating comprehensive draft, supplemental, and final documents) would best facilitate informed and forward-looking decision-making. The EIS comprehensively assesses activities that may

occur in a given season in advance of receiving applications. The analysis in this EIS would make future NMFS reviews of ITA applications more efficient and more effective.

NMFS intends to use this EIS as the required NEPA documentation for the issuance of ITAs for Arctic oil and gas exploration activities. If proposed activities fall outside the scope of this EIS, NMFS may tier from this EIS to support future Arctic MMPA oil and gas authorization decisions. BOEM intends to conduct proposal-specific NEPA analyses that either tier from this EIS or incorporate this EIS by reference, which will provide some administrative streamlining for the agency thus making the process more efficient. Council on Environmental Quality (CEQ) regulations specifically encourage and provide for such use of broad-scope, programmatic documents. Moreover, the FEIS includes analysis of the feasibility and potential effectiveness of mitigation and monitoring measures that could be included in future authorizations. For an explanation of the benefits of tiering, refer to 40 CFR 1508.28.

The completion of an EIS does not mean that NMFS is then unable to make the required “negligible” impact findings under the MMPA. The definitions of and standards for “significance” under NEPA and “negligible” under the MMPA are different and not inextricably linked. For example, NEPA outlines multiple factors that may contribute to an activity being “significant,” while the evaluation of “negligible impact” under the MMPA is related solely to the effects of the proposed action on marine mammal populations.

There is no conflict of jurisdiction between NMFS and BOEM created by this EIS. BOEM is the federal agency with authority to authorize oil and gas exploration activities on the federal OCS. Through this EIS, NMFS does not assert any authority or jurisdiction over these activities. Rather, NMFS has the jurisdiction to implement the MMPA with respect to the marine mammal species under its jurisdiction (i.e., everything but walrus and polar bears in the Arctic) in both state and federal waters.

Issue 2B - Programmatic EIS

Summary of Comments:

Comments differed as to whether the EIS is, and whether the EIS should be, a programmatic document.

- Some comments requested clarification that the EIS is programmatic, designed to assist with planning, and that more site-specific analysis would be required to assess specific proposals. The lack of specificity in this EIS, it was asserted, would preclude its use to justify authorizations of particular projects. NMFS should describe how they and BOEM would "tier" off of the SEIS in its future NEPA reviews, including what parts of the SEIS would or would not apply to future reviews. To provide clarity, BOEM should state what level of additional NEPA analysis it would generally rely on to support activity authorizations.
- Commenters asked for an explanation of how decision makers can draw definitive conclusions regarding potential effects on marine mammals or other ecosystem components given the lack of details for the operations identified under each alternative.
- One comment challenged whether NEPA gives agencies the authority to engage in non-programmatic impact analyses in the absence of a specific proposed action.
- Commenters requested clarification of the time-frame of activity; from 5-year period analyzed in the DEIS to now seemingly covering oil and gas exploration activities in the Beaufort and Chukchi seas in perpetuity in the SEIS.
- Commenters requested clarification of how the document would be used given the different applicability of the EIS to NMFS and BOEM statutory responsibilities. While it appears to only address seismic surveys and ancillary activities for BOEM, NMFS is using the SEIS for those activities and for drilling activities. Since all of the action alternatives include drilling activities, it

is unclear how BOEM can exclude drilling activities from its participation as a coordinating agency.

Response to Comments:

NMFS acknowledges that this document is programmatic in nature. CEQ regulations specifically encourage and provide for the use of programmatic documents and tiering from statements of broad scope to those of narrow scope documents to eliminate repetitive discussions of the same issues and to focus on the actual issues ripe for decision at each level of environmental review (40 CFR 1500.4(i); 40 CFR 1502.20; 40 CFR 1508.28). CEQ regulations state (40 CFR 1502.4(c)):

> When preparing statements on broad actions (including proposals by more than one agency), agencies may find it useful to evaluate the proposal(s) in one of the following ways:
>
> (1) Geographically, including actions occurring in the same general location, such as body of water, region, or metropolitan area.
>
> (2) Generically, including actions which have relevant similarities, such as common timing, impacts, alternatives, methods of implementation, media, or subject matter.

NEPA allows an agency to consider environmental impacts and to conduct an environmental analysis at the earliest possible stage. Based on activity levels and MMPA ITA requests over the last several years, NMFS is able to conduct this analysis based on reasonably foreseeable forthcoming applications. Completion of this EIS will help enhance administrative streamlining of the MMPA process and is meant to eliminate duplication of analysis on an individual MMPA ITA basis per CEQ regulations. This EIS will be used from the time the Record of Decision is signed until there is scientific evidence that the analysis needs to be updated to address changing conditions or activities.

BOEM will use the analysis in this programmatic document, as appropriate, to support NEPA analysis for specific G&G projects and ancillary activities in the future. Environmental Assessments (EAs) are generally used by BOEM to evaluate the effects of G&G activities and to determine whether further mitigation or an Environmental Impact Statement (EIS) are necessary. Ancillary activities are evaluated within EIS's under each lease sale, but specific ancillary activity notices (30 CFR 550.202) are also reviewed further using a Categorical Exclusion Review (CER) or an EA, as appropriate. The analysis in this programmatic document will be incorporated by reference, as appropriate and applicable, to support these project-specific NEPA documents.

Issue 2C - Limitation on NMFS Actions during Preparation of the EIS

Summary of Comments:

One commenter stated that NEPA regulation prohibit NMFS from issuing Incidental Harassment Authorizations (IHAs) until an ongoing programmatic EIS is complete; thus NMFS is prohibited from granting IHAs to Shell for its 2012 drilling plan. NEPA prohibits piecemeal approvals while a programmatic EIS process is ongoing, except under strictly prescribed circumstances that are not applicable in this situation.

One commenter cautioned that if NMFS were to allow oil and gas activities to go forward pending completion of the EIS, it would risk undermining the overarching aim of the programmatic EIS process to establish appropriate standards for future oil and gas activities that address and mitigate potential cumulative effects of the activities.

Response to Comments:

The CEQ regulations at 40 CFR 1506.1 address limitations on federal actions during the NEPA process; specifically, 40 CFR 1506.1(c) states:

while work on a required program environmental impact statement is in progress and the action is not covered by an existing program statement, agencies shall not undertake in the interim any major federal action covered by the program which may significantly affect the quality of the human environment unless such action:

1. is justified independently of the program;
2. is itself accompanied by an adequate environmental impact statement; and
3. would not prejudice the ultimate decision on the program. Interim action prejudices the ultimate decision on the program when it tends to determine subsequent development or limit alternatives.

As stated previously, BOEM is the federal agency with jurisdiction over permitting oil and gas exploration activities on the federal OCS. BOEM has determined that permitting and authorization of Outer Continental Shelf (OCS) exploration activities in the U.S. Arctic Ocean while this EIS is in preparation meets all of the above criteria. Additionally, NMFS determined that authorizing take of marine mammals incidental to conducting OCS exploration activities while this EIS is in preparation meets all of the above criteria. NMFS is preparing this more broad-based EIS voluntarily. The issuance of MMPA ITAs requires NMFS to conduct an analysis of the effects on the human environment. Therefore, the agency only issues ITAs (including IHAs) after conducting a thorough NEPA analysis and including necessary mitigation measures to reduce impacts to marine mammals, their habitats, and the availability of marine mammals for subsistence uses. NMFS prepared separate NEPA documentation regarding Shell's applications for IHAs for its 2012 and 2015 exploration drilling activities.

Issue 2D - Pre-decisional

Summary of Comments:

One comment argues that the EIS is not helpful as a guide for subsequent agency regulatory decisions that would be required to address a greater number of activities. By limiting future agency action, the EIS violates NEPA principles and becomes a "decisional document."

Response to Comments:

The EIS helps inform future decisions as to whether or not to issue MMPA ITAs and is an analysis tool, not a "decisional document". No precedent for future actions or decision in principle about future considerations would be made by the decision process and Record of Decision (ROD) related to this EIS.

Issue 2E - Scope of Analysis

Summary of Comments:

Many comments expressed dissatisfaction with the scope of the EIS. Mainly, it was asserted that the scope of the EIS should be limited to anticipated levels of take of marine mammals. The potential for future oil and gas activities to impact terrestrial mammals, birds, fish, land use, and air quality was deemed irrelevant to a NMFS decision about whether to authorize incidental take of marine mammals. NMFS has no authority over polar bears and walrus, and there is no purpose or need for any NEPA analysis prepared by NMFS to address the impacts of incidental take of polar bears and walrus by the oil and gas industry in the Arctic. Another comment requested that NMFS specifically limit the EIS to exploration activities and to review future extractive activities separately.

Several commenters also took issue with the geographic scope of the EIS, specifically:

- That as the Cook Inlet area is included within BOEM's 5-year plan; it should be analyzed in this EIS.

- That the discussion of nearshore, coastal, and terrestrial areas may not be relevant to regulatory analyses in the SEIS. Most coastal terrestrial regions may not be federally regulated and the proposed terrestrial coastal mitigations under this EIS may not apply. It is recognized that there may be selected coastline areas withdrawn by the federal government from state ownership in the National Petroleum Reserve-Alaska (NPR-A), adjacent to the Beaufort Sea in the northwest area of Alaska.
- That NMFS should clarify that only federal waters are included in the analysis.
- The scope of the SEIS was inappropriately limited in several aspects that include the geographic area that may be impacted by Arctic oil and gas development, the probability of oil spills, the pollutants generated by spills and the range of pollutant migration from the initial spill site.
- The scope of Arctic development impact analysis must be expanded to include the potential of oil spills throughout the range of vessel transits.

One commenter suggested that in defining alternatives by activity level, NMFS confuses the nature of the proposed action (incidental take, not oil and gas activity) and the agency's desire to define the proposed action (the anticipated frequency and intensity of incidental take, not the frequency of oil and gas activity), with the NEPA requirement that the impacts of the proposed action should be compared to a reasonable range of alternatives. Commenter suggested clarification that MMPA ITAs only authorize incidental take, not the underlying activity.

Response to Comments:

For the purposes of NMFS' action, the focus of the EIS should be on potential effects to marine mammals. The comprehensive analysis of potential effects to marine mammals evidences this approach. However, this EIS does not only cover NMFS' action, it also analyzes the effects of BOEM's issuance of G&G permits for seismic activities. NMFS also agrees that issuing IHAs would not directly cause negative impacts to terrestrial mammals, birds, fish, land use, air quality or other environmental resources and that NMFS has no authority to include mitigation measures in IHAs for any marine species or trust resource not under its jurisdiction. This fact does not, however, preclude the need to analyze potential impacts of the proposed actions (NMFS' and BOEM's) on other sensitive environmental resources outside of the agency's jurisdiction and the human environment. Because NMFS has jurisdiction in both federal and state waters for implementing the MMPA, this EIS appropriately includes analysis of impacts to resources in both state and federal waters of the U.S. Arctic.

NMFS decided early on to limit the spatial scope of the EIS to the Arctic from the border between the U.S. and Canada in the Beaufort Sea to Nome in the Bering Sea. This spatial extent includes the areas where seismic surveys, ancillary activities, and exploratory drilling may occur in the U.S. Arctic, as well as vessel transit routes through the Bering Strait and staging and possible resupply ports. Inclusion of the Cook Inlet area was deemed unnecessary and imprudent given regional differences, differences in the foreseeability of oil and gas activities, and other factors. Analysis of potential activities in Cook Inlet would occur via a separate NEPA document.

The commenter is correct that NMFS' action is the authorization of marine mammal take, not the authorization of the underlying activity, although as pointed out above, this NEPA document is intended to evaluate both NMFS' authorization of marine mammal take as well as BOEM's OCSLA issuance of G&G permits and ancillary activity notices for the underlying activity. It is appropriate, however, for NMFS to identify alternatives that vary by activity level because marine mammal take is predicted and calculated directly based on the level of activity. Further, because marine mammals are often difficult to detect in the field by direct observations, the amount of activity that actually occurred is the best surrogate for understanding what the level of take that likely occurred.

Issue 2F - Jurisdictional Overreach

Summary of Comments:

One comment expressed concern that future use of, and tiering from, the EIS may extend NMFS' regulatory jurisdiction over land and water management issues, and sought clarification from NMFS regarding its intentions. Several commenters expressed concern that the mitigation measures presented in the EIS exceed NMFS' jurisdiction or conflict with other agencies' regulatory programs. Such comments include the following:

- NMFS only has regulatory jurisdiction over specific marine mammals.
- NMFS lacks any authority to establish closures or presumptive caps or limits on OCS oil and gas activities in the Arctic Ocean See 16 U.S.C. Â§ 1371(a) (5) (A) (i) (Secretary "shall allow" incidental taking that meets applicable statutory standards).
- Polar bear mitigation measures could contradict those issued by the U.S. Fish and Wildlife Service (USFWS).
- NMFS has no legal authority over walrus and should clarify that it would not seek to include conditions for USFWS' trust species in its future IHAs or LOAs. With regard to impacts to walruses and polar bears from BOEM-authorized activities, the EIS should defer to USFWS by incorporating its analysis of impacts as included in prior USFWS EAs and Biological Opinions.
- Zero discharge requirements that encroach on the Environmental Protection Agency (EPA) Clean Water Act (CWA) jurisdiction. The proposed zero discharge mitigation measure described in the Arctic EIS is not in accord with the conclusions of the EPA in the Arctic National Pollution Discharge Elimination System (NPDES) General Permits finalized in the fall of 2012.
- Proposed mitigation measures encroach on Department of the Interior (DOI) jurisdiction over offshore oil and gas activities.
- Proposed requirements for Oil Spill Response Plans that conflict with Coast Guard jurisdiction under Oil Pollution Act of 1990 (OPA-90).
- Vessel restrictions fall under the purview of the U.S. Coast Guard.
- Proposed measures duplicate and contradict state lease stipulations and mitigation.
- Language that mandates portions of Conflict Avoidance Agreements (CAAs), which are voluntary and beyond NMFS' jurisdiction.
- NMFS should not consider power-downs or shutdowns of exploration drilling activity, which fall within the drilling safety realm of the Bureau of Safety and Environmental Enforcement (BSEE), as mitigation measures and must consult BSEE before considering doing so. The EIS should clarify in writing that authorizations for oil and gas G&G activities in state-owned waters are under the jurisdiction of the State. A problem exists with the proposed mitigation measures that restrict some or all exploration and vessel activities to at least 5 nautical miles (8 km) from the shore. Time/area closure locations in the Beaufort Sea include areas in state-owned waters where there are active state leases.
- The introduction of a separate suite of mitigations and time/area closures may establish duplicative and potentially conflicting requirements emanating from two separate jurisdictional layers of federal management. The result could be operators submitting duplicate authorization submittals and obtaining approval for activities to comply with one jurisdiction that simultaneously may not comply within the second jurisdiction. An example of conflicting exploration requirements is in the SEIS, Chapter 4 - Environmental Consequences, Section 4.2.3,

Vol. 1, page 4-9. It states that the timing of drilling operations is proposed to end by approximately early November. NMFS should clarify why this does not reflect the latest federal restrictions, which reflect the Alaska standards of an October 31st deadline for activities that penetrate hydrocarbon bearing layers.

- Describe and clarify the requirement for separate federal authorizations by their respective agencies for operators in the Beaufort and Chukchi seas, and clarify which agency has primacy for specific issues of conflict between NMFS and USFWS.
- Clarify that issuance of ITAs by NMFS for activities in federal waters would not limit the number of ITA applications and authorizations for activities in state waters.
- The FEIS should detail NMFS authority - to analyze and mitigate impacts to species from oil and gas activity, and make clear that the authority to regulate the level of oil and gas activity in the Arctic remains squarely with BOEM.
- NMFS does not issue ITAs for discharge of pollutants or the mere physical presence of vessels.
- NMFS cannot directly restrict the number of surveys, only the number of MMPA takes.

Response to Comments:

Decisions flowing from this EIS would constitute an exercise of NMFS' existing authority under the MMPA and would not extend NMFS' jurisdiction over land and water issues. As provided for by the CEQ regulations, NMFS intends to use this EIS as the required NEPA documentation for the issuance of ITAs for Arctic oil and gas exploration activities. If proposed activities fall outside the scope of this EIS, NMFS may tier from this EIS to support future Arctic MMPA oil and gas authorization decisions pursuant to CEQ regulations.

Under CEQ's regulations implementing NEPA, all relevant, reasonable mitigation measures that could improve the project are to be identified if they are not part of the proposed action, even the mitigation measures that are outside the jurisdiction of the lead agency or the cooperating agencies, and thus would not be committed as part of the RODs of these agencies (NEPA's Forty Most Asked Questions 19b; 40 CFR 1502.14(f), 1502.16(h), and 1505.2(c)). CEQ explains that because the EIS is the most comprehensive environmental document, it is an ideal vehicle in which to lay out not only the full range of environmental impacts but also the full spectrum of appropriate mitigation. Including all relevant, reasonable mitigation measures would serve to alert agencies or officials who can implement these extra measures, and would encourage them to do so. However, NMFS would not include measures to mitigate impacts on polar bears and walrus in its ITAs. NMFS would only include any non-standard mitigation measures identified in the FEIS in individual MMPA ITAs after a comprehensive review and analysis of the specific project to ensure that impacts are at the lowest level practicable and to ensure a negligible impact on affected marine mammal species or stocks under NMFS' jurisdiction and their habitats and to ensure no unmitigable adverse impact on the availability of marine mammal species for taking for subsistence uses. Pursuant to the MMPA, NMFS has the authority to impose mitigation measures to reduce impacts to marine mammal species and/or stocks and their habitat in both state and federal waters to ensure the least practicable adverse impact on marine mammals. Inasmuch as a proposed mitigation measure may be associated with a reduction of adverse impacts to marine mammals or their habitat (e.g., requirements related to discharge), NMFS may require it pursuant to the MMPA subject to a consideration of the likely ability of the measure to reduce impacts and its practicability of implementation.

Mitigation measures must be considered even for impacts that by themselves would not be considered "significant." (NEPA's Forty Most Asked Questions 19a; 40 CFR 1502.14(f), 1502.16(h), and 1508.14). Even though NMFS cannot require a CAA or enforce the provisions of a voluntary CAA, it is reasonable for NMFS to acknowledge and consider any relevant mitigation measures that are identified in the CAAs.

As noted several times already, BOEM is the agency with jurisdiction for authorizing oil and gas exploration activities on the federal OCS. The State of Alaska has jurisdiction for authorizing such activities in state waters. NMFS has the authority to issue MMPA authorizations (which authorize the take of marine mammals, not the underlying activity itself), with the associated mitigation and monitoring requirements, in both federal and state waters. As a decision-support tool, this EIS is not designed to limit the number of seismic surveys, rather it considers and analyzes the effects of several reasonable levels of seismic activity. As noted previously, if activity levels exceeded those contemplated in this EIS, BOEM and NMFS would need to conduct additional NEPA analyses prior to issuing permits or authorizations. Last, NMFS' authority allows for the inclusion of mitigation requirements to affect the least practicable adverse impact within the context of a proposed activity. More importantly, MMPA authorizations may only allow "small" numbers of take, and, in order to issue them, NMFS must find that the effects on marine mammal species/stocks are negligible and that the activity will not have an unmitigable adverse impact on subsistence uses. To the commenter's point, if these standards are not met, NMFS could deny issuance of an IHA (or in a rulemaking multi-survey scenario, limit the number of surveys in order to meet the standards), either of which could be interpreted as limiting the number of surveys. However, absent the necessary case-specific MMPA analysis, NMFS is not contemplating limiting surveys in this EIS, rather analyzing reasonable ranges of activity levels that are likely to occur.

Information presented in this EIS does not contradict analyses and measures already imposed by BOEM. The proposed timeframe of ending activities in November and not by October 31 correlates with recent regulations. All activities that would penetrate into hydrocarbon bearing layers would cease by October 31; however, other activities related to the exploratory drilling programs, such as demobilization efforts could continue past this date.

Issue 2G - 5-Year Incidental Take Regulations

Summary of Comments:

One comment suggests that NMFS write 5-Year (ITRs) for oil and gas exploration activities, instead of using this EIS. Another commenter asserts that the Purpose and Need as currently written improperly suggests that NMFS intends to issue 5-year ITRs.

Response to Comments:

The promulgation of 5-year MMPA ITRs does not negate the requirement to conduct a thorough NEPA review. Whether NMFS authorizes the take of marine mammals incidental to oil and gas exploration activities in the U.S. Arctic through the issuance of ITRs or annual IHAs, the agency is required to conduct a NEPA analysis (e.g., EA, EIS). Through this EIS, NMFS contemplates authorizing the take of marine mammals, incidental to these activities through the issuance of either ITRs or IHAs. However, to date, applicants have only requested annual IHAs related to oil and gas exploration programs in the U.S. Arctic.

Issue 2H - Scoping Process

Summary of Comments:

Several comments asserted deficiency with the scoping process employed for the EIS. Many comments noted that in light of the following NMFS should have informed the public and provided additional scoping opportunities.

- Changes to the stated purpose of the EIS since 2007—inclusion of a Very Large Oil Spill (VLOS), potential effects of seismic activities, and alternative approaches for BOEM to issue G&G permits

- The NOI for the 2011 DEIS did not specify that the intent of the document was to analyze a finite level of exploration activities.
- NMFS must not require power-down or shutdown zones without providing an opportunity for public comment.

Another related comment takes issue with NMFS' explanation that the 2011 DEIS was based on new information becoming available, as the EIS fails to identify the information driving the significant changes that appear in the document. Another commenter felt their previous comments were overlooked and not properly addressed in the SEIS.

Commenters renewed a request for a workshop involving industry representatives to determine the appropriate level of exploration activities to be addressed in the EIS.

Commenters noted that several issues identified in the scoping report and at the scoping meeting were not included in the SEIS. These included:

- The need for a stable domestic energy supply.
- Benefits to the state and nation from oil and gas development and benefits to the oil and gas industry from predictability in permitting process.
- Economic considerations.

Response to Comments:

The scope of the EIS' analysis is indeed somewhat larger than the scope of the 2007 DEIS. Specific points raised in comments are addressed below:

- *Effects of seismic activities*. The effects of seismic activities have been analyzed in numerous BOEM and NMFS NEPA documents over recent years. In each of these processes, stakeholders have provided valuable input regarding the potential effects of seismic activities. The issues surrounding these activities are thus well known, and are analyzed comprehensively in this EIS. Further, it is reiterated that future NEPA documents may be necessary to support decisions regarding specific, individual IHA applications. Concerned members of the public would have another opportunity to provide input during the MMPA process for individual requests. At that time, the public can comment on mitigation measures proposed for inclusion in individual authorizations, such as power-down and shutdown zones.
- *Alternative approaches to seismic activities*. Once seismic activities were incorporated into the proposed action, it was necessary (as per NEPA requirements) to analyze alternate means of accomplishing the underlying objective of identifying potential hydrocarbon resources in an environmentally responsible manner.
- *VLOS*. A VLOS is a very low probability, high-impacts event that is illegal and not part of the proposed action. At the request of some stakeholders, the EIS includes a summary of the potential effects of a VLOS as analyzed in recent BOEM NEPA documents. Additional scoping on this issue was not necessary.
- *Level of activities*. From early stages of this EIS process, NMFS has coordinated with other federal agencies, as well as industry regarding exploration scenarios appropriate for analysis. This coordination continues through various mechanisms in the NEPA process. For instance, in response to comments on the EIS, NMFS decided to increase the maximum number of exploratory drilling programs contemplated in the alternatives.
- *New DEIS*. The 2011 DEIS incorporates many new studies, as well as new information regarding potential oil and gas activities, that have emerged subsequent to release of the previous draft

document. These new studies are referenced throughout the document. Additionally, this EIS analyzes potential exploratory drilling programs in the U.S. Arctic, which were not considered or analyzed in the 2007 DPEIS, thus taking a more comprehensive look at potential exploration activities that may be conducted in the reasonably foreseeable future.

- *Workshop Request and Scoping.* NMFS conducted a new scoping phase for this EIS after we determined it was appropriate to withdraw the 2007 DPEIS and initiate a new EIS instead of completing that one. On February 8, 2010, NMFS published a Notice of Intent to prepare this EIS in the *Federal Register* (75 FR 6175). The public was afforded 60 days to provide comments, and those comments were considered in preparation of the 2011 DEIS. Additionally, in December 2009, NMFS met with representatives from the oil and gas industry to determine proposed levels of oil and gas exploration activities in the U.S. Arctic in the reasonably foreseeable future. We also encouraged them to include additional information on activity levels in the scoping comments.
- *Energy Supply and Economic Considerations.* The need for a stable domestic energy supply and reducing dependence on foreign oil is the overarching goal of the President's all-of-the-above energy strategy. To this end, oil and gas reserves in the OCS represent significant sources that currently help meet U.S. energy demands and are expected to continue to do so in the future. The benefits of producing oil and natural gas from the OCS include not only helping to meet this national energy need but also generating money for public use (see Section 1.4.1 Purpose). The economic implications of the scenario in this EIS are analyzed for each of the six alternatives in Chapter 4 under the heading Socioeconomics.

Issue 2I - Impact Criteria

Summary of Comments:

Comments on the impact criteria addressed definitions, take, impact levels, evaluation of risk, and the differences between NEPA and MMPA impact criteria.

The following comments are general concerns:

- Impact criteria lack objectivity.
- There is no basis for comparing effects across resources, such as a cost-benefit analysis or other assessment of relative value between human economic activity and physical/biological impacts.
- The criteria that NMFS uses for measuring impacts and setting mitigation are outdated. NMFS should update the way it measures the impact of these proposed activities with current information.
- Commenters noted several omissions and inadequacies in NMFS' analysis of impacts. For example, NMFS states that the vertical seismic profilers and vertical cable surveys are used as part of the drilling program, but has not analyzed the effects of those sound sources as part of the proposed drilling operations. Vertical seismic profilers are airgun arrays with the potential to generate source levels at or above 238 dB re 1 µPa at 1 m.
- Minor and short-term behavior effects appear to be judged more consequential than known impacts.
- There is no cost-benefit analysis or attention to the probability of impacts. Little attention is paid to the severity of impacts.

- Conclusions lack supporting data and findings are not incorporated into a biologically meaningful analysis. It is not clear how NMFS combines the impact criteria to reach final impact determination conclusions of negligible, minor, moderate, or major.
- It is unexplained how the environmental analysis relates single animal risk effect to the population level effects analysis, and whether the analysis is premised on a deterministic versus a probabilistic risk assessment approach.
- NMFS attempts to quantify take in the SEIS using undisclosed data that potentially understates effects and is not sufficiently integrated into effects analysis.
- Impact criteria should be adjusted to reflect MMPA standards and include analysis of potential impacts to each hunt. Current impact criteria tend to mask impacts to local communities, especially over the short-term. One commenter cautioned that consistent with NMFS' prohibition against impacts that cause marine mammals to abandon or avoid hunting areas, an expectation that hunters can travel beyond traditional hunting areas to take whales is untenable since it creates an increased risk to human life.
- Low level risks from industry activities are labeled “moderate” while non-industry activities involving mortality to marine mammals of concern are labeled as “minor.”

Regarding magnitude and intensity, commenters stated the following:

- As the discussion is currently structured, NMFS, at certain points, ties the impact criteria for magnitude or intensity to the effects on a certain proportion of the population, but not to whether each level of impact would result in a violation of the standards of the MMPA. At other times, the impact criteria and accompanying analyses are silent with respect to impacts on the population.
- NMFS ties the "magnitude or intensity" impact criteria rating in the EIS to whether an impact can be mitigated. NMFS appears to believe that an impact of medium magnitude or intensity can be mitigated and therefore would not violate the "no unmitigable impact to subsistence" standard. The EIS should clarify if NMFS envisions impacts being mitigated in relation to the remaining impact criteria: duration, geographic extent, and context. If this is to occur, the EIS should explain how it would be accomplished.

Several commenters suggested changes to the analysis of impacts to marine mammals:

- NMFS needs to clearly identify in the EIS whether and to what extent the proposed levels of industrial activity could have population-level effects on marine mammals using the optimum sustainable population as a benchmark and incorporate potential biological removal (PBR) into its analysis of bowhead whales. This approach, using information from the stock assessment, current subsistence harvest quotas, and natural mortality to assess potential biological removal offers an excellent example of an analytical model directly tying proposed activities to statutory standards.
- The impact criteria for marine mammals should be related to disturbance effects forcing animals to miss feeding opportunities, deflecting migratory animals, potential for stress related impacts, and other risk factors.

Many commenters disagreed with the impact levels as assessed in the EIS, expressing concern that NMFS has failed to adequately analyze impacts. Specifically:

- Using the model in the BOEM, Draft Programmatic Environmental Impact Statement for Atlantic OCS Proposed Geological and Geophysical Activities in the Mid-Atlantic and South Atlantic Planning Areas at 2-12 (March 2012), BOEM found marine mammal takes from the seismic activity in the Atlantic would amount to 140,000 injuries of marine mammals or Level A takes and 13.5 million disturbances for marine mammals or Level B takes. Seismic and drilling activity

predicted in the Arctic is of a larger scale and more concentrated than in the Atlantic. Arctic activities include up to 180,000 km of seismic survey transect lines per year plus exploration drilling. The Atlantic activities include up to 77,000 km of seismic transect lines per year and no drilling. The Arctic project area is 322,401 square km, the Atlantic is 854,779 square km. Thus, the Arctic seismic activity could be larger in scale and more intensely concentrated than the Atlantic, potentially suggesting even larger numbers of mammals could be taken from the activities.

- There are no mitigations strong enough and no recovery periods long enough that could protect certain habitat and species that could be compromised.
- Alternative 3 was unchanged between the DEIS and the SEIS. In the DEIS, NMFS concluded the effects of seismic surveys on bowheads would be of medium intensity, and in the SEIS they changed the categorization to medium to high with no explanation. NMFS should revert to the original conclusion. In no way does the reaction of bowhead whales to past surveys meet NMFS' definition of high intensity.
- The agencies must correct or support the decision to elevate impacts to other species described in the SEIS beyond levels at which they were classified in the prior DEIS.
- NMFS' analyses are flawed and inconsistent with the longstanding record of oil and gas activities in the Arctic. With current mitigation measures in place, oil and gas leasing, exploration and development activities have had no known adverse impacts to marine mammal populations in the Arctic Ocean. As one example, the bowhead whale has been exposed to the full range of oil and gas activities in the Alaskan OCS since the 1960s. The best available scientific information indicates to a high degree of reliability that routine oil and gas activity has no more than a negligible impact on the western Arctic bowhead stock, amounting to nothing more than very minor changes in migration paths and vocalization rates. The stock has experienced robust growth for many decades while exposed to oil and gas activities, and the stock is healthy and resilient to any adverse environmental, subsistence, and anthropogenic effects. The SEIS inexplicably concludes the impact of oil and gas activities under all action alternatives is either moderate or moderate to major. This finding is directly contradictory to four decades of data and scientific opinion, including NMFS' own determinations.
- The environmental consequences analysis highlights the importance of bowhead whale calves to maintain the continued recovery and long-term viability of the Bering-Chukchi-Beaufort (BCB) seas population. However, there is no scientific support whatsoever for any assumption or speculation that seismic operations have such impacts or could result in the loss or injury of a whale. To the contrary, all of the scientific evidence shows that seismic and other anthropogenic activities, including commercial whaling, have not been shown to cause the separation of cow/calf pairs or abandonment of a calf. There is no supporting evidence presented by NMFS in the SEIS to justify the determination of such significant impacts to bowhead whales from the activities outlined in Alternatives 4 and 6.
- The growth of the BCB bowhead whale population, concurrent with decades of Arctic OCS exploration and development activity, as well as numerous recent studies indicate that whale reactions to industry activities are complex, depend on many factors, and should not be oversimplified or exaggerated as was done in NMFS' impact analysis. The commenter noted that extensive scientific evidence suggests that the reactions of bowhead whales to OCS industry activities generally result in only minor, short-term impacts to individual animals with no biologically significant effects at a population level. The SEIS inclusion of more recent studies that suggest greater tolerance of industry sound by bowhead whales, particularly feeding whales, appear to have been overlooked during the actual impact determination.

- NMFS concludes that this level of activity would result in moderate impacts on bowhead whales; beluga whales; subsistence hunting; air quality; acoustics; visual resources; and land and water ownership, use, and management. The EIS should explain the scientific justification for that conclusion given uncertainties regarding the long-term, population-level effects that may result from the proposed level of seismic and drilling activities on marine mammals. It also is not clear that the proposed number of surveys, individually or in combination, would have no more than a negligible impact on marine mammals, the threshold for issuing an incidental take authorization under the MMPA.
- Geological and geophysical activities do not require an EIS, given they are limited by scope, duration, and impact. These activities do not have the potential to "significantly" affect the environment or subsistence resources, and there has not been a need for an EIS to address these activities. Should the agencies proceed to issue a FEIS, they must make clear in the document that the contemplated activities would not have a "significant impact" on the environment.
- The SEIS erroneously fails to conclude that the impacts of oil and gas exploration activities have "negligible" impacts on ice seals, polar bears and Pacific walrus. The conclusions drawn in the SEIS are contrary to the record. In the case of polar bears and Pacific walrus, the USFWS has consistently concluded, in the context of issuing MMPA ITA regulations, that Arctic oil and gas activities have had no more than a "negligible" impact. These conclusions have been challenged numerous times in court and upheld in all cases.

Commenters questioned how risk was evaluated in the impact analysis, specifically:

- Conflicting risk assessments yield unreasonable worst case judgments that contravene weight of evidence.
- Characterizations of risk are highly subjective.
- Risk assessment is not reproducible and conflicts with the absence of observable field effects. The approach would yield as many different assessments as there are risk assessors and thus could not possibly yield reproducible results. Such inconsistency in risk assessment does not provide adequate guidance for future agency decisions. The analysis remains deficient and inadequate to guide future agency decisions. The SEIS analysis discusses "potential effects" in a speculative manner, failing to consider the probabilities of both occurrence and scope of effect that are necessary for a valid, balanced assessment of contradictory scientific studies. The assessment in the EIS remains largely a theoretical exercise that is inconsistent with long-term observable indicators of ecosystem health-- principally that the bowhead whale population has grown during time of both industry activity and subsistence hunting. The discontinuity between the SEIS impact assessment that asserts the effect of potential short-term avoidance in the context of bowhead whale population health warrants highly protective mitigations and the International Whaling Commission assessment that intentional mortality of a small number of bowheads has no meaningful population level effect requires explanation.

Commenters noted the following issues in the EIS regarding definitions:

- The impact criteria provide no objective or reproducible scientific basis for agency personnel to make decisions.
- Terms such as “perceptible”, “noticeably alter”, and “observable change in resource condition” should be defined. NEPA does not define the term “potential effect” nor does the Endangered Species Act (ESA), the MMPA or the OCSLA. However, the SEIS analysis is replete with references to potential effects, most of which are questionable due the lack of scientific certainty or support. The possibilities of effects, often based on model predictions, are, in fact, hypothetical but often stated simply as effects thereby inferring a conclusion that the stated level of impact

would occur. The SEIS also gives almost no attention to the use of probability of impacts or field validation to temper findings of potential effects that are based largely on conjecture. The SEIS also provides little attention to the potential severity of effects. The SEIS confuses future agency decision-making, as it presents an extensive list of potential effects as if they are certainties -- and then demands they be mitigated. This would make it difficult for the EIS to inform, guide or instruct agency managers to differentiate between activities that are expected to have no effect, minor effect or major effect, and whether to a few animals or to an entire population. The application of mitigation measures should differentiate among activities according to levels of impact and risk, but the EIS analyses fail to do so.

- Problems with definitions and implementing the impact categories (negligible, minor, moderate, etc.) remain in the EIS. To avoid unnecessary litigation, the EIS must reconcile the terminology used in this analysis with the terminology used to issue IHAs, which is the action this EIS purports to analyze.

Several commenters pointed out the differences in impact criteria between NEPA and the MMPA, specifically:

- The impact criteria fail to inform agencies how impacts relate to their substantive regulatory responsibilities. In particular, the EIS fails to articulate thresholds for “significance” under NEPA or “negligible” under the MMPA. The EIS characterizes impacts as negligible, minor, moderate or major and this does not correspond to the MMPA standards. Although these criteria may be considered sufficient for purposes of the analyses required under NEPA, they do not necessarily meet the standards applicable under the MMPA for issuing incidental take authorizations that only small numbers of animals are taken, that such takes have no more than a negligible impact on the affected marine mammal species and stocks, and that the activities do not have an unmitigable adverse impact on the availability of marine mammals for subsistence uses. The EIS should be revised to include a fuller analysis of each alternative and discuss whether it meets the requirements of the MMPA. NMFS should take steps to ensure that this information is available before an authorization is issued and should acknowledge that supplemental environmental analyses under NEPA may be necessary.
- The impact analysis has flaws with regard to the analyses for the issuance of ITAs. For example, other than the no action alternative, all of the alternatives analyzed indicate a "minor" impact on marine mammals, which is defined by NMFS as something greater than "negligible." However, this is inconsistent with the longstanding factual record that shows oil and gas activities In the Arctic have had no more than a negligible impact on marine mammals. By purporting to have at least a "minor" impact on marine mammals, the EIS is in conflict with the "negligible impact" standard for ITAs.
- NMFS’ impact criteria provide a rough estimation of whether more or less than 30 percent of a marine mammal population may suffer behavioral harassment, but the EIS does not analyze whether this level of take meets the small numbers and negligible impact requirements of the MMPA.
- NMFS should revise the definitions for the overall summary impact levels of negligible, minor, moderate, or major or describe how they fit in with the relevant MMPA criteria. NMFS’ document fails to disclose what level of impact would be permissible under the MMPA. The new impact criteria do not illuminate whether activities presented in various alternatives meet the statutory standards of the MMPA or which activities might have potentially significant impacts under NEPA.

Response to Comments:

NMFS describes its methods for determining levels of impact in Section 4.1.3 of the FEIS. There, NMFS identifies separate levels of effect and corresponding definitions for Intensity/Magnitude (separate definitions for impacts that are low, medium and high), Duration (separate definitions for impacts that are temporary, interim, and long-term), Extent (separate definitions for impacts that are local, regional, and state-wide) and Context (separate definitions for resources that are common, important, and unique). These levels of effect in turn define the "Summary Impact Levels"—Negligible, Minor, Moderate, and Major—which further help to understand potential impacts. NMFS defines these terms using quantitative standards where practicable and qualitative standards where appropriate. NMFS considers use of the definitions as the best available approach to facilitate objective analysis and to allow for comparison of impacts across resources. Where NMFS uses terms that are not specifically defined in Section 4.1.3 of the FEIS, the ordinary meaning of the term is intended. Based on public comments and reconsideration of the evidence in the context of some resources, we changed the final impact levels (i.e., negligible, minor, moderate, or major) for some of the resources analyzed in the FEIS.

Regarding the comments about tying the impacts of the alternatives to the substantive regulatory findings under Section 101(a)(5) of the MMPA, we evaluated the potential impacts of the proposed action on the human environment, as required by NEPA. However, impacts of a specific proposal and whether or not it meets the required findings under Section 101(a)(5) of the MMPA will be analyzed upon receipt of a specific proposal, and in the context of a specific single proposal, whereas the EIS analyzes the potential effects of a suite of proposals addressed under a given alternative. This programmatic EIS will aid in that analysis; however, it is not a decision document. Additionally, the terms "negligible" under NEPA and "negligible" under the MMPA have very distinct and separate meanings and are not inextricably linked to each other (the first meaning the ordinary use, the latter being tied to the lack of adverse effects on the population). Given the difference in the definitions under NEPA and MMPA and the difference in the manner in which the negligible standard is applied (in the analysis of multiple projects versus the analysis of a single project under MMPA), a finding of something more than "negligible" under NEPA for the entire suite of activities addressed under an alternative does not necessarily mean that a single action will not be "negligible" as defined under the MMPA. Alternately, one should not assume that all future activities evaluated under the alternatives in this EIS and proposed under the MMPA would be found negligible. Impacts of activities (such as the higher levels contemplated under Alternatives 3 and 4) will be evaluated regularly and incorporated into the baseline for MMPA determinations.

Commenters had a wide range of comments regarding the assessment of impacts of the different Alternatives. Some commenters suggested that the EIS completely overstates the expected effects and that there have been few to no observed impacts on marine mammals from industry activities, while others suggest that we have not analyzed the aggregate effects of the Alternatives, which results in gross underestimation of the likely effects. The EIS presents extensive science indicating the effects of seismic airguns and other industry oil and gas exploration activities on marine mammals (including the specific species affected in the Arctic), including different forms of behavioral responses (avoidance, feeding interruption, vocalization modification), as well as masking of important auditory cues. The FEIS also presents a well-supported conceptual framework illustrating how disturbance effects can translate to effects on vital rates of individuals in certain circumstances (e.g., different contexts or scales), which can then result in population level consequences if enough individuals are impacted in ways that impact reproduction or survivorship. Alternative 2 in the FEIS analyzes a level of industry activity that is similar to a level conducted in the mid-2000s to early 2010s, the types of collaboration and mitigation that have been implemented, and the fact that the bowhead population has been increasing and subsistence hunts have been broadly successful with systematic industry coordination in place. However, in Alternatives 3 and 4, the EIS contemplates levels of concurrent seismic and drilling operations that exceed those that have been conducted in the recent past. In the EIS, we employ several quantitative methods to help understand the aggregate effects of these potential Alternatives (calculating takes of multiple activities,

calculating the total area ensonified above certain levels, a rudimentary modeling method to assess the chronic acoustic effects, though not PBR as that metric is specific to mortality, which is not anticipated here) and when our impact criteria are considered, the effects on some marine mammals may be moderate, or even potentially major (bowheads).

BOEM applies an appropriate level of NEPA analysis and documentation to each specific oil and gas activity it permits or authorizes. An Environmental Assessment (EA) is intended to provide evidence and analysis for determining whether to prepare an EIS or a finding of no significant impact (40 CFR 1508.9). The analysis in this programmatic EIS document will be used to inform subsequent, project-specific NEPA analyses by BOEM.

Additional responses to comments that concern the strengths and weaknesses of various scientific approaches are provided in Issue Category 7, Biological Resources.

Issue 2J - Significance Thresholds

Summary of Comments:

Comments called for enhanced discussion of significance thresholds for potential adverse effects to marine mammals, and that NMFS must clearly define significance thresholds and identify which alternatives may result in potentially significant impacts. Additional data are necessary for making strong conclusions about the potential impacts of any of the alternatives.

NMFS does not define how they determine significant thresholds of impacts for each alternative.

Response to Comments:

The EIS does not utilize significance thresholds in addition to the levels of effect already provided. The current assessment terms (i.e., negligible, minor, moderate, and major), which indicate comparative levels/significance of effects, are sufficient to inform NMFS resource management decisions, particularly in terms of the MMPA, which contains its own standards unrelated to “significance” under NEPA.

Issue 2K - Selecting Alternatives and Mitigation Measures

Summary of Comments:

One comment asked NMFS to identify which mitigation measures would be used, arguing that deferring the selection of mitigation measures until a later date, when the public may not be involved, violates NEPA.

One commenter asserted that the proposed actions being regulatory decisions (rather than actions of lessees and operators) is a new interpretation for the NEPA process and the selection of a preferred alternative, and questions the value of finalizing this EIS without the initial action of a project application, cautioning that it may encourage predetermination of specific industry activities by federal agencies based on an allowable scope of actions, not by the project proponent's preferred action.

Response to Comments:

The EIS analysis accounts for those mitigation measures already established through applicable law, regulation, and policy. The EIS also identifies potential mitigation measures and analyzes their effectiveness in reducing environmental impacts, as well as their practicability for implementation. The need for these mitigation measures only arises in the context of specific proposed actions. If in the future a project proponent requests an ITA from NMFS, and NMFS’ project-specific analysis indicates a potential for adverse effects, then NMFS may reference back to this EIS for analysis of which mitigation measures would be appropriate. This approach affords the public multiple opportunities for involvement, including the scoping period and comment period for this EIS, as well as additional MMPA processes specific to decisions on future projects. Section 2.4.12 of this FEIS lists the mitigation measures

considered but not carried forward, and sections 4.5.2.4.17 and 4.5.3.2.6 of this FEIS contain explanations of mitigation measures considered and analyzed in the DEIS and SEIS that have been removed from consideration in future MMPA ITAs based on the analysis contained herein.

The proposed action as defined in this EIS is not a new interpretation for NEPA. NEPA requires federal agencies to assess the environmental consequences of their actions. NMFS determined that a robust EIS process would best facilitate informed and forward-looking decision-making. The EIS comprehensively assesses activities that may occur in a given season in advance of receiving applications. The analysis in this EIS would make future NMFS reviews of ITA applications more efficient and more effective, which is not a new interpretation of NEPA.

Issue 2L – Incomplete or Unavailable Information

Summary of Comments:

One commenter noted that the EIS does not consistently apply requirements of 40 CFR 1502.22 and requested more consideration of NMFS' and BOEM's previous conclusions which stated an inability to adequately analyze potential effects and make informed decisions as to potential effects.

Commenters noted that the EIS identifies a number of data gaps concerning marine mammals, fish, and invertebrates but insists that there is an adequate basis for making an assessment of impacts. The degree of uncertainty regarding impacts to marine mammals greatly handicaps the agencies' efforts to fully evaluate the impacts of the permitted activities, and NMFS' ability to determine whether the activity is in compliance with the terms of the MMPA. NMFS was encouraged to acknowledge these data-gaps in the EIS as required by NEPA and to work to gather the missing information. It was noted that this problem becomes even more difficult in the light of the dramatic changes in the Arctic due to a shifting climate. Several comments make direct or implied statements that missing information may be necessary to decide among alternatives (per 40 CFR 1502.22):

- As noted throughout comments, the extent of missing information in the Arctic for bowhead whales, includes:
    - The long-term effects of disturbance on bowhead whales are unknown.
    - The potential for increased stress is unknown, and it is unknown whether impulsive sounds affect the reproductive rate or distribution and habitat use over a period of days or years. There are some data indicting specific habitat use in the Beaufort Sea, information is especially lacking to determine where bowhead aggregations occur in the Chukchi Sea.
    - What is known about the sensitivity of bowhead whales to sound and disturbance indicates that the zones of influence for a single year included as many as twenty-one surveys, four drillships, and dozens of support vessels "including ice management vessels" would be considerable and almost certainly include important habitat areas. The assumption that the resulting effects over five years would be no more than moderate is unsupported.
- Throughout the EIS, there are additional acknowledgements of missing information, but without any specific findings as to the importance to the agencies' decision making, as required by Section 1502.22, including:
    - Foraging movements of pack-ice breeding seals are not known.
    - There are limited data as to the effects of masking. The greatest limiting factor in estimating impacts of masking is a lack of understanding of the spatial and temporal scales over which marine mammals actually communicate.

- It is not known whether impulsive noises affect marine mammal reproductive rate or distribution.
- It is not currently possible to predict which behavioral responses to anthropogenic noise might result in significant population consequences for marine mammals, such as bowhead whales, in the future.
- The potential long-term effects on beluga whales from repeated disturbance are unknown. Moreover, the current population trend of the Beaufort Sea stock of beluga whales is unknown.
- The degree to which ramp-up protects marine mammals from exposure to intense noises is unknown.
- Chemical response techniques to address an oil spill, such as dispersants could result in additional degradation of water quality, which may or may not offset the benefits of dispersant use.
- There is no way to tell what may or may not affect marine mammals in Russian, U.S., or in Canadian waters.

- There is too little information known about the existing biological conditions in the Arctic, especially in light of changes wrought by climate change, to be able to reasonably understand, evaluate and address the cumulative, adverse impacts of oil and gas activities on those Arctic ice environments including:
  - Scientific literature emphasizes the need to ensure that the resiliency of ecosystems is maintained in light of the changing environmental conditions associated with climate change. Uncertainties exist on topics for which more science focus is required, including physical parameters, such as storm frequency and intensity, and circulation patterns, and species response to environmental changes.
  - There is little information on the potential for additional stresses brought by oil and gas activity and increased shipping and tourism and how these potential stressors may magnify the impacts associated with changing climate and shrinking sea ice habitats. There are more studies that need to be done on invasive species, black carbon and aggregate noise.
  - It was noted that a majority of the studies available have been conducted during the summer and there is limited data about the wintertime when there is seven to eight months of ice on the oceans.
- Previous BOEM documents, as well as NMFS comments, have acknowledged data gaps concerning marine fish. The agencies' prior conclusions are equally applicable in the context of this EIS. The fish and Essential Fish Habitat (EFH) impacts analysis is substantively incomplete and unsupported by rigorous analysis. There are many data gaps, including gaps concerning distribution, population abundance, and life history statistics for the various Arctic fish species.
- The many additional studies already underway contradict the statement in the EIS that such studies are cost prohibitive these include:
  - A study undertaken by BP, the North Slope Borough, and the University of California would help better understand masking and the effects of masking on marine mammals. It would also address ways to overcome the inherent uncertainty of where and when animals may be exposed to anthropogenic noise by developing a model for migrating bowhead whales.

  - The National Oceanic and Atmospheric (NOAA) has convened working groups on Underwater Sound mapping and Cetacean Mapping in the Arctic.
  - BOEM has an Environmental Studies Program that includes a number of ongoing and proposed studies in the Beaufort and Chukchi seas that are intended to address a wide-variety of issues relevant to the EIS.
  - NMFS' habitat mapping workshop is scheduled to release information and the Chukchi Sea Acoustics, Oceanography, and Zooplankton study is underway.

- Whether enough is known about beluga whales and their habitat to accurately predict impacts; issues relevant to effects on walrus, as identified in the U.S. Geological Survey (USGS) report.
- Limiting the level of activities also limits the amount of data that can be collected.
- Lack of information concerning overlap between proposed activities and marine mammal presence precludes a full assessment of effects. The agencies need to use caution when evaluating cumulative effects when data do not exist. Those unknowns, or the limited statistical power of many studies to detect effects/impacts should be acknowledged and stated clearly in the EIS, so that the public and decision makers have an accurate understanding of the impacts and limitation in the available knowledge.
- Oil and gas activities in the Arctic should not be expanded until there is adequate information available both from western science and local and traditional knowledge to adequately assess potential impacts and make informed decisions.
- Ambient noise budgets are not very well known for the Arctic.
- Invasive species studies are unavailable for the Arctic.

Response to Comments:

Rarely does a scientific analysis comprehend *everything* about its subject, whether ecosystem, species, sociocultural system, etc. This is especially true for studies that require years of research in a dynamically changing environment like the Arctic. Regulations implementing NEPA understand and address this issue by setting out a methodical process to be followed wherever an analysis is fettered by incomplete information. This process is provided at 40 CFR 1502.22 and briefly described in Section 4.1.2 of the EIS -Incomplete and Unavailable Information. Federal agencies are required to evaluate items of incomplete information through a multistep process that requires the disclosure and discussion of incomplete information as well as, in some cases, the evaluation of incomplete information against one or more prescribed standards. NMFS' EIS diligently follows the protocol set out in 40 CFR 1502.22 and makes clear why enough existing information is sufficient to support a reasoned choice between EIS alternatives.

It is acknowledged that several past reports and analyses pertaining to the Beaufort and Chukchi Seas reference a variety of data gaps concerning marine mammals, fish, and other resources. These statements can be instructive, but are in no way dispositive; in other words, making such a statement does not mean that there is not enough information known to choose between the six alternatives carried forward for analysis in this particular EIS. First, the Beaufort and Chukchi Seas have continued to be, and are, the subject of many highly productive scientific studies, which have, by design, specifically addressed many of the "data gaps" asserted in previous studies and analyses. Scientific understanding of the Beaufort and Chukchi seas has increased tremendously over recent years, due to studies conducted or funded by NOAA, BOEM, other federal agencies, industry, academia and other organizations. Second, as acknowledged in 40 CFR 1502.22, the amount and type of information required are highly dependent upon the particular decision to be made. NMFS has determined, and made clear, that the best available scientific information is sufficient to make a reasoned choice between the EIS alternatives. Please see Section 4.1.2 of the EIS for further discussion of this important issue.

Issue 2M - Cooperating Agencies

Summary of Comments:

Commenters stated problems with the participation of cooperating agencies, as follows:

- The State of Alaska should be consulted and asked to participate as a cooperating agency. The State of Alaska remarked that it had not sufficiently been consulted or invited to participate in this NEPA process. Absent solicited input from the State of Alaska, NMFS has failed to suitably assess potential exploration activity levels in the state-owned waters where there are currently 166 active leases. Without information and analysis on the potential activity in state-owned waters it is unclear how the agency can determine whether the range of alternatives analyzed in the EIS are adequate, reasonable, and whether the analysis complies with OSCLA requirements to balance protecting human, marine, and coastal environments with the need to expeditiously explore and develop the OCS (43 U.S.C. Â§ 1332(3)).
- BOEM should have more than a cooperating agency role since the proposed action includes BOEM issuance of G&G permits. This NEPA process is duplicative of other recent federal agency efforts by BOEM. It is not clear in the EIS how much input BOEM had in developing the document.
- Several comments requested an explanation of the role of the USFWS and noted potential duplicative analyses given that federally-listed species were evaluated in the EIS, specifically:
    - Explain why USFWS is not a cooperating or co-lead agency. They have MMPA trust species that are evaluated, and significant mitigation measures in the EIS are based on these trust species.
    - The USFWS is obligated to take part in an EIS assessment pertaining to activities that may pose a risk to these species.
    - The reason USFWS is not a part of this purported interagency effort is not explained in the EIS. At a minimum, the EIS should have no effect on the process used to manage impacts to polar bears and walruses through the issuance of ITAs and LOAs.
    - Under USFWS current draft ITR regulations for polar bears and Pacific walrus in the Chukchi Sea, NMFS analyzed up to three simultaneous exploratory drilling operations. NMFS' final biological opinion purports that BOEM anticipates no more than two simultaneous drilling units in the Chukchi, while the SEIS analyzes up to four.

Response to Comments:

Although the State of Alaska is not a cooperating agency on the EIS, copies of the EIS were provided to the following State of Alaska agencies for review and comment:

- Alaska Oil and Gas Conservation Commission
- Department of Community and Regional Affairs
- Department of Fish and Game
    - Region II, H&R
    - Subsistence Division
- Department of Transportation and Public Facilities
    - State Pipeline Coordinator
    - Joint Pipeline Office

- Office of the Governor
- Department of Environmental Conservation
    - Anchorage District Office
    - Northern Alaska District Office
- Department of Natural Resources
    - Citizen's Advisory Commission on Federal Areas
    - Division of Geological and Geophysical Surveys
    - Division of Oil and Gas
    - Division of Water, Fairbanks
    - Office of Project Management and Permitting

Of the above agencies, only the Alaska Department of Natural Resources submitted formal comments. NMFS worked cooperatively with the Alaska Department of Natural Resources and Alaska Department of Environmental Conservation on completion of the FEIS, and they were provided with preliminary drafts of the FEIS for review prior to publication. Based on activity levels in the past five years, NMFS determined that a reasonable level of activity was analyzed in this EIS. As stated previously, this EIS does not place a cap on oil and gas exploration in state and federal waters of Alaska.

The roles of cooperating agencies under NEPA are defined by the agencies preparing the NEPA document and are specific to the proposal being evaluated. For this EIS, BOEM's role as a cooperating agency, rather than the lead agency or co-lead agency, in no way diminished BOEM's input and participation in the content and preparation of the EIS.

BOEM will use this programmatic NEPA analysis to support future project-specific NEPA analyses. Coverage under the Endangered Species Act (ESA) for protected species is a separate but interrelated process. In addition to analysis under NEPA, for each new project, BOEM considers whether any threatened or endangered species may be impacted. If so, BOEM consults either informally or formally, as appropriate, with the applicable Service (USFWS or NMFS). Each agency has issued programmatic Biological Opinions to cover certain species that may be impacted by certain suites of activities authorized by BOEM. Accordingly, a species and project may be covered by a current programmatic biological opinion issued by the USFWS (May 8, 2012) or NMFS (June 4, 2015). If the project is not covered under a programmatic biological opinion, BOEM will engage in a new or additional consultation with the appropriate agency.

Although the USFWS was not an official cooperating agency during the preparation of this EIS, they reviewed and provided comments on preliminary drafts of the DSEIS and FEIS and have participated in interagency meetings during this process. Agencies are required to analyze impacts to all potentially impacted resources in the NEPA analysis regardless of jurisdiction. The mitigation measures analyzed in Sections 4.5.2.4.16, 4.5.2.4.17, 4.5.3.2.3, and 4.5.3.2.5 would only be included in authorizations for species under NMFS' jurisdiction. However, there is the potential for these measures to reduce impacts to walruses and polar bears. It would be up to the discretion of the USFWS to include such measures in authorizations issued by USFWS. NMFS will not include mitigation measures in ITAs for species not under our jurisdiction. Sections 4.5.2.4.14 and 4.5.2.4.15 list measures that have typically been required by USFWS for walruses and polar bears, respectively, in past authorizations. Those measures are included in the FEIS for analysis purposes only and are not included in the suite of standard and additional mitigation measures that make up the Alternatives.

Issue 2N - New Approach

Summary of Comments

Several comments suggest that the structural issues in the DEIS are so significant that NMFS should abandon the document and start over with a new approach. Specific flaws cited include:

- There is an obviously gross avoidance of the question of oil spills and an inherently conflicted set of conclusions that should preclude all permitting activities by the U.S. Coast Guard, Alaska Department of Environmental Conservation, BOEM, and BSEE because of failure to provide the minimum protections of law, much less the higher protections of law required by the MMPA and ESA.

Commenters cited the following reasons to not finalize the EIS:

- There are no identifiable legal, regulatory, scientific, policy or procedural benefits to completing the EIS. Even if the EIS were appropriately conceived, which it is not, NMFS would have to re-write it to correct the many deficiencies in the analysis. Elements of the material are inconsistent with available science. If not fixed, the flaws would complicate or prevent the issuance of defensible IHAs in the future.

Response to Comments:

Oil spills are accidental or unlawful events that are evaluated according to three different size categories: small; large; and very large. A small oil spill is defined as less than 1,000 barrels. Small fuel spills could occur during G&G or exploration drilling activities. Information regarding small fuel spills from G&G or exploration drilling activities is discussed in Section 4.2.7 of this EIS. A large or very large oil spill is not considered part of the proposed action for any alternative because the occurrence of such a spill is not a highly unlikely event. However, if a very large spill were to occur, it could result in adverse impacts on the resources discussed in the EIS. For this reason, the potential impacts of a very large oil spill are discussed and analyzed in Section 4.10 of this EIS.

NMFS views the EIS as a valuable tool in the decision-making process and disagrees that it suffers from significant structural issues. NMFS intends to complete the EIS process. Additional justification regarding the reasoning for completing this EIS can be found in the response to issue 2A earlier in this document.

ISSUE #3. COMPLIANCE WITH OTHER LAWS AND REGULATIONS

Many comments expressed opinions as to whether NMFS' EIS process complies with other applicable laws, regulations, and policies.

Issue 3A - General

Summary of Comments:

Commenters requested more complete descriptions of applicable statutes and regulations, how actions threaten to violate applicable laws (in accordance with CEQ regulations), how alternatives would meet the requirements of the law, and more transparency regarding how agencies are authorized to act.

- Commenters stated that the EIS fails to addresses several important requirements of the OCSLA, MMPA, ESA, Information Quality Act and Paperwork Reduction Act in the analyses. Comments received from the USFWS indicated a need for NMFS to list the Migratory Bird Treaty Act (MBTA) in Section1.8 of the EIS.
- One commenter went on to say that the failure to identify and properly address the requirements of the statutes, gives undue weight to considerations involving incidental taking of marine mammals under the MMPA and virtually ignores the requirements of OCSLA.
- Suggestions were made that the EIS be revised to align with the requirements of NEPA, the MMPA and the OCSLA. As currently drafted, there are areas of the EIS that are out of line with the requirements of NEPA and OCSLA. For example, it is unclear whether NEPA and CEQ scoping and consultation requirements were fulfilled prior to the preparation of the Supplemental DEIS. A deficient scoping process appears to have contributed to NMFS' failure to select a reasonable range of alternatives to include in the EIS. This failure, including the absence of an alternative that addresses exploration activity levels likely to proceed following a major discovery in the region, i.e. an exploration success case, increases the risk that the FEIS would create a *de facto* cap on exploration in the Alaska OCS. Once activity levels in the region exceed activity levels analyzed in the FEIS, operators would be unable to obtain the authorizations necessary to conduct exploration activities until NMFS and BOEM complete additional NEPA analysis. The delays attendant to the preparation of this supplemental NEPA analysis would prejudice later applicants for authorizations in an anticompetitive manner that violates the OCSLA policies on free market competition and expeditious development.
- Another commenter wanted the EIS to clarify that very large oil spills are illegal under the Clean Water Act and MMPA.
- One commenter expressed concern that a FEIS that does not reflect a real proposal or set of proposals by actual applicants, any prospective environmental impacts to specific resources and locations, any real need for mitigation measures to address a definable impact problem or stakeholder concern, and any real agency action or decision, whether programmatic or project-specific would not simplify or expedite future project-specific regulatory processes. Instead commenters noted that proceeding to finalize the EIS would create significant problems for BOEM in carrying out the mandates of OCSLA and for NMFS in carrying out its responsibilities under the MMPA.

Response to Comments:

Chapter 1of the EIS sets forth the Purpose and Need for the EIS. Section 1.8 addresses Federal laws, regulations, Executive Orders, and other requirements applicable to federal permitting of oil and gas activities in the Arctic Ocean. These statutes, regulations and other requirements are germane to the oil and gas activities addressed in the EIS and include NEPA, the Endangered Species Act, the MMPA, the

OCSLA, the Magnuson-Stevens Fishery Conservation and Management Act, the Coastal Zone Management Act, the Clean Air Act and the Clean Water Act. A section regarding the Migratory Bird Treaty Act has been added to the FEIS as section 1.8.16. Other statutes that apply, but are not directly germane to federal permitting of oil and gas activities are not included in the Section 1.8. For example, the Paperwork Reduction Act and the Information Quality Act (IQA) are not listed in Section 1.8.

There is no requirement under NEPA or the IQA to include a discussion of IQA compliance in a draft or final EIS. Neither the CEQ NEPA implementing regulations (40 CFR Parts 1500-1508) nor NOAA Administrative Order (NAO) 216-6 specify which statutes, regulations, Executive Orders or other requirements should be addressed in the Purpose and Need section of an EIS. Although there is no requirement to address IQA compliance in an EIS, the IQA does apply to the EIS. The IQA applies broadly to information disseminated by federal agencies. Thus, NMFS must conduct a pre-dissemination review of a draft and final EIS before release to ensure that the EIS complies with NOAA's Information Quality Guidelines, which was done for this document.

Regarding third party information, the NOAA Information Quality Guidelines recognize that use of third party information is a common practice in NOAA, and the Guidelines are not intended to prevent use of reliable outside information. The Guidelines state:

> Although third-party sources may not be directly subject to [the IQA], information from such sources, when used by NOAA to develop information products or to form the basis of a decision or policy, must be of known quality and consistent with NOAA's information quality guidelines. When such information is used, any limitations, assumptions, collection methods, or uncertainties concerning it will be taken into account and disclosed. (NOAA Information Quality Guidelines, Part II)

Thus, third party information is treated differently than NOAA information under the Information Quality Guidelines. NOAA must ensure that third party information is of known quality and consistent with the Information Quality Guidelines, but NOAA is not required to conduct the same level of pre-dissemination review that is required of information developed and disseminated by NOAA.

This EIS aligns with the requirements of NEPA, the MMPA and OCSLA. NMFS completed the SEIS in accordance with CEQ regulations. Scoping was conducted in 2010 prior to release of the DEIS in December 2011. Comments received during the scoping period were considered and used to shape the alternatives and analysis in the DEIS. In preparing the SEIS, NMFS used the comments received on the DEIS (both written submissions and public meeting transcripts) to make appropriate changes to the document. CEQ regulations do not require an additional scoping period when an agency is preparing a supplemental NEPA document. Specifically, 40 CFR 1502.9(c)(4) states: "Agencies… Shall prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement unless alternative procedures are approved by the Council." Additionally, completion of this EIS does not create "significant problems" for BOEM and NMFS in carrying out their responsibilities under OCSLA and the MMPA, respectively. Rather the analysis contained in this EIS will aid the agencies during their decision-making processes.

NMFS has determined that the summaries of applicable statutes and regulations (Section 1.8 of the EIS) have an appropriate level of detail for the EIS. Additionally, the EIS goes into more extensive detail about the requirements of OCSLA in Section 1.1.2 (BOEM and BSEE Statutory and Regulatory Mandates Relevant to the Scope of Analysis). Distinctions between the Purpose and Need for NMFS and BOEM were clearly outlined in Section 1.3 (Purpose and Need for Action). The summary on the CWA (see section 1.8.10) has been expanded to state that the CWA prohibits the discharge of oil or hazardous substances into the navigable waters of the United States.

Issue 3B - Marine Mammal Protection Act

Summary of Comments:

Many of the comments concerning regulatory compliance focused on the requirements of the MMPA. These comments asserted that NMFS should:

- Reconsider use of the term “taking” in reference to the impacts to marine mammals since these animals are going to be killed.
- Clarify whether or not the killing of marine mammals is an acceptable activity within the MMPA.
- Ensure that activities are in fact negligible and cause the least practical level of effect. It is essential that decision-makers reviewing the FEIS be able to determine whether the proposed levels of industrial activity would comply with, or through mitigation can be brought into compliance with the substantive standards of the MMPA.
- Provide a specific finding that the proposed activities “would not” have an adverse impact to subsistence practices. NMFS needs to include, for each alternative and each mitigation measure, an explanation of the measures that would ensure the "least practicable impact" to marine mammals, as required by the MMPA. Without this information, NMFS cannot make an informed decision as to which of the action alternatives are appropriate given the unequivocal requirements of the MMPA. NMFS must include in the FEIS conclusions as to whether each of the alternatives would adhere to these mandatory requirements of the MMPA, including whether each alternative would comply with the no unmitigable adverse impact standard for each individual hunt for each individual community.
- Ensure oil and gas activities do not reduce the availability of any affected population or species to a level insufficient to meet subsistence needs.
- Reassess the legal uncertainty and risks associated with issuing marine mammal take authorizations under the MMPA based upon a scope as broad as the Arctic Ocean.
- Create a permanent system of enforcement and reporting for marine mammal impacts to ensure compliance with terms of IHAs. This system should be developed in consultation with the North Slope Borough (NSB) and the Inupiat Community of the Arctic Slope (ICAS) and should be based on the CAA.
- Correct the disparity of enforcement by the federal government for oil companies and subsistence hunters, which are monitored at the hunting site the whole hunting season.
- Change the current system of managing harassment and take of species, since the current system is ineffective.
- The MMPA requires that when developing mitigation measures, like safety radii and other requirements based on acoustic criteria that they must be practicable.
- Provide status updates on IHAs, once authorized.
- Adopt an ecosystem based management approach consistent with the policy objectives of the MMPA and the policy objectives of the Executive Branch and President Obama's Administration.
- Not take action until a revised EIS is released that addresses the concerns of the local community and includes a fully developed analysis of compliance with MMPA standards.
- One commenter noted that they disagreed with NMFS' conclusion that the MMPA precludes the agency from imposing permanent closures to oil and gas activities in certain areas. The commenter argued that the MMPA requires NMFS to identify these areas if they are essential to

ensuring the protection of subsistence harvest and of bowhead whales and other marine mammal populations. In particular, it was noted that the community of Nuiqsut has asked federal agencies to create a deferral area of a10-mile radius around Cross Island to provide ongoing protections for that food-gathering location. The commenter noted that by foreclosing the consideration of permanent deferral areas and failing to assess how deferral areas might support compliance with the substantive MMPA standards, NMFS is excluding from analysis important considerations that are highly relevant to the ultimate decision as to how activity should be permitted in the Beaufort and Chukchi seas.

- NMFS should define the alternatives for MMPA ITAs by the frequency and intensity of a range of incidental take levels, not by specific activity levels.

Several commenters asserted that NMFS should not issue permits until it can prove that:

- Drilling would not negatively impact marine mammals and their breeding, feeding, and migration habitats.
- NMFS can protect marine mammals from the cumulative impacts of industrial noise in the Arctic.
- The agency has completed a full and adequate analysis of the potential effects of this activity and understands how to effectively mitigate them.
- The impacts of oil and gas exploration on Arctic wildlife are disclosed in the EIS.

Other comments asserted that NMFS is currently prohibited from issuing IHAs for certain activities:

- Given the clear potential for serious injury and mortality, few if any seismic operators can legally obtain an IHA.
- BOEM should consider applying to NMFS for a programmatic take authorization. NMFS should then revise its EIS based on the findings from that rulemaking process.

Commenters requested the following modifications regarding take:

- NMFS should also consider whether it would be preferable to use a statistical analysis to predict take from the activities rather than past data from prior exploration work. For example, in preparing a similar programmatic EIS to evaluate oil and gas activities in the Atlantic, BOEM calculated estimated take numbers using an Acoustic Integration Model (AIMÂ), a 4D, individual-based, Monte Carlo statistical model designed to predict exposure propagating through space and time.
- There is no clear definition of what constitutes a take, nor is there a consistent discussion of the criteria used to determine acoustic effects.
- NMFS must clearly define its threshold for take and quantify the number of marine mammals which would be taken.
- The SEIS continues to analyze take of species in a cursory manner by failing to adequately quantify takes and to meaningfully incorporate take numbers into its impact analysis.
- Putting aside the faults in the actual take numbers that NMFS lists in the SEIS, NMFS fails to integrate those take numbers into its effects analysis. NMFS makes only limited references to estimated takes in its analysis of effects. NMFS must more meaningfully integrate potential take numbers into its analysis by using takes to determine whether activity levels would take more than small numbers or have more than a negligible impact, as well as analyze whether activity levels would have potentially significant effects.

- It is important that NMFS' EIS properly quantify potential take of marine mammals from oil exploration and assess specific take numbers within an impact and alternatives analysis. The EIS does not provide an adequate basis for the issuance of ITAs. Absent important information on the number and nature of potential takes that may occur incidental to the proposed activities, NMFS cannot make an informed, science-based judgment as to whether those takes would involve a small number of animals and whether their total impact would be negligible as required under the Marine Mammal Protection Act.
- Take of marine mammals would increase significantly if the EIS and the current species take analysis are adopted.
- One of the problems with trying to look at the cumulative impacts is the way take estimates are handled. NMFS leaves this to the applicants who claim they cannot do any better than they are doing now because they don't know how to estimate density, and the result is that techniques are used that come out with density estimates and take estimates that are low.
- NMFS must consider the biological significance of the impacts (i.e., whether the take would result in adverse impacts on the fitness or health of the individuals taken or cumulatively would have population-level effects), as well as required measures to mitigate such taking.
- Exposure to sound does not equal an incidental take. The MMPA and implementing regulations are premised upon injury, harassment and population level effects. The resource agencies are unable to present consistent and documented guidance that defines what constitutes an acoustic take, and the threshold for determining when behavioral takes rise to a population level effect (avoidance versus displacement) in a manner to reasonably evaluate an action. It is impossible for the EIS to fulfill its NEPA requirement to assess the environmental consequences of the alternative.
- One commenter noted that even if minor behavioral changes are presumed or shown, they may not necessarily rise to a level that meets the statutory take threshold. The EIS fails to adequately define NMFS' criteria for discerning the difference between sound exposures; response and incidental take (at either the individual or population levels). The analysis moves forward using an implicit, unstated assumption that exposure to sound is a de facto take under the MMPA, and thus establishes a proxy argument that exposure to sound equals a take.

Response to Comments:

The term "take" is defined in MMPA (16 U.S.C. § 1361 et seq.). "Take" means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." 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]." The term "take" is used correctly in the EIS. Proposed activities are not anticipated to kill and/or waste marine mammals. If the analysis of a specific proposal indicates the potential for death or serious injury of marine mammals and that potential cannot be negated through the inclusion of mitigation measures, then NMFS would not issue an IHA and would consider issuing regulations and associated Letters of Authorization, which do allow for "take" of marine mammals by serious injury or mortality. However, as the analyses in this EIS indicate, the likelihood of serious injury or mortality from these proposed exploration activities are unlikely.

Sections 101(a)(5)(A) and (D) of the MMPA (16 United States Code [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 proposed authorization is provided to the public for review. Authorization for incidental takings shall be granted if:

- NMFS finds that the taking would have a negligible impact on the species or stock(s);
- NMFS finds that the taking would not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant); and
- 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." Additionally, 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.

The purpose of the EIS is to evaluate the potential effects of expected types and levels of OCS exploration seismic surveys and drilling activities in the U.S. Arctic Ocean. The significance of the effects is evaluated in terms of context and intensity per CEQ's regulations at 40 CFR 1508.27. The analyses in this programmatic EIS and any proposal-specific NEPA documentation for an IHA application must support findings of negligible impact on the species or stock(s) and unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses for NMFS to issue an IHA.

This EIS allows NMFS and BOEM to comprehensively assess activities that may occur in a given season in advance of receiving applications. Moreover, the FEIS includes analysis of the feasibility and potential effectiveness of mitigation and monitoring measures that could be included in future authorizations. The EIS would facilitate NEPA evaluations of specific proposed activities. However, the determination of whether or not a specific action adheres to the required MMPA ITA findings is conducted at the individual project level. At that time, the public is again afforded an opportunity to comment on NMFS' preliminary analyses and determinations. The FEIS also contains a complete analysis of the practicability of all considered mitigation measures. Additionally, the public is also afforded the opportunity to comment on mitigation measures for each individual ITA once the notice of proposed IHA or proposed rule are published for public comment in the *Federal Register*. NMFS intends to use this EIS as the required NEPA documentation for the issuance of ITAs for Arctic oil and gas exploration activities. If proposed activities fall outside the scope of this EIS, NMFS may tier from this EIS to support future MMPA oil and gas authorization decisions. BOEM intends to conduct proposal-specific NEPA analyses that either tier from this EIS or incorporate this EIS by reference.

The NMFS Incidental Take Program website (http://www.nmfs.noaa.gov/pr/permits/incidental/index.htm) provides information on all in-process, active, expired, and withdrawn ITA applications. Once an ITA is issued, it is posted to the website. Additionally, all ITA holders are required to submit final reports on the activities and take levels, which are also posted on the NMFS Incidental Take Program website.

NMFS and BOEM have determined that because Sections 101(a)(5)(A) and (D) of the MMPA (16 United States Code [U.S.C.] § 1361 *et seq.*) specify incidental take authorizations may be issued to "U.S. citizens who engage in a specified activity," BOEM is not the appropriate party to apply to NMFS for rulemaking under MMPA.

BSEE is responsible for enforcing compliance with requirements for OCS activities. In addition, NFMS, BOEM, USFWS, and BSEE jointly monitor ongoing OCS activities for compliance with and effectiveness of required mitigation measures. The interagency team employs an adaptive management approach to mitigation of adverse effects from permitted and authorized OCS activities. An additional permanent system of enforcement and reporting is not necessary.

As noted previously, the MMPA allows for NMFS to issue or deny authorizations, condition the issuance of authorizations (if certain measures allow us to reach necessary findings), and prescribe mitigation, as appropriate based on our evaluation of each application submitted. Because there may be times or circumstances in which it would be possible for industry activities to occur without having an unmitigable adverse impact on subsistence uses, the permanent closure of any area is not an appropriate application of the MMPA.

NMFS determined that activity levels, not take, are the appropriate way to define alternatives for two reasons. Practically, activity levels are the currency in which companies plan and in which take authorizations can be bounded. Takes are calculated directly from activities (thereby allowing NMFS to authorize them); however, it would be very difficult to enforce or bound the allowances of an IHA based on observed take, whereas IHAs are designed to bound the activities associated with the expected impacts. Substantively, all takes are not created equal. Because of the way they are quantified, some would be expected to be lower level exposures barely qualifying as a take, while others might be expected to cause more concern. Considering activity levels, instead of takes alone, allows for the consideration of context within different activity types and levels and, therefore, a more comprehensive evaluation of the likely impacts.

Regarding take and the evaluation of impacts, as described in the EIS, NMFS does not assume that exposure to any sound equates to a take. Rather, generalized thresholds have been established that identify the received levels of sound above which marine mammals are expected to respond to sound at the level considered a take based on the best available science documenting how they have been observed responding in the past. These generalized thresholds can then be used in combination with animal density and information about the activity to predict the number of takes expected to occur. This number is just one piece of the analysis, as all takes are not the same. Moreover, an understanding of the ultimate consequences of any take(s) depends on further consideration of contextual issues, such as the total duration of exposure to the stressors in question and whether the takes are occurring in an area or time that is of specific importance to the individual (e.g., feeding or calving areas), which was considered in the EIS both in the impact criteria and the mitigation analysis.

An EIS is not inherently required to include take numbers, as there are other ways of estimating and evaluating the scope, magnitude, or extent of the effects of actions (e.g., one could refer to the percentage of the population likely taken, the percentage of the range of the population likely impacted, etc.). However, NMFS typically includes some reference to take numbers in NEPA documents associated with MMPA ITAs. In this case, rather than modeling all new speculated activity areas, NMFS chose to use past modeled activities to serve as a generalized indicator of the levels of take that could be expected with certain activity scenarios. Either method comes with the weakness of not knowing exactly where, when, or how specific activities will occur in the future, however, both methods also allow for a broad understanding of the differences between the total effects of the different activity levels. Modeling of the specific take numbers of any particular action is typically conducted via the MMPA analysis at the point in time when the exact location, timing, and nature of a particular operation can be identified in detail and allows for NMFS to make an informed decision regarding the specific MMPA findings for that activity (small numbers and negligible impact), which is not required in the NEPA document.

Issue 3C - International Treaties and Conventions

Summary of Comments:

One comment requested that the EIS be revised to ensure compliance with Article 18 of the Vienna Convention of the Law on Treaties and the Espoo Convention, which states that a country engaging in offshore oil and gas development must take all appropriate and effective measures to prevent, reduce and control significant adverse transboundary environmental impacts from proposed activities and must notify and provide information to a potentially affected country.

Response to Comments:

The Espoo (EIA) Convention sets out the obligations of parties to assess the environmental impact of certain activities at an early stage of planning. It also lays down the general obligation of states to notify and consult each other on all major projects under consideration that are likely to have a significant adverse environmental impact across boundaries.

In developing the EIS, NMFS complied with CEQ's published guidance on the applicability of NEPA to proposed federal actions that may have transboundary impacts. The CEQ concludes, "NEPA requires agencies to include analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States. Such effects are best identified during the scoping stage, and should be analyzed to the best of the agency's ability using reasonably available information. Such analysis should be included in the EA or EIS prepared for the proposed action." In complying with these independent NEPA requirements, NMFS complies with Article 18.

Issue 3D - Outer Continental Shelf Lands Act

Summary of Comments:

- One comment requested that the EIS give appropriate weight to OCSLA and the benefits of offshore oil and gas exploration and development. A related comment requested that the EIS clarify why it (and not the BOEM leasing process) is the appropriate vehicle for considering exclusion areas.
- Another commenter suggested that several essential factors of the OCSLA were overlooked, such as lease conditions and time limits. The agencies are reminded that the OCSLA is a national policy established that dictates that the OCS is to be considered a vital national resource reserve held by the federal government for the public, which should be made available for expeditious and orderly development, subject to environmental safeguards, in a manner which is consistent with the maintenance of competition and other national needs.
- Another commenter expressed frustration that it is not clear where areas excluded from leasing are to be discussed between this EIS, a recent BOEM EIS, or as part of lease sale decisions. The EIS contains little or no assessment of the impact of alternatives on BOEM's ability to meet the OCSLA requirements for exploration and development. All of the alternatives would slow the pace of exploration and development such that lease terms may be violated and economically viable exploration could be impaired.
- One commenter noted that free market competition would be compromised if the FEIS and ROD do not include activity levels likely to proceed under an exploration success case scenario. If activity levels are not increased, early applicants for BOEM authorizations would receive the benefit of an expedited authorization and permitting process because the NEPA analysis required to support their activities would already be in place when they submit their applications. Conversely, operators who apply for authorizations after the activity levels in the FEIS are exceeded would be prejudiced by delays they would experience while NMFS and the BOEM

conduct additional NEPA analysis. These delays could prevent federal and state leaseholders from exploring their leaseholds during their lease terms. The FEIS and ROD should analyze an alternative that encompasses all activities that the BOEM may be called upon to permit in the foreseeable future in order to fulfill the promises made by the government to leaseholders.

Response to Comments:

Congress amended the OSCLA in 1978 to provide for the "expedited exploration and development of the Outer Continental Shelf . . ." 43 U.S.C. § 1802(1). The EIS acknowledges and furthers this mandate. BOEM is responsible for implementation of the OCS Program as established by the OCSLA. During development of a 5-year OCS leasing program, the Secretary of the Interior may elect to exclude certain areas from leasing. At the lease sale stage, the Secretary may defer areas from inclusion in a specific proposed lease sale. The exclusion areas discussed in this EIS are areas being considered for limitations on specific activities to mitigate potential adverse effects; they are not areas being considered for exclusion from OCS leasing. Appropriate levels of NEPA analysis will be developed for each specific project that BOEM authorizes or permits—these will continue to be developed within the applicable regulatory deadlines to be consistent with the maintenance of competition and other national needs (as mandated by OCSLA).

Issue 3E - Contractual Outer Continental Shelf Lease Agreements

Summary of Comments:

- Several commenters asserted that limitations on future exploration and development violate contractual agreements between the federal government and lessees.
- Another commenter noted that the management requirements of the EIS are in addition to, and may be redundant or conflicting with the mitigations of the BOEM's OCS 5-year leasing program 2012-2017 (BOEM, 2012a). The oil and gas lease stipulations are an integral foundation for the safe and considerate regulatory program for all areas of the OCS, including offshore areas of Alaska. A comprehensive Mitigation/Program Tracking process is already in place to provide a tool for regulators and the public to consider and evaluate protective mitigations, as well as effective human and environmental safety measures already being utilized offshore (BOEM, 2013). The guidance for on-going mitigation would continue throughout the stages of exploration and development: national five-year program; regional multi-sale stage; specific lease sale stage; exploration plan stage; and development and production plan stage.

Response to Comments:

Neither the EIS nor the ROD at the conclusion of this NEPA process would impose a limit or cap on the level of OCS exploration activities. In Section 2.5.2 of the EIS, establishing a cap to limit the total number of seismic survey and exploration drilling activities that may occur in the EIS project area on a per season basis was considered and dismissed from further consideration. The EIS scenario provides a reasonable level of activities for the purpose of supporting NEPA analysis for the issuance of ITAs, G&G permits, or ancillary activities in the foreseeable future. NMFS and BOEM will continue to implement appropriate mitigation for individual projects as they arise.

Issue 3F - Air Quality Jurisdiction

Summary of Comments:

Several commenters asserted the EIS needs to be revised to reflect the change in authority over air emissions on the Beaufort and Chukchi seas.

Response to Comments:

The EIS has been revised to reflect the transfer of air quality jurisdiction on Alaska OCS (see Section 1.8.9). On December 23, 2011, President Obama signed Public Law 112-74, the *Consolidated Appropriations Act, 2012* (the Act). The Act contains a section that amends Clean Air Act Section 328(a)(1) and (b), which pertains to the control of air pollution from OCS sources. The effect of the Clean Air Act amendment is to transfer from the EPA to BOEM the authority to regulate air pollution from OCS sources that are "adjacent to the North Slope Borough (NSB) of the State of Alaska."

Issue 3G - Government-to-Government Consultation

Summary of Comments:

Comments indicated that government-to-government (G2G) consultation should include:

- Increased focus on how NMFS and other federal agencies are to protect natural resources and subsistence hunting.
- More consultation to facilitate more incorporation of Traditional Knowledge (TK).
- NMFS should initiate direct contact with the Kotzebue IRA, ICAS and Native Village of Barrow, and include in tribal government consultations.
- Tribes should be included in meetings with stakeholders and cooperating agencies; the tribes noted that a system be in place because self-monitoring of industry activities is not being reported to the tribes.
- NMFS should initiate consultation early and meet in person. Do not use contractors.
- U.S. and Canada need an integrated and cooperative approach to assessing impacts from hydrocarbon development in the Arctic. NMFS should coordinate with Toktoyaktuk and the Canadian government due to transboundary impacts and non-binding co-management agreements with indigenous peoples in Canada. Without this consultation, the EIS fails to observe the no harm principle in considering the transboundary impacts of the exploratory activities.
- TK shared with agencies as part of consultation should be kept for later inclusion and better tracked, so it is not lost over time or as staff changes occur in the federal agencies.

Response to Comments:

NMFS conducted government-to-government dialog with the potentially affected federally recognized tribes and Native organizations in both formal agency meetings and in the open public forum throughout the NEPA process. In addition to the consultation initiated by NMFS, federally recognized tribes may request consultation with NMFS and/or BOEM. Federally recognized tribes are free to discuss any issues of concern during consultation, including protection of natural resources, subsistence, and incorporation of TK. Beginning at the early stages of this EIS, NMFS staff members have worked with several Alaska Native Organizations (ANOs). Both NMFS and BOEM value the contribution that Alaska Native knowledge and experience can provide with regard to understanding marine mammals and the environment in general.

The proposed action of this EIS does not entail impacts that warrant consultation on transboundary impacts.

Issue 3H - Executive Orders

Summary of Comments:

One comment stated that the EIS runs afoul of Executive Order (EO) 13580 because it does not analyze a particular project, is duplicative, creates the need for additional OCS documents, and is based upon questionable authority.

Another stated that Executive Order 13112 is not an optional Executive Order and agencies need to fully comply with Section 2 of Executive Order 13112 specifying federal agency duties.

Response to Comments:

The EIS comprehensively assesses activities that may occur in a given season in advance of receiving applications, thus facilitating NEPA evaluations of specific proposed activities. NMFS intends to use this EIS as the required NEPA documentation for the issuance of ITAs for Arctic oil and gas exploration activities. If proposed activities fall outside the scope of this EIS, NMFS may tier from this EIS to support future Arctic MMPA oil and gas authorization decisions. BOEM intends to conduct proposal-specific NEPA analyses that either tier from this EIS or incorporate this EIS by reference. CEQ regulations specifically encourage and provide for such use of broad-scope, programmatic documents. Moreover, the FEIS includes analysis of the feasibility and potential effectiveness of mitigation and monitoring measures that could be included in future authorizations. NMFS' proactive approach would foster efficient and timely review of any ITA applications and is consistent with the goals of EO 13580.

EO 13112 requires federal agencies to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. A discussion of invasive species is

provided in Section 3.2.1.1, and analysis under each alternative is provided for potential effects of invasive species on lower trophic levels, as well as potential cumulative effects for lower trophic levels, water quality, environmental contaminants and ecosystem functions, fish and essential fish habitat, and terrestrial mammals.

Issue 3I - Coordination with Other Agencies/Stakeholders

Summary of Comments:

A variety of comments asserted ways in which NMFS should coordinate with other agencies or stakeholders to ensure an integrated regulatory approach.

- NMFS should develop mechanisms to ensure coordinated effort (federal and state agencies, industry, affected communities, NGOs, and stakeholders) to improve integration of scientific data and develop a long-term monitoring program. A recommendation was made to improve the quality and usefulness of the data collected through the implementation of mitigation and monitoring measures.
- ITA activities in state waters should be considered independently and be allowed on a project specific basis in coordination with the State.
- NMFS should integrate its planning and permitting decisions with coastal and marine spatial planning efforts. Alternatives and specific time/area closures proposed in the EIS must be coordinated among the agencies and the lessees. Communication and concurrence must be reinforced among federal departments to avoid conflicting authorizations and mitigations.
- NMFS should consult with the Alaska Eskimo Whaling Commission (AEWC) on how to better integrate adaptive management into NMFS and BOEM decisions.

- Consulting with USGS would make NMFS better informed regarding the likelihood and extent of successful exploration and development.
- The EPA should have been consulted on the EIS as it has made public its intent to prepare a General Permit for geotechnical investigations in the Arctic. NMFS should consider geotechnical investigations, including coring, in the EIS as these activities are both connected and similar to the actions being analyzed in the EIS. Since the EIS already analyzes exploration drilling inclusion of this activity would not entail significant additional analysis.
- Prior to issuing a FEIS, NMFS should consult with the identified agencies in order to develop a complete picture of foreseeable future actions in the planning region.
- Although the EIS includes impacts to marine mammal species under USFWS jurisdiction, the USFWS did not participate in the preparation of this EIS. Recommendation was made that since USFWS issues the Incidental Take Authorizations for walruses and polar bears, NMFS and BOEM should collaborate on these efforts to streamline the process.
- NMFS should work with other agencies, such as BOEM, USFWS, USGS, the North Slope Borough (NSB), the State of Alaska, Alaska Native Organizations, academia, NGOs, and industry to develop a comprehensive, long-term monitoring program for the Arctic ecosystem, including its marine mammal populations. NMFS should conduct a workshop with industry to determine the level of exploration activities that these parties plan to undertake in the region in future years.
- Develop a plan that shows how many proposed oil and gas activities could occur without harming the marine ecosystem or subsistence way of life. Federal policymakers determined no activities should occur until such information and planning was in place.
- NMFS should think carefully about how to integrate the timing of the adaptive management process with the decisions to be made by both NMFS and BOEM regarding annual activities. The EIS presents an important opportunity to coordinate this collaborative process with the decision making schedules of both NMFS and BOEM.
- Coordination among the federal agencies should be done prior to finalizing planning requirements and associated standard and additional mitigation measures to prevent conflicting requirements among regulators. Authorizations from two or more federal agencies may result in requiring operators to submit applications to two different federal agencies for the same program and may result in lessees/operators complying with one jurisdiction and simultaneously operating out of compliance for the second jurisdiction.

Response to Comments:

NMFS understands the benefits of consulting and coordinating with other federal, state, and local agencies and stakeholders. In addition to its NEPA processes and Government-to-Government consultations, NMFS hosted annual Open Water Meetings since the 1990s through 2013 to inform and seek input from stakeholders on proposed offshore activities, potential MMPA authorizations, and mitigation requirements. Section 119 of the MMPA grants NMFS the authority to enter into cooperative agreements with Alaska Native Organizations, including, but not limited to, Alaska Native Tribes and tribally authorized co-management bodies. NMFS currently has three co-management agreements with ANOs specific to species found in the U.S. Beaufort and Chukchi Seas and which are relevant to the scope of this EIS. Those agreements are with the Alaska Beluga Whale Committee for Western Alaska beluga whales, with the AEWC for the Western Arctic stock of bowhead whales (also known as the Bering-Chukchi-Beaufort stock), and with the Ice Seal Committee for the Alaska stocks of ringed, bearded, spotted, and ribbon seals. NMFS has worked closely with the AEWC throughout the development of this EIS to ensure that concerns of the bowhead whale subsistence hunters are adequately

addressed in the EIS and that an appropriate suite of mitigation measures are analyzed to ensure no unmitigable adverse impact on the availability of the species for taking for subsistence uses. Similar invitations for participation were extended to the ABWC and ISC, but they did not request frequent and formal interaction with NMFS on the development of the EIS.

NMFS also coordinates with BOEM, which is the federal agency with expertise on the geology and hydrocarbon potential of the OCS. BOEM has expertise regarding the likelihood and extent of successful exploration and development for the OCS in the U.S. Arctic Ocean. BOEM Alaska Region experts work closely with both BLM and USGS experts to correlate data, information, and knowledge on the geology and hydrocarbon potential of the North Slope and adjacent offshore areas.

NMFS has also worked closely with the EPA throughout the development of this EIS. The EPA has served as a consulting agency and has reviewed preliminary drafts of the DEIS, SEIS, and FEIS in order to provide input and comment on the sections where they have jurisdictional expertise. During the scoping phase of this EIS, NMFS invited the USFWS to serve as a cooperating agency on this EIS. Due to resource limitations, the USFWS declined the request. However, USFWS staff reviewed preliminary drafts of the FEIS to ensure accuracy of the description of the baseline and analysis of species under their jurisdiction.

NMFS shared preliminary drafts of the SEIS and FEIS with the State of Alaska for their review. However, as mentioned previously, because NMFS has jurisdiction in both federal and state waters for implementing the MMPA, this EIS appropriately includes analysis of impacts to resources in both state and federal waters of the U.S. Arctic. Considering projects in state waters independently would undermine the cumulative and comprehensive analysis in this EIS.

NMFS agrees that a comprehensive, long-term monitoring plan for the Arctic is needed and outlines its plans for developing one in Chapter 5. NMFS convened a workshop in November 2014 to discuss the development of a comprehensive, long-term monitoring plan with representatives from agencies, Native marine mammal commissions, industry, and environmental organizations. NMFS also lays out its plans for adaptive management in Chapter 5.

NMFS has worked closely with the Department of the Interior (DOI) and EPA on the development of this EIS and the mitigation measures contained herein. In the case where one agency requires a more stringent measure to protect a trust resource, the more stringent measure is the one to be followed.

ISSUE #4. ALTERNATIVES

Comments regarding alternatives covered a wide range of issues. Some pointed out potential flaws in the alternatives themselves or in the ways they were analyzed. Others questioned the adequacy of the current range of alternatives or suggested new alternatives for analysis.

Issue 4A - Expression of Preferred Alternative

Summary of Comments:

Many comments expressed a preference for a particular alternative, and suggested that in the FEIS, NMFS should identify its preferred alternative, including the rationale for its selection.

Response to Comments:

Preferences for particular alternatives have been noted. NMFS will identify its preferred alternative in the FEIS. The rationale for the selected alternative will be presented in the Record of Decision.

Issue 4B - The No Action Alternative

Summary of Comments:

Commenters asserted NMFS incorrectly describes the No Action Alternative when it implies a decision to stop issuing authorizations. Such a decision without any pending proposals would conflict with the mandates of the MMPA and OCSLA. If NMFS wants to analyze such a policy, it should create a new alternative.

Commenters noted that the No Action Alternative would be the status quo- review and, if appropriate, issuance of project-specific MMPA and OCSLA approvals.

Comment also noted that the EIS overstates the adverse impacts of the No Action Alternative.

Response to Comments:

Analysis of a No Action Alternative is required under NEPA and its implementing regulations. Question 3 of NEPA's Forty Most Asked Questions acknowledges that there are two distinct interpretations of "no action," depending on the nature of the proposal being evaluated. The "no action" alternative may be thought of in terms of continuing with the present course of action until that action is changed. In such a case, "no action" is "no change" from current management direction or level of management intensity. The second interpretation of "no action" may also mean the proposed activity would not take place, and the resulting environmental effects from taking no action would be compared with the effects of permitting the proposed activity or an alternative activity to go forward.

The proposed action of this EIS is to comply with the MMPA by issuing ITAs if, and only if, all regulatory requirements are met. It follows that the No Action Alternative would be to refrain from issuing authorizations. NMFS has the authority (indeed, the duty) to deny application for ITAs where the proposed activity would impact marine mammals, their habitats, or the subsistence uses of marine mammals in a manner inconsistent with MMPA standards. Selection of the No Action Alternative in this process would not constitute a new policy under which NMFS refuses to grant ITAs. Instead, selection of the No Action Alternative would reflect an analytical conclusion that granting ITAs for the types of activities analyzed in the EIS would violate the MMPA.

NMFS has an obligation to evaluate each MMPA application it receives. Selection of the No Action Alternative in this programmatic document does not relieve NMFS of the duty to evaluate individual applications going forward or otherwise preclude NMFS from issuing authorizations for the take of marine mammals, incidental to activities once the agency determines the action is consistent with MMPA standards.

NMFS' analysis of the No Action Alternative accurately assesses the potential impacts (both beneficial and adverse) of implementing that alternative.

Issue 4C - Range of Alternatives Inadequate

Summary of Comments:

- Some comments asserted that the current range of alternatives does not meet NEPA requirements and fails to identify mitigation measures, environmentally preferable alternatives, other options for developing oil and gas without causing significant environmental effects, or an alternative that is commensurate with the anticipated level of oil and gas exploration.
- Similarly, some comments noted strong similarities between projected effects of multiple alternatives, a purported indication that the range of alternatives is inadequate.
- Another commenter appreciated that NMFS expanded the range of alternatives, but felt the lack of explanation for how they arrived at those alternatives frustrates the fundamental purpose of NEPA to ensure information is available to public officials and citizens prior to action being taken. Furthermore, the same commenter felt there is nothing in the SEIS to suggest that the increased maximum activity level was based on a calculation of exploration activities likely to occur following a major discovery in the region.
- A different commenter suggested the alternatives should be based on different management regimes instead of activity levels, since management regimes are within NMFS control and activity levels are not.
- Analysis of impacts under Alternative 3 in the EIS is insufficient as it varies little from the analysis of impacts under Alternative 2 in the EIS despite adding many activities. This highlights the failure to analyze the collective impact of the variety of activities analyzed in the alternative.
- Other comments received on the EIS noted that the range of alternatives considered is adequate. The EPA commented that based on their review of the EIS the current suite of alternatives is adequate given the regular fluctuation of anticipated activity. Projections may again increase if oil or natural gas prices rise substantially over the next few years.

Response to Comments:

NMFS determined that the EIS evaluates an appropriate range of alternatives. The agency bears the responsibility for deciding which alternatives to consider in an EIS (*North Slope Borough v. Andrus*, 642 F.2d 589, 601 (D.C.Cir.1980)). The agency need follow only a "rule of reason" in preparing an EIS (*Natural Resources Defense Council, Inc. v. Morton*, 458 F.2d 827, 834, 837 (D.C.Cir.1972)), and this rule of reason governs "both which alternatives the agency must discuss, and the extent to which it must discuss them" (*Alaska v. Andrus*, 580 F.2d at 475; Allison v. Department of Transp., 908 F.2d 1024, 1031 (D.C.Cir.1990)).

As discussed in Section 2.4 of the DEIS and SEIS, NMFS and BOEM engaged in a comprehensive process to identify and analyze alternatives and mitigation measures:

1) Evaluating alternative concepts suggested during the scoping period (such as using alternative technologies to airguns for seismic surveys);
2) Reviewing potential alternatives in the context of NMFS' and BOEM's regulatory requirements;
3) Assessing potential levels of seismic exploration and exploratory drilling activities, and a suite of Required Standard Mitigation Measures; and

4) Identifying a range of potential Additional Mitigation Measures that need further analysis and may be applied to alternatives pursuant to the MMPA ITA process and the BOEM OCSLA permitting process.

NMFS worked closely with BOEM, the agency with jurisdiction over and expertise in oil and gas exploration and development on the federal OCS, in determining the levels of activity contemplated in each alternative. Those levels were based on what is reasonably likely in the foreseeable future based on past activity levels and information available regarding future plans by the oil and gas industry. If there is a major discovery in the region, the agencies realize that this could lead to increased interest and applications for oil and gas activities. This EIS will support project-specific NEPA analysis within the levels of activity presented. If activities exceed the levels analyzed in this EIS, additional and appropriate NEPA analyses would continue to be developed.

All of the alternatives analyzed in the EIS would be available to the NMFS decision maker. The decision maker may choose one, part, a combination, or none of the alternatives.

Regarding the comment that alternatives should not be based on activity levels but management regimes, please see earlier response regarding why activity levels are appropriate for characterizing alternatives. Additionally, however, we note that NMFS is addressing our management regime by virtue of analyzing the range of mitigation measures that we could potentially apply. Additionally, our management regime is further discussed in Chapter 5 where we address monitoring, engagement with subsistence users, and adaptive management.

The fact that the EIS analysis indicates that no significant adverse effects would occur under any of these alternatives is further evidence that NMFS properly designed environmentally sensitive alternatives and mitigation measures. This lack of significant effects could also be a root cause of the similarity in potential effects asserted by several comments.

Issue 4D - Improper Dismissal of Alternatives

Summary of Comments:

Several comments state that NMFS improperly dismissed alternatives (this topic is further addressed under the "Additional alternatives suggested" subheading, below).

Response to Comments:

Comments received during the scoping process and during the DEIS public comment period suggested additional alternatives or features to be incorporated into the alternatives. Many of these concepts have been incorporated into the alternatives that are analyzed in this EIS (such as time/area closures or the use of alternative technologies to airguns to collect seismic data). Others have been dismissed from further consideration after careful review and consideration by NMFS and BOEM. "Reasonable alternatives include those that are practical or feasible from the technical and economic standpoint and using common sense…" (CEQ's Question 2a of NEPA's Forty Most Asked Questions). Alternatives also must meet the purpose and need of the proposal (40 CFR 1502.13), as presented in Section 1.3 of the EIS. Discussion of alternatives considered, but not brought forward for full analysis is provided in Section 2.5 of the FEIS. These rationales were also presented in the DEIS and SEIS.

Issue 4E - Limit on Activities

Summary of Comments:

- Many comments expressed concern that by predicating all action alternatives on a limited amount of activity (at most, two exploration programs in the Chukchi Sea and two exploration programs in the Beaufort Sea), the EIS arbitrarily limits allowable levels of oil and gas activities. They

assert that NMFS should not limit the number of activities as long as the number of takes is consistent with MMPA requirements.

- An analysis is necessary examining how many different lessees there are, where their respective leases are in each planning area (Beaufort vs. Chukchi seas), when their leases expire, and when they anticipate exploring (by activity) their leases for hydrocarbons. To assume there to be only one exploratory drilling program per planning area (Alternative 2) or only two exploratory drilling programs in the Beaufort Sea (one occurring in state waters) and two in federal waters of the Chukchi Sea per year is unrealistic to lessees that explore their leases relative to contractual lease clocks/calendars.
- Commenters felt that varying ranges of oil and gas activities are not alternatives to the proposal for incidental take authorizations and are inconsistent with the Purpose and Need.
- Others assert that implementing multiple programs per year is preferred and that appropriate mitigation can be determined through ITA and G&G permit approvals.
- Other commenters felt that NMFS lacks the statutory or regulatory authority to allocate permits in a way that limits or restricts activities that a lease holder is authorized to carry out. These comments go on to warn that arbitrarily limiting industry in this manner would shut out leaseholders, interfere with BOEM's ability to meet OCSLA requirements, raise contractual and anti-competitiveness concerns, prevent efficiencies, and extend any adverse impacts over more time. The suggested solution to these concerns is to increase the level of activities within the action alternatives.
- Commenters noted that because NMFS arbitrarily limits the level of activity analyzed in the EIS, the EIS defeats the informational purpose of an environmental impact analysis by depriving the decision-maker and the public of the full range of information related to exploration at levels higher than those considered in the alternatives.
- Commenters assert that past activity levels are poor predictors of future activity levels and should not be used to estimate reasonably foreseeable activity levels. The number of exploration drilling programs must be increased in the alternatives, as the alternatives in the SDEIS do not represent a reasonable range. Per CEQ guidance and case law, the range of alternatives should be based on the purpose and need. NMFS must meet with BOEM and industry and develop alternatives that entail activity levels that will likely occur given current interest, future lease sales, and a success case for current exploration efforts.

Response to Comments:

The analysis scenario provides a reasonable level of activities for the timeframe of the EIS and is based on input from industry, historical trends, and the availability of suitable exploration seismic survey vessels and drilling units. The EIS scenario was not arbitrarily derived and provides a basis for analysis; it is not intended to impose a limit or cap on the level of OCS exploration activities. Section 2.5.2 of the EIS specifically states, "The alternatives carried forward for analysis in this EIS include a range of exploration activities at different activity levels. While these separate activity level alternatives do not function as "caps," they do serve as the maximum annual level of activities for which NEPA coverage under this EIS exists for NMFS' and BOEM's issuance of ITAs and permits, respectively, in a given year". Should the level of activity exceed the level analyzed in the EIS, NMFS and BOEM would complete additional NEPA analyses. As discussed above in response to comments on the No Action Alternative, NMFS remains committed to evaluating each application for an MMPA ITA on its own merits.

As noted previously in this response to comments document, NMFS determined that activity levels, not take, are the appropriate way to define alternatives for two reasons. Practically, activity levels are the

currency in which companies plan and in which take authorizations can be bounded. Takes are calculated directly from activities (thereby allowing NMFS to authorize them), however – it would be very difficult to enforce or bound the allowances of an IHA based on observed take, whereas IHAs are designed to bound the activities associated with the expected impacts. Substantively, all takes are not created equal – because of the way they are quantified, some would be expected to be lower level exposures barely qualifying as a take, while others might be expected to cause more concern. Considering activity levels, instead of takes alone, allows for the consideration of context within different activity types and levels and, therefore, a more comprehensive evaluation of the likely impacts.

Issue 4F - Unprecedented Level of Activities

Summary of Comments:

Commenters asserted that Alternatives 2 through 5 analyze an unprecedented level of activities, and worry that as written, the EIS violates NMFS' jurisdiction by preemptively approving specific levels of activities.

Response to Comments:

NMFS determined that the analysis scenario provides a reasonable level of activities over the timeframe of the analysis in this EIS. The EIS analyzes the potential effects of different levels of activities; it does not approve any level of activity or any specific activities. The EIS itself is not a "decisional" document but is rather an analysis tool to be used when making decisions through the MMPA ITA process.

When industry submits a proposal, NMFS and BOEM would complete proposal-specific environmental reviews (as well as regulatory and technical reviews, as appropriate) of the proposed activities to verify that the activities fall within the ranges evaluated in the EIS. If the proposed activities fall outside of the scope of the EIS or there is substantive, relevant, new information that should be considered, additional NEPA analysis would be completed.

Issue 4G - Alternative Flaws

Summary of Comments:

Several comments cited specific flaws in alternatives:

- Alternative 6 is infeasible because NMFS cannot reasonably mandate use of technologies that are not commercially available, not fully tested, are unproven, and should not be considered reasonably foreseeable. It is impossible to perform detailed impact analysis for speculative technologies.
- Alternative 5 should not purport to convey critical habitat status to areas that actually do not enjoy any special status.
- The action alternatives should include seismic, shallow hazard and possibly drilling to account for future lease sales scheduled for 2015 and 2016.
- Alternative 3 lacks substantive analysis despite the increased level of activity over Alternative 2, including failing to adequately consider collective impacts of multiple surveys, drilling, and ice-breaking activities on marine mammals.
- Alternative 2 states that on-ice surveys occur only when there is bottom-fast ice in the winter, but they may also extend onto floating ice in shallow water and in some circumstances, on floating ice in deep water.
- While it is reasonable to assume that many outstanding leases would not ultimately result in development (or even exploration), NMFS should have truth-tested with its cooperating agency

whether the maximum level of activity it assumed was, in fact, a reasonable assumption of the upper limit on anticipated activity. BOEM would have been able to provide NMFS with guidance on one of these leases. Use of a properly constructed scenario would have provided NMFS with a more realistic understanding of the level of activity necessary to allow current leaseholders an opportunity to develop their leases within the lease terms.

- The attempt to link alternatives with activity levels conflict with prior NEPA analyses, including the 2007 PDEIS (NMFS/MMS 2007) and the 2006 PEA (MMS 2006).
- One comment notes that Alternative 4 allows for increased levels of drilling is ironic as several companies have announced that they are suspending plans for drilling.

Response to Comments:

NMFS determined that the alternatives evaluated in the EIS are appropriate and reasonable and contain the appropriate level of analysis of collective impacts under each alternative. The proposed actions considered in the EIS are:

- issuance of ITAs, by NMFS, for the incidental taking of marine mammals during G&G permitted activities, ancillary activities, and exploratory drilling activities in the U.S. Beaufort and Chukchi seas, Alaska, under Section 101(a)(5) of the MMPA; and
- authorization of G&G permits and ancillary activities in the U.S. Beaufort and Chukchi seas, Alaska, by BOEM under the OCSLA.

The analysis scenario provides a reasonable level of activities for the timeframe of the EIS and includes activities related to both past and proposed OCS lease sales. NMFS worked closely with BOEM throughout the entire development process of this EIS to determine an appropriate range of activity levels.

The EIS does not propose or even evaluate the establishment of any special status areas. Time and area restrictions are analyzed in the EIS as potential means to mitigate effects to marine mammals during time of habitat usage when the animals may be more susceptible to adverse effects and to avoid multiple-use conflicts with communities' subsistence activities. The designation of these time and area restrictions as contemplated mitigation measures is not a new practice, as NMFS has required time/area closures as mitigation measures in past MMPA authorizations issued to the oil and gas industry conducting activities in the U.S. Beaufort and Chukchi seas.

The analysis of alternative technologies concludes that most new technologies would not be technically or economically feasible during the timeframe of the EIS analysis; the purpose of including and completing the analysis is to document such findings and to aid in future analyses, which may be tiered from this EIS.

BOEM develops NEPA analysis at each stage of its oil and gas exploration and development process under OCSLA. Accordingly, BOEM will continue to develop NEPA analysis to evaluate other activities, such as exploratory drilling, as these projects arise in the future. Lease sales proposed in BOEM's 2012-2017 5-Year Program would each be evaluated with an EIS prior to conducting any sale. Furthermore, analysis of the scenarios presented in this document does not limit the ability of current leaseholders to develop their leases within the terms of those leases.

Language has been added to Section 2.4.5.3 to note that on-ice seismic surveys may also extend onto floating ice in shallow water and in some circumstances on floating ice in deep water.

The approach in this EIS does not conflict with prior NEPA analyses. As noted previously, activity levels are the currency in which companies plan and in which take authorizations can be bounded. Therefore, NMFS determined that it was appropriate to "link alternatives with activity levels." Considering activity levels allows for the consideration of context within different activity types and levels and, therefore, a more comprehensive evaluation of the likely impacts. Moreover, the 2007 PDEIS noted by the commenter was never completed and withdrawn in October 2009 (74 FR 55539, October 28, 2009).

Issue 4H - Additional Alternatives Suggested

Summary of Comments:

Many comments suggested NMFS analyze additional alternatives not included in the EIS, including alternatives that:

- Require, incentivize, or test the use of new technologies in the Arctic.
- Incorporate the community-based adaptive management approach of the CAA.
- Benefit subsistence activities.
- Prepare an alternative with a reduced number of seismic surveys and an increased number of drilling programs. One commenter noted that such an alternative would align more closely with foreseeable activities in the region and would not increase any effects on marine mammals.
- Benefit conservation by incorporating standard mitigation measures, additional mitigation measures, as well as limiting late season drilling.
- Establish permanent subsistence and ecological deferral areas in addition to time and place restrictions for Hanna and Herald shoals, Barrow Canyon, and the Chukchi Sea ice lead system.
- Institute a phased, adaptive approach for increasing oil and gas activities; avoids redundant seismic surveys; develops a soundscape approach and consideration of caps on noise or activity levels for managing sound sources during the open water period; and provides a clear basis for judging "negligible" impacts under the MMPA.
- Include an alternative that accounts for activity levels likely to follow a discovery/future lease sales and takes into account published Federal Hydrocarbon Resource Assessments, federal and state lease offerings (recent and planned), and industry response foreseeable following a string of exploration success in the planning region over the next 10 years.
- Are not bound by unwarranted additional mitigation measures or do not all include additional mitigation measures.
- Require time/area closures for any alternative selected.
- NMFS should consider an ecosystem-based management plan to conserve habitat for the bowhead whale and other important wildlife subsistence species of the Arctic.

Several commenters suggested development of an alternative focusing on an evaluation of the amount of anthropogenic noise that marine mammals might be exposed to, rather than using numbers of activities as proxies for sound should be developed and incorporated into the EIS. Many commenters referred to this as the creation of a sound budget where the total amount of sound that is put into the environment is what is limited and what is measured. It was noted by one commenter that this could also be a method that where western science could corroborate the long standing observations of subsistence hunters who report that bowhead whales and belugas whales are very sensitive to sound. Commenters noted that it would be more logical to limit the amount of sound introduced in managing the Arctic versus counting how many drill ships or seismic operations were occurring.

The SEIS improperly conducts its alternatives analysis without an actual sound budget in place for comparisons between alternatives with respect to harassment of species.

One commenter noted that the alternative based on accumulation of sound exposure level/sound budget could evaluate:

- different types and numbers of industrial activities,

- different frequencies produced by each activity,
- location and timing of activities,
- overlap in time and space with marine mammals and,
- TK about how marine mammals respond to anthropogenic activities.

It was noted that threshold levels could be based on simulation modeling using the above information. This approach would use a valid scientific approach, one that could be considered as robust, and probably more, than the current approach of assessing numbers of activities.

NMFS and BOEM should work together to adopt a phased approach to oil and gas exploration activities in the U.S., with increased levels of activities contingent on and supported by:

- Adequate baseline information on the marine wildlife, habitats, and communities at risk from such operations.
- A better understanding of the long-term and cumulative impacts of oil and gas exploration and other human activities on marine mammal populations in combination with impacts due to climate disruption.
- Mitigation measures that are proven to be effective at reducing injury and disturbance of marine mammals and avoiding adverse impacts on subsistence communities.
- Enhanced capabilities for responding to oil spills in ice conditions.
- Conduct supplemental activity-specific environmental analyses under NEPA that:
- Provide detailed information on proposed seismic surveys and drilling activities and the associated environmental effects.
- Work with industry to ensure that the necessary information is available to estimate the number of takes as accurately as possible given current methods and data.
- Encourage BOEM to make activity-specific analyses available for public review and comment rather than issuing memoranda to the file or categorical exclusions that do not allow for public review/comment.
- Make analyses available for public review and comment before NMFS makes its final determination regarding applications for incidental take authorizations.

Response to Comments:

Comments received on the EIS that suggested additional alternatives were reviewed and either considered for analysis in the FEIS or an explanation for why they were considered and rejected from further analysis provided in the FEIS (see Section 2.5). The alternatives analyzed must be reasonable and must meet the purpose and need of the proposal (40 CFR 1502.13), as presented in Section 1.3 of the EIS. Most of the suggested alternatives above do not qualify as reasonable alternatives in this EIS because: they are out of the scope of the EIS (e.g., benefit subsistence activities); they are suggestions for research (e.g., test the use of new technologies); they are already addressed as mitigation measures in the EIS (e.g., time and place restrictions); or they are predicated on value judgments with which NMFS disagrees (e.g. the implication that the effects analysis is inadequate or that the analysis of mitigation measures is unwarranted). An explanation of why specific suggested alternatives are not carried forward for further analysis is provided in Section 2.5 of the EIS. NMFS and BOEM already use and intend to continue to use an adaptive management approach to mitigation of adverse effects of OCS exploration seismic and drilling activities in the U.S. Arctic Ocean.

ISSUE #5. SCENARIO, ASSUMPTIONS, AND ACOUSTIC CRITERIA

Comments regarding the scenario and assumptions raised concerns with the levels of activity proposed, the scope of the EIS analysis, and the analytical assumptions relied upon. Many comments also expressed concerns regarding new acoustic criteria being developed by NMFS.

Issue 5A - Proposed Action

Summary of Comments

Concerns with the characterization of the proposed action included:

- The EIS lacks an actual proposed action and instead identifies several alternative hypothetical ranges of generic oil and gas exploration and ancillary activities. The EIS does not analyze real actions or reach findings that may be meaningful on a project specific basis for activities at a given geographic location and time. One commenter noted that an improperly conceived and poorly executed EIS based on unsubstantiated assumptions would not create efficiency or value for agencies in their decision making process.
- The FEIS should clarify the term "program" to be in accord with authorized levels of activities. Comments noted that the current language in the EIS could be read to preclude arbitrarily an operator from simultaneously drilling more than one well in a sea or on a prospect. If the definition is read to restrict a company to the use of only one rig per sea, it would prevent these operators from simultaneously drilling on more than one of their leases or prospects in a theater at a time. This definition is also problematic because it imposes a restriction on the scope of Exploration Plans that is inconsistent with the purpose of these plans under OCSLA and with the BOEM's obligation to review Exploration Plans under NEPA. Comments recommend that the term "program" be defined for the analytical purposes of the FEIS using a standardized metric of impact-producing activities.
- The EIS does not consistently recognize that multiple ice breakers could operate as a result of the exploration drilling programs.
- The EIS is not clear if the references to ancillary activities refer solely to activities that support seismic surveys and drilling programs (e.g. support vessels) necessary for exploration or if the scope includes initiatives associated with field development and production operations.

One commenter noted that intention of the exploration actions in the EIS are not to find out what is out there but rather to find out where extraction operations would yield the best results and that the EIS is the action that would allow rapid expansion of hydrocarbon extraction in the Arctic.

Response to Comments

The proposed action and reasonably foreseeable scenarios analyzed in the EIS were developed with input from other federal agencies and industry, is based on real world information, and represents the most reasonably foreseeable levels of activity. The analysis in the EIS is intended to support NMFS in its issuance of ITAs under the MMPA and to support BOEM with respect to its permits for G&G activities and authorizations of ancillary activities. Even though the complete details of specific future actions are not known, the EIS lays out the bounds and general parameters of expected activities in enough detail for the agencies to adequately broadly evaluate the effects on the environment from the different alternatives, which reflect combinations of agency decisions. Additional, more granular assessment will be undertaken once more details are known for a given project and will further support agency decisions. The possibility of multiple icebreakers operating as a result of exploration drilling programs is acknowledged in portions of the EIS that discuss the scenario.

Text has been added to Section 2.4.3 to clarify the term "program" as used in this EIS. To clarify, "program" is used only to simplify the analysis of impacts; it does not change the way the BOEM issues G&G permits for seismic surveys or applications for permits to drill for exploratory drilling, and it does not limit the number of drilling rigs a single company may employ at one time per sea under an approved EP. Moreover, an individual "program" may require the use of multiple support vessels in addition to the source vessel or drilling unit conducting the actual data acquisition or drilling of the wells, respectively. Those support vessels do not count as separate "programs" as defined for evaluation purposes in this EIS. However, for the sake of analysis in this EIS (which necessitates a good sense of the spatial and temporal extent of the projected activities), one "program" indicates the use of only one source vessel (or two/three source vessels working in tandem, e.g. ocean-bottom cable [OBC] surveys) or one drilling unit (i.e. drillship, jackup rig, SDC, etc.) at a time, e.g., not surveying multiple sites or drilling multiple wells concurrently.

Within the scope of this EIS, ancillary activities are those activities conducted on a lease to obtain data and information to ensure proper exploration activities. Ancillary activities also support development and production activities, but development and production are not part of the scenario analyzed in this EIS. Ancillary activities are typically geological or geophysical activities and are always on lease.

Issue 5B - Spatial Scope

Summary of Comments

Several comments criticized the geographic areas considered in the EIS.

- NMFS should not have designated any "special habitat areas" without undergoing a full review process.
- If Kotzebue is included in the EIS area because it is an eligible area for exploration activities, then the EIS needs to include recommendations for mitigating impacts.
- NMFS should exclude transit areas from the scope of the EIS to avoid placing any unauthorized mitigation measures on these areas.
- The discussions of terrestrial mammals may not be directly relevant to federal offshore authorizations covered under this EIS (not limited to: Vol. 2, 4.5.2.5, p. 4-178, 4-179; 4.5.3.2 'p. 4-199, p. 4-203, p. 4-203, p. 4-207, p. 4-208,4-210, 4-279, 4-323, 4-362, 4-390, 4-443, 4- 453, 4-475, 4-476, 4-483,4-544, 4-546, 4-576,4-596, 4-616,4-635; and Appendix A Mitigations of the Draft SEIS). The land-based habitats for these mammal populations are remote from distant federal waters greater than 3 nm offshore. The analysis of potential impacts of events offshore in the Chukchi or Beaufort seas upon caribou, grizzly bears, muskox, furbearers on land is difficult to validate, due to the long distances between federal offshore activities and on land terrestrial habitats (not limited to: Vol. 2, 4.10.6.12.1, p. 4-443, 4-444; 4.10.7.12, p. 4-475; 4.10.7.17, p. 4-479). The inclusion of these terrestrial discussions may not be directly relevant to the purposes and needs of the EIS for the OCS.

Response to Comments

The "special habitat areas" referred to by the commenter are actually identified as potential time/area closures in the mitigation measures section of the EIS to further the NEPA analysis contained within the EIS. This approach is particularly useful in understanding the context of potential impacts and how those impacts may vary in different locations. These areas are not "designated" in the sense that they have any heightened regulatory protection or status, such as "critical habitat" as defined by the Endangered Species Act. These areas were identified based on their importance to species for biological life functions (e.g, feeding) or as traditional hunting grounds. Recommending such time and area closure restrictions for consideration in the MMPA Section 101(a)(5) process is fully within the purview of NMFS. Therefore,

while NMFS considers review of these areas under NEPA to be appropriate, any other form of "full review process" is unnecessary.

Although the proposed action evaluated in the EIS does not include activities offshore of Kotzebue, many of the mitigation measures identified in the EIS could serve to mitigate potential adverse effects in the Kotzebue area. Moreover, actual seismic surveys and exploratory drilling operations would occur a considerable distance away from Kotzebue. The analyses did not identify Kotzebue-specific adverse effects; therefore, no additional mitigation measures are considered or required.

The focus of the EIS is on effects to marine mammals, their habitats, and the availability of marine mammals for subsistence uses. It is true that if the proposed action has consequences on transit, then NEPA would require consideration and perhaps mitigation of those impacts.

Because this EIS also contemplates the issuance of MMPA ITAs for oil and gas exploration activities in state waters, as well as considers impacts to transits close to shore from resupply activities of OCS operations, inclusion of discussion of potential impacts to caribou is relevant to the analysis. Additionally, onshore infrastructure and aircraft and helicopter flights from shore to the OCS operations may disrupt caribou. Therefore, analysis is appropriately incorporated into the EIS.

Issue 5C - Temporal Scope

Summary of Comments

Several comments criticized the timeframe considered in the EIS.

- NMFS needs to coordinate with industry on time period covered by the EIS, how information would be utilized, and what level of activities would occur. The DEIS of 2011 was limited to a 5-year period but the Supplemental EIS is not similarly time bound. To prevent against these uncertainties, the FEIS should be limited to a period of time in which the reasonably foreseeable level activity can be determined and the associated impacts to species analyzed.
- Because recent years have indicated that some drilling may be possible from June-November, NMFS should extend the temporal extent of the drilling season analyzed.
- The various stages of oil and gas exploration are connected actions that should be analyzed together in the EIS.
- The EIS should account for the additional time required to strike first oil under each alternative and mitigation measures and the resulting impact on economic considerations.
- For future planning, NMFS should consider and incorporate the 2016 Chukchi OCS lease sale, the 2017 Beaufort Sea OCS lease sale, as well as annual Beaufort state leases sales held by the State of Alaska.

Response to Comments

Industry coordination. NMFS has coordinated with other federal agencies and industry regarding potential oil and gas activities in the Arctic, including the timing of activities, how information would be utilized, and the level of potential activities. In response to industry concerns, NMFS has increased the maximum number of potential drilling programs contemplated in the EIS from up to two concurrent programs in each sea in a given year to up to four concurrent programs in each sea in a given year.

Timeframe of EIS. NMFS decided not to create a time limit on the usefulness of the EIS as was done in the DEIS. The analysis contained in the FEIS will be used from the time the Record of Decision is signed until there is scientific evidence that the analysis needs to be updated to address changing conditions or activities. This approach will help to enhance administrative streamlining of the MMPA process.

Drilling season. The temporal extent of the drilling season considered in the EIS (July through October) is adequate and reasonable.

Considering other stages. While the various stages of oil and gas exploration are certainly connected, it should not be presumed that engaging in one stage would necessarily lead to the next stage. This concept is illustrated clearly in the very nature of exploration, a process in which companies search for – but do not necessarily find – economically recoverable hydrocarbon resources. If exploratory activities are not successful, then no development or production or decommissioning would occur. By limiting the scope of this EIS to the exploration phase, NMFS focuses its analysis on a discrete set of activities and does not devote resources to other types of activities that may or may not ever occur. If development and production are proposed at some later point, federal agency decisions regarding those activities would be informed by additional NEPA documents that take into account current conditions and specific project plans.

Additional time. Potential economic effects stemming from each alternative are analyzed in the Socioeconomics subsections provided in the Section 4 analysis of each alternative. It is difficult to quantify economic impacts from delays in the production of oil and gas caused by the selection of a particular EIS alternative. Given the many conditions and factors upon which production of Arctic oil and gas hinges, the asserted link is highly conditional and attenuated. The existing socioeconomic analysis sections contain sufficient discussion of those economic effects that are reasonably expected to occur from selection of each EIS alternative.

Incorporation of Lease Sales. BOEM continues to serve as a cooperating agency on the EIS and shares its expertise with NMFS; this includes relevant information derived from public comments on BOEM's 5-Year Plan and upcoming lease sales.

Issue 5D - Analytical Assumptions

Summary of Comments

Comments questioned some assumptions made in the analysis:

- Treating all drilling operations or seismic operations the same is unreasonable, as sound footprint could vary widely with the different types of drilling or surveys, etc.
- The EIS' assumption that time and place restrictions would not reduce the number of exploration activities is unfounded.
- NMFS should explain its assumptions and the precautionary factors it applies to: estimates of seismic activities; source sizes and characterizations; underwater sound propagation; population estimates and densities of marine mammals; noise exposure criteria; and marine mammal behavior.
- The assumptions for Alternative 2 are not considered sufficient. If there were a drilling operation and one or two seismic operations situated in a north-south orientation, it is feasible that bowhead and beluga whales could be deflected dramatically from their normal migratory route across the Beaufort Sea. Additional analyses (and possibly stipulations) are needed in the EIS concerning the geographic placement of seismic surveys, site clearance/shallow hazard surveys, and exploratory drilling for all the alternatives.
- The current description of in-ice surveys only includes "2D seismic surveys towing a single, long streamer." It is likely that within the 5 year term intended to be covered by this EIS that equipment would be developed allowing 3D seismic surveys towing multiple streamers to be conducted in ice covered waters. It is recommended that NMFS include this in their definition of in-ice seismic surveys and assumptions.

- The analysis of sound sources and associated acoustic footprints is based on the average distances from the sound sources to the various sound threshold levels used by NMFS to delineate harassment, as measured during previous seismic surveys of various types, rather than actual modeling of propagation loss associated with the proposed types and numbers of sound sources. Decision makers need more specific information because these sound sources may ensonify large portions of the Chukchi and Beaufort Seas. For example, NMFS has estimated that Alternative 2 would ensonify 35 percent of the Chukchi Sea and 14 percent of the Beaufort Sea at the 120-dB re 1 µPa threshold (page 4-50); whereas, alternative 3 would ensonify 58 percent of the Chukchi Sea and 19 percent of the Beaufort Sea at the 120-dB re 1 µPa threshold (page 4-245). The significance of these estimates is difficult to interpret and predict given the vague set of assumptions on which they are based.
- To the extent that a VLOS is not part of the proposed action, it should not be evaluated in this EIS.

Specific concerns were noted about assumptions of analysis of impacts to bowhead whales. The effects of seismic exploration in the Beaufort and Chukchi seas, particularly with respect to the Bering, Beaufort and Chukchi seas population of bowhead whales, have been the subject of detailed analyses by BOEM (formerly MMS) and NMFS. Each successive analysis, performed under the auspices of the OCSLA, NEPA, ESA, and MMPA, has comprehensively reviewed the available information regarding seismic impacts and the status of this population, regarding which there has been essentially no change over the time period involved. Rather it was noted that what has changed in these analyses over time are:

- Increasingly unrealistic assumptions about the extent of expected survey activity (referred to in the EIS as the foreseeable level of activity).
- Increased significance accorded to speculative impacts for which there are no supporting data.
- Decreased significance accorded to the highly credible scientific data demonstrating the continued health and growth of the BCB stock and the insignificant effects of seismic activity.
- Decreased significance accorded to feasibility and practicability.
- Increased stringency of proposed restrictions on seismic survey activity.

Response to Comments

It is acknowledged that different drilling operations and different seismic operations can produce different sound footprints. Because this EIS does not analyze any particular, specific exploration drilling plans or seismic survey operations, it utilizes scenarios comprising typical activities, as described in Section 4.2.5. Future NEPA documents and MMPA analysis documents prepared to support individual decisions regarding ITA applications would analyze more specifically the unique sound footprint of proposed equipment and activities, as necessary.

In analyzing the Proposed Action, NMFS considers several scenarios entailing different levels of oil and gas activities in the Arctic. NMFS also analyzes the potential benefits of time and place restrictions as possible mitigation measures to reduce the impact of the proposed action. Analysis of both these concepts is appropriate under NEPA; the asserted assumption is not required in order for NMFS to analyze both of these concepts. The comment assumes an assumption that was not made.

Explanation of the precautionary factors NMFS applies to these identified concepts is provided in the activity descriptions in Chapter 2, the baseline information in Chapter 3, and the analysis of potential impacts in Chapter 4.

Text was added to Section 2.3.2.3 to account for the possibility of conducting 3D in-ice seismic surveys during the timeframe of this EIS.

The commenter is correct in stating that a VLOS is not part of the proposed action, and further, the possibility of a rare event like a VLOS is remote. However, because the consequences of a VLOS can be considerable, potential impacts from a VLOS are included and analyzed independently in Chapter 4.

NMFS uses the best scientific information available to consider potential impacts of oil and gas exploration activities on the biology and behavior of marine mammals. While science has indicated a steady increase in the BCB bowhead whale population over the last decade, this does not mean that the activities are not impacting behavior of the animals or potentially interfering with subsistence hunting activities. Further, the larger concerns relate to the higher future levels of activity that are projected by the industry that exceed those that have occurred in more recent years. The concerns that NMFS articulates for these higher levels of activity are not speculative, but rather outline potential avenues for either direct disturbance effects or acoustic habitat impacts (e.g., masking), from combination of these higher levels of activities, to translate to impacts on individual fitness levels (e.g., reproductive success or survival). To the commenters note, the EIS has been clarified to indicate that 1) the large percentage of the EIS area ensonified (up to 45%), that relates to areas above 120dB from all sources, even seismic, is intended to get at the area that will be ensonified and have the potential for acoustic masking, whereas 2) a much smaller area (>2% in all Alternatives) is ensonified above the Level B harassment take threshold. Additionally, a quantitative chronic and cumulative analysis was conducted in response to commenter input, and the results are addressed in the EIS and add detail to our understanding of potential chronic and cumulative effects of the combined activities. The analyses in the EIS are appropriate and utilize all available information.

Issue 5E – Acoustic Criteria

Summary of Comments

- Notice a revised version of the SEIS for public comment after the 2013 comments and NMFS' new acoustic criteria are incorporated.
- NMFS Should Issue a Second SEIS for public comment following the finalization of the Sound Exposure Level (SEL) Acoustic Criteria and their incorporation into the EIS. NMFS suggests in the SEIS that it would incorporate the new acoustic criteria for impulsive sounds into the FEIS without additional NEPA public review and comment. However, in order to properly inform this NEPA process, stakeholders must have an opportunity to review and comment on NMFS' application and incorporation of the new acoustic criteria in the EIS itself. Acoustic impacts are the basis for the majority of IHAs that NMFS issues for offshore exploration in the Arctic. The new acoustic criteria would provide guidelines to NMFS to determine when a take has occurred and when a species has experienced an acoustic impact. NEPA and CEQ regulations emphasize the importance of public involvement, including a full opportunity for public review and comment. When detailed information is presented for the first time in a FEIS (and not included in a Draft EIS), that conflicts with NEPA's public commenting provisions and may rise to level of NEPA violation. If NMFS proceeds directly to a FEIS and ROD after incorporating the new acoustic criteria, it would deprive the public of the opportunity to comment on the application of the new criteria to the EIS assessment of impacts and evaluation of mitigation measures.
- Ensure that legitimate scientific standards, including credible, current noise exposure measures are used.
- NMFS should not use the 120/160/180 dB thresholds for take because they are not scientifically supportable. NMFS should instead adopt the Southall criteria.
- The environmental review fails to present a realistic picture of harm. It uses a standard for measuring impacts that the scientific community has roundly rejected and that the agency admits is outdated.

Many commenters remarked about the new acoustic criteria and how it could change the effects analysis in the EIS:

- NMFS' proposed timeline to wait and include new acoustic criteria at a later date was considered insufficient and questionable. Commenters remarked that the EIS improperly relies solely on the current acoustic criteria to estimate species takes. The new acoustic criteria revisions may result in a moderate to large increase in the number of predicted behavioral harassment takes of baleen whales and a small to moderate increase in the number of takes of toothed whales.
- The EIS indicates that new acoustic criteria would be developed to assess the impact of acoustic effects. The EIS does not substantively address the problems with the current criteria or explain what the new criteria would be or how these new criteria would be applied. As a result, it is impossible to evaluate the validity of the environmental consequence analysis under either the current or potential future criteria.
- Use of received level alone is seriously limited in terms of reliably predicting impacts of sound exposure. If NMFS continue to use this approach, it should at least incorporate a more representative probabilistic approach, such as a risk function with a 50 percent midpoint at 140 dB (RMS) that accounts, even qualitatively, for contextual issues likely affecting response probability.
- NMFS must revise the thresholds and methodology used to estimate take from airgun use. The following parameters should be incorporated:
    - Use specific thresholds for specific species, where possible. These thresholds should be expressed as a linear risk function where appropriate. If a risk function is used, the 50 percent take parameter for all baleen whales should not exceed 140 dB (RMS). For certain species, including bowhead whale, beluga whale and harbor porpoises, NMFS should use 120 dB (RMS).
    - Airgun arrays should be treated as a mixed acoustic type, behaving as a multi-pulse source closer to the array. Take thresholds for the impulsive component of airgun noise should be based on peak pressure rather than on RMS.
    - NMFS should produce a sound exposure map representing noise levels at relevant frequencies during the open water season.

A commenter expressed concern about the changes to NMFS new acoustic criteria:

- If NMFS does change the current Level A acoustic criteria, then for MarVib and for oil and gas seismic, NMFS should use the Southall criteria for Level A physical effects. The record for these Southall criteria is clear and supportive, in contrast to the lack of record for the criteria that NMFS is considering.
- The EIS record is inadequate for any informed comment on any changes that NMFS may be considering in acoustic criteria for Level B behavioral effects. The record does not support the need for any more stringent Level B criteria.
- NMFS should always assess the practicability of any changes in acoustic criteria.
- One commenter noted that before NMFS proposes new acoustic criteria, they should include discussion of the benefits and costs of any proposed new criteria. The commenter noted in their opinion that this may be difficult to do because there is no evidence of harm and that there is no record supporting derivation of the new acoustic criteria that NMFS is considering.
- The EIS expressly and inaccurately relies on its Appendix B technical memo to support and explain new Level A physical injury criteria for all sounds. NMFS' reliance is misplaced because

the Appendix B technical memo expressly does not apply to seismic or pile driving, and it never mentions MarVib.

- NMFS has not published new numerical criteria for Level B behavioral effects. However, NMFS has published in the SEIS a discussion of a new approach/methodology for assessing Level B behavioral effects that NMFS is considering for oil and gas operations. This discussion only applies to seismic (pulsed/impulsive). It does not apply to MarVib or to any other non-pulsed/non-impulsive sounds.
- NMFS does not propose any specific numbers for changes to the current 160 dB acoustic criterion for Level B behavioral takes.
- NMFS has not provided enough specifics and detail to allow informed comment at this time on changes to Level B behavioral effects acoustic criteria. It was noted that the current Level B acoustic criteria appear to be adequately protective. The Navy and NMFS use the 160 dB for Navy airguns, and the Navy cannot find any evidence of behavioral effects from its operations.
- There is no rational basis for using revised acoustic criteria that would impede use of MarVib. In order to ensure that this does not happen, NMFS should expressly address MarVib in any proceeding to consider new acoustic criteria.
- Although MarVib is a promising new technology which likely would never replace seismic airguns, NMFS should more fully recognize the advantages of MarVib in any proceeding involving acoustic criteria. The public should have notice of and an opportunity to comment on this proceeding. The record for this proceeding should be transparent, and the proceeding should comply with IQA Guidelines. Of course, these same requirements should apply to any and all proceedings that consider new acoustic criteria.
- Peer review should determine Council for Regulatory Environmental Modeling (CREM) compliance for all models used in any new acoustic criteria similar to what NMFS and the Navy did for the AIM model (http://www.nmfs.noaa.gov/pr/pdfs/permits/lfa_aim_review.pdf).

Response to Comments

Regarding NMFS' revisions of acoustic criteria, in the 2013 SEIS, NMFS indicated we were working on updating acoustic thresholds both for Level A (injury) and Level B Harassment (behavioral), and we intended to incorporate those updates into the FEIS. Since then, NMFS convened both peer-review and Federal Agency review of proposed revised acoustic thresholds for Level A and Level B Harassment. Input from these reviews, as well as further evaluation by NMFS, led us to move forward with the process (including additional peer and public review) for updating acoustic thresholds for Level A Harassment but also recognize that we have significant work left to do on the acoustic thresholds for Level B Harassment, and additional time would be needed. Therefore, the FEIS includes the near-final updated acoustic thresholds for injury (which apply to all activity types, including Marine vibroseis), but not for behavioral harassment, as NMFS is waiting to undertake the behavioral harassment threshold updates until the acoustic injury updates are complete. The 2013 SEIS included consideration of, and referenced, a detailed description of draft acoustic injury thresholds for the public to review at that time. Since that time, those thresholds have been modified through that process based on public and peer review, and the new near-final thresholds are included in this FEIS (see Section 4.2.6.3), as well as consideration of how the new injury thresholds would, or would not, affect our analysis of likely effects of sound exposure on marine mammals.

The process for updating the acoustic injury thresholds provided multiple public comment periods, allowing for and addressing extensive input from the public, including those interested in Arctic oil and gas issues. NMFS included reference to that process, and consideration of preliminary draft thresholds, in the SEIS. This EIS has taken more than six years to complete, and it would have been ineffective and

contrary to the goals of the EIS to wait until the acoustic injury guidance were complete and then publish another draft of this EIS prior to finalization. NMFS is charged with considering the best available science and did that to the best of its ability considering the parallel and long-term nature of these two related projects.

Of note, once the thresholds are final, NMFS will work with all applicants to assist in the transition to the use of the updated injury thresholds. We understand the analyses performed to support MMPA applications sometimes take months to years, and redoing all of the quantitative modeling based on these new thresholds could be expensive and time-consuming. NMFS will work with applicants during this transition period to ensure the best available science is adequately considered and marine mammals adequately protected, while minimizing the negative effects on applicants.

Separately, NMFS conducted an evaluation of how the new thresholds would affect the analyses of the likelihood of acoustic injury for Arctic seismic activities. As described in the EIS, the calculated distances at which one might be concerned Permanent Threshold Shift (PTS) would occur were not far different from those calculated using the older thresholds, most taxa were similar or smaller, and mysticetes were similar and a little larger. This means that our analysis of the likelihood of potential injury does not change much nor does our consideration of the likely effectiveness of the traditional standard shutdown zones. Regarding behavioral harassment thresholds, due to our need to ensure adequate consideration of contextual factors, we have delayed that update and continue to apply the traditional generalized behavioral harassment thresholds, while also qualitatively considering contextual factors.

ISSUE #6. PHYSICAL ENVIRONMENT

Comments on the physical environment primarily addressed concerns regarding air quality and water quality, as well as several concerns related to greenhouse gases such as the persistence of sea ice, changes in sea level, and ocean acidification.

Issue 6A - Air Quality and Emissions

Summary of Comments:

The majority of comments regarding air quality addressed concerns about which pollutants should be targeted for analysis and how and where those pollutants are measured.

- Air quality analysis should include emissions from all vessels associated with oil and gas exploration regardless of whether they are subject to direct regulation or listed on a permit. The use of stack testing results is also recommended.
- Emissions of NO_x and SO_2 should be analyzed, particularly for operators not using ultra-low or low sulfur fuel.
- The analysis should not apply control factors to seismic or G&G surveys because permits have not even been applied for yet.
- Evaluation of potential air impacts is outdated in light of jurisdiction transfer. Some sources would not be subject to EPA regulations or air permitting.
- The air quality impacts analysis should account for CO, PM, NO_x, and $PM_{2.5}$, as well as ozone and secondary particulate matter.
- Using exclusions zones around oil and gas activities would not prevent pollutant levels from exceeding regulatory standards. Air pollution is expected to be highest within the exclusion zone and would likely exceed applicable standards. The EIS should account for these impacts.
- The EIS should consider the full emissions potential of the equipment to be used while operating in the project area.
- The lessee should be granted the authority to use alternative models on a case-by-case basis granted by BOEM to accommodate special circumstances.

Other comments about air quality expressed general concerns about increases in oil and gas activities causing higher levels of pollution.

- One comment stated that oil and gas activities can release numerous pollutants, and the EIS should analyze effects from increased emissions, especially black carbon.
- Comments also stated NMFS should analyze a worst-case scenario for offshore oil and gas activities, and suggested identifying the total number of oil and gas projects that may operate during a single season, the potential proximity of these operations, and the impacts of these multiple and/or clustered operations upon local and regional air quality.
- One comment disagreed with the use of recent draft air permit because the permit does not account for all emissions and impacts.
- Another commenter suggested reviewing recent IHA applications to determine instances when icebreakers are included in seismic, geological, and geophysical surveys and update the air emissions information accordingly.

One comment stated that EPA issued air permits should be required for oil and gas companies who are engaging in exploration operations.

One commenter pointed out a discrepancy in the impact level of emissions from survey vessels and emissions of CO2 from drilling programs. In a table on page 2-52 of the SEIS, NMFS classifies the impacts as negligible to minor, but on page 4-51 of the SEIS NMFS states they are minor to moderate.

One commenter took issue with the description of diesel retrofits reducing emissions on page 4-41 of the SEIS. The commenter asserted that the use of diesel engine retrofits that employ technologies such as Selective Catalytic Reduction, or the use of alternative fuels such as Ultra Low Sulfur Diesel (ULSD), are not known to improve engine performance or fuel economy and have no direct impact on reducing emissions of CO2. In fact, diesel retrofits may cause increased back pressure on engines resulting in reduced engine efficiency, increased fuel consumption, and increases in related CO2 emissions.

One commenter noted the following regarding the discussion of EPA Significant Impact Level (SILs) on Page 4-43 of the SEIS.

- This section cites the definition of Significant Impact Level (SIL) that is used in nonattainment areas (40 CFR 51.165). No nonattainment areas exist onshore for the areas covered by this SEIS. Under EPA rules, exceeding a SIL does not mean the National Ambient Air Quality Standards (NAAQS) are threatened unless you are in a nonattainment area. In attainment areas, exceeding the SILs is acceptable under EPA rules and requires a cumulative impact analysis to determine if NAAQS are exceeded, which is what NEPA guidance requires. The SIL, expressed as an ambient pollutant concentration is used to determine whether the ambient impact of a particular pollutant (once it is determined to be emitted in significant mass amounts) is significant enough to warrant a complete source impact analysis involving modeling the collective impacts of the proposed project and emissions from other existing sources.

Response to Comments:

The air quality analysis includes an inventory of all emissions from sources that would not occur were it not for the proposed project. This includes sources other than those considered for permitting. The Department of Interior (DOI) now has jurisdiction for emissions on the OCS adjacent to the North Slope of Alaska, which includes the Beaufort Sea and Chukchi Sea OCS. Procedures for assessing air emissions under the DOI Air Quality Regulatory Program are found at 30 CFR Part 550 Subpart C. Under the program, no air permit would be issued; rather the air quality analysis submitted by the project proponent would be reviewed and evaluated by a BOEM Alaska air quality specialist, and approval of the proposed plan is evidence of the approved analysis of air quality impacts from the stationary facility. In addition to the analysis required for the proposed facility, the BOEM requires an accounting of emissions from all sources related to the proposed project. This includes emissions from sources on land, sea, and air; both mobile and stationary sources; and both temporary and permanent (or long-term) sources of emissions. There is no provision in the DOI air quality regulatory program for stack testing and such testing is not a requirement under NEPA to disclose project air quality impacts. The EIS contains the newest information regarding federal jurisdiction for air permitting on the OCS.

While operators on the Chukchi Sea and Beaufort Sea OCS would likely use ultra-low sulfur fuel, emissions of NO_x and SO_2 would be included in the air quality assessment.

Consideration of controls for emission sources is intended only for stationary sources, such as drillships and production platforms. The marine engines used for seismic or G&G surveys do not require permits nor control strategies under the DOI Air Quality Regulatory Program (30 CFR Part 550 Subpart C). However, all marine engines are controlled at the OEM (Original Equipment Manufacturer) under MARPOL.

While stationary emission sources on the Arctic OCS are no longer subject to EPA permitting procedures, the sources are regulated under the DOI Air Quality Regulatory Program at 30 CFR Part 550 Subpart C, which incorporates significance thresholds established by the EPA. Under the program, no air permit would be issued; rather the approval of the proposed plan is evidence of the approved analysis of air quality impacts from the stationary facility. The analysis of air quality under the DOI program would be supplemented by the requirements for an air quality assessment for compliance under NEPA.

The air quality assessment, which includes a review of compliance to the DOI Air Quality Regulatory Program, if applicable, would include an assessment of emissions of carbon monoxide (CO), PM (both coarse, PM_{10}, and fine particles, $PM_{2.5}$), NO_x, and volatile organic compounds (VOC). Ozone is a regional phenomenon and is not appropriately addressed on a project level. Assessment of secondary formation of $PM_{2.5}$ is not required under either the DOI Air Quality Regulatory Program or under NEPA. However, BOEM Alaska has initiated a proposal for a comprehensive air emissions dispersion analysis for the Arctic OCS emissions to be competed in Fiscal Year 2018. The study would include an assessment of ozone and secondary formation of $PM_{2.5}$.

The air quality analysis required under the DOI Air Quality Regulatory Program is not limited to an exclusion zone. However, the program is limited to assessment of just the stationary OCS sources, such as the drillship or production platform. The remaining emissions from all other sources are assessed under the NEPA air quality analysis. Both the DOI program and NEPA analysis are designed to report the air quality impacts on the nearest shore and nearest onshore communities.

The air quality assessment would include an impact analysis of emissions from the stationary facility (drillship or platform) and all other emissions associated with the proposed project that would not occur were it not for the operation of the proposed project. Therefore, the air quality assessment would represent disclosure of total project emissions while operating within the program area.

Regarding the use of alternative models on a case-by-case basis, BOEM regulations at 30 CFR 550.218 require that air quality modeling use the guidelines in Appendix W of 40 CFR part 51 with a model approved by the Director.

While it is true that additional oil and gas operations cause additional emissions, each proposed project would be assessed individually and cumulatively to account for total emissions and air quality impacts on the shore.

The air quality assessment accounts for emissions of the criteria pollutants (excluding ozone) and precursor pollutants, namely, carbon monoxide (CO), nitrogen oxides (NO_x), sulfur dioxide (SO_2), coarse particulate matter (PM_{10}) and fine particulate matter ($PM_{2.5}$), and volatile organic compounds (VOC). The EPA requires the reporting of emissions of greenhouse gases (GHG), which would be reported to the EPA independent of the EIS. Studies of black carbon (BC) have been initiated to study effects in the Arctic mainly because deposits of BC on snow and ice prevent the reflection of light (Quinn, Stohl, Arneth, et al., 2011). Thus, BC is considered a factor in Arctic warming. Observation data suggests that the main source of BC particles in the Arctic is originating from high-latitude locations in Eurasia. The highest concentration of particles, also referred to as “Arctic Haze,” occurs in the late winter and early spring because of more efficient transport mechanisms during this time of the year. Oil and gas activities on the Arctic OCS occur in the summer ice-free season and emissions of particulate matter would not be deposited on ice and snow. In addition, BC particles have a lifetime of days to weeks and are not globally well mixed. Further, BC emission estimates are subject to major uncertainties due to knowledge gaps in emissions parameters as well as activities in major emitting sectors. Consequently, emissions from short-term summer drilling on the Arctic OCS are unlikely to cause a measurable increase in the formation or effect of BC and no analysis of impacts due to BC are included in the assessment of air quality impacts.

The air quality assessment of proposed projects on the OCS reflect worst-case scenarios and include emissions from all vessels operating within the entire program area that are associated specifically with a specific proposed project.

The discrepancy noted by a commenter regarding the impact level of emissions from survey vessels and emissions of CO_2 from drilling programs has been corrected in the FEIS. New text has been inserted into the document in Section 4.5.1.3.3 to provide clarification and documentation for the use of ULSD and after-market control technologies to lower emissions. The discussion of SIL has been deleted from the document.

Reference to the air quality analysis included with the application for an EPA air permit by ConocoPhillips has been deleted from the EIS.

Issue 6B - Water Quality and Discharges

Summary of Comments:

Several comments addressed the concept of zero discharge.

- The term “zero discharge” as used is confusing; there would be some discharge under any exploration scenario.
- Require that zero discharge technology be implemented for all drilling proposals to protect water quality and subsistence resources.
- Using the best management practice of near-zero discharge, as is being implemented by Shell in Camden Bay in the Beaufort Sea, would be the best method for mitigating impacts to marine mammals and ensuring that habitat is kept as clean and healthy as possible.
- It is not clear how zero discharge would be regulated since the EPA has already issued an NPDES General Permit for both the Beaufort and Chukchi Seas. This approach also appears to conflict with the BOEM approval of Shell's Chukchi Sea Exploration Plan which notes that "impacts to marine water quality from the proposed action are expected to be highly localized and minor." In addition, BOEM also noted "The effects are below thresholds that define significant effects for water quality defined in Appendix B of the EA. "
- The mitigation measure related to discharge of drilling muds does not address the current industry plan of recycling muds and then discharging any unused or remaining muds at the end of the season. At the very least, no drilling muds should be discharged.
- Recycling of drilling muds should not become mandatory as it is not appropriate for all programs. Drilling mud discharges are already regulated by the EPA NPDES program and are not harmful to marine mammals or the availability of marine mammals for subsistence.
- There is little to no effects analysis of permitted discharges or mitigation measures that would support requiring recycling of drilling muds.
- NMFS should confer with EPA regarding the proposed zero discharge limitation.
- More stringent regulation of marine vessel discharge is needed for exploratory drilling operations, support vessels, and other operations to eliminate possible environmental contamination through the introduction of pathogens and foreign organisms through ballast water, waste water, sewage, and other discharge streams.
- There should be no on-ice discharge of drilling muds due to the concentrated nature of waste and some likely probability of directly contacting marine mammals or other wildlife like Arctic foxes

and birds. Even if the muds are considered non-toxic, the potential for fouling fur and feathers and impeding thermal regulation properties seems a reasonable concern.

- Discharges associated with exploration are authorized under General Permits, and the EPA has determined that these discharges would not result in unreasonable degradation to the marine environment. The EPA has promulgated regulations to ensure discharges regulated through the NPDES do not cause unreasonable degradation. It represents a mandate and an independent assessment of the impacts by a separate agency that the impacts from discharges would be negligible to minor and should be incorporated into the Environmental Consequences sections of the EIS that address the potential effects of discharges.
- Section 4.5.1.5.2 of the SEIS concludes that effects of water quality in the proposed action area from oil and gas activities are expected to be negligible. It is not clear how this statement squares with the proposed additional mitigation measures proposed elsewhere that would restrict certain exploration drilling discharges. By making this conclusion about water quality, it does not appear that those previously discussed restrictions are justified.

One comment on water quality and discharges expressed concerns about increases in oil and gas activities leading to higher levels of pollution (through discharges, oil spills, and drill cuttings).

Another commenter noted that drilling substances are toxic and kill all life, therefore all drilling should be banned, specifically noting that mercury is extremely toxic.

Response to Comments:

BOEM conducts a NEPA analysis of all new exploration plans and applications to conduct geological and geophysical activities, including analysis of cumulative effects as defined by CEQ regulations at 40 CFR 1508.7:

> "Cumulative impact" is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions.

The definition of the term “zero discharge” is discussed in Section 2.5.4 of the EIS and in numerous other documents such as EPA’s biological evaluations for NPDES general permits, and various environmental assessments and environmental impact statements authored by NMFS and BOEM. Section 2.5.4 of the EIS describes the effects of offshore oil and gas exploration activities in the U.S. Beaufort and Chukchi Seas and explains the origination of the term “zero discharge” in this context. In Section 2.5.4 of the EIS, establishing an alternative built around the requirement for zero discharge from exploration drilling activities that may occur in the EIS project area was considered and dismissed from further consideration. Rather, the EIS considers, as additional mitigation measures, the reduction, limitation, and/or zero discharge of specific discharge streams. The inclusion of such mitigation measures would be analyzed on a case-by-case basis when specific MMPA ITA applications are submitted to NMFS. The FEIS contains a detailed analysis of each mitigation measure presented in the EIS. The analysis for each potential mitigation measure includes: a description of which activities it would be applied to; the purpose of the measure; the science, support for reduction of impacts, and likely effectiveness of the measure; the practicability of implementing the measure; a history of the measure’s implementation; and NMFS’ rationale for categorizing the mitigation measure as a standard measure, an additional measure, or one dismissed from further consideration in the EIS. Regarding this specific mitigation measure, we kept it in the additional mitigation measure category. Part of our rationale reads: “We recommend further study and evaluation before requiring large scale implementation of this measure.” Our full explanation and rationale for this decision can be found in Section 4.5.2.4.16 of the FEIS. Including this mitigation measure does not contradict the conclusions regarding the effects of the proposed action on water quality. Our decision to include this additional mitigation measure was based on potential impacts to marine mammals not on water quality.

The NPDES Arctic General Permit includes restrictions specific to the discharges of drilling muds and drill cuttings, and effluent limitations and monitoring requirements for all authorized discharges. The EPA has also developed biological evaluations during the analysis and decision making of the NPDES General Permit for both the Beaufort and Chukchi Seas, for ESA consultations, and extensive public and stakeholder outreach, tribal consultations, and gathering of traditional knowledge data collection by the EPA Region 10 Office regarding the permit action, restrictions, requirements, and the discharge limitations discussed within this document. The analyses concluded that the discharges would not cause an unreasonable degradation of the marine environment.

Any lessee-proposed OCS activities would be subject to appropriate EPA permitting requirements and limitations. The need for any additional restrictions on discharges would be considered on a case-by-case basis when specific proposed activities are evaluated.

Vessel discharges are regulated under EPA's NPDES Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels (VGP). The EPA signed the current VGP on March 28, 2013, to replace the 2008 VGP when it expired on December 19, 2013. The 2013 VGP expires on December 18, 2018 and provides NPDES permit coverage nationwide for discharges incidental to the normal operation of commercial vessels greater than 79 feet in length. EPA's VGP is only applicable within three nautical miles. Discharges from vessels in the OCS are regulated by the U.S. Coast Guard.

The Non-indigenous Aquatic Nuisance Prevention and Control Act (NANPCA) (16 U.S.C. 4701-4751) was passed in 1990 and amended by the National Invasive Species Act of 1996 (NISA). The U.S. Coast Guard developed regulations (33 CFR 151) that implement provisions of the Act and amendment. Vessels brought into the State of Alaska or federal waters are subject to these Coast Guard regulations, which are intended to reduce the transfer of invasive species. The regulations require the "removal of fouling organisms from hull, piping, and tanks on a regular basis and dispose of any removed substances in accordance with local, state, and federal regulations." The regulations, however, do not specifically call for the same removal procedures for ocean-bottom cables or seismic equipment.

Issue 6C - Climate Change

Summary of Comments:

Several comments expressed concerns about impacts related to climate change, such as reductions in sea ice, changes in sea levels, and ocean acidification.

- EIS should analyze impacts associated with sea ice loss and warming Arctic sea water.
- EIS should analyze differences in impacts from oil and gas activities during high ice years and low ice years.
- Effects of GHG (particularly sea level rise and ocean acidification) are a concern.
- It is difficult to understand how the action alternatives would have an impact on climate, with limited oil production in the given time frame. Even if the analysis were to be extended through full production, the incremental GHG emissions from combustion of the oil produced would be minor.
- All aspects of climate change altering the Arctic environment need to be fully considered.
- If oil and gas production is being called "ecosystem goods", then the "ecosystem costs" of that production must also be examined for a true, sober analysis.
- The evaluation of impacts from the proposed activity levels should be reexamined, since they are applied inconsistently in regards to climate change.

- Ocean acidification is of great concern, and it is imperative that this impact of climate change be discussed in the EIS.
- The public is given the impression that agency action would make no difference in climate change, but this circumvents NEPA's purpose and prevents the consideration and adoption of solutions which could mitigate future harm.
- The remote Arctic Ocean and its wildlife are already under great stress from climate change. It is no place to search for more oil to burn, which would only exacerbate the effects of climate change that are already threatening the area. The climatic changes are weakening the Arctic's ability to handle the stresses oil companies' presence causes. The entire environment of the ocean is weakened because food sources are changing, water chemistry is changing, and temperatures are changing. Summarily, the Arctic Ocean wildlife, plant life, and integrity are challenged. It could not withstand the threats involved with oil acquisition and ancient technology.

Response to Comments:

There is extensive discussion of climate and meteorological data and their implications for climate change, changes in sea levels, and ocean acidification throughout Chapters 3 and 4 of the EIS. NMFS and all federal regulatory agencies share these concerns regarding warming, reduced sea ice, increased open water periods, areal extents of open water, and, in general, the potential changes resulting from anthropogenic effects. Chapters 3 and 4 provide extensive affected environment descriptions and environmental consequences of oil and gas exploration activities in the Beaufort and Chukchi seas regarding changing sea ice, climate conditions, and ocean acidification. Project related effects in regards to climate change are discussed, and the best available scientific information was utilized in the process of analysis. The most current sea-ice extent data, including the loss of multi-year ice during the 2007 winter season and the long term cycles in ice cover, have been discussed at length in the EIS.

ISSUE #7. BIOLOGICAL RESOURCES

Comments on biological resources predominantly addressed introduced sound and potential effects on whales, but a variety of other comments expressed specific concerns regarding walrus, seals, fish, invertebrates, and habitats in general.

Impacts on Marine Mammals

Many comments addressed the potential effects of oil and gas activities on marine mammals. In the majority, these comments expressed concerns regarding the introduction of anthropogenic sound to the marine environment (primarily for cetaceans), but other comments also addressed potential disturbance or injury by aircraft and ships themselves, rather than strictly introduced sound.

Issue 7A - Introduced Sound (Includes Bowhead Whales)

Summary of Comments

In general, these comments suggested concerns regarding wide-ranging impacts of repeated and persistent introductions of sound and a lack of knowledge about the various ways that introduced sound could impinge on behavior and affect populations. Some of these comments addressed general issues with respect to behavioral disturbance and population level effects, including concerns over potential greater vulnerability of bowhead mothers and calves to disturbance, while many others were specifically concerned with the application of threshold levels and distance limitations. One general comment suggested that analysis of potential impacts at this stage is speculative at best because of lack of definitive information regarding sound source levels, the type and duration of proposed exploration activities, and mitigation measures. The majority of comments addressed concerns regarding seismic surveys, threshold levels, and their potential effects on whales, in particular bowhead whales. One comment asserted that it is important for NMFS to look at the possibility of affecting a global population of marine mammals.

Many general comments on the potential for disturbance to marine mammals from introduced sound argued for the inadequacy of current levels of protection against adverse impacts:

- All industrial activity is not the same. Some activities are louder (i.e., seismic) than others (i.e., echosounders for imaging the bathymetry). Additionally, the qualities and frequencies of sound differ among activities. Thus, some activities would likely have more of an impact on marine mammals than others.
- Noise impacts on key habitats and important biological behaviors of marine mammals (e.g., breeding, feeding, communicating) could cause detrimental effects at the population level. Consider the following:
    - According to an IWC Scientific Committee report, repeated and persistent exposure of noise across a large area could cause detrimental impacts to marine mammal populations.
    - A recent study associated reduced underwater noise with a reduction in stress hormones, providing evidence that noise may contribute to long-term stress (negatively affecting growth, immune response to diseases, and reproduction) for individuals and populations.
    - NMFS must assess how industrial activities affect annual rates of recruitment and survival.
- Most marine mammals primarily rely on their acoustic sense, and they would likely suffer more from noise exposure than other species. While marine mammals have seemingly developed strategies to deal with noise and related shipping traffic (e.g., changing vocalizations, shifting migration paths, etc.), the fact that some species have been exposed to anthropogenic changes for

only one generation (e.g., bowhead whales) makes it unlikely that they have developed coping mechanisms appropriate to meet novel environmental pressures, such as noise. Marine mammals living in relatively pristine environments, such as the Arctic Ocean, and have less experience with noise and shipping traffic may experience magnified impacts.

- The lack of observed avoidance is not necessarily indicative of a lack of impact (e.g., animals that have a learned tolerance of sound and remain in biologically important areas may still incur physiological [stress] costs from exposure or suffer significant communication masking). NMFS should exhibit caution when interpreting these cases.
- Conclusions that behavioral responses of bowhead are "expected to be temporary" are unsupported by data and should be explained.
- Effects from multiple years of exploration drilling are considered "long-term" in the acoustic environment section, but not so in the bowhead whales section.
- The EIS should compare the extent of past activities and the amount of noise produced to what is projected with the proposed activities under the alternatives, and the EIS must also consider the fact that the bowhead population may be approaching carrying capacity, potentially altering the degree to which it can withstand repeated disturbances.
- NMFS should include information in the EIS on the existence of valid scientific studies on whether prior industrial activity affected the bowhead whale stock in any way.
- The EIS should consider the impacts of sub-bottom profilers and other active acoustic sources commonly featured in deep-penetration seismic and shallow hazard surveys. EIS should contain more discussion of the combined effects of drilling and ice management, and the resulting disturbance zones. Thruster-stabilized platforms for deep-water drilling also need to be considered.
- More effort should concentrate on managing noise using consensus-based standards (rather than agency-specific standards), consistent with the US National Technology Transfer and Advancement Act.
- There needs to be more analysis of noise and other disturbance effects specific to harbor porpoise; the EIS acknowledges that harbor porpoise have higher relative abundance in the Chukchi Sea than other marine mammals.
- The perpetuation of this flawed line of reasoning is seen where it states that preliminary analyses by Christie et al. (2009) and Koski et al. (2009) showed a stronger tendency for migrating whales to avoid operating airguns than feeding whales. The EIS fails to mention that these traveling whales all entered and moved through the 120 dB (rms) sound level. The EIS then cites a 2008 MMS document to say most whales would be expected to avoid the sound source at 116 to 135 dB (rms) without ever analyzing and using the new data. Clearly sound level is not the only factor influencing whale deflections around seismic sound sources.
- Icebreaking equipment associated with shipping in the Bering Strait during winter could have significant impacts on marine mammals.
- The disruption or take of marine mammals in the water from noise generated by helicopters and other heavy load aircraft is not adequately addressed.

Threshold levels and distance limitations were concerns expressed in many comments. In the majority, these advocated changes to increase protective levels for marine mammals:

- When determining what constitutes Level B take, NMFS should consider the frequency component, nature of the sound source, cetacean hearing sensitivities, and biological significance.

The 160 dB threshold is antiquated and should be replaced by a combination of Sound Exposure Level limits and Peak (not RMS) Sound Pressure Levels or other metrics.

- NMFS must more precisely define a Level B take and establish rational criteria to support presumptions that takes result from exploration activities.
- NMFS should thoroughly evaluate "masking" effects of industrial activities, such as loss of communication space and energetic costs of masking, associated far lower received levels than the EIS currently employs. Masking is not adequately analyzed in impact analyses.
- Masking thresholds should be derived from Clark et al. (2009), recognizing that masking begins when received levels rise above ambient noise.
- The range of airgun volumes, source levels, and distances to the 190-, 180-, 160-, and 120- dB re 1uPa harassment thresholds vary markedly and cannot be used to determine with any confidence the full extent of harassment of marine mammals. NMFS should work with BOEM to estimate the site-specific acoustic footprints for each sound threshold and the expected number of marine mammal takes, accounting for all sound sources and their cumulative impacts.
- In the SEIS, NMFS failed to calculate acoustic footprints for specific activities and to estimate takes for all sounds sources (i.e., vertical seismic profilers, vertical cable surveys).
- The number of estimated takes in the SEIS raises significant concerns for affected populations.
- Modeling of site-specific parameters is not possible using information in the programmatic assessment.
- Seismic airgun surveys are more disruptive to marine mammals than suggested by the "unlikely impacts" evaluation peppered throughout the EIS:
    - They are known to disrupt foraging behavior at distances greater than the typical 1000 meter observation/mitigation threshold.
    - Behavioral disturbance of bowhead whales have been observed at distances of 7 km to 35 km.
    - Marine mammals are seen in significantly lower numbers during seismic surveys indicating impacts beyond the standard 1000 meter mitigation set-back.
    - Impacts may vary depending on circumstances and conditions and should not be dismissed just because of a few studies that indicate only "negligible" impacts.
- The EIS must further explore a threat of biologically significant effects, since as much as 25 percent of the EIS project area could be exposed to 120 dB sound levels known to provoke significant behavioral reactions in migrating bowhead whales, multiple activities could result in large numbers of bowhead whales potentially excluded from feeding habitat, exploration activities would occur annually over the life of the EIS, and there is a high likelihood of drilling around Camden Bay.
- The EIS fails to reflect research that contradicts the findings in Richardson et al. (1990); fails to address deficiencies in the Richardson et al. (1999) study; and fails to consider newer studies challenging the assertion that bowhead whales commonly deflect around industry sound sources.
- Analysis in Section 4.5.2.4.9.1 of the SEIS should incorporate monitoring data from more recent site clearance / shallow hazard surveys.
- In the Arctic, sound levels follow a highly distinct seasonal pattern dominated in winter by ice-related sound and then altered by sound from wind, waves, vessels, seismic surveys, and drilling

in the open-water period. The sound signatures (i.e., frequency, intensity, duration, variability) of the various sources are either well known or easily described and, for any given region, they should be relatively predictable. The primary source of anthropogenic sound in the Arctic during the open-water season is oil and gas-related seismic activity, and those activities can elevate sound levels by 2-8 dB (Roth et al. 2012). NMFS and BOEM should be able to compare seasonal variations in the Arctic soundscape to the movement patterns and natural histories of marine mammals and to subsistence hunting patterns.

- NMFS needs to consider the full complement of vessels involved in an operation (e.g., drill ship with crew change vessels, ice management vessels, oil response vessels, fuel barges) as a source of continuous noise that needs to be quieter than 120 dB.
- Potential impacts of increased use of mid-frequency or upper mid- to high-frequency industrial communication sonars and multibeam echosounders must be evaluated.
- NMFS should conduct more rigorous analysis for birds and mammals and look at how multiple surveys interact to modify marine mammal foraging.

Other general comments contradicted assertions that the expected levels of introduced sound might seriously affect the behavior, and consequently the populations, of marine mammals. One comment argued that that there is no evidence of any biologically significant impacts at the individual or population level. Another noted contradictory statements regarding potential injurious sound levels being more likely in the Beaufort Sea, despite the lack of long-term or cumulative effects from past and current activity. The rest of the comments addressed the temporary and short-term nature of the effects, rapid recoveries, lack of evidence for effects, and generally argued that effects are negligible and populations of whales are stable:

- Oil and gas leasing, exploration, and development in the Arctic Ocean has had no known adverse impact on marine mammal species and stocks, and the reasonably anticipated impacts to marine mammals from OCS exploration activities occurring in the next five years are, at most, negligible.
- Seismic operations are most often in timescales of weeks and reduce the possibility of significant displacement since they do not persist in an area for an extended period of time. However, little evidence of area-wide displacement exists or has been demonstrated.
- There is no scientific support whatsoever for any assumption or speculation that seismic operations have such impacts or could result in the loss or injury of a whale. To the contrary, all of the scientific evidence shows that seismic and other anthropogenic activities, including commercial whaling, have not been shown to cause the separation or abandonment of cow/calf pairs.
- The western bowhead whale population has been increasing for over 20 years, suggesting impacts of oil and gas industry on individual survival and reproduction in the past have likely been minor. The suggestion that exploration activities may cause changes in migration patterns, displacement from important feeding and resting areas, and separation of mothers and calves is overstated.
- These activities are unlikely to have any effect on the other four stocks of bowhead whales. Only the western North Pacific stock of humpback whales and the Northeast Pacific stock of fin whales would be potentially affected by oil and gas leasing and exploration activities in the Chukchi Sea. There would be no effect on the remaining worldwide stocks of humpback or fin whales.
- Most impacts would be due to harassment of whales, which may lead to behavioral reactions from which recovery is fairly rapid.
- The EIS overstates the potential for oil and gas activities to introduce sound into the environment.

- There is no reference of research data that proves the propagated sound waves from airguns may harm marine life during operations. Include citation stating that airguns are under scrutiny for their potential to harm marine life.
- Short-term avoidance should not be confused with displacement and the impact of minor displacement on hunting should not be confused with what is biologically significant to marine mammals. There is no evidence of area-wide displacement.
- The implication that takes occur at lower sound levels than recognized by NMFS in their regulations exaggerates the potential for takes and potential consequences of takes, as well as potential cumulative effects of overlapping areas of sound.

A few comments regarding threshold levels and distance limitations argued that avoidance behavior was protective and the significance of such behavioral impacts to populations is minor. Further, the suggestion was made that deflection distances are overstated and not supported by the data:

- The EIS analysis does not adequately consider the fact that many animals avoid vessels regardless of whether they are emitting loud sounds and may increase that avoidance distance during seismic operations (Richardson et al. 2011). Therefore, it should be a reasonable assumption that natural avoidance serves to provide another level of protection to the animals. There is no evidence that whales remain within harmful sound levels, regardless of the amount of food present.
- The 120 dB threshold may represent a lower level at which some individual marine mammals would exhibit minor avoidance responses. While this avoidance might, in some but not all circumstances, be meaningful to a native hunter, scientific research does not indicate dramatic responses in most animals. In fact, the detailed statistical analyses often needed to confirm subtle changes in direction are not available. The significance of a limited avoidance response (to the animal) likely is minor (Richardson et al. 2011).
- Bowhead whales do not routinely deflect 20 kilometers from seismic operations. The EIS asserts that bowhead whales have rarely been observed within 20 kilometers of active seismic operations but fails to utilize other information that challenge the validity of this assertion. Section 4.10.5.4.4 of the DEIS does not provide any distances or data to support its suggestion that marine mammals may have trouble navigating between seismic surveys and drill operations because of overlapping sound signatures. The SEIS is not clear on whether this purported avoidance is significant to the individual whale.
- There is insufficient scientific evidence to justify a decision that all animals within a 160 dB ensonified area should be considered a biological or statutory take; this level is overly cautious and unrealistically overstates impacts.
- The proposed 120 dB sound level for a behavioral effects threshold is often below ambient sound levels in the Arctic.

Response to Comments:

NMFS is concerned about the potential impacts of oil and gas activities on marine mammals. Since 1968, there have been more than 250 seismic surveys conducted in the Arctic OCS by industry, academia, and the government (BOEM 2012, NGDC 2012). The highest levels of activity (seismic and exploration drilling) occurred in the early- to mid-1980s. In addition, there are a substantial number of barges that provide fuel and goods to the villages in every open water season. Yet there is no evidence that the bowhead whale population has been harmed by these activities or the sound associated with oil and gas exploration. The most recent estimate of abundance derived from an ice-based census in 2011 was 16,892 bowhead whales in the Western Arctic stock (Givens et al. 2013). This is a substantial increase over the previous estimate from the 2001 ice-based census of 10,470 bowhead whales (George et al.

2004), which was subsequently revised to 10,545 bowhead whales (Zeh and Punt 2004, cited in Allen and Angliss 2011). The estimated annual rate of increase from 1978 to 2001 was 3.4 percent, during which time abundance doubled from approximately 5,000 to approximately 10,000 whales (George et al. 2004). The estimated rate of increase from 1978 to 2011 is 3.7 percent (Givens et al. 2013).

NMFS uses the best scientific information available to conduct impact analyses. Section 4.5.2.4 of the FEIS contains a robust discussion of known and potential impacts of oil and gas exploration activities on marine mammals, including bowhead whales. The analyses take into account the different types of activities and sound sources that could be used during seismic surveys, ancillary activities, and exploratory drilling, which include descriptions of studies regarding responses to aircraft and helicopters, vessel movements, and icebreakers, as well as sub-bottom profilers, echosounders, and side scan sonars. Moreover, the analyses consider whether the activities may impact marine mammal habitats, which include food sources and the "acoustic" habitat wherein marine mammals use acoustic cues to detect prey and predators, communicate with conspecifics, navigate, and for other important functions. The specific subsections within Section 4.5.2.4 contain more detailed analyses of these issues for each species or marine mammal group. In the case where more recent science has become available since publication of the SEIS, or more recent analyses were conducted (e.g., chronic and cumulative acoustic analysis, see Section 4.5.2.4.9 of the FEIS), we updated the relevant sections in Chapters 3 and 4 with that information, including newer information on harbor porpoise and belugas, as recommended by commenters. Additionally, Chapter 4 contains a discussion of a conceptual framework illustrating how disturbance effects *can* translate to effects on vital rates of individuals in certain circumstances (e.g., different contexts or scales), which can then result in population level consequences if enough individuals are impacted in ways that impact reproduction or survivorship. Alternately, our analysis also points out where mitigation or specific operational parameters minimize the likelihood of more severe effects from the proposed activities and where data indicate that specific populations of marine mammals have been increasing in recent years (suggesting a lack of adverse population-level effects at the current levels of activity). The baseline information in Chapter 3 notes which stocks of each species is likely to occur in the EIS project area. Only the Western Arctic stock or BCB stock of bowhead whales would occur in the EIS project area. Therefore, impacts are not anticipated to any other stock of bowhead whales from the activities analyzed in this EIS.

In response to public comments that NMFS should better analyze the effects of masking (where higher background noise levels inhibit reception or interpretation of critical acoustic cues) in addition to the more direct physiological and behavioral effects of sound exposure, NMFS conducted a first-order assessment of the chronic and cumulative effects of noise produced by oil and gas exploration activities in the Beaufort and Chukchi Seas. As described in Section 4.5.2.4.9 of the FEIS, modeling was conducted for a 3.5-month period (July through mid-October) for 10 locations (receiver sites) of biological importance and for six scenarios corresponding to alternatives in this EIS. "Lost listening area" was calculated among scenarios and relative to a baseline ambient noise estimate and considered the hearing sensitivity of low and mid-frequency cetaceans. "Lost communication space" was calculated among scenarios and relative to ambient estimates for a 1/3 octave band representing dominant frequencies of bowhead whale vocalizations. Broadly, as indicated in more detail in Section 4.5.2.4.9 of the FEIS, results for all three activity levels indicate substantial losses in listening area for both mid- and low-frequency marine mammal species at the three eastern-most sites, with lesser losses and no losses at the other seven sites. Bowhead communication space did not notably decrease at any site except site 8 (bowhead migration route with cow-calf pairs) at the deeper depth. The complete report is attached as Appendix F of the FEIS (Cumulative and Chronic Effects in the Arctic). Excerpts of the results are included in Section 4.5.2.4.9 of the FEIS and are referenced elsewhere in the document, both in relation to changes in the acoustic environment and in potential impacts on marine mammal species. Additional public review (via the MMPA ITA process), and potentially peer review, of the methods, assumptions, and possible interpretations included in this approach will be solicited in order to ensure appropriate consideration and application of this analysis in a management context.

The analyses take into consideration the fact that different activities use different types of sound sources (e.g., airguns for seismic surveys or drillships/drill rigs for exploratory drilling) and that different responses may occur based on the type of equipment used. While this EIS does not address specific proposals, MMPA ITA applications over the last decade have included fairly similar types of equipment, and this EIS includes a comprehensive assessment of the types of devices likely to be used in the foreseeable future for these activities. Therefore, the analysis of impacts is not too speculative at this time. Additionally, more targeted analyses will be conducted when individual proposals are received at the MMPA stage.

With respect to the extent of past activities and projected activities under the alternatives, there were 137 industry open-water marine seismic surveys (2D, 3D, and high-resolution) in the Beaufort Sea between 1969 and 2000 and 57 in the Chukchi Sea between 1969 and 1990. The maximum number of surveys in a single year was 16, which occurred in 1984 in the Beaufort Sea. Between 2006 and 2015, there have been 13 open-water marine seismic surveys in the Beaufort Sea, and 14 in the Chukchi Sea: that is a 90.5 percent and 75.5 percent decrease in the number of survey activities respectively in recent times. These numbers do not include 44 scientific surveys conducted between 1969 and 2011. Even Alternative 4 only posits six new Beaufort and five new Chukchi seismic surveys per year—this still represents a substantial reduction compared with past levels of activity when they were at their highest level.

Section 4.5.2.4.3 of the FEIS discusses potential effects of echosounders, sub-bottom profilers, and side scan sonars on marine mammals. Where species specific information is available about the effects of these devices that information is included in the specific species sections. In the past, these devices have been used in conjunction with seismic airguns. Because their ranges to both injury and harassment thresholds are smaller than seismic airguns, their effects have been considered subsumed by the seismic pulses. Alternately, when sometimes operated for small amounts of time when seismic airguns are not in use, the smaller degree of effects (which are the similar in nature to those analyzed for seismic airguns) have been expected to be covered by the authorized take estimate. . When and if these sources are used at greater scales or for longer time periods, the effects will be quantitatively considered through the MMPA ITA process.

In order to issue an ITA under Section 101(a)(5) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and the availability of such species or stock for taking for certain subsistence uses.

To reduce the potential for disturbance from acoustic stimuli associated with the activities and to reduce the potential for biologically significant impacts, NMFS requires the implementation of mitigation measures in the issued MMPA ITAs. This EIS analyzes a suite of standard and additional mitigation measures to ensure that impacts are at the lowest level practicable. Some examples of standard mitigation measures that are implemented to reduce impacts from acoustic sources for marine mammals include: (1) exclusion zones; (2) power-down procedures; (3) shutdown procedures; and (4) ramp-up procedures. All of the mitigation measures are described in Appendix E of the FEIS, with full analyses of each measure contained in Chapter 4.

Issue 7B - Beluga Whales

Summary of Comments:

Several comments expressed specific concerns with respect to beluga whales from noise and disturbance. Generally, if noise disrupts important behaviors (mating, nursing, or feeding), or if animals are displaced from important habitat over long periods of time, then impacts from noise and disturbance could affect

the long-term survival of populations. As noted in one comment, beluga whales are known to avoid seismic surveys at distances greater than 10 km. Further, ice management, they asserted, has the potential to disturb significant numbers of beluga whales. The EIS does not discuss the beluga whales' well-documented reaction to ships and ice breakers in the context of surveying with ice breaker support or exploratory drilling. Finally, they argue that beluga whales' strong reactions to higher frequencies illustrate the failure of the EIS to calculate ensonified zones for sub-bottom profilers, side scan sonar, and echosounders.

Response to Comments:

Seismic surveys produce transient disturbances on the seascape primarily because vessels must stay in constant motion in order to engage in seismic surveying activities over a large area. Seismic survey vessels typically do not operate in areas with extensive sea ice, and, furthermore, during the open water season most belugas would be found using Kasegaluk Lagoon or would be along the OCS shelf break. BOEM has not leased any areas near the shelf break or Ledyard Bay Critical Habitat Unit (LBCHU), which includes Kasegaluk Lagoon. Moreover, the LBCHU is a protected area for Spectacled Eider ducks, and, currently, BOEM cannot permit OCS activities within that area. Consequently, there could not be any ice management or ice breaking within LBCHU, and, without leases near the OCS shelf break, there is very little commercial impetus to engage in seismic surveying that far north of the existing OCS leases in the Chukchi or Beaufort Seas.

Section 4.5.2.4.11 of the FEIS contains an analysis of potential impacts and discusses the science regarding beluga whale reactions to ships and icebreakers. While Finley and Green (1993) have clearly shown belugas reacting to icebreaking from 50 km (31 mi) away, the same rule cannot be perfectly applied to ice management, which is the ice-related activity typically anticipated during the open water season. Unlike icebreaking, which relies on an icebreaker ship smashing through areas of sea ice, ice management involves pushing or diverting ice away from operations at a relatively slow speed. Consequently, ice management activities are expected to be much "quieter" than icebreaking activities, resulting in a much smaller area of effects on beluga whales. Though similar in that they both involve the use of ships with icebreaking capabilities, the two activities are very different, as are the disturbances created by these different activities.

This distinction is described in a NMFS proposed IHA notice (76 FR 68974, November 7, 2011):

> Measurements of the icebreaking supply ship Robert Lemeur pushing and breaking ice during exploration drilling operations in the Beaufort Sea in 1986 resulted in an estimated broadband source level of 193 dB re 1 mPa at 1 m (Greene, 1987a; Richardson et al., 1995a).
>
> Sound levels during ice management activities would not be as intense as during icebreaking, and the resulting effects to marine species would be less significant in comparison. During ice management, the vessel's propeller is rotating at approximately 15–20 percent of the vessel's propeller rotation capacity. Instead of actually breaking ice, during ice management, the vessel redirects and repositions the ice by pushing it away from the direction of the drillship at slow speeds so that the ice floe does not slip past the vessel bow. Basically, ice management occurs at slower speed, lower power, and slower propeller rotation speed (i.e., lower cavitation), allowing for fewer repositions of the vessel, thereby reducing cavitation effects in the water than would occur during icebreaking.

The area of effect for sub-bottom profilers, side scan sonar, and echo-sounders are typically very limited compared to actual seismic surveys since the sound produced by these devices is focused and produced on a much smaller scale than with airgun arrays (see also response to 7A immediately above regarding how these sources are typically addressed in MMPA authorizations). Usually they would only be used for brief periods of time to obtain more high-resolution data from the substrate in a highly localized area, usually measured in 10's of meters. Consequently, because of the narrow focus, brevity, and small area of additional noise production, the effects from the use of sub-bottom profilers, side scan sonars, and echo-sounders would be so greatly reduced as to be negligible to practically non-existent. To the

commenter's question, NMFS is unaware of studies indicating especially strong reactions to these higher frequency sources of a nature not already considered in Section 4.5.2.4.11. Section 3.2.4.2 contains more detailed information on the hearing capabilities of beluga whales.

Issue 7C - Gray Whales

Summary of comments:

One comment addressed the gray whale, asserting that gray whales need more specific attention in the analysis rather than being lumped in with other cetaceans. The comment asserted the EIS analysis for gray whales is faulty in the following ways:

- Contrary to what the EIS claims (without support), gray whale feeding and migration patterns do not closely mimic those of bowhead whales: gray whales migrate south to Mexico and typically no farther north than the Chukchi Sea, and are primarily benthic feeders.
- Analysis of the effects for Alternatives 2 and 3 does not discuss either the gray whale's reliance on the Chukchi Sea for its feeding or its documented preference for Hanna Shoal.
- The EIS states that both populations (bowhead and gray whale) increased despite previous exploration activities. Gray whale numbers, however, have declined since Endangered Species Act (ESA) protections were removed in 1994, and there is speculation that the population is responding to environmental limitations.
- Gray whales can be disturbed by very low levels of industrial noise, with feeding disruptions occurring at noise levels of 110 dB.

The same comment went on to suggest that the EIS needs to more adequately consider effects of activities and possible closure areas in the Chukchi Sea (e.g., Hanna Shoal) on gray whales. When discussing the possibility that area closures could concentrate effects elsewhere, the EIS focuses on the Beaufort Sea, such as on the Beaufort shelf between Harrison Bay and Camden Bay during those time periods.

Another commenter suggested that gray whale prey would be destroyed by an oil spill.

Response to Comments:

Gray whale and bowhead feeding and migration patterns are substantially different, and the text of the Final EIS has been modified accordingly. Chapter 3 of the FEIS (Section 3.2.4.2) describes the migratory path and feeding areas of the eastern Pacific stock of gray whales. This section also explains that 20 years ago gray whales were commonly observed in the vicinity of Hanna Shoal, unlike current observations showing their highest numbers within 50 miles of the Chukchi coast in the eastern Chukchi Sea. This change has occurred despite a current population that is much larger than the gray whale population 20 years ago. The reasons for the shift in gray whales from Hanna Shoal to the Chukchi Sea coastal areas are unclear.

While gray whale numbers have declined since being de-listed from the ESA in 1994, counts of gray whales peaked in 1997/1998 at 29,758, before dropping to 18,178 in the 2001/2002 survey. However, counts in 2006/07 were 19,126 and in 2010/11 were 20,990 (Durban et al. 2013; Laake et al. 2009). While the observed declines may very well be due to the population reaching or exceeding the carrying capacity of their environment, this cause-effect linkage remains speculative at this point and as such it is not appropriate in this analysis. Please see Section 3.2.4.2 for coverage of this topic.

The impacts of seismic survey noise are discussed in Section 4.5.2.4.12.1 of the FEIS where it states:

> Malme et al. (1986) studied the responses of feeding eastern gray whales to pulses from a single 100 in^3 airgun off St. Lawrence Island in the northern Bering Sea. They estimated, based on small sample sizes, that 50 percent of feeding gray whales ceased feeding at an average received pressure level of 173 dB re 1 μPa, and that 10 percent of feeding whales interrupted feeding at received levels of 163 dB. However,

> findings in Russia and British Columbia have shown that gray whales have no apparent change in feeding patterns resulting from seismic surveys (Yazvenko et al. 2007, Bain and Wouldiams 2006).
>
> Behavioral effects on baleen whales from 2D/3D seismic surveys are therefore expected to result primarily in avoidance. Gray whales are the only baleen whale regularly observed within the EIS project area. Should any interactions occur, effects on gray whales would be of medium intensity, interim to long-term duration (because repeated over successive years) duration, local to regional in extent, and important in context. The summary impact level for gray whales would therefore be minor.

These studies constitute the best available scientific knowledge regarding the effects of seismic surveys and noise production on gray whales. Furthermore, it is unlikely that gray whale feeding would be disrupted by noises in excess of 110 dB since background noise in the Chukchi and Beaufort Seas frequently exceeds 110 dB, and as stated in Section 3.2.4.2 of the FEIS:

> Gray whales produce broadband signals ranging from 100 Hz to 4 kHz (and up to 12 kHz). The most common sounds on the breeding and feeding grounds are knocks, which are broadband pulses from about 100 Hz to 2 kHz and most energy at 327 to 825 Hz. The source level for knocks is approximately 142 dB re 1 μPa-m (Jones and Swartz 2009, Richardson et al. 1995).

In light of the fact that most gray whales feed in the Chukchi Sea, not the Beaufort Sea, too much focus has been given to the Harrison Bay to Camden Bay region with respect to gray whales. Due to the low number of gray whale observations in and around Hanna Shoal in the recent past, and the higher numbers of gray whales being noted in coastal waters, closing Hanna Shoal would be unlikely to provide any real benefits to gray whales, while lead and coastal water deferrals, such as may be found in Lease Sale 193 would be more likely to protect gray whale migration and feeding areas in the eastern Chukchi Sea, most of which occur within 50 miles of the coast as stated in Section 3.2.4.2 of the FEIS. Modifications have been made to the document to deemphasize the importance of this region to gray whales.

Should a large or very large oil spill occur in the EIS project area, there is the potential for large scale impacts to gray whale prey. However, the occurrence of a large or very large oil spill is a highly unlikely event, and DOI has issued regulations requiring strict protocols to reduce the likelihood of such an event from occurring. While there is the potential for a small fuel spill to occur, those impacts are expected to be negligible. That discussion is contained in Section 4.5.2.4.12.1 of the FEIS.

Issue 7D - Direct Injury

Summary of Comments:

Several comments focused on direct physical injury or potential disturbance to marine mammals from oil and gas activities.

The suggestion was made that the EIS improperly dismisses the risk of mortality and serious injury from acoustic impacts. For example:

- Ship strike risk. The EIS fails to consider the adverse synergistic effect that at least some types of anthropogenic noise can have on ship-strike risk (for example mid-frequency sounds with frequencies in the range of some sub-bottom profilers have been shown to cause North Atlantic right whales to break off their foraging dives and lie just below the surface, increasing the risk of vessel strike).
- Ship strike risk. Impacts from ship-strikes (fatal and non-fatal) need to be given greater consideration, especially with increased ship traffic and the development of Arctic shipping routes.
    - Potential impacts on beluga whales and other resources in Kotzebue Sound need to be considered with vessels traveling past this area.

  - There is great concern for ship strikes of bowhead and other whales, and these significant impacts must be addressed in conjunction with the project alternatives.
  - Because of the possibility of mortality or serious injury of bowheads through ship strikes, NMFS needs to address the "negligible impact" standard and determine if ship strikes could affect "annual rates of recruitment or survival."

- Threshold shift. Recent studies indicate that anthropogenic sound can induce permanent threshold shift (PTS) at lower levels than anticipated.
- Hearing loss. Hearing loss remains a significant risk, and the statement that hearing impairment, injury, or mortality is "highly unlikely" should be explained (in light of the lack of data to support such a statement). Since the agency has not required aerial or passive acoustic monitoring as standard mitigation, appears unwilling to restrict operations in low-visibility conditions, and has not firmly established seasonal exclusion areas for biologically important habitat, hearing loss is a significant risk.
- Strandings. The EIS discounts the potential for marine mammal strandings and death due to seismic testing, even though at least one stranding event of beaked whales in the Gulf of California correlated with geophysical survey activity.
- Stress and survival. The EIS makes no attempt to assess the long-term effects of chronic noise and noise-related stress on life expectancy and survival, although terrestrial animals could serve as a proxy.

The EIS argues that reliance on monitoring for adaptive management, and agency assurance that activities would be reassessed if serious injury or mortality occurs, is inappropriate, given the probability that even catastrophic declines in Arctic populations would go unobserved.

One comment argued there is no evidence that serious injury, death, or stranding by marine mammals can occur from exposure to airgun pulses, even in the case of large airgun arrays—no whales or other marine mammals have been killed or injured by past seismic operations.

Another comment stated the potential for air and water pollution to divert bowhead whales requires comparative analysis of discharge location and waste streams and their overlap with whale migrations. Several comments noted the need to assess potential impacts from discharges (from drilling, vessels, etc.), including behavioral impacts and the sensitivity of bowheads due to their known sense of smell.

Response to Comments:

The effects of other noise sources such as sub-bottom profilers on beluga whales were analyzed in Section 4.5.2.4.11 of the FEIS; the general impacts of other noise sources were then analyzed in the general context in Section 4.5.2.4.3. In these sections, we determined that the frequencies produced by some sources such as sub-bottom profilers were too high to create TTS and/or PTS among pinnipeds or most cetaceans expected to occur in the area. However, based on some recent reports (e.g., Southall et al. 2013), NMFS recognizes that these types of sound sources can sometimes result in behavioral responses that rise to the level of take. NMFS will take this into consideration when analyzing MMPA requests that include the use of such equipment (see responses to 7A and 7B above). In addition, the area of disturbance produced by these devices was much too small and restricted to have any functional applicability to marine mammal species in the Beaufort or Chukchi Seas. Likewise, because of the very low potential for these other noise sources to measurably impact marine mammals, the risks of ship strikes are unlikely, especially since Protected Species Observers (PSOs) are required on all survey vessels. There have been no reports of marine mammals in the Beaufort or Chukchi Seas reacting to the use of sub-bottom profilers or any other noise-producing equipment as was suggested by a comment.

Vessels traveling to and from the Chukchi and Beaufort Seas typically bypass most coastal communities with the exceptions of Nome, Wainwright and possibly Barrow, where they occasionally resupply and/or rotate crews. However, such traffic typically has a low rate of occurrence, and the vessels tend to be much smaller than seismic vessels or drillships. Because transiting vessels avoid most coastal communities there should be little effect on Kotzebue Sound or any other coastal area.

There may be an increasing risk of ship strikes on marine mammals in the Arctic due to the increasing number of vessels transiting through the Beaufort and Chukchi Seas. However, the numbers of vessels associated with OCS oil and gas exploration in Arctic waters are very small in comparison and should not substantially increase the overall risks of striking marine mammals. Control of vessel traffic unrelated to OCS oil and gas activities are not within the purview of either NMFS or BOEM. Furthermore, unlike barge and commercial vessel traffic, as a standard mitigation, OCS oil and gas operations require the presence of PSOs, aerial flights, etc. to lessen the already low likelihood of a ship strike. Consequently, vessel traffic related to OCS oil and gas activities would not substantially add to the current or projected risks of ship strikes because of the small period of time and restricted scale of those activities, monitoring requirements, and operational restrictions applied to these activities. Moreover, NMFS required several mitigation measures in past ITAs requiring operators to reduce speed in low visibility conditions to reduce even further the likelihood of ship strikes. Based on these factors, the risk of ship strike is highly improbable. Therefore, it is not addressed when making a negligible impact determination under the MMPA.

The issues of hearing loss (TTS/PTS) and noise were fully analyzed within Section 4.5.2.4, Section 4.6.2.4, Section 4.7.2.4, and Section 4.8.2.4 of the FEIS. There should be little to no risk of hearing loss among any of the pinniped species or the polar bears, little risk to mysticete whales, and an even smaller risk to odontocete cetaceans from the noise produced by seismic surveys or any of the other survey methods associated with OCS oil and gas activities. Though a small degree of PTS could potentially occur to a small number of marine mammals, it is not expected to be of a degree that would have adverse impacts on individual fitness.

Marine mammal stranding and mortality were analyzed in Section 4.5.2.4.2 of the FEIS. The analysis indicated that there have been no marine mammal strandings associated with OCS oil and gas activities in the Beaufort or Chukchi Seas to date. In areas farther south, the use of sonar has been linked with stranding of beaked whales since at least 1963 (Ketten 2009). However, beaked whales typically feed in deep water and have never been observed in the Chukchi or Beaufort Seas. The effects to mysticetes, belugas, killer whales, and harbor porpoises, as well as pinnipeds and polar bears would be insufficient to result in any PTS or TTS except in the event of very rare or unlikely occurrences, such as the event of a bowhead swimming over a discharging airgun and choosing to remain over the airgun for a prolonged time.

Although bowhead whaling has been occurring for thousands of years, and oil and gas activities have been occurring since the late 1970's and early 1980's in this region, bowhead whales have flourished, as have gray whales and belugas. Within the last decade, at least one bowhead whale was landed that had a stone harpoon head imbedded in its body, indicative of the great age of these whales. If the life expectancy of bowhead whales or gray whales were being shortened by ongoing OCS activity, one might expect that the older whales would have long since become stressed and died. This is not the case; in fact, the opposite holds true, with burgeoning populations that are approaching the environmental carrying capacity. Such population characteristics have existed alongside OCS activity.

With aerial and ship based marine mammal monitoring in effect, any catastrophic accidents would certainly be noticed in a short time. Furthermore the Aerial Surveys of Arctic Marine Mammals (ASAAM) project funded by BOEM and conducted by NOAA would quickly detect any catastrophic losses of marine mammals in either the Beaufort or Chukchi Seas. Richardson et al. (1995) and a host of behavioral and physiological studies, as well as 30+ years of MMS/BOEMRE/BOEM surveys clearly

show few, if any, noticeable effects from seismic surveying to marine mammal populations. Seismic airguns operate at frequencies that are at the lower end of what odontocetes can effectively hear (i.e., the frequencies occur in the range of lower sensitivity). Furthermore, the decibel levels that could elicit a TTS or PTS occur so close to the sound source that most marine mammals would find it very difficult if not impossible to locate the sound source and stay with it while a seismic vessel is underway. If marine mammals remain in the vicinity when approached by a seismic survey, they would only be exposed for 2-8 potentially louder pulses of noise before the vessel and survey passed beyond the area where marine mammal hearing could be at risk. Historically, whales have migrated through or near drillships that were releasing wastewater, air pollution, and muds into the environment. The area of effects from these pollution sources was much smaller than the area of noise effects from seismic surveying or drilling, and any diversions around the site have been linked to noise production, not pollutants during previous OCS activities. It follows that marine mammals would divert around the larger area of effects from sound long before they could be affected by the smaller area of effects from pollutants, particularly wastewater and drilling muds, which encompass relatively tiny areas.

Section 4.5.2.4.10.1 discusses potential impacts from discharges, including behavioral impacts on bowhead whales. Because drilling discharges typically dilute within 100 m from the discharge point, it is unlikely that there would be significant or large scale impacts to the bowhead whale migrations.

Issue 7E - Walrus, Seals and Polar Bears

Summary of Comments:

Effects of oil and gas activities on polar bears, walrus and ice seals were addressed by a number of comments. There were a variety of topics addressed:

Walrus

- Walrus could also be affected by operations in the Bering Sea. For instance, the winter range and the summer range for male and subadult walrus could place them within the Bering Sea, potentially overlapping with bottom trawling.
- Surveys recently conducted during the open water season documented upwards of a thousand walrus in a proposed exploratory drilling (study) area, potentially exposing a large number of walrus to stresses associated with oil and gas activity, including drilling and vessel activity. Since a large proportion of these animals in the Chukchi Sea are comprised of females and calves, it is possible that the production of the population could be differentially affected.
- NMFS should include a discussion of the recent disease outbreak affecting walrus, include this outbreak as part of the baseline, and discuss how potential similar future events (of unknown origin) are likely to increase in the future.
- USFWS has consistently concluded that Arctic oil and gas activities have no more than a negligible impact on walrus and polar bears. The conclusions in the EIS of “minor” impacts are, therefore, erroneous and NMFS must defer to and incorporate USFWS findings.

Seals and Polar Bears

- NMFS should consider whether ice management or ice breaking have the potential to seriously injure or kill ice seals resting on pack ice, including in the area of Hanna Shoal that is an important habitat for bearded seals.
- NMFS should consider that on-ice surveys may directly disrupt nursing polar bears in their dens and ringed seals in their lairs, potentially causing abandonment, or mortality if the dens or lairs are crushed by machinery.

- NMFS should include a discussion of the recent disease outbreak affecting seals and walrus, include this outbreak as part of the baseline, and discuss how potential similar future events (of unknown origin) are likely to increase in the future.
- Short-term displacement that occurs during a critical and stressful portion on the animals annual life cycle (e.g., molt in seals) could further increase stress to displaced individuals and needs to be considered.
    - Disturbance to ringed and bearded seals from spill clean-up activities during the early summer molt period would greatly increase stress to these species.
- Impacts to polar bears from project impacts to seals/prey should not be dismissed.
- The best scientific data suggest that there have been no measureable effects on ice seal populations due to oil and gas activities over the last 30 years.
- The SEIS should emphasize that the risk of industry operations on polar bear populations are negligible and are also unlikely to affect polar bear habitat. Therefore, mitigation beyond USFWS requirements is unnecessary.
- Direct impacts of proposed activities on polar bears should be evaluated based on current levels of abundance and not on assumptions of population level impacts incorporated into the ESA listing decision.
- There is no indication to date that polar bears would be displaced (other than temporarily) from key areas or resources or that there would be any measurable effects on reproductive success or survival from exploration activities.

Sea Ice Impacts on Walrus, Seals, and Polar Bears

- Other commenters noted that the loss of sea-ice habitat due to climate change may make polar bears, ice seals, and walrus more vulnerable to impacts from oil and gas activities, which needs to be considered in the EIS. The EIS needs to adequately consider impacts in the context of climate change:
    - The added stress of habitat loss due to climate change should form a greater part of the EIS analysis.
    - Both polar bears and ringed seals may be affected by multiple-year impacts from activities associated with drilling (including an associated increase in vessel traffic) given their dependence on sea-ice and its projected decline.
    - Shifts in distribution and habitat use by polar bears and walrus in the Beaufort and Chukchi seas attributable to loss of sea ice habitat is insufficiently incorporated into the EIS analysis. The EIS only asserts that possible harm to subsistence and to polar bear habitat from oil and gas operations would be negligible compared to the potential for dramatic sea ice loss due to climate change and changes in ecosystems due to ocean acidification. For walrus and ice seals, the EIS simply notes potentially catastrophic climate effects without adequately considering how oil and gas activities might leave species more vulnerable to that outcome.
    - Sub-adult polar bears that return to land in summer because of sea-ice loss are more likely to be impacted by activities in the water, onshore support of open water activities, and oil spills; this could represent potentially major impacts to polar bear populations and should be considered in any FEIS.

- Walrus feeding grounds are being transformed, and walrus are hauling out on land in large numbers, leaving them vulnerable to land-based disturbances.

Response to Comments:

Walrus. Male and subadult walruses in the Bering Sea are unlikely to be affected by the proposed action due to the fact that the proposed activities would occur in the Chukchi and Beaufort Seas, mostly during the open water season (July-October). Though there may be some effects to walruses in the Bering Sea from bottom trawling, those issues are under the purview of the USFWS, not NMFS or BOEM, and would best be analyzed in a NEPA document written by the USFWS for activities in the Bering Sea, rather than the Chukchi and Beaufort Seas.

The study referenced in a comment was the marine mammal monitoring of Statoil's 2010 seismic survey (Blees et al. 2010), and there was a period lasting a few days, when over 1,000 walruses passed through the survey area enroute to coastal haulouts. Due to well established marine mammal mitigation requirements, operations were curtailed during this movement of animals, and so large numbers of walruses were not exposed to firing airguns during this timeframe. Likewise, current lease stipulations require industry to decrease, or cease activity if marine mammals could be exposed to stimuli that could have an adverse effect on them. Consequently, there should be no adverse effects to marine mammals or their populations, including Pacific walruses, as a result of the proposed activities.

The sick bearded and ringed seals (Chukchi Coast – 2011), polar bears (Chukchi & Beaufort Seas – 2012), and Pacific walruses (near Wainwright, AK - 2011) have been found from Barrow down to southeast Alaska (young ribbon seal – February 2012). To date no biological or environmental agent has been identified as the cause of these illnesses. A full analysis of this issue cannot be made until the causal agent is identified, since there is no way to determine the parameters specific to this particular illness. However, a discussion of the outbreaks have been included in Section 3.2.4.3 and included in the baseline information for the appropriate species.

As noted earlier in this comment response appendix, the "negligible impact" finding pursuant to Section 101(a)(5) of the MMPA and a finding of "minor" or "significant" under NEPA are not co-related. Each statute has different standards with different requirements and definitions of terms. USFWS is required to determine if activities for which an applicant has requested an MMPA ITA would have a negligible impact on the affected species or stock (in this case walrus or polar bears). USFWS makes those findings specific to the analyses conducted for those specific MMPA requests. While the NEPA analyses help inform the MMPA analyses, they are independent.

Seals and Polar Bears. Sections 4.5.2.4.12.1 and 4.5.2.4.14.1 discuss the potential impacts of icebreaking on seals and polar bears, respectively. Icebreaking is unlikely to adversely affect pinnipeds in the Chukchi or Beaufort Seas with the exception of denned ringed seal pups. Reeves et al. (1998) noted that some ringed seal pups have been crushed in their lairs by icebreaker traffic. However, in order for such an event to occur, ice breaking must occur between mid-March and Mid-May, well before most activities could occur, in the Chukchi and Beaufort Seas. Furthermore, most ringed seals give birth in areas of shorefast ice, while the OCS activities would occur much farther from the coastline, in areas where few ringed seals would choose to whelp. It is extremely unlikely a bearded seal pup would be crushed by an icebreaker, since they are accomplished swimmers and divers immediately after birth, and could avoid being crushed. Walruses and spotted and ribbon seals are unlikely to be in the area during the time when ice breaking becomes necessary.

On-ice surveys have the potential to disrupt nursing polar bears and ringed seals in their lairs and female polar bears with young in their dens; however, the use of scent-trained dogs has had great success in identifying and avoiding denned polar bears and ringed seals. The use of these dogs has been required for on-ice surveys in past IHAs, was considered as an additional mitigation measure in the SEIS with the analysis recommending it for inclusion as a standard mitigation measure in the FEIS.

The issue of displacing marine mammals during critically important life stages is similar to the issue of crushing seals with icebreakers, in that both are unlikely for similar reasons. Ice seals molt during May-June, with some species going into early/mid-July for their molt. For ringed seals, the molt would mostly occur on the shorefast ice while activities would be conducted far out to sea, and far beyond the limits of the shorefast ice. Bearded seals would be molting on ice, mostly in the ice front as it retreats north and away from potential lease areas, negating much of the potential risks from OCS activities. Meanwhile, spotted seals would continue to molt at their coastal haulouts, and ribbon seals, being rare to uncommon in the eastern Chukchi and Beaufort Seas, would not be measurably affected. These species typically breed immediately after whelping their pups and before beginning their molt. Thus breeding generally occurs between April and the end of May, well before OCS activity traditionally begins. Gray and bowhead whales typically calve on their way into and through the Chukchi Sea, mostly in the lead systems which are closer to and somewhat parallel to the Chukchi shoreline of Alaska. Oil and gas operators have very little to no incentive to enter these lead systems when their leases are much farther off shore, so it is highly unlikely that mysticete cetaceans would be disturbed in their traditional calving areas. Similarly beluga whales calve in shallow lagoons and protected areas along the Chukchi coast so there is no likelihood that they would be affected during the calving season or during their molt, which also occurs in the same area, particularly around Kasegaluk Lagoon.

Polar bears give birth to their cubs in dens during the early winter (January), so they too should remain unaffected, particularly since it appears that a higher percentage of pregnant polar bears using the Beaufort Sea are denning onshore in recent years. Meanwhile walruses calve and molt during spring and early summer, having completed most of their reproductive duties before the July-October open water season when OCS activity typically occurs.

Loss of sea ice. As discussed in Issue 6, impacts related to climate change are evaluated throughout Chapters 3 and 4 of the FEIS. The polar bear's dependence on pack ice and the effects of climate change on this critical habitat were recognized by listing the polar bear as Threatened under the ESA (73 FR 28211, 15 May 2008). The oil and gas industry operates under LOAs (issued by the USFWS) for incidental take of polar bears and Pacific walrus, which contain mitigation measures specific to these species. Examples of typical mitigation measures are given in Section 4.5.2.4.15 (Polar Bears) of the FEIS. NMFS also recognizes the critical issue of walrus haulouts and how they are affected by changes to receding pack ice. USFWS LOA mitigation measures for aircraft and vessels are designed to avoid potentially deadly stampedes at haulouts. Other specific concerns related to walrus and habitat changes are discussed in Section 4.5.2.4.14 (Pacific Walrus) of the FEIS. Specific discussion of habitat change with respect to polar bears is given in Section 4.5.2.4.15 (Polar Bears). Most effects on polar bears and ice seals as a result of the proposed action would be temporary and would not have population level effects.

The combined effects of climate change and oil and gas exploration were analyzed in the 2010 status review for bearded and ringed seals (Kelley et al. 2010, Cameron et al. 2010) and in the status reviews for ribbon and spotted seals (Boveng et al. 2008, Boveng et al. 2009). In these reviews, it was determined that oil and gas activities presented a very minor threat to the survival of these species relative to the potential threat posed by climate change.

Likewise, OCS activities present little threat to the continued existence of bowhead and gray whales, Pacific walruses, or polar bears when compared to the potential effects of climate change. The decline in sea ice may result in a prolonged open water season allowing for more OCS activity, while lessening the amount of available ice habitat for pinnipeds and polar bears. Consequently, there could be population redistributions of marine mammals from areas that have greater ice losses to areas with lesser or no losses of sea ice. If activities were to occur during the open water season (July-October), particularly in areas with less sea ice, the effects to marine mammal species would likely be lessened since marine mammals could be expected to shift their occupancy of the Chukchi or Beaufort Sea in synchrony with the ebb and flow of sea ice cover.

Existing mitigations such as a grizzly/polar bear, and walrus interaction plan, if implemented, would greatly reduce the potential effects of onshore facilities on polar bears that have relocated to coastal habitat due to losses of sea ice. Presently more polar bears have been noted coming to shore along the Beaufort Sea coast between Prudhoe Bay, Alaska, and Point Thompson, Alaska; however, there is no way to accurately predict how, or whether, this situation would change in the near future.

Models typically provide very limited inferences of future conditions, particularly with respect to sea ice presence, extent, age, etc. Consequently any "predictions" relating to an anticipated future state of sea ice in the Arctic would be considered speculative.

Issue 7F - Impacts on Fish and Invertebrates

Summary of Comments

Some comments argued for further treatment of fish species, invertebrates, sea turtles, birds and terrestrial mammals. In general, these comments suggested that the current analysis is inadequate or inaccurate.

Several comments were concerned with impacts on fish species, and argued that analyses were inadequate and further study is needed:

- The statement in Section 3.2.2.3.2 of the DEIS that "cod [are] abundant in the region, and their enormous autumn-winter pre spawning swarms are well known" fails to identify the "region" discussed and is inconsistent with the fact no well-known pre spawning swarms occur in areas available for oil and gas leasing, and large aggregation of cod have not been common in recent fish surveys there.
- Impacts on fish species, fish habitat, and fisheries are poorly understood and inadequately presented in the EIS. NMFS should consider the following:
    - The EIS substantially understates the scale of impact on and value of fish species, and fails to consider any measures to mitigate their effects.
    - Airgun surveys are known to significantly affect the distribution of some fish species, which can impact fisheries and displace or reduce the foraging success of marine mammals that rely on them for prey.
    - Airguns have been shown experimentally to dramatically depress catch rates of some commercial fish species, by 40 to 80 percent depending on catch method, over thousands of square kilometers around a single array.
    - While migratory fish may evade threats by swimming away, many fish, especially sedentary fish, would "entrench" into their safe zone when threatened, and prolong exposure to potentially damaging stimulus. Assuming that fish would "move out harm's way" is an irresponsible management assumption and needs to be verified prior to stating that "enough information exists to perform a full analysis."
    - Impacts on fisheries were found to last for some time beyond the survey period, not fully recovering within 5 days of post-survey monitoring.
    - The EIS appears to assume without support that effects on both fish and fisheries would be localized.
    - Fish use sound for communication, homing, and other important purposes, and can experience temporary or permanent hearing loss on exposure to intense sound.
    - Other impacts on commercially harvested fish include reduced reproductive performance and mortality or decreased viability of fish eggs and larvae.

  - A rigorous analysis is necessary to assess direct and indirect impacts of industry activities on rare fish populations.
  - A rigorous analysis is needed that investigates how two or more noise generating activities interact to displace fish moving/feeding along the coast, as acoustic barriers may interrupt natural processes important to the life cycle and reproductive success of some fish species/populations.
  - Seismic activity can damage fish swim bladders.
  - It is unclear if there have been scientific studies looking at long-term effects on fish or fish resources in the Arctic. No data differs from demonstrated lack of effects. This needs to be clarified.
  - Concerns were raised about the loss of tom cod from seismic activity (and effects on seals that prey upon them). This needs to be addressed.
- NMFS should analyze the impacts to invertebrate and fish resources of introducing artificial structures (i.e., drilling platform and catenaries; seafloor structures) into the water column or the seafloor.
- Given that the time/area closures are for marine mammals, Alternative 5 would be irrelevant and generally benign in terms of fish and EFH, so it is wrong to state that the closures would further reduce impact.

Among fish, salmon were addressed specifically by two comments:

- NMFS should reexamine the analysis of sockeye and coho salmon. Comments include:
  - The known northern distribution of coho salmon from southern Alaska ends at about Point Hope (Mecklenburg et al. 2002).
  - Sockeye salmon's (O. nerka) North Pacific range ends at Point Hope (Mecklenburg et al. 2002). Both sockeye and coho salmon are considered extremely rare in the Beaufort Sea representing no more than isolated migrants from populations in southern Alaska or Russian (Mecklenburg et al. 2002).
  - The discussion of coho salmon and sockeye salmon EFH on pages 3-74 to 3-75 of the DEIS is unnecessary and should be deleted.

It was suggested that NMFS should reconsider the EIS' analysis of Chinook salmon and possibly include the species based on the small but significant numbers of the species that are harvested in the Barrow domestic fishery.

One comment suggested that impacts of seismic airgun surveys on squid, sea turtles, cephalopods, and other invertebrates need to be included and considered in terms of the particular species and their role as prey of marine mammals and commercial and protected fish.

One comment noted that the text in the Marine Fish and Migratory Fish sections did not change much between the DEIS and SEIS, but effects were changed from negligible to minor (a higher level of impact). NMFS should provide an explanation as to why the effects changed.

One comment referred to impacts to terrestrial mammals and noted that there has been no negative impact on the Porcupine caribou herd from onshore oilfields and there is no indication that additional activity would negatively impact them; industry adequately mitigates impacts.

Response to Comments

NMFS agrees that protection of fish stocks and early life stage habitat, the ability to predict recovery rates of local fish populations, the impact on downstream populations that are not directly affected by activities described and analyzed in this document, and providing mitigation aimed toward avoiding significant impacts due to increased anthropogenic and natural effects are all legitimate scientific concerns. NMFS recognized many of these issues in its analysis in Chapter 4 of the EIS. Additional data on these subjects would continue to be sought and incorporated into future project-specific MMPA analyses. Both NMFS and the cooperating agencies (BOEM and the North Slope Borough) are actively pursuing research, allowing further insights into the concerns listed in these comments. Nonetheless, NMFS determined there is sufficient information available and analyzed in the FEIS (see Section 4.5.2.2) to make scientifically informed decisions with respect to the alternatives. Potential impacts resulting from the Alternatives on fish and essential fish habitat would be minor.

While the proposed time/area closures described in Alternative 5 and in Alternatives 2, 3, 4, and 6 as potential mitigation measures were designed specifically to reduce impacts to marine mammals during periods of important life functions (e.g., feeding) or during traditional subsistence hunting periods, by virtue of the fact that oil and gas exploration activities would not be occurring for some period of time in those locations, if those areas also serve as important habitat to fish or encompass EFH, there would be indirect beneficial impacts to fish and EFH. Therefore, the statement that if these closures were implemented impacts to fish and EFH would be reduced is accurate.

Salmon have been recently reported by several sources, both western science journals and compilations of local and traditional knowledge, to be occurring farther north in Arctic rivers, streams and the marine environment. Older publications concerning range of salmon species should not be regarded as completely accurate in a time of rapidly changing environmental conditions that are documented within the described environment in this analysis. In many of these reports, warming sea temperatures and decreases in sea ice are attributed to the salmon movement, range extensions in marine waters, and entry into previously-undocumented freshwater spawning areas. The FEIS has been updated, as appropriate, based on comments regarding salmon and cod distribution in the project area.

The effects of seismic energy on invertebrate populations are increasingly debated in light of case studies in European waters of the Atlantic Ocean involving populations of cephalopods. Numerous laboratory studies have attempted to illustrate the potential effects on invertebrate populations, both larval and adult, by seismic energy (see Section 4.5.2.1.1 of the FEIS). Of particular note are studies involving crabs and lobsters, both important commercial species.

NMFS updated the criteria used to assess impacts to biological resources between the DEIS and SEIS (see Table 4.5-17). The update to the criteria necessitated the change in impact level for marine and migratory fish species.

No sea turtle species occur in the EIS project area. Therefore, analysis of these species is not required in the EIS.

In 2009, the U.S. placed a moratorium on commercial fisheries in the U.S. Chukchi and Beaufort seas; therefore, no analysis of impacts on commercial fisheries from the analyzed oil and gas exploration activity types is required in this EIS.

Issue 7G - Impacts on Birds

Summary of Comments:

One comment argued that NMFS should conduct more rigorous analysis for birds. Specifically, this comment asked how multiple seismic surveys in the same region might modify the foraging of marine birds (e.g., where forage fish have been displaced to deeper water or away from nesting areas). Other

comments expressed concern about displacement and death of endangered eiders and murrelets. Another referenced the potential incidental take of ESA listed eiders in the event of a ship strike, noting that NMFS should provide authorized incidental take levels when discussing takes of USFWS species.

Response to Comments:

NMFS agrees that protection of bird species and their prey are legitimate and important concerns. The level of information and analysis provided is commensurate with the level of potential impacts, especially considering that bird species would not specifically be impacted from the issuance of MMPA ITAs by NMFS. The analysis in Chapter 4 includes information on the potential numbers of birds that could be susceptible to bird strikes from proposed activities, which includes an analysis of how impacts may change based on multiple seismic surveys occurring in the same region. However, the numbers of potential mortalities for each species are considered small by comparison with the post-breeding populations. By law, NMFS is unable to provide authorized incidental take levels of species under the jurisdiction of another federal agency. Applicants would need to request such analyses and authorized take levels from the appropriate agency. In the case of bird species, the USFWS is the authorizing agency. BOEM has consulted with the USFWS pursuant to section 7 of the ESA regarding the impacts of the G&G permits that they authorize for seismic surveys in the Arctic. BOEM includes mitigation measures to protect ESA-listed bird species in the G&G permits they issue.

Issue 7H - Impacts on Habitat (Special Areas, Protected Areas /Ecosystems)

Summary of Comments:

Impacts on specific habitat areas are addressed by comments including:

- Marine mammal concentration areas are one potential example of important ecological areas that require robust management measures to ensure the health of the ecosystem as a whole. Impacts to marine mammal concentration areas, especially those areas where multiple marine mammal species are concentrated in a particular place and time, are more likely to cascade throughout populations and ecosystems.
    - Displacement from a high-density feeding area, in the absence of alternate feeding areas, may be energetically stressful.
- The conclusion that Camden Bay is of particular importance to bowhead whales is not supported by the available data (e.g., Huntington and Quakenbush 2009, Koski and Miller 2009, and Quakenbush et al. 2010). Occasional feeding in the area and sightings of some cow/calf pairs in some years does not make it a uniquely important area. Occasional feeding by bowhead whales is insufficient justification for a Special Habitat Area designation for Camden Bay. Under this reasoning, the entire length of the Alaska Beaufort Sea coast would also have to be designated.

Other comments expressed concerns about invasive species, biologically important areas, and ecosystem effects:

- EIS should include more analysis of the increased risk of introducing invasive species through oil and gas activities, including more explanation of its “moderate” conclusion.
- Multiple simultaneous surveys in several areas across the migratory corridor could result in a broader regional biological and subsistence impact. Deflection could occur across a large area of feeding habitat. Biologically important areas all along the Arctic coast need to be considered.
- NMFS should include a flow chart that shows cause-and-effect relationships through each layer of the food web.

- The EIS should address that sometimes the best geological prospects happen to conflict with some of the marine mammal productivity areas, calving areas, or birthing areas.
- All species in the Arctic marine ecosystem are important and at risk from oil and gas activities. NOAA must recognize and address this.

Response to Comments:

There are specific mitigation measures analyzed in the FEIS that consider temporal and spatial restrictions for specific areas important to biological productivity, life history functions for specific marine mammal species of concern, and marine mammal subsistence activities. In response to public comments, NMFS has reconsidered Camden Bay as a uniquely important feeding area for bowhead whales. Modifications to the FEIS were made to remove Camden Bay as an important habitat area, and considerable discussion of this topic has been added to the document. Instead time/area closures were added in the FEIS around Cross Island and Kaktovik to account for the importance of those areas as bowhead whale subsistence hunting grounds.

The EIS considers the impacts of multiple simultaneous activities, and the conceptual examples presented in Section 4.2.5 illustrate how and when overlap in the ensonified zones could occur. The suite of mitigation measures analyzed in the EIS are aimed at reducing impacts to marine mammal species and their habitats and to the availability of marine mammals for taking for subsistence uses. Included in that suite of mitigation measures are potential time/area closures to protect animals during feeding (or during times of other important life functions) and to protect subsistence activities. NMFS conducted a rigorous review and analysis of appropriate locations and times to analyze for potential time/area closures. Those considerations and analysis are described throughout the EIS. The extensive analysis in this EIS indicates the agencies' understanding that the Arctic marine ecosystem is important.

BOEM's NEPA analyses under the OCSLA four-stage review process utilize more and more specific information at each stage of OCS activities. The four stages proceed from an EIS on a Five-year Program through a regional-level EIS on a lease sale to a site-specific EA or EIS on an exploration or development and production plan. Thus, as the location, time, and specific circumstances of the activities become known and/or are better understood, informed decisions about conflicts between the best geological prospects and marine mammal productivity, calving, or birthing areas can be made based upon an appropriate level of analysis.

The EIS broadly considers the importance and influence of ecosystem function in Sections 4.5.1.6, 4.6.1.6, 4.7.1.6, 4.8.1.6, and 4.9.1.6, as well as through the consideration of cumulative effects. However, as necessary in the context of the statutes NMFS and BOEM implement and the actions and findings that this EIS is intended to inform, the focus in this document is more heavily on the impacts to managed species, their habitat, subsistence uses of marine mammals, and resources towards which mitigation, monitoring, and other actions can be directed to address. While, for example, an Arctic food web graphic may be broadly educational (and many different versions are available on the internet), data that are robust enough to support management actions are more available and focused on direct interactions between the proposed oil and gas exploration activities and protected species, their habitat, and availability of marine mammals for taking for subsistence uses.

ISSUE #8. SOCIOCULTURAL ISSUES

Comments addressing sociocultural issues expressed concerns with subsistence resources, public health and environmental justice, and human health and safety. One general comment suggested that the analysis should be broadened to account for diverse uses of land and water resources.

Issue 8A - Subsistence

Summary of Comments:

Comments on subsistence were generally concerned with disruption of hunts, the health and well-being of subsistence animals, and the perception of changes in the taste or healthful benefits of subsistence species (tainting).

- Many people depend on the Beaufort and Chukchi seas for subsistence resources. Protection of these resources is important to sustaining food sources, nutrition, athletics, and the culture of Alaska Natives for future generations. The EIS needs to consider not only subsistence resources, but the food, prey, and habitat of those resources in its analysis of impacts.
- EIS lacks in-depth analysis of impacts to subsistence and should analyze the following in more detail: how climate change could make species more vulnerable to impacts from oil and gas activities; oil spill effects; long-term impacts to communities from loss of whale hunting tradition; impacts outside the project area, such as Canadian Beaufort; and impacts from multiple authorizations over multiple years.
- The analysis should consider potential impacts on a community by community basis. NMFS does not address the potential impacts from operations in the western Beaufort Sea (such as in Harrison Bay) to the fall hunt in Barrow. It is unclear in the EIS how the impacts of drilling in Harrison Bay would be mitigated to protect the Barrow subsistence hunt.
- Impacts to subsistence resource could lead to impacts to food security and increased reliance on store-bought foods with less nutritional value.
- NMFS should use information gathered from subsistence grounds and provide real information to communities about what would happen and when.
- Activities in September and October could interfere with bowhead and beluga migrations; even minor interference could disrupt hunts.
- Impacts to subsistence could include effects to health and welfare of animals (e.g., blubber getting hard as a result from seismic activities); reduction of animals; noise effects making whales more skittish and difficult to hunt; aircraft noise effects on other subsistence resources, such as polar bears, walrus, seals, caribou, and coastal and marine birds; water pollution and bioaccumulation from increased ship traffic through the Bering Straits. Impacts to subsistence can cause disruptions in the network of sharing practices and availability of foods for celebratory activities.
- The EIS focuses on impacts to subsistence resources that occur in the immediate vicinity of the drilling rigs but does not clearly assess the impacts that associated support vessels would have over a much larger area. For example, many support vessels would be staged at least 25 miles from the drilling unit. Moreover, vessels supporting development activity in the eastern Beaufort Sea must pass Point Barrow in their transit to and from the drilling locations. NMFS needs to include these ancillary impacts in its review.
- Impacts to subsistence can occur in subtle manners, such as via deflection. Deflection of bowhead whales from ice breaking or ice management activities should be incorporated into the

EIS. There is a lack of data on when whales return to their normal migratory path following a disturbance, and the EIS does not explain how hunters would be able to hunt after the disturbance has ceased. The EIS should examine how many years in a row these disturbances might occur.

- Impacts of subsistence resources moving to Russian waters needs to be examined in the EIS. At the Barrow Government to Government Meeting on the SEIS on April 13, 2013 one commenter stated: "*another issue that we expressed was that the walruses were scattered over to Russia. And -- and we expressed our concerns in that regard in dealing with the agreements that were authorized and the impact that it had as a result. We had our ice cellars empty for two years. No walrus. And so how is that addressed in this one?*"
- The EIS needs more analysis of non-marine mammal subsistence resources relied on by Native Alaskan communities, such as fish. Their migrations and food sources may be impacted.
- The EIS needs more analysis of effects of perceived contamination of subsistence resources.
- Tainting of subsistence resources could likely occur from water quality discharges.
- The sections on water quality and subsistence require a discussion of mitigation measures and how NMFS intends to address local community concerns about contamination of subsistence food from sanitary waste and drilling muds and cuttings.
- Impacts from climate change could impact the EIS project area, and the EIS should note potential impacts to Native Alaska storage practices of subsistence resources including ice cellars and other traditional mechanisms for keeping foods.
- Impacts need to consider the effects of loss of sea ice cover, seasonally ice-free conditions on the availability of subsistence resources to Arctic communities.
- The EIS needs to separate the discussion of the subsistence hunt from the protection of marine mammals and incorporate traditional knowledge into the analysis. NMFS must ensure oil and gas activities do not reduce the availability of any affected population or species to a level insufficient to meet subsistence needs. It was suggested that NMFS should not proceed with the proposed levels of activity until a comprehensive management plan has been developed for the Arctic, in consultation with affected communities. Subsistence-based communities have emphasized consistently the importance of incorporating traditional knowledge and limiting exploration activities until the impacts of oil and gas exploration are fully understood and mitigated such that authorized activities do not adversely affect the availability of marine mammals for subsistence uses.
- One commenter stated that subsistence harvest should be ended as it is not sustainable. Another commenter noted that the EIS conflates the issues and risks of industry operations on the subsistence hunt with risks to species/biological systems and incorrectly assumes risks to subsistence hunt that are not borne out by previous experience.

Response to Comments:

CEQ regulations state (40 CFR §1502.15): "The environmental impact statement shall succinctly describe the environment of the area(s) to be affected or created by the alternatives under consideration. The descriptions shall be no longer than is necessary to understand the effects of the alternatives." NMFS and BOEM acknowledge the pivotal importance of subsistence food and subsistence practices to the indigenous people of the North Slope. The EIS contains a thorough discussion of the broad importance of subsistence (Section 3.3.2) and fully analyses the potential direct and indirect effects of OCS exploration activities on subsistence resources and activities. The analyses incorporate both western science and traditional knowledge. Moreover, Additional Mitigation Measures C2 and C3 could help reduce impacts of exploratory drilling operations on water quality and therefore also reduce impacts on subsistence

resources. Section 4.5.3.2 (Subsistence) in the FEIS includes analysis of the potential impacts to subsistence resources, not just marine mammals, and a discussion of the many mitigation measures to relevant protection of subsistence resources and activities. The analysis includes discussion of the feasibility, anticipated effectiveness, and jurisdictional authorities for each proposed mitigation measure. While we are not able to predict with absolute certainty how many years in a row activities that could disturb marine mammals may occur, the activity levels considered in the EIS are based on historical activity levels and logical assumptions based on active leases and logistical capabilities in the region (based on when we started this EIS process in early 2010). The analysis addresses the issue of deflection and how that may or may not impact the success of a whale hunt. Also, the analysis looks at the fact that activities from an exploratory drilling program may not occur just at the well drill site but could reach further out based on the presence of multiple vessels up to 25 miles from the drillship/drill rig.

The EIS addresses potential impacts to Subsistence-Harvest Patterns, Sociocultural Systems, and Environmental Justice, including public health effects. As required, the EIS also addresses the contribution of the activities to cumulative effects on subsistence. Activities in Canadian and Russian waters that could impact marine mammal subsistence species of the North Slope are considered in the cumulative effects section of the EIS. Section 3.3.2.6 of the FEIS discusses potential influences of climate change on subsistence resources and uses, including impacts to ice cellars.

In the SEIS, Additional Mitigation Measure D4 was analyzed for its potential to reduce impacts to the fall bowhead whale hunt at Barrow. Based on the analysis contained in the SEIS and consultation with the AEWC, NMFS has determined that this mitigation measure should become standard. NMFS has included it in the list of Standard Mitigation Measures in the FEIS (now Standard Mitigation Measure D5).

NMFS addresses local community concerns about contamination of subsistence foods and water during public meetings and hearings, government-to-government meetings, through public comment periods for individual MMPA ITAs, and in programmatic and proposed action NEPA analyses. The EIS includes analysis of potential effects to public health, including contamination of subsistence foods and water. Further, NMFS included analysis of environmental contaminants and ecosystem functions (Section 4.5.1.6). Moreover, the thorough analysis to the physical environment, lower tropic levels, and fish, which serve as habitat and prey for marine mammals enhances the consideration of impacts to subsistence.

Sections 101(a)(5)(A) and (D) of the MMPA (16 United States Code [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 proposed authorization is provided to the public for review. Authorization for incidental takings shall be granted if:

- NMFS finds that the taking would have a negligible impact on the species or stock(s);
- NMFS finds that the taking would not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses (where relevant); and
- the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth.

The analysis in this EIS must be robust enough to support NMFS findings on the potential level of effects to both marine mammals and to subsistence activities. To issue ITAs under the MMPA, NMFS must make a finding of negligible impact on the species or stock(s) and no unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses. NMFS would not issue an ITA if the analysis indicated there was the potential for unmitigable adverse impacts on the availability of marine mammal

species or stocks for subsistence uses. NMFS included traditional knowledge throughout the impact analysis in this EIS.

BOEM is committed to protecting subsistence resources and activities. This policy is clearly demonstrated through BOEM's practices in regulating oil and gas geophysical surveys and exploratory drilling activities. BOEM would only permit OCS activities when the disruption to subsistence harvest of resources can be minimized in such a manner that the disruption is short term and is the result of incidental or accidental encounters.

Issue 8B - Environmental Justice and Public Health Effects

Summary of Comments:

Public health and/or Environmental Justice (EJ) concerns were expressed in many comments—generally, commenters felt that analyses of effects on local native communities were inadequate and did not account for the changes that could occur in "a way of life."

- The EJ analysis is inadequate because it does not adequately address the following: combined impacts of air and water pollution, sociocultural impacts, and economic impacts on Inupiat people; baseline health conditions of local communities and how they may be impacted by oil and gas activities; potential exposure to toxic chemicals and diminished air quality; the unequal burden and risks imposed on Inupiat communities; and EJ impacts to all Inupiat communities.
- The EIS should analyze effects of increased community stress, including loss of subsistence resources.
- Human health assessments should use current information that accounts for affected communities' high susceptibility to health problems.
- Industrial activities such as oil and gas exploration and production jeopardize the long-term health and culture of native communities. There is potential for impacts to Arctic ecosystems and associated subsistence resources; community and family level cultural impacts related to the subsistence way of life; and preserving resources for future generations.
- Native communities are at risk from multiple threats including climate change, increased industrialization and access to the North Slope, melting ice, and stressed wildlife. NMFS should stop authorizing offshore oil and gas activities until these threats to Inupiat culture are addressed.
- The EIS confirms affected communities' worst fears about the potential negative impacts from offshore drilling and our government's willingness to place our communities at risk.

Response to Comments:

The EIS contains a thorough discussion of public health and Environmental Justice concerns.

Section 3.3.3 of the FEIS presents an overview of public health in the areas that constitute the affected environment for the proposed action. The affected environment for public health analysis purposes consists of the eight communities in the NSB and one community of the Northwest Arctic Borough (NAB) whose residents may be affected by the proposed oil and gas exploration activities in the Beaufort and Chukchi seas. The description of health conditions presented in this EIS is considerably broader than what has, until recently, typically been included in an EIS to describe the health of affected populations. This wider scope is driven by two reasons. The first relates to changing expectations for what constitutes a sufficient examination of human health within the regulatory process. North Slope residents, the NSB municipality, the Alaska Inter-Tribal Council, the Iñupiat Community of the Arctic Slope, the EPA, and the National Research Council (NRC) have all advocated strongly for the inclusion of a more systematic and broad-based appraisal of human health concerns in planning processes and on the national level. The second reason has to do with data availability. Data have only recently become available that allow the

health of the affected environment to be described explicitly; previously, most relevant health indicators were available only at the state level, for all rural Alaska populations, or for all Alaska Natives as a group.

In conducting its NEPA analysis, NMFS uses the best available scientific information, as well as traditional knowledge from the potentially affected communities. The potential direct and indirect impacts to public health are evaluated in detail in Section 4.5.3.3 of the FEIS for Alternative 2. The analysis considers Diet and Nutrition, Contamination, Acculturative Stress, Safety, Economic Effects, and Health Care Services. The cumulative effects analysis for public health (Section 4.11 of the EIS) considers the incremental contribution of each alternative to overall cumulative public health effects from past, current and reasonable foreseeable activities in the North Slope region.

Section 3.3.9 of the FEIS discusses Executive Order 12898, which requires federal agencies to identify and address disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on low-income populations and minority communities (1994). Disproportionate high and adverse human health or environmental effects occur when the health effects of an action are significant or above generally accepted norms (e.g. infirmity, illness or death); the risk or rate of hazard exposure is significant and exceeds the rate to the general population; or the population is exposed to cumulative or multiple adverse exposures to environmental hazards.

The EIS addresses the Environmental Justice concerns identified through scoping, government-to-government, and public hearings as they are related to direct, indirect, and cumulative effects of OCS exploration activities.

As noted several times already, NMFS has no authority to authorize offshore oil and gas activities. Rather, NMFS authorizes the take of marine mammals incidental to conducting such activities pursuant to Section 101(a)(5) of the MMPA. Authority to authorize oil and gas activities on the OCS lies with DOI. DOI only authorizes such activities if they are in conformance with the applicable statutes and regulations.

Issue 8C - Human Health and Safety

Summary of Comments:

A few comments expressed concerns over safety for workers and inadequate regulatory oversight of oil and gas activities, especially given the Arctic environment.

- NMFS should consider the systematic safety concerns and problems with the oil and gas industry, the current lack of regulatory oversight, the lax enforcement of violations, and how these factors would be exacerbated in the Arctic environment.
- NMFS needs to consider the length of the work season since a shorter period would increase risks to workers.
- Well designs should be deep enough to withstand storms and the harsh environment.

Response to Comments:

Following the Deepwater Horizon explosion and resulting oil spill in the Gulf of Mexico, comprehensive reforms to offshore oil and gas regulation and oversight were developed and implemented by BOEM. The reforms strengthen requirements for everything from well design and workplace safety to corporate accountability. A discussion of the specific reforms is provided in Section 1.1.3 of the FEIS.

BSEE is responsible for ensuring safe OCS operations and for monitoring OCS activities to ensure compliance with federal laws, regulations, lease stipulations, permit or plan conditions, and required mitigation. BSEE is also responsible for the oversight of pollution prevention and oil spill contingency and response planning for OCS operations. BSEE's regulations are at 30 CFR Part 250 and Part 254.

BOEM and BSEE have continuing authority over all exploratory activities on the OCS, and mechanisms already exist to protect human safety and the environment in the event of unfavorable conditions. If ice or other environmental conditions render continued exploration activities unsafe, BOEM and BSEE would use their existing authority to order operations to cease.

No portion of any seafloor drilling equipment would extend above the mudline. The mudline cellar, or glory hole, must be deep enough to ensure that the top of the blowout preventer stack is below the deepest probable ice-scour depth (30 CFR 550.442(l)).

Issue 8D - Cultural Resources

Summary of Comments:

One comment pointed out that authorization of marine mammal incidental take would have no impacts on cultural resources, yet impacts under Alternatives 2 and 3 are rated as "negligible" instead of "none." Meanwhile, impacts under Alternative 4 of the DEIS are rated as "moderate" even though additional mitigation measures are applied.

Another commenter noted that protection of shipwrecks in the nearshore areas around Point Hope and Wainwright should be preserved.

Response to Comments:

Although the authorization of marine mammal incidental take would have no impacts on cultural resources, the full range of activities in the proposed action associated with the ITA application may have effects on cultural resources. NMFS has reviewed the impact level definitions and the conclusions of the cultural resources analyses. The text has been corrected.

The issuance of MMPA ITAs will have no impact on shipwrecks in the nearshore areas around Point Hope and Wainwright. Additionally, current oil and gas exploration activities do not happen along the Chukchi Sea coast, thus allowing for the continued protection of shipwrecks in the area.

Issue 8E - Visual Resources

Summary of Comments:

Comments regarding the visual analysis of the EIS noted that the four scenic quality rating units establish artificial boundaries for visual evaluation and that the duration of visual impacts was not defined. The evaluation does not take into consideration temporary or interim activities, and the minimal visual impacts associated with short duration activities. It was suggested that a balance of multiple uses can be agreed based upon temporal seasonal uses that do not conflict. The perspective in the EIS is lacking in the discussions, and needs to be substantiated, and more accurately summarized. It was also noted that visual sensitivity evaluation has some components that are value based, and may result in biased results based upon the values of the evaluators and the criteria utilized. The state questioned the validity of the final results for overall sensitivity and noted that these results would likely be challenged by marine and land users who hold contrasting values for visual sensitivity priorities, and may not reflect the state's resource management principles that mandate management of lands and resources for the maximum benefit of the best interests of the people of the state.

Response to Comments:

Use of scenic quality rating units is a common approach used for both land-based and offshore visual impact analyses. These polygons are established based on conspicuous changes in land use or physiographic features of the landscape and provide for an assessment of impacts within areas of shared landscape character. Conclusions are based on expected long-term impacts, as short-term or temporary impacts would not permanently alter landscape character or quality.

The discussion of visual sensitivity has been removed from the document. Though disclosure of potential visual sensitivity is commonplace in visual impact analysis, we agree that not enough information is available to support assumptions of sensitivity within the EIS project area. Impact determinations are thus based solely on expected change in landscape character and do not include consideration of viewer sensitivity to potential impacts.

ISSUE #9. ECONOMIC EFFECTS

Most economic comments argued for potential or understated economic benefits of exploration that outweigh any adverse impacts. A few comments addressed general economic concerns, while the rest expressed socioeconomic concerns for native communities.

Issue 9A - General

Summary of Comments

Several comments addressed broader economic concerns regarding opportunity costs for companies, regarding the impacts to transportation as follows:

- The EIS does not give sufficient attention to the impacts of the alternatives and mitigation measures on the development of OCS resources. This should include lost opportunity costs and the effect of time and area closures given the already very short open water and weather windows available for Arctic industry operations.
- The conclusion of negligible or minor impacts to transportation under Alternative 5 in the DEIS is unsubstantiated. Transportation would be severely restricted in time and space by restrictions on vessel traffic, seismic surveying, exploration drilling, and ancillary services. One comment suggested that delaying exploration activity would not compromise property rights or immediately trigger compensation.
- Offshore leases do not convey a right to proceed with full exploration, development, or production.
- The EIS transportation section needs to include an evaluation of Port Clarence as a viable harbor of refuge. The EIS fails to recognize that marine lightering from larger vessels to smaller vessels is critical for shallow landings, including supply of Kotzebue, which requires a lightering of up to 15 nautical miles (nm). Similarly, the Red Dog Mine operates through the Delong Mountain Terminal, with ore barges lightering to Panamax and Handymax at a substantial distance offshore three to five nm, versus directly loading at the terminal. Additionally the EIS transportation section should be updated to include aircraft and vessel traffic descriptions of current and planned initiatives by state, federal, and private industry to address transportation service and response concerns.

Another commenter noted that the EIS needs to elaborate on the relationship of mainland tourism and its relationship to offshore activities. Oil and gas activities should not be prohibited or restricted based solely on current or future potential recreation based activities.

Response to Comments

The effects of time and area closures are analyzed under Alternative 5 in the FEIS. Increased costs to transportation due to space use conflicts could occur, but those impacts are considered to be minor in duration and extent. Additionally, this EIS does not limit transportation in the region not associated with oil and gas exploration activities.

The FEIS acknowledges under Alternative 5 the potential for minor impacts to transportation from increased vessel traffic and time/area closures that could limit aircraft overflights in the area.

In Chapter 3, we address the lack of deep water ports or an industrial port system in the Beaufort or Chukchi Sea and recognize the lightering that occurs as a result. The resulting analysis in Chapter 4 is appropriate for the activities under consideration in this EIS. The broader issue of maritime traffic increasing is appropriately addressed in the Cumulative Effects section of the EIS, and Red Dog Mine is mentioned specifically. Port Clarence is merely a candidate site in a study by the US Army Corps of

Engineers to evaluate locations for a deep-draft port system. The project is still in the study and seeking funding support stages.

This EIS does not prohibit or restrict oil and gas activities based solely on current or future potential recreation-based activities.

Issue 9B - Socioeconomic

Summary of Comments

Most socioeconomic comments supported oil and gas activities and argued that analyses in the EIS inadequately or improperly described the economic impacts on communities.

- The EIS understates short- and long-term economic benefits from oil and gas development and does not take into account indirect jobs and business generated by increased oil and gas activity and excludes on-lease activities associated with current and future production. The EIS should describe how next steps after successful exploration would affect production and development of production infrastructure onshore for storage and transportation of oil. The distribution of revenue from eventual production should be described in the EIS. The socioeconomic impact assessment in the FEIS should include by reference economic data relating to market forces and tax structures, and future economic benefits from exploration activities could be reasonably ascertained by economic modeling. This type of data was captured and analyzed by Northern Economics and the Institute for Social and Economic Research at the University of Alaska in studies completed in 2009 and 2011. The EIS does not address how the proceeds from offshore oil and gas drilling would be shared with affected communities. The EIS does not account for reasonably foreseeable socioeconomic impacts from development and production, and did not account fully for employment impacts, impacts to villages and regional corporations, and revenue generated by future lease sales.
- The analysis of socioeconomic impacts is inadequate because: it fails to fully consider effects from unrealized employment, payroll, government revenue, and other benefits such as local hire; the analysis is improperly in a manner inconsistent with the analysis of other types of impacts; there is inadequate consideration of the effects of instituting additional mitigation measures; the projected increase in employment appears to be low; the forecasts of future activities ignore economic forces such as market prices; and positive impacts were not captured adequately.
- Restricting the number of programs would result in greatly reduced economic opportunities and resources and development opportunities for federal leaseholders, the State of Alaska, the NSB, northern Alaska communities, and the nation. Long-term effects would negatively affect the state.
- In its current form, the EIS does not capture the foreseeable socioeconomic benefits of OCS exploration or the foreseeable socioeconomic detriments of a cessation of current activity levels as addressed in the No Action Alternative.
- The EIS should be consistent and consider the probability of finding oil and gas due to knowledge acquired from prior seismic surveys and wells drilled over the last 30 years. The studies of potential oil/gas reserves by USGS are not included in the EIS evaluation of future reasonably foreseeable events. The EIS should include a more complete review of aggregate industry interest and exploration effort. The EIS should analyze the socioeconomic impacts of development and production as indirect effects with exploration as the precursor to development and production activities; these activities cannot occur without exploration.
- The EIS as currently constituted would compromise the economic feasibility of developing oil and gas in Alaska. The EIS would impose restrictions on the scope of exploration plans that are inconsistent with the purpose of exploration plans under OCSLA and with BOEM's obligation to

review exploration plans under NEPA, creating negative economic impacts. Specifically the EIS would adversely impact the ability of regional corporations to benefit their shareholders, discourage potential investors in the Alaska's resources, and increase the length of time required to assess resources. Specifically

- For each alternative, the EIS should account for the effect of its proposed actions or inaction on state and federal lease sale revenue. Under Alternative 1 there is a probability that at a minimum the federal government would return several billion dollars to current leaseholders (NMFS 2013, 4-29). However, the EIS fails to include a similar accounting for the economic impact Alternative 1 would have on the state government. If state leaseholders are unable to obtain the IHAs necessary to explore their leases, it is likely that they too would have to be compensated for the loss of value of leases they purchased in good faith. The economic impact assessment of Alternative 1 must also account for foregone future state and federal lease sale revenue. NMFS should consult with BOEM and the State of Alaska to develop a complete picture of planned future lease sales and the revenue these sales are projected to generate. This data should be used to assess the negative economic impacts of selecting Alternative 1 and the positive economic impacts from selecting an action alternative.
- The time/area closures that restrict or prohibit G&G exploration activities are characterized to be negligible to minor at a statewide and national level and minor at the local level (Vol. 2, 4.11.7.13.4, p. 4-617in the SEIS) under Alternative 5 reasonably foreseeable cumulative effects analysis. These general assumptions are not substantiated with data, and one commenter questioned the validity of the analyses that low impacts would be foreseen. It is expected that reduced exploration would directly and negatively affect local and state economies and may also prevent the meeting of national energy needs, causing much higher than negligible to low economic impacts at the state, local, and the national level.
- The EIS assumption that there would be a minor impact, not exceeding the significance threshold is not substantiated at Alternative 6 socioeconomic cumulative effects analysis. Under this alternative, there would likely be economic and practical delays due to unavailability of technologies not yet commercially available (Vol. 2, 4.11.8.13.1, p. 4-636 in the SEIS). As mentioned above for Alternative 5, there is a lack of data to substantiate the level of socioeconomic impact as minor. The costs and delays from requiring these not yet available technologies may have resultant high impacts to local economies, state development and revenues, and reduced capacity to meet national energy needs.
- The EIS should examine using revenues generated from a Community Development Quota-type program based on the oil and gas industry extraction resources and applying these funds to development of community infrastructure that could accommodate the influx of new workers and benefit local residents.

Response to Comments

The proposed actions analyzed in this EIS are issuance of ITAs and authorizations for G&G permits, which are not expected to generate significant economic activity. The short and long term and indirect economic benefits of oil and gas development and production are beyond the scope of this document.

Currently, revenue sharing from offshore oil and gas development has not been enacted in Alaska. Moreover, potential revenue distribution from oil and gas development and production is beyond the scope of this document.

The activities described in this analysis would not generate state or federal revenues. Other economic impacts to employment, income, and revenues, are expected to be limited and short in duration. The issuance of ITAs and authorizations for G&G permits are not expected to generate significant or long term employment, income, or revenues. Any economic impact associated with future development is speculative and beyond the scope of this analysis.

The EIS scenario of four exploratory drilling programs per season per sea does not restrict the number of potential future programs; it is a scenario describing what is considered to be foreseeable for the purposes of this analysis. Future activities can still occur beyond the program described in the document and would be analyzed accordingly.

The economic feasibility of developing commercial oil and gas resources in Alaska depends on many factors, including oil and gas prices, resource estimates and accessibility, and available technologies. The activities described in the EIS are not expected to directly affect shareholder benefits, discourage investment, or increase the time required for resource assessment, as those factors are determined outside of the program described in the EIS.

Section 4.4.1.1 (Socioeconomics) considers the possibility that Alternative 1 could result in future permits or authorizations not being issued, which could lead to a loss of future potential revenues accruing to the Federal, State, and Local governments. Any potential future losses that could result if Alternative 1 did hypothetically lead to delayed or cancelled lease sales could be in the form of tens of millions of dollars in foregone revenues accruing to Local and State government and billions of dollars in forgone revenues accruing to the Federal government. There is not enough information, with respect to activities described in this scenario to give a specific estimate of the amount of revenue that could be foregone if Alternative 1 did actually result in delayed or cancelled lease sales. The EIS scenario does not restrict the number of potential future programs, and future activities that generate revenues could still occur beyond the scenario described in the FEIS and would be analyzed accordingly at that point.

ISSUE #10. CUMULATIVE EFFECTS

Summary of Comments

Commenters noted concerns that drilling in the Arctic could have a negative impact globally. Additionally it was noted by commenters that there have been impacts onshore from prior seismic activity that has affected traditional hunting onshore. Local residents noted that nearshore development is affecting fisheries and offshore development that has affected whaling. Alternatively, another commenter felt that too much emphasis was placed on the cumulative effects analysis and that while NEPA requires a consideration of cumulative effects, it does not specify the relative weighting given to these considerations.

One commenter suggested a database to track human activities to better assess cumulative impacts, while another suggested employing new analytical tools such as BP's "Cumulative Effects Working Group." A commenter praised the cumulative effects analysis in the 2006 Programmatic EIS and suggested that NMFS and BOEM review that analysis.

Various comments raised the following general concerns about the analysis of cumulative effects in the EIS:

- The list of reasonably foreseeable future activities is incomplete.
- The section lacks an analytical framework and methodology and should use a quantitative approach. The EIS also needs to do a better job of measuring adverse impacts and giving the reader a clear understanding of how those effects are measured.
- Many "negligible" or "minor" impacts would actually be more severe when considered cumulatively.
- The potential impacts of these industrial activities and environmental changes, both individually and cumulatively, demand a comprehensive approach towards managing the Arctic Ocean resources.
- The cumulative effects analysis does not adequately analyze cumulative and synergistic effects from the multi-faceted and dynamic acoustic environment in which Arctic marine mammals live.
- Analysis underestimates overall impacts to bowhead and other animals that travel great distances and are exposed to a wide range of anthropogenic impacts.
- Cumulative effects are overstated, given the lack of any past record that OCS activities have caused cumulative effects, the transitory nature of seismic vessels, and the fact that animals avoid loud noises.
- There is no evidence after 30 years of exploration activities, often with multiple operations across Canada and U.S. waters, that anything approaching a regional level effect on bowheads has occurred. Just because the project area is large does not mean the cumulative effects are regional in scope.
- The failure to analyze the collective impact of the variety of activities is highlighted by the fact that the analysis of impacts under Alternative 3 varies little from Alternative 2, despite adding many activities.
- The cumulative effects analysis uses a 5-year time frame as a "reasonably foreseeable future" for the basis for its assumptions. However, this does seem to meet the "longer time frame" goal identified in the introduction.

- The decision to break the analysis into individual components misses the overall big picture of fundamental ecosystem change that would cumulatively result from the proposed oil and gas activities.
- It was noted that the only cumulative impact with a "major" rating was for visual resources. And the commenter noted that it has not been demonstrated that impacts on visual resources can act cumulatively in two areas as far apart as the Chukchi and Beaufort Sea Planning Areas. Also, the Chukchi lease areas are so far offshore as to not be visible from shore or subsistence use areas.
- The cumulative effects analysis should also provide information regarding the effect and mitigation/enforcement approach the resource agencies are applying to other sectors, as it appears that NMFS does not pursue enforcement action equally among other entities whose operating noise sources routinely and repeatedly expose marine mammals, which levels exceed those described in the SEIS as harmful.
- The EIS needs to understand that while the laws of the United States end at our borders, the impacts marine mammals face extend beyond our borders into neighboring Canada and Russia. Thus, any EIS that incorporated mitigation plans that hope to effectively mitigate harm to marine mammals which occur in the Beaufort and Chukchi seas needs to evaluate the total impacts felt by marine mammals from not only U.S. activities but also development activities from neighboring countries to set reasonable limits on interference to these animals.

Other comments asserted that the EIS should provide more specific in-depth analysis of potential adverse cumulative effects to/from the following, including how they interact with one another spatially and temporally:

- marine mammals, including their habitat, migratory pathways, prey, and acoustic impacts
- fisheries
- subsistence resources, harvest activities, and traditional livelihoods
- North Slope communities
- climate change and ocean acidification
- oil spills and dispersants
- ocean noise, including noise from drilling platforms, vessels, aircraft, and other forms of transportation
- air and water quality, including emissions and discharges
- research and monitoring activities
- dispersants
- invasive species
- employment, socioeconomics, and income
- recent mortality events involving walrus and ice seals
- past activities
- current and future activities including deep water port construction, increased vessel traffic through the opening of the Northwest Passage, production at the Liberty prospect, production of offshore oil and gas resources (including platforms and pipelines), and oil and gas activities in the Canadian Beaufort Sea and the Russian Chukchi Sea

- the combined effects of multiple surveying and drilling operations through the years
- commercial fishing and entanglement in fishing gear
- imaging techniques and other new technologies
- past, present, and future Incidental Take Authorizations
- military activities

Response to Comments

NMFS recognizes the importance of considering all past, present, and reasonably foreseeable future activities and their collective impacts on the environment. NMFS determined the scope of the cumulative analysis is appropriate for the programmatic nature of the EIS and is in accordance with the provisions of NEPA regulations to keep environmental documents concise and no longer than absolutely necessary (40 CFR 1502.2(c)), to evaluate similar actions generically (40 CFE 1502.4(c)), and to use tiering to focus on the actual issues ripe for decision (40 CFR 1502.20). As provided for by the CEQ regulations, NMFS intends to use this EIS as the required NEPA documentation for the issuance of ITAs for Arctic offshore oil and gas exploration activities. If proposed activities fall outside the scope of this EIS, NMFS may tier from this EIS to prepare additional NEPA documentation in support of future Arctic MMPA oil and gas authorization decisions.

The cumulative effects analysis provided in Section 4.11 of the EIS identifies past, current, and reasonably foreseeable future activities that could have effects on the resources potentially affected by the proposed action, including: offshore and onshore oil and gas exploration, development, and production; scientific research; mining exploration, development, and production; military facilities and training exercises; air and marine transportation; major community development projects; subsistence; and recreation and tourism. The cumulative analysis also considers the influence of continuing climate change. Using this information, the impact analyses provide an overall cumulative assessment, and the conclusions clearly identify the estimated incremental contribution of the proposed action to the cumulative effects on environmental resources.

Regarding the exploration of analytical tools to better understand cumulative effects, as a result of public comments on the SEIS, NMFS undertook a first-order modeling exercise to help better understand the chronic and cumulative effects of noise on marine mammals (see Section 4.5.2.4.9 of the FEIS and brief summary in the response to Issue 7B above). The results of this assessment are described in the FEIS and then were considered in the effect analyses in Chapter 4. Additionally, the BP Cumulative Effects effort referenced in one comment resulted in a published article since the publication of the SEIS, and the results are referenced in Section 4.2.6.6 of the FEIS, where the take of marine mammals from each Alternative is quantified.

One commenter suggested that NMFS should outline an enforcement scheme in the EIS, seemingly to address sectors that produce loud noise and do not currently have permits or authorizations under the MMPA. In this EIS, we address the likely impacts of foreseen oil and gas exploration activities for companies that intend to pursue MMPA ITAs. With the exception of the contributions to cumulative impacts, we do not address other activities that may or may not require MMPA ITAs in this EIS. Therefore, analyzing a potential enforcement scheme of those activities is beyond the scope of this EIS.

ISSUE #11. SCIENCE-BASED DECISION MAKING

The majority of comments on science-based decisions addressed the need to include more traditional knowledge, to include all available studies and information, and to develop more studies and research to address potential gaps in knowledge.

Issue 11A - Additional Information Warranting Consideration

Summary of Comments

Some comments identified available and more recent studies or information that were not included in the DEIS. Commenters suggested consideration and inclusion of roughly one hundred additional scientific studies and reports. Some of the specific comments are:

- The EIS does not include more recent data on bowhead whales in the actual analysis (though it does mention some of the work). NMFS relies almost exclusively on Richardson et al. (1995) and neglects to consider the results of more recent studies such as Christie et al. (2009, 2010) and Koski et al. (2009).
- EIS consistently fails to use new information, instead relying on past NMFS and MMS analyses, which were conducted without new data and used overly conservative estimates. The EIS should incorporate new information about protecting biologically significant areas.
- Within the analysis of Section 4.5.2.4.9.1 in the DEIS, NMFS should consider information derived from evaluating impacts from BP's Northstar production island, where vessel traffic caused bowheads to deflect or change calling behavior.
- There is a lack of information in the section about petroleum plays (Vol. 1, 3.1.3.4, p. 3-13 of the SEIS). This section discusses petroleum plays analyzed in resource assessments for the Beaufort and Chukchi seas and the Hope Basin. This section is incomplete due to the absence of currently published and available BOEM estimates of the probabilistic range of undiscovered, technically recoverable volumes of oil and gas. The sections describing exploration history on the Beaufort Sea shelf and the Chukchi Sea do not include current information about the renewed exploration interests and activities in the Arctic region starting in 2005. This resurgence has generated offshore seismic data acquisition and new drilling activities that occurred in 2012.
- New studies identifying pathways by which anthropogenic noise can affect vital rates and populations of animals, including the 2005 National Research Council study, which proposed a model for the Population Consequences of Acoustic Disturbance; and ongoing Office of Naval Research program whose first phase has advanced the NRC model; and the 2009 Okeanos Workshop on cumulative impacts; should be used.
- NOAA recently launched the Synthesis of Arctic Research (SOAR) and the North Pacific Marine Research Institute's industry-supported synthesis of existing scientific and traditional knowledge of Bering Strait and Arctic Ocean marine ecosystem information. This information should be used to develop an inventory/database of seismic sound sources used in the Arctic in order to better understand long-term, population-level effects of seismic and drilling activities.

The EIS should include recent survey data and other studies that demonstrate the limits of current knowledge about marine mammals in the Arctic Ocean. This included the preliminary results from 2012 surveys that documented bowhead whales moving throughout the Chukchi and Beaufort Seas more than previously thought. These studies reported the bowhead migration in the Chukchi Sea as starting earlier, with bowhead whales spotted more frequently and in greater numbers than in prior years. The 2012 surveys also reported greater numbers of grey whale calves than in any previous survey years. The more recent 2012 surveys reported spotting several species not commonly encountered that include humpback,

fin, minke, and killer whales which could indicate a continuing trend towards greater cetacean species diversity and abundance in the northeastern Chukchi Sea.

Commenters noted that NMFS should make full use of the best scientific information and assessment methodologies, and rigorously analyze impacts to the physical, biological, and subsistence resources identified in the DEIS. Steps should be taken to:

- Move away from arbitrary economic, political or geographic boundaries and instead incorporate the latest science to address how changes in one area or species affect another.
- Develop long-term, precautionary, science-based planning that acknowledges the complexity, importance, remoteness and fragility of America's Arctic region. The interconnected nature of Arctic marine ecosystems demands a more holistic approach to examining the overall health of the Arctic and assessing the risks and impacts associated with offshore oil and gas activities in the region.
- NMFS should carefully scrutinize the impacts analysis for data deficiencies, as well as statements conflicting with available scientific studies.

Response to Comments

The EIS used the best scientific information available at the time of preparation. The information and references have been updated as needed in the FEIS, with attention paid to filling in data gaps where they have been identified. The new information identified by commenters has been reviewed and incorporated as appropriate for the scope of the EIS.

The EIS demonstrates a comprehensive evaluation of the relevant literature and information, including the most up-to-date studies from 2010 and later. Bibliographic citations and references are listed in Chapter 7 of the FEIS.

Three years of monitoring efforts for the Northstar project indicated that in one of these years "the southern edge of the bowhead whale fall migration path may have been slightly (2 -3 mi) further offshore during periods when higher sound levels were recorded; there was no significant effect of sound detected on the migration path during the other two monitored years (Richardson et al., 2004 as cited by Allen and Angliss, 2010). Further, the evidence suggested that the possible deflection occurred when certain vessels were in the area and not as a result of sound emanating from the Northstar facility itself (Allen and Angliss, 2010). The EIS demonstrably considers many of the Northstar studies and reports; for example: Blackwell and Greene (2006); Braund and Associates (1996); Dames and Moore (1996b); Day et al. (2005); and Shepard et al. (2000).

The EIS gives due consideration to the NRC report (2005a)—Marine mammal populations and ocean noise: Determining when noise causes biologically significant effects. The key theme of the Okeanos Workshop (Wright, 2009) was "that noise does not act in a vacuum." The participants emphasized the interaction of noise with other factors and asserted a lack of management focus on cumulative stressors. Cumulative impacts, including consideration of introduced sound, are comprehensively analyzed in the EIS. Moreover, NMFS has given further consideration to the information provided by the Okeanos Workshop and has modified the cumulative analysis in the FEIS accordingly.

Regarding the need for long-term, holistic planning in the Arctic, NMFS has acknowledged this and several of the practices that have evolved concurrently with the MMPA process support this approach, such as the Open Water Season Conflict Avoidance Agreement and planning meetings, as well as the annual organized peer-review meetings that support the MMPA requirement for independent peer review. Also, as described in Chapter 5, NMFS held a Meeting in November 2014 specifically to help develop a robust comprehensive approach to MMPA–required monitoring in the Arctic. Additionally, NMFS is involved with other non-regulatory planning groups, such as the Arctic Waterways Safety Committee.

NMFS is working with this group (which includes members from Alaska Native subsistence hunter groups, local jurisdictions, and industry representatives) to develop best communication and mitigation strategies to avoid conflicts between scientific research vessels and marine mammal subsistence hunters.

Issue 11B - Traditional Knowledge

Summary of Comments

Greater appreciation of Traditional Knowledge (TK) was suggested by some commenters to augment science and provide information not provided by western science.

- Both western science and TK should be applied in the EIS. Should clearly define TK and explain that it protects traditional ways of life and valuable information. TK used in the document should be used with consent.
- NMFS must obtain and incorporate TK before it commits to any management decisions that may adversely affect subsistence resources.
- Specific examples of where TK should be incorporated: developing deferral areas based on input from whaling captains and communities; TK from whaling captains regarding bowhead whales and their ability to smell, sensitivity to water pollution and discharges; and potential interference with subsistence activities or tainting of food; hunt times and locations. Hunters not only have Arctic experience and ongoing observations of their environment but also have approximately 30 years of experience designing effective mitigation measures through the CAAs.
- Based on TK, there are not enough data to really determine season closures or times of use because subsistence users do not know where so many of these animals go when they are not near the coast.
- Applying TK is not only observing the animals, but seeing the big picture of the Arctic environment.

Specifically it was requested to NMFS by the AEWC that in the Final SEIS, a reference be made to the reliability of TK regarding bowhead whales. The AEWC offers the following suggested language: "Traditional knowledge," including both environmental understanding gained and passed down through generations and ongoing local environmental observations can be a rich source of information for regulators facing decisions related to activities in the Arctic. In the case of bowhead whales, the reliability of traditional knowledge has been scientifically verified on at least two occasions. First, the population census of the Bering-Chukchi-Beaufort Seas stock of bowhead whales, undertaken over decades by the North Slope Borough Department of Wildlife Management, is based on a study design conceived in 1982 to test four concepts articulated by Eskimo hunters about bowhead whale behavior and population status. This research, which was subjected to intense peer review at annual meetings of the Scientific Committee of the International Whaling Commission and through a series of peer review meetings on the biology of the bowhead whale, was successful in verifying Eskimo hunters' understanding of bowhead whale behavior during the spring migration at Barrow. It also led the way to development of a robust and successful research program focused on the periodic census of the bowhead whale population, with related data and statistical analysis. More recently, a study of traditional knowledge related to bowhead whales at St. Lawrence Island were found to be consistent with studies of the Bering-Chukchi-Beaufort Seas stock of bowhead whales conducted elsewhere.

Response to Comments

NMFS understands that in order to develop a deeper understanding of the Arctic environment, it must seek out and consider TK. TK was incorporated into the analysis of effects in several FEIS sections, including Section 4.5.1.6 (Environmental Contaminants and Ecosystem Functions), Section 4.5.2.4.10 (Bowhead Whales), Section 4.5.3.2 (Subsistence), and Section 4.5.3.3 (Public Health). Traditional

Knowledge is also a component of mitigation and monitoring, as many PSOs are also Inupiat or Yupik and apply TK in performing the monitoring duties of these positions. NMFS worked closely with the AEWC throughout the development of the EIS and included their input and knowledge as TK in the relevant sections of the EIS. Additionally, several mitigation measures, such as time/area closures have been developed based on TK (e.g., Cross Island/Kaktovik fall blackout period). NMFS has included additional TK in responses to comments. New information and/or analysis related to TK has been incorporated into the FEIS, including the language suggested by the AEWC in the above comment in Section 3.3.2.3 of the FEIS. All TK is appropriately cited to the person who conveyed the information.

Issue 11C - Data Gaps

Summary of Comments

Many comments pointed to alleged information gaps that could hinder science-based decision making. Major themes included:

- Potential for sound from offshore activities to impact marine mammals; basic information on abundance, trends, and stock structure of most Arctic mammal species; potential impacts of oil spills and pollution.
- Baseline data for marine mammals and fish; impacts from climate change; baseline info on the composition and ecology of marine resources and ecosystems; subsistence harvest surveys.
- Propagation of airgun noise from in-ice seismic surveys.
- Whether enough is known about beluga whales and their habitat to accurately predict impacts; issues relevant to effects on walrus, as identified in the USGS 2011 report.
- Lack of information concerning overlap between proposed activities and marine mammal presence precludes a full assessment of effects.
- There is not enough known about the Chukchi Sea side of the EIS project area. Modeling can only use a small body of data, which fails to provide adequate results of what impacts could be. The EIS should reflect this difference between the Chukchi and Beaufort.
- Ambient noise budgets are not very well known for the Arctic. USGS (2011) indicated that these types of data were needed for scientists to understand the magnitude and significance of potential effects of anthropogenic sound on marine mammals.
- Data gaps of general issues including climate change, marine mammals and bowhead whales were noted by commenters.

A commenter noted that in the SEIS, NMFS supplemented its discussion on marine mammals with recent survey data. However, the commenter expressed concern that this new information does not fill the data gaps, as NMFS still acknowledges throughout the EIS that critical information about Arctic marine species and the effects of noise is lacking. In light of these remaining large gaps in information the commenter noted that NMFS must examine whether missing information is essential to the decision and, if so, must obtain it.

Response to Comments

The studies, reports, and other information suggested by commenters have been reviewed and, where applicable and appropriate, information from these documents has been incorporated into the FEIS.

Issue 11D - Needed Research and Studies

Summary of Comments

There were many comments suggesting possible research areas or new studies to better inform decisions regarding oil and gas activities:

- Testing noise levels of drill ships, especially jack-up platforms and dynamic-positioning thrusters. Consider the impacts of mid-and high-frequency sound sources or thrusters.
- Noise impacts of heavy transport aircraft and helicopters.
- Ambient noise budgets are not very well known in the Arctic, but the USGS (2011) indicated that this type of data was needed "for scientists to understand the magnitude and significance of potential effects of anthropogenic sound on marine mammals". This would also assist NMFS in developing a comprehensive baseline from which to measure cumulative impacts.
- Effects on marine mammals from underwater acoustic communication systems. One commenter noted that the hypothesis has not been disproven by research that seal mortality has increased due to seismic exploration activity in 2010-11. There is no conclusion to this hypothesis because research on seal response to noise has not been successfully conducted in the Arctic. In fact, scientists know very little about seals in the Arctic because they have been unable to capture and tag but a few, and none of these have been studied for their response to seismic exploration procedure.
- A comprehensive inventory of acoustic conditions in the Arctic.
- NMFS should undertake an effort to quantify past and current vessel activity in the Arctic, to compare that information to known data on bowhead whales, and then to quantify predicted impacts to bowhead whales from potential vessel strikes given the tremendous increase in the level of activity proposed by the DEIS.
- More recent information regarding oil spills derived from the Deep Water Horizon event data.
- NMFS and BOEM should consider a deferral on exploration drilling until the concerns detailed by the U.S. Oil Spill Commission are adequately addressed.
- New techniques including vibroseis and vessel-quieting technology.
- Oil and gas activities in the Arctic must be coupled with long-term species monitoring programs supported by industry funding, and research must be incorporated into a rapid review process for management on an ongoing basis. By allowing the science and technology to develop first we can provide more concrete, feasible and effective mitigation strategies so we can provide both energy security and proper wildlife protections. One commenter noted that the Arctic is one region where limits on sound-generating activities can be implemented pro-actively, before other human activities increase. Developing an inventory/ database of seismic sound sources used in the Arctic, as suggested by the USGS, could be a good first step (Hutchinson and Ferrero 2011). Such a database may reduce the need for expensive or redundant acoustic modeling and monitoring, in sensitive or biologically significant habitats, and could contribute to developing more effective mitigation strategies.
- Recommended that any G&G activities in the Arctic must be accompanied by a parallel research effort that improves understanding of ecosystem dynamics and the key ecological attributes that support polar bears, walrus, ice seals and other ice-dependent species. NMFS, as the agency with principal responsibility for marine mammals, should acknowledge that any understanding of cumulative effects is hampered by the need for better information. NMFS should acknowledge the need for additional research and monitoring particularly regarding marine mammals and the

topics identified by USGS and other science centers, such as the National Marine Mammal Laboratory. The EIS should describe a program of work to address these gaps and explain clearly how new information would be incorporated into future decisions.

- Identification of important ecological areas should be an ongoing part of an integrated, long-term scientific research and monitoring program for the Arctic, not a static, one-time event. As an Arctic research and monitoring program gives us a greater understanding of the ecological functioning of Arctic waters, it may reveal additional important ecological areas that BOEM and NMFS should exclude from future lease sales and other oil and gas activities.
- A broader synthesis of available information on bowhead whales and other marine mammals.
- An ecosystem-wide, integrated synthesis of available information for Arctic marine mammals, particularly lesser-studies species such as beluga whales, walruses, and ice seals. Robust monitoring plans could provide a vehicle.
- An economic impacts study on the subsistence economy, adverse and cumulative aggregate impacts to human health, and climate change impacts on the economies of coastal communities of Alaska.
- Ecosystem dynamics and the key ecological attributes that support polar bears, walrus, ice seals, and other ice-dependent species. Identification of important ecological areas as part of an integrated, long-term, scientific research and monitoring program for the Arctic.
- Baseline information on the composition and ecology of marine resources and ecosystems.
- Baseline information for marine mammals and fish.
- Basic information on abundance, trends, and stock structure of most Arctic mammal species.
- Impacts to marine mammals from climate change.
- Potential for sound from offshore activities to impact marine mammals.
- Potential impacts of oil spills and pollution to marine mammals.
- Propagation of airgun noise from in-ice seismic surveys.
- Lack of information about marine mammals in the Arctic and potential impacts of anthropogenic noise, oil spills, pollution and other impacts on those marine mammals undercuts the agency's ability to determine the overall effects of such activities.
- A satellite tagging study noted (regarding bowhead whales), that little is known about whale migrations in the Chukchi Sea, including whether the main migration route passes through the oil and gas exploration and development area, or how long whales may remain in that area. These findings demonstrate that more research is needed before NMFS can make informed decisions about the impacts of oil and gas activities on marine mammals.

Response to Comments

NMFS utilizes best available information in the EIS and has determined that enough information is available to the decision maker to make a reasoned choice between the alternatives evaluated in the EIS. NMFS understands that quality management of resources depends on quality science and that additional information regarding the Arctic OCS environment can always improve decision-making. The list of suggested studies above would be taken under advisement as NMFS continues its efforts to promote a fuller scientific understanding of the Beaufort Sea, Chukchi Sea, and North Slope environments and in the development of the Comprehensive Monitoring Plan, as appropriate (see Chapter 5).

It should be noted that a large body of information regarding the Beaufort Sea and Chukchi Sea environments has been compiled via the BOEM Alaska Region Environmental Studies Program (ESP). The ESP conducts a systematic and aggressive research program to study and monitor affected environments and communities on the North Slope of Alaska. Since 1975, over $300 million in studies of the environment of the Alaska OCS and adjacent areas have been commissioned through the ESP alone. The ESP would continue to fund the collection of additional environmental information and commission additional research regarding important environmental and social issues within the Beaufort Sea, Chukchi Sea, and the North Slope region. NMFS would continue to work with BOEM to bring valuable studies to fruition. Interested parties are also encouraged to submit study proposals for consideration in the ESP process.

ISSUE #12. MITIGATION AND MONITORING

There were many comments that addressed a wide variety of concerns related to mitigation and monitoring, including issues of effectiveness, implementation, time/area restrictions, vessel restrictions, aerial surveys, subsistence mitigation, discharges, emissions, and adaptive management. Comments also addressed the Standard Mitigation Measures and Additional Mitigation Measures specifically, and several comments offered potential new mitigation measures.

Issue 12A - General

Summary of Comments

There were several general comments addressing mitigation measures generically or all mitigation measures. Such comments addressed matters of clarity or ambiguity and asked for specific changes or action by NMFS.

- NMFS needs to eliminate the concept of "additional mitigation measures" and decide in the ROD on a final suite of applicable mitigation measures.
- Many mitigation measures are unclear or left open to agency interpretation, expanding uncertainties for future exploration or development.
- NMFS needs to revise the DEIS to include a more complete description of the proposed mitigation measures.
- The proposed mitigation measures would severely compromise the economic feasibility of developing oil and gas in the Alaska OCS.
- Mitigations for the Beaufort Sea should not be applied to or affect activities in the Chukchi Sea. They are two different worlds, the depth of the ocean, the movement of the ice, the distance away from our subsistence activity.
- Many of the mitigation measures suggested throughout the DEIS are not applicable to in-ice towed streamer 2D seismic surveys and should not be required during these surveys.
- NMFS should ensure that research and monitoring are transparent and peer reviewed.
- Analysis of mitigation measures in the SEIS is flawed and incomplete.
- The measures proposed are inadequate to protect the Arctic ecosystem.
- All feasible mitigation measures that reduce impacts to marine mammals and to subsistence activities should be included.
- While the mitigation measures outlined in the EIS represent a good first step in the right direction, they do not go nearly far enough.
- The EIS seeks to impose mitigation measures on activities that are already proven to be adequately mitigated and shown to pose little to no risk to either individual animals or populations.
- The EIS' reliance on future mitigation measures required by the FWS and undertaken by industry is unjustified. It refers to measures typically required through the MMPA and considers that it is in industry's self-interest to avoid harming bears. The EIS cannot simply assume that claimed protections resulting from the independent efforts of others would mitigate for potential harm.
- Including measures to mitigate already negligible or minor impacts is unwarranted, as well as impractical relative to cost-benefit analyses.

- One commenter noted an absence of analysis of oil and gas exploration activities during the months of November through June and recommended that the EIS clarify that there are no additional restrictions during November through June other than those documented in the EIS. Otherwise, the SEIS should specify the timeframes when restrictions apply.

Response to Comments

Per CEQ guidance (NEPA's Forty Most Asked Questions, Question 19), mitigation measures discussed in an EIS must cover the range of impacts of the proposal. Mitigation measures must be considered even for impacts that by themselves would not be considered "significant." All relevant, reasonable mitigation measures that could improve the project are to be identified, even if they are outside the jurisdiction of the lead agency or the cooperating agencies, and thus would not be committed as part of the RODs of these agencies. Because the EIS is the most comprehensive environmental document, it is an ideal vehicle in which to lay out not only the full range of environmental impacts but also the full spectrum of appropriate mitigation (40 CFR 1502.14(f), 1502.16(h), and 1508.14).

In this EIS, NMFS evaluated existing and proposed relevant, reasonable mitigation measures. NMFS also evaluated and eliminated from further evaluation potential measures that are not feasible or not expected to be effective at mitigating adverse effects. Section 101(a)(5) of the MMPA requires NMFS to set forth the "means of effecting the least practicable adverse impact" (i.e., mitigation) on marine mammal species and their habitat and on the availability of such species or stocks for taking for subsistence uses. These measures are implemented to ensure that the activity will have the least practicable adverse impact on marine mammal species or stocks and their habitat and will not have an unmitigable adverse impact on the availability of species or stocks for taking for subsistence uses. Sections 4.5.2.4.16, 4.5.2.4.17, 4.5.3.2.3, and 4.5.3.2.5 of the FEIS contain robust analyses of the mitigation measures, including the likely effectiveness of the measure, the ability of the measure to reduce impacts to affected resources, and the practicability for applicant implementation, as well as an indication of the various activity types when a measure would apply. Here, in the FEIS, we have identified Standard Mitigation Measures that these NEPA analyses have allowed us to conclude are both necessary and feasible to ensure the least practicable adverse impact on marine mammal populations/stocks and their habitat for the analyzed activities moving forward. These Standard measures will be required in every ITA NMFS issues for the indicated activities. Separately, NMFS has identified a "tool box" of Additional Mitigation Measures that may be appropriate in certain circumstances, but which necessitate more project-specific analysis and discussion of implementation with the applicant. The EIS contains a basic analysis of the likely benefits and practicability of these Additional Mitigation Measures, but the necessary project-specific analysis will occur later during the MMPA process, and the decision of whether to require the measure will be made at that time. Additionally, the FEIS contains an analysis of mitigation measures that were considered in either the DEIS or the SEIS but have not been carried forward in this FEIS. The final analysis and determination for those mitigation measures can be found in Sections 4.5.2.4.18 and 4.5.3.2.7 of the FEIS.

While a small number of the mitigation measures would only be applicable in one of the two seas, NMFS determined that it is appropriate to apply the same mitigation measures in both the Beaufort and Chukchi seas. We recognize the different oceanographic characteristics. However, the mitigation measures analyzed in Sections 4.5.2.4.16 and 4.5.2.4.17 are designed to reduce impacts on marine mammals, and the same species occur in both seas. Because of differences in subsistence hunting patterns in the two seas, the measures contained in Sections 4.5.3.2.3 and 4.5.3.2.5 clearly state in which areas they would apply.

At this programmatic stage of analysis, some of the mitigation measures are intentionally general; further clarification and detail would be provided for applicable measures for proposal-specific analysis. For example, projects were primarily predicted to occur between June and November, however, they could potentially be proposed outside of those months, in which case NMFS would consider these general

measures addressed here as applicable, though we would also consider any project specific issues that may be specifically germane to the alternate time period. The descriptions of the mitigation measures have been reviewed and revised for clarity as needed, including additional explanation of our rationale for how we would implement or require the Additional Mitigation Measures.

Requirements for Arctic research and scientific monitoring are beyond the scope of this EIS. Further discussion on research can be found in the responses to comments on Issue #11 Science-based decision making.

Monitoring in support of mitigation requirements and for near-field effects are discussed in Section 5.3 of the FEIS. Responses to comments related to monitoring are provided below in Issue 12I.

Issue 12B - Effectiveness of Mitigation Measures

Summary of Comments

Many comments expressed concerns about the efficacy, practicability, or feasibility of the mitigation measures. These comments generally questioned past practices and asserted or implied that mitigation measures should be evaluated to determine their effectiveness.

- We strongly encourage NMFS to include a separate section devoted exclusively to assessing whether and to what extent each individual mitigation measure is effective at reducing impacts to marine mammals and the subsistence hunt. NMFS should use these revised portions of the EIS to discuss and analyze compliance with the "least practicable adverse impact" standard of the MMPA.
- The EIS mischaracterizes the effectiveness and practicability of particular measures. The DEIS seeks to impose mitigation measures on activities that the analysis concludes holds little to no risk to either individual animals or populations.
- The EIS does not standardize measures that are plainly effective.
- To date, standard practices for individual seismic surveys and other activities have been of questionable efficacy for monitoring or mitigating direct physical impacts (i.e., acute impacts on injury or hearing) and have essentially failed to address chronic, population level impacts from masking and other long-term, large-scale effects, which most likely are the greatest risk to long-term population health and viability.
- Many of these mitigation measures are of questionable effectiveness and/or benefit, some are simply not feasible, virtually all fall outside the bounds of any reasonable cost-benefit consideration, most are inadequately evaluated.
- Consideration needs to be given to whether mitigation is more effective if operations are grouped together or spread across a large area.
- The EIS fails to analyze variations of measures that may be more effective than the ones proposed.
- Evaluating efficacy of mitigation measures should include discussion of feasibility and issues of safety for those upon which they are imposed.
- The cumulative cost of the numerous mitigation measures should be addressed when assessing feasibility.
- Efficacy of mitigation measures imposed upon industry operations should be considered in the context of effects from other activities, such as increasing commercial traffic.

One comment asserted that NMFS should work with BOEM to incorporate a broader list of mitigation measures that would be standard for all oil and gas related incidental take authorizations in the Arctic region, as follows:

- Detection-based measures intended to reduce near-source acoustic impacts on marine mammals
    - require operators to use operational- and activity-specific information to estimate exclusion and buffer zones for all sound sources (including seismic surveys, subbottom profilers, vertical seismic profiling, vertical cable surveys, drilling, icebreaking, support aircraft and vessels, etc.) and, just prior to or as the activity begins, verify and (as needed) modify those zones using sound measurements collected at each site for each sound source;
    - assess the efficacy of mitigation and monitoring measures and improve detection capabilities in low visibility situations using tools such as forward-looking infrared or 360° thermal imaging;
    - require the use of passive acoustic monitoring to increase detection probability for real-time mitigation and monitoring of exclusion zones; and
    - require operators to cease operations when the exclusion zone is obscured by poor sighting conditions;
- Non-detection-based measures intended to lessen the severity of acoustic impacts on marine mammals or reduce overall numbers taken by acoustic sources
    - limit aircraft overflights to an altitude of 457 m or higher and a horizontal distance of 305 m or greater when marine mammals are present (except during takeoff, landing, or an emergency situation);
    - require temporal/spatial limitations to minimize impacts in particularly important habitats or migratory areas, including but not limited to those identified for time-area closures under Alternative 4 (i.e., Camden Bay, Barrow Canyon/Western Beaufort Sea, Hanna Shoal, the Beaufort Sea shelf break, and Kasegaluk Lagoon/Ledyard Bay critical habitat);
    - prevent concurrent, geographically overlapping surveys and surveys that would provide the same information as previous surveys; and
    - restrict 2D/3D surveys from operating within 145 km of one another;
- Measures intended to reduce/lessen non-acoustic impacts on marine mammals
    - reduce vessel speed to 9 knots or less when transiting the Beaufort Sea;
    - reduce vessel speed to 9 knots or less within 274 m of whales;
    - avoid changes in vessel direction and speed within 274 m of whales;
    - reduce speed to 9 knots or less in inclement weather or reduced visibility conditions;
    - use shipping or transit routes that avoid areas where marine mammals may occur in high densities, such as offshore ice leads;
    - establish and monitor a 160-dB re 1 μPa zone for large whales around all sound sources and do not initiate or continue an activity if an aggregation of bowhead whales or gray whales (12 or more whales of any age/sex class that appear to be engaged in a non-migratory, significant biological behavior (e.g., feeding, socializing)) is observed within that zone;

- require operators to cease drilling operations in mid- to late-September to reduce the possibility of having to respond to a large oil spill in ice conditions;
- require operators to develop and implement a detailed, comprehensive, and coordinated Wildlife Protection Plan that includes strategies and sufficient resources for minimizing contamination of sensitive marine mammal habitats and that provides a realistic description of the actions that operators can take, if any, to deter animals from spill areas or respond to oiled or otherwise affected marine mammals the plan should be developed in consultation with Alaska Native communities (including marine mammal co-management organizations), state and federal resource agencies, and experienced non-governmental organizations; and
- require operators to collect all new and used drilling muds and cuttings and either reinject them or transport them to an EPA-licensed treatment/disposal site outside the Arctic;

- Measures intended to ensure no unmitigable adverse impact to subsistence users
  - require the use of Subsistence Advisors; and
  - facilitate development of more comprehensive plans of cooperation/conflict avoidance agreements that involve all potentially affected communities and co-management organizations and account for potential adverse impacts on all marine mammal species taken for subsistence purposes.

A final comment on effectiveness took issue with NMFS' compliance with Open Water Peer Review Panel recommendations. The comment describes several pieces of the Panel's recommendations and asserts that NMFS should clarify how these concerns will be addressed, as follows:

- The peer review panel states that "a single sound source pressure level or other single descriptive parameter is likely a poor predictor of the effects of introduced anthropogenic sound on marine life." The panel recommends that NMFS develop a "soundscape" approach to management, and it was understood that the NSB Department of Wildlife suggested such an alternative, which was rejected by NMFS. If NMFS moves forward with using simple measures, it is recommended that these measures "should be based on the more comprehensive ecosystem assessments and they should be precautionary to compensate for remaining uncertainty in potential effects." NMFS should clarify how these concerns are reflected in the mitigation measures set forth in the DEIS and whether the simple sound pressure level measures are precautionary as suggested by the peer review panel.

Comments by the AEWC expressed concerns about the discussion and treatment of several specific mitigation measures, including

- Safety zones, start-up and shut-down procedures, use of Marine Mammal Observers during periods of limited visibility for preventing impacts to bowhead whales and the subsistence hunt.
- The EIS should include a discussion of the significant scientific debate regarding the effectiveness of many mitigation measures that are included in the DEIS and that have been previously used by industry as a means of complying with the MMPA.
- NMFS must discuss to what extent visual monitoring is effective as a means of triggering mitigation measures, and, if so, how specifically visual monitoring can be structured or supplemented with acoustic monitoring to improve performance. Also noting that also note that NMFS should clearly analyze whether poor visibility restrictions are appropriate and whether those restrictions are necessary to comply with the "least practicable impact" standard of the MMPA.

Response to Comments

The DEIS and SEIS contained analyses of a wide range of mitigation measures that looked at the context of the manner and degree in which the measure is likely to reduce adverse impacts to marine mammals, likely effectiveness, and practicability of implementation, which are the components of our "least practicable adverse impact" analysis.

Additionally, the FEIS contains a focused analysis of each Additional Mitigation Measure, and analysts from NMFS and BOEM have thoroughly reviewed each Standard Mitigation Measure. The FEIS reflects this review (see Sections 4.5.2.4.16, 4.5.2.4.17, 4.5.3.2.3, and 4.5.3.2.5). That analysis indicated that the majority of measures should remain in the initial category in which they were placed in the SEIS. However, NMFS has determined that some of the Additional Mitigation Measures should become standard and vice versa and that some measures should be dismissed from further consideration. The Additional Mitigation Measures analysis in the FEIS also contains a section regarding considerations for future implementation. Further analysis also indicated that some of the measures should not be carried forward for further analysis or consideration. Sections 4.5.2.4.18 and 4.5.3.2.7 of the FEIS contain the analyses and rationales for those measures.

Many commenters suggested variations on the themes of the measures that have been analyzed in this EIS, such as, for example, restricting vessels from operating seismic within different distances of one another. Where a measure has been comprehensively analyzed, it is not necessary within this EIS to separately analyze every iteration of a measure. Factors that are important to the analysis have been identified in the EIS and general recommendations included, and any more case-specific analyses will be conducted pursuant to the MMPA analysis as needed.

In 2012 and 2015, BOEM considered requiring exploratory drilling operators to cease drilling operations in mid- to late September in the Chukchi Sea to reduce the possibility of having to respond to a large oil spill in ice conditions and analyzed it as a proposed mitigation measure in the NEPA documents. BOEM later required the condition in the approved Exploration Plans. BOEM may use this measure in the future; however, BOEM will consider such a requirement on a case-by-case basis, as the details of the measure's implementation may vary in consideration of project-specific circumstances.

Section 5.4 of the FEIS contains information regarding tools for mitigating impacts on subsistence. NMFS outlines methods to improve communication between oil and gas operators and subsistence communities and is committed to supporting streamlined processes to make communication easier and more effective, including working with hunter groups other than bowhead hunters. While some companies have employed subsistence advisors who serve as the designated contact between a given company and the affected communities, other operators may find another method to be more effective after discussions with the communities. Therefore, we do not intend to make the use of subsistence advisors a required Standard Mitigation Measure in the FEIS.

In Section 2.5.2 of the FEIS, NMFS discusses the data gaps that limit our ability to utilize "sound budgets" or sound caps" to manage the effects of acoustic exposure in a more chronic or cumulative manner. That said, in response to public comments, NMFS undertook a first-order modeling exercise to help better understand the chronic and cumulative effects of noise on marine mammals, and the results are described, and then were considered in the effect analyses in Chapter 4. The chronic and cumulative effort was a first step towards figuring out how to better characterize and assess chronic and cumulative effects. Although these initial results did not point to any obvious management solutions and more work is needed, they help us understand the sorts of chronic effects that may be experienced in some areas when certain combinations of activities are conducted.

Issue 12C - Implementation

Summary of Comments

While there is good information on the existence of some Important Ecological Areas, the lack of information about why some concentration areas occur and what portion of a population of marine mammals uses each area hampers the ability of NMFS to determine the benefits of protecting the area. This lack of scientific certainty should not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Several comments asserted that requirements to implement mitigation measures are unclear and should be mandatory. Such comments asserted that additional mitigation measures should be removed, and a final suite of applicable mitigation measures should be established:

- Language regarding whether or not standard mitigation measures are required is confusing.
- The EIS should definitively establish the full suite of mandatory mitigation measures for each alternative that would be required for any given site-specific activity, instead of listing a series of mitigation measures that may or may not apply to site-specific actions.
- Mitigation measures should be mandatory for all activities, rather than on a case-by-case basis.
- The necessary or appropriate mitigation measures should be analyzed case-by-case in the context of issuing ITAs/IHAs/permit/approval, the nature and extent of the risk or effect to mitigate, and cost and effectiveness of implementing the measures. The scope of necessary measures should be dictated by specific activity for which approval or a permit is being sought.
- There is no point to analyzing hypothetical additional mitigation measures in an EIS that is a theoretical analysis of potential measures undertaken in the absence of a specific activity, location, or time. If these measures were ever potentially relevant, reanalysis in a project-specific NEPA document would be required.

Response to Comments

NMFS included the consideration of time/area closures as Additional Mitigation Measures in Alternatives 2, 3, 4, and 6 and as requirements in Alternative 5. We included these closures for specific areas important to marine mammal biological productivity, life history functions for specific marine mammal species of concern, and subsistence activities. The inclusion or exclusion of specific time/area locations was based on the best available information, including western science and traditional knowledge. If newer science later indicates altering these locations, then NMFS will assess this through our adaptive management process (see Section 5.5 of the FEIS) and when a specific application is received.

Section 2.4.2 describes NMFS' review of the mitigation measures and the process for implementation at the individual MMPA ITA stage. The FEIS analysis for all Standard Mitigation Measures notes for which activities each Standard Mitigation Measure would apply. These measures would be included in any issued MMPA ITA for that activity type. The FEIS analysis of all Additional Mitigation Measures clearly identifies for which activities each Additional Mitigation Measure would apply and also explains our rationale for when and how they may be included in any issued MMPA ITA. As noted earlier in this document, per CEQ guidance, an EIS is an appropriate vehicle for describing and analyzing a suite of mitigation measures. However, the MMPA necessitates that NMFS require mitigation in each MMPA authorization that will effect the least practicable adverse impact on affected marine mammal stocks and their habitat, and some-level of project specific assessment is necessary to strike that balance. NMFS will continue to conduct analyses under the MMPA when a specific application is received, which will also afford the public an additional opportunity to comment on the appropriateness of mitigation measures for that site-specific action.

Issue 12D - Time/Area Restrictions

Summary of Comments

There were a large number of comments expressing concerns regarding time/area restrictions in general. These comments addressed both sides of the issue, with many comments asserting that the time/area closures were unwarranted, arbitrary, or unnecessary, while others supported the closures or argued they were insufficient and should target other specific areas. A final group of comments identified concerns with closures in specific areas.

Many general comments asserted that time/area closures are unwarranted, arbitrary, or unnecessary:

- Limiting access to our natural resources is not an appropriate measure and should not be considered.
- The identified time/area closures are unwarranted, arbitrary measures in search of an adverse impact that does not exist.
- There is no information about what levels of oil and gas activity are foreseeably expected to occur in the identified areas in the absence of time/area closures, or what the anticipated adverse impacts from such activities would be. Without this information, the time/area closure mitigation measures are arbitrary because there is an insufficient basis to evaluate and compare the effects with and without time/area closures except through speculation.
- Arbitrary seasonal closures would effectively reduce the brief open water season by up to 50 percent in some areas of the Chukchi and Beaufort seas.
- The realistic drilling window for offshore operations in the Arctic is typically 70 - 150 days. Any infringement on this could result in insufficient time to complete drilling operations.
    - Arbitrary end dates for prospective operations effectively restrict exploration in Camden Bay by removing 54 percent of the drilling season.
    - Placing the time closures chronologically in sequence, results in closures from mid-July through at least mid-September, and in some cases through mid-October. This leaves less than half of the non-ice season available for activity in those areas, with no resulting resource and species protection realized.
    - Timing restrictions associated with Additional Mitigation Measures (e.g., D1, B1) in the SEIS would significantly reduce the operational season.
    - Closing the entire Beaufort Sea shelf break from mid-July to late September would eliminate industrial activity for the entire open water season.
    - NMFS must weigh the socioeconomic impact of these measures before requiring them.
- The arbitrary limits to the duration of programs would cause high intensity, short and long term adverse effects and restrictions to oil and gas land and water uses.
- Evaluate the necessity of including dates within the EIS. Communication with members of village Whaling Captains Associations indicate that the dates of hunts may shift due to changing weather patterns, resulting in a shift in blackout dates.
- NMFS' conclusion that implementation of time closures does not reduce the spatial distribution of sound levels is not entirely correct (Page 4-283 Section 4.7.1.4.2 of the DEIS). The closures of Hanna Shoal would effectively eliminate any industrial activities in or near the area, thereby reducing the spatial distribution of industrial activities and associated sound.

- The designation of geographic boundaries by NMFS and BOEM should be removed, and projects should be evaluated based upon specific project requirements, as there is not sufficient evidence presented that supports that arbitrary area boundary determinations would provide protection to marine mammal species.
- Proposed options in the SEIS to implement a subset of time/area closures or smaller buffers on a project-specific basis should be considered.
- There is a lack of scientific evidence around actual importance level and definition of these closure areas.
- The descriptions of these areas do not meet the required standard of using the best available science.
- Special Habitat Areas arbitrarily restrict lease block access.
- Current constraints on industry activity during subsistence hunts provide adequate protection; time/area closures are unnecessary.
- Buffer zones are impractical and significantly increase the area of operational limitations
- NMFS must first identify new Sound Exposure Level (SEL) acoustic criteria before the impact of buffer zones can be assessed.
- The mechanism for implementing time/area closures is unclear and impedes planning exercises.
- NMFS failed to demonstrate the effectiveness of implementing time/area closures beyond those already required.
- NMFS must eliminate the closure areas unless it can demonstrate that the measures are necessary, effective, and practicable.

Other comments supported the closures or argued they were insufficient and should target other specific areas.

- The proposed time/area closures are insufficient to protect areas of ecological and cultural significance.
- If the closures intended to reduce disturbances of migrating, feeding, and resting whales are not reducing the level of impact they should not be considered effective mitigation measures.
- Time/area closures represent progress, but NMFS' analysis that the closures provide limited benefits is faulty and needs further evaluation.
- Avoiding exploratory drilling proximate to the spring lead system and avoiding late season drilling would help to reduce the risk of oil contamination in the spring lead. At a minimum, NMFS should consider timing restrictions in the Chukchi Sea to avoid activities taking place too early in the open water season.
- Routing vessels around important habitat should be standard, and drilling equipment must be moved out of closure areas.
- FEIS must consider including additional (special habitat) areas and developing a mechanism for new areas to be added over the life of the EIS.
- Currently identified areas with high wildlife and subsistence values should also receive permanent deferrals, including Camden Bay, Barrow Canyon/Western Beaufort Sea, Hanna Shoal, shelf break at the Beaufort Sea, and Kasegaluk Lagoon/Ledyard Bay Critical Habitat Unit.

- Time/area closures should be included in any alternative as standard avoidance measures and should be expanded to include other deferral areas, including:
    - North of Dease Inlet to Smith Bay.
    - Northeast of Smith Bay.
    - Northeast of Cape Halkett where bowhead whales feed.
    - Boulder Patch communities.
    - The Coastal Band of the Chukchi Sea (~50 miles wide) [Commenting on the original Lease Sale 193 EIS, NMFS strongly endorse[d] an alternative that would have avoided any federal leases out to 60 miles and specifically argued that a 25-mile buffer [around deferral areas] is inadequate].
    - IEAs (Important Ecological Areas)
    - Ledyard Bay and Kasegaluk Lagoon merit special protection through time/area closures. Walrus also utilize these areas from June through September, with large haulouts on the barrier islands of Kasegaluk Lagoon in late August and September.
    - The Barrow area during the subsistence hunt in that village. AEWC invites NMFS to Barrow to discuss this with Barrow Whaling Captains.
- Additional analysis is required related to deferral areas specific to subsistence hunting. The FEIS must confront the potential need for added coastal protections in the Chukchi Sea.
- NMFS must include in a revised EIS a discussion of additional deferral areas and a reasoned analysis of whether and to what extent those deferral areas would benefit our subsistence practices and habitat for the bowhead whale.
- Although the results are not published yet, additional analyses from USGS tagging studies (such as those presented at the 2012 Alaska Marine Science Symposium) could be used to better delineate the important habitat area in order to actually mitigate impacts and protect the species.
- The EIS failed to define and establish applicable buffers for protected areas, despite noting that they would be required and would further reduce impacts within special habitat areas.
- Place-based closures are too limited and time/area closures should be adaptive to account for changes in distribution and migration patterns over time.

A group of comments identified concerns regarding closures in specific areas. These included comments on closures associated with, Kasegaluk Lagoon/Ledyard Bay, Point Lay, Hanna Shoal, the area between the Burger prospect and the coast, Barrow Canyon, Beaufort Sea Shelf Break, Camden Bay, Nuiqsut/Cross Island, and Kaktovik.

Kasegaluk Lagoon/Ledyard Bay:

- Mitigation measures already exist under BOEM Lease Stipulation 7 for Ledyard Bay. Redundancies should be removed.

Point Lay:

- Operators could stage at leasing areas but hold off on exploration activity until July l5 or until Point Lay beluga hunt is completed.
- The need for prohibiting transit of exploration support vessels into the Chukchi Sea until July l5 or until Point Lay beluga hunt is completed is unsubstantiated since the entire Lease Sale 193

does not overlap geographically with Point Lay subsistence activities and industry already works with Point Lay to avoid interfering with the hunt.

- NMFS should consider designing larger exclusion zones (detection-dependent or -independent) around river mouths with anadromous fish runs to protect beluga whale foraging habitat, insofar as these areas are not encompassed by seasonal closures.

Hanna Shoal:

- There needs to be information as to how and why the boundaries of the Hanna Shoal were drawn; it is otherwise not possible to meaningfully comment on whether the protection itself is justified and whether it should be further protected by a buffer zone.
- The October 15 end date for the closure of the Hanna Shoal area is too late in the season to be responsive to concerns regarding walrus and gray whales. As indicated in the description in the EIS of the measure by NMFS and USGS walrus tracking data, the area is used little after August. Similarly, few gray whales are found in the area after September.
- Areas to the south of Hanna Shoal are important to walrus, bowhead whales, and gray whales.
- Hanna Shoal merits special protection through time/area closures. It is also a migration area for bowhead whales in the fall and used by polar bears.
- The time/area closure of Hanna Shoal is difficult to assess and to justify and should be removed from Alternative 5 and Additional Mitigation Measure B1 of the SEIS.
- The Hanna Shoal closure cannot be justified on the basis of mitigating potential impacts to subsistence hunters during the fall bowhead whale hunt as the EIS acknowledges that the actual hunting grounds are well inshore of Hanna Shoal, and there is no evidence that industry activities in that area could impact the hunts.
- Current science does not support closure of the Hanna Shoal area for protection of the walrus.
- Closure of the Hanna Shoal area for gray whales on an annual basis is not supported, as recent aerial survey data suggests that it has not been used by gray whales in recent years, and the historic data do not suggest that it was important for gray whales on a routine (annual) basis.
- Hanna Shoal should be removed as a closure area since it cannot be justified on the basis of protecting the subsistence hunt, walrus, or gray whales. If retained, then the closure dates must be clarified.
- The statement that eliminating exploration activities through the time/area closures on Hanna Shoal would benefit all assemblages of marine fish, with some anticipated benefit to migratory fish, is incorrect. Most migratory fish would not be found in offshore waters.
- Using vessels transiting between the coast and Hanna Shoal as a mechanism of impact to subsistence hunts and rationale for the closure is unjustified.
- Removing bowhead and gray whale protection as rationale for closing Hanna Shoal in the EIS is supported by industry.

Between Burger prospect and coast:

- There should be a buffer zone between Burger and the coast during migration of walrus and other marine mammals.

Barrow Canyon:

- Quiet buffer areas should be established to protect areas of biological and ecological significance, such as Barrow Canyon and Hanna Shoal.
- Barrow Canyon merits considerable protection through time/area closures. In the spring, a number of marine mammals use this area, including bowhead whales, beluga whales, bearded seals, ringed seals, and polar bears. In the summer and fall this area is also important for gray whales, walrus, and bearded seals.
- A time/area closure is indicated for Barrow Canyon from September 1 to the close of Barrow's fall bowhead hunt, but dates are also provided for bowhead whales (late August to early October) and beluga whales (mid-July to late August), both of which are vague and outside the limits of the closure. The Barrow Canyon time/area closure needs to be clarified or removed.
- Expand Barrow Canyon time/area closure area to the head of Barrow Canyon (off the coast between Point Barrow and Point Franklin), as well as the mouth of Barrow Canyon along the shelf break.
- Active leases exist in State waters within this closure area.
- This closure area should either be clarified or removed.
- There are no data to suggest industrial activities would result in impacts.
- There is no explanation regarding boundary delineations.
- There is no indication that Barrow Canyon or the Western Beaufort Sea contain unique communities.

Beaufort Sea Shelf Break:

- The time/area closure for the Beaufort Sea shelf break needs to be justified by more than speculation of feeding there by belugas.
    - There is no evidence cited in the EIS stating that the whales are feeding there at that time and that it is an especially important location.
    - Most belugas sighted along the shelf break during aerial surveys are observed traveling or migrating, not feeding.
    - Placing restrictions on the shelf break area of the Beaufort Sea is arbitrary especially when beluga whale impact analyses generally find only low level impacts under current standard mitigation measures.
    - There is no scientific data presented, nor evidence of need to support closing the Beaufort Sea shelf area.
    - The lack of information for the shelf break precludes accurately assessing implications for industry and fails to demonstrate what impacts would be mitigated by closing the area.

Camden Bay/Cross Island and Kaktovik:

- The time/area closure for Camden Bay (Alternative 4 and Additional Mitigation Measure B1 of the DEIS) is both arbitrary and impracticable because there is no demonstrated need. BOEM's analysis of Shell's exploration drilling program in Camden Bay found anticipated impacts to marine mammals and subsistence are minimal and fully mitigated. The measure needs to be clarified, modified, or removed.

- Any protections for Camden Bay should extend beyond the dimensions of the Bay itself to include areas located to the west and east, recently identified by NMFS as having special significance to bowhead whales.
- Camden Bay was improperly removed as a time/area closure in the SEIS.
- Removing Camden Bay contradicts TEK and whaling captains' knowledge of the importance of the area to bowhead whales.
- The delineation of Camden Bay needs to be clarified and include the local whalers' interpretation of what constitutes the bay.
- The Camden Bay time/area closure should be reinstated and include the broader Camden Bay area.
- NMFS needs to explain how it determined that Kaktovik does not use Camden Bay for subsistence hunts.
- The use of Camden Bay by cow-calf pairs makes it biologically important.
- Removing Camden Bay as a time/area closure aligns with the best available science and was warranted due to lack of demonstrated need for such a closure. For the same reason, NMFS should withdraw all time/area closures.
- The addition of a time/area closure for Kaktovik and Cross Island in the SEIS is important for protecting bowheads for subsistence hunts.
- Including Kaktovik and Cross Island as time/area closures is unnecessary and unsubstantiated.
    - There have been no known conflicts since adopting CAA measures.
- The proposed closure periods are inconsistent and should be clarified.
- Include shutdown of activities in specific areas corresponding to start and conclusion of bowhead whale hunts for all communities that hunt bowhead whales, not just Nuiqsut (Cross Island) and Kaktovik.
- Nuiqsut has long asked federal agencies to create a deferral area in the 20 miles to the east of Cross Island. This area holds special importance for bowhead whale hunters and the whales.

Additional comments received regarding time/area closures included:

- NMFS should clarify that time/area closures will not apply in state waters and should remove delineation of such closure areas within waters under state jurisdiction on the figures in the EIS. Activities approved in state waters can be considered for state authorization on a project specific basis. Therefore, restrictions at Cross Island, other barrier islands in state waters, and other state-owned waters of the Beaufort Sea should not apply.
- The DEIS should also consider to what degree the time/place restrictions could protect marine mammals from some of the harmful effects from an oil spill. Avoiding exploration drilling during times when marine mammals may be concentrated nearby could help to ameliorate the more severe impacts discussed in the DEIS.
- The time/area closures are for mitigation of an anticipated large number of 2D/3D seismic surveys, but few 2D/3D seismic surveys are anticipated in the next five years. There is no scientific evidence that these seismic surveys, individually or collectively, resulted in more than a negligible impact.

- A delayed start could increase the risk of losing control of a VLOS that would more likely occur at the end of the season when environmental conditions (ice and freezing temperatures) rapidly become more challenging and hazardous.
- Consider a time/area closure during the winter and spring in the Beaufort Sea that captures the ice fracture zone between landfast ice and the pack ice where ringed seal densities are the highest. Particular caution should be taken in early fall throughout the region, when peak use of the Arctic by marine mammals takes place.
- The FEIS must clarify that time/area closures to protect USFWS trust species would not be applied by NMFS in an IHA, but may be by USFWS.
- The EIS should clearly identify areas where activities would be prohibited to avoid any take of marine mammals. It should also establish a framework for calculating potential take and appropriate offsets.
- How the restricted time period were determined needs to be described in the FEIS.
- How the restricted area boundaries were determined needs to be described in the FEIS.

Response to Comments

Decades of study in the Alaska OCS Region elucidated the heightened importance of many areas across the North Slope and within the Beaufort and Chukchi seas. The consideration of time/area closures in the suite of possible mitigation measures in this FEIS is appropriate. In order to issue an ITA under Section 101(a)(5) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable adverse impact (i.e. mitigation) on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and the availability of such species or stock for taking for certain subsistence uses. NMFS used the best scientific information available and traditional knowledge when considering time/area closures to protect marine mammals and subsistence hunts of marine mammals. Where additional recommendations for how to address time area closures (enlarging, decreasing, modifying) have been made in public comments, and include specific, well justified rationale (supported by science), NMFS has modified the analyses accordingly in the FEIS to consider those recommendations. Upon receipt of an application for an ITA, NMFS would determine if all activities or a subset of the activities contained in the request would need to be limited in the time/area closures identified in this FEIS during the listed timeframes. In line with the requirements of the MMPA, these time/area closures are designed to achieve one or both of the following purposes: 1) to minimize the effects of acoustic disturbances on marine mammals by reducing either the *number* of individuals (in higher density areas) exposed to sound levels above certain thresholds or by reducing the duration or levels of sound that individuals are exposed to during times when they may be more susceptible to adverse impacts (such as when inter-species communication is especially critical or when they are utilizing a preferred habitat and the inability to do so as a result of temporary displacement could result in adverse energetic impacts), or 2) to avoid or minimize adverse impacts to the availability of marine mammals for subsistence uses. As noted in the FEIS, the time/area closures could be applied to any of the oil and gas exploration activities analyzed in the FEIS, not just 2D and 3D seismic surveys. NMFS would not apply time/area closures to protect USFWS trust species in any NMFS issued ITA. However, USFWS may decide to use the analysis contained in this FEIS to include closures to protect their own trust resources in any ITA issued by USFWS.

NMFS reviewed the suggestions for additional time/area closures beyond those contained in the DEIS and SEIS. Based on the best available science and the purposes the closures are meant to achieve, we added a closure area from Point Franklin to Barrow in the Chukchi Sea to protect bowhead and gray whales. Additionally, we included measures to protect bowhead whale hunts in the coastal communities

of the Beaufort and Chukchi seas. Many of the areas recommended in the comment letters were already included in the closures identified in the DEIS and SEIS and contained in this FEIS.

All of the areas analyzed in this EIS are done so in the context of time/area closures, not permanent deferrals from oil and gas activities. The appropriate mechanism for considering exclusion of areas from leasing is when BOEM requests public comments on its Five Year OCS Oil and Gas Leasing Program and later when considering lease sales as described at the leasing stage of the OCSLA. During the Five-Year Program stage, the public is afforded the opportunity to make recommendations regarding the size, timing, and location of proposed lease sales for the next five years. At the lease sale stage, BOEM invites the public to make comments regarding a specific sale and potential exclusions. See Section 2.5.1 of the FEIS for additional discussion on this topic.

Regarding reducing impacts in the spring lead system, NMFS has included an Additional Mitigation Measure that would restrict transit of oil and gas exploration vessels into the Chukchi Sea prior to July 1. Additionally, to date, oil and gas exploration activities have not occurred in the Chukchi Sea in the spring months.

NMFS estimates take for a specific project once we receive an ITA application. Section 4.2.6 of the FEIS provides an explanation of how we estimate take for MMPA ITAs. The section also includes tables that outline representative estimates from recent years for the activities considered in this FEIS. The mitigation measures analyzed in this EIS and that would be included in any issued MMPA ITA are designed to offset potential marine mammal takes, including the use of the time/area closures analyzed herein.

Section 5.5 of the FEIS describes the adaptive management process that NMFS intends to employ through this EIS. The adaptive management process is intended to allow for the appropriate modification of time/area closures and other measures in response to new science and developments in technology to implement mitigation measures. Additionally, while time/area closures have been considered here and designated as either standard or additional measures, opportunities to reconsider the Additional Mitigation Measures and to consider potentially new time/area closures (as appropriate if new information becomes available), as well, will arise as individual projects are considered under the MMPA authorization process, which provides for public comment. However, due consideration of major known areas of importance to marine mammals has been given here, and decisions regarding the designation of standard mitigation made accordingly.

Issue 12E - Acoustic Restrictions

Summary of Comments

- Mitigation distances and thresholds for seismic surveys are inadequate as they fall far short of where significant marine mammal disturbances are known to occur. More stringent mitigation measures are needed to keep oil and gas activities in the Arctic from having more than a negligible impact.
- The benefits of concurrent ensonification areas need to be given more consideration in regards to 15 mile vs. 90 mile separation distances.
- NMFS should consider a measure that defines the conditions under which greater separation would be required.
- The EIS implies that requiring airgun surveys to maintain a 90-mile separation distance would reduce impacts in some circumstances but not in others, depending on the area of operation, season, and whether whales are feeding or migrating.
    - NMFS does not provide any biological basis for this finding.

  - This analysis fails to consider that the measure would affect only the timing, not the spatial extent of the survey effort: the overall area of ensonification would remain the same over the course of a season since survey activities would only be separated, not curtailed.
  - If NMFS believes that surveys should not be separated in all cases, it should consider a measure that defines the conditions in which greater separation would be required.

- A number of detection-based measures should be standardized (e.g., sound source verification, Passive Acoustic Monitoring [PAM]).
- Noise reduction measures should be implemented by industry within US waters and by US companies internationally but especially in areas of the Arctic which have not yet been subjected to high levels of man-made noise.
- For open water and in-ice marine surveys, include the standard mitigation measure of a mitigation airgun during turns between survey lines and during nighttime activities.
- NMFS fails to consider a number of recent studies on TTS in establishing its 180/190 dB safety zone standard. NMFS should conservatively recalculate its safety zone distances in light of these studies, which indicate the need for larger safety zones, especially for the harbor porpoise:
  - A controlled exposure experiment demonstrating that harbor porpoises are substantially more susceptible to TTS than the two species, bottlenose dolphins and beluga whales, that have previously been tested;
  - A modeling effort indicating that, when uncertainties and individual variation are accounted for, a significant number of whales could suffer TTS beyond 1 km from a seismic source;
  - Studies suggesting that the relationship between temporary and permanent threshold shift may not be as predictable as previously believed; and
  - The oft-cited Southall et al. (2007), which suggests use of a cumulative exposure metric for TTS in addition to the present RMS metric, given the potential occurrence of multiple surveys within reasonably close proximity.
- Acoustic restrictions extend exclusion zones and curtail lease block access (e.g., studies by JASCO Applied Sciences Ltd in 2010 showed a 120 dB safety zone with Hanna Shoal as the center would prevent Statoil from exercising its lease rights because the buffer zone would encompass virtually all of the leases). A 180 dB buffer zone could still have a significant negative impact on lease rights depending on how the buffer zone was calculated.
- Restrictions intended to prevent sound levels above 120 dB or 160 dB are arbitrary, unwarranted, and impractical. Restrictions at the 120 dB level are impracticable to monitor because the resulting exclusion zones are enormous, and the Arctic Ocean is an extremely remote area that experiences frequent poor weather.
- The additional buffer zones around closed areas for pulsed sounds >160 dB and continuous sounds >120 dB are arbitrary and impractical.
- The best scientific evidence does not support a need for imposition of restrictions at 120 dB or 160 dB levels. One of the most compelling demonstrations of this point comes from the sustained period of robust growth and recovery experienced by the Western Arctic stock of bowhead whales, while exposed to decades of seismic surveys and other activities without restrictions at the 120 dB or 160 dB levels.

- The DEIS improperly rejects the 120 dB safety zone for bowhead whales and the 160 dB safety zone for bowhead and gray whales that have been used in IHAs over the past five seasons. It claims that the measure is ineffective because it has never yet been triggered, but does not consider whether a less stringent, more easily triggered threshold might be more appropriate given the existing data. For example, the DEIS fails to consider whether requiring observers to identify at least 12 whales within the 160 dB safety zone, and then to determine that the animals are engaged in a non-migratory, biologically significant behavior, might not constitute too high a bar, and whether a different standard would provide a greater conservation benefit while enabling survey activity.
- NMFS should consider implementing mitigation measures designed to avoid exposing migrating bowhead whales to received sound levels of 120 dB or greater given the best available science, which demonstrates that such noise levels cause behavioral changes in bowhead whales.
- NMFS rejected expanding safety zones for cow-calf pairs to 120 dB and to 160 dB for large aggregations of whales because the zones would be too large to monitor. NMFS should then consider other means of monitoring large zones, such as PAM.
- During discussion of additional mitigation measure B3in the DEIS, NMFS suggests that there is an additive effect of the seismic programs in terms of sound. This statement is not quantified in any way implying that in areas where overlap occurs that sound levels may greatly increase. This is incorrect as written. Given that seismic operations use impulsive sound rather than continuous sound there are few locations where sound pulses from both operations would be received simultaneously. At most locations the pulses would be received sequentially and would not exceed the sound level of the closer of the two operations. In the very small areas where pulses were received simultaneously with the same RMS pressure level the sounds would add incoherently (with random phase) and at most would increase sound pressure levels by 3 dB. When the received levels of the overlapping pulses differ by 10 dB or more their combined level would be less than 1 dB greater than the strongest pulse. The flawed conclusion that the sound levels are additive is then used to justify this additional mitigation measure. Due to lack of supporting evidence, this mitigation measure should be removed.

Response to Comments

Mitigation distances, thresholds, sound level restrictions and exclusion zones. As described in Section 4.2.6.5 of the FEIS, NMFS has identified a 160-dB threshold for behavioral harassment for impulsive sources such as seismic, and a 120-dB threshold for behavioral harassment for continuous sources such as drilling. Additionally, NMFS has acknowledged that bowheads sometimes respond at levels of impulsive sound below 160 dB. While these behavioral responses to lower levels may not always rise to the level of a take, they could potentially interfere with subsistence hunting if they occurred in a certain time or place. For these reasons, when implementing time/area closures (which are designed primarily to minimize behavioral harassment by either reducing numbers or severity of effects), we have recommended considering a buffer zone that would minimize received levels within the protected area. However, we acknowledge that these buffers could vary based on the specific circumstances. Moreover, for additional mitigation measures, we will consider them in the context of the proposed activity and the practicability of implementation (e.g., the degree to which the usage of a particular buffer zone would inhibit the ability of a company to explore a lease is an important part of any analysis).

Separately, one commenter references 120-dB and 160-dB safety zones that were used for the past five seasons, which is inaccurate. These measures were included in IHAs for a few seasons but have not been required in over five years. After review, we determined that the measures were not effective, primarily because a lot of effort was put into monitoring the zone, while the measure was never triggered (i.e., never offered any protection), see Section 4.5.2.4.17 for more details. Shutdowns are generally considered more effective at closer distances (and intended to avoid potential injury or more severe

behavioral responses), where the observers are more likely to detect encroaching animals and turn off the source. As noted previously, evaluating mitigation involves a balancing of the likely reduction of adverse impacts along with an understanding of the likely effectiveness of the measure and the practicability of applicant implementation. On the whole, this balance better supports the use of a smaller shutdown zone (such as 180-dB).

As a general overview, over the years, although responses of individuals have been documented, there is no evidence that usage of the standard mitigation exclusion distances for sound associated with oil and gas exploration, in combination with the other measures that have been required, have allowed harm to the bowhead whale population. The most recent estimate of abundance derived from an ice-based census in 2011 was 16,892 bowhead whales in the Western Arctic stock (Givens et al. 2013). This is a substantial increase over the previous estimate from the 2001 ice-based census of 10,470 bowhead whales (George et al. 2004), which was subsequently revised to 10,545 bowhead whales (Zeh and Punt 2004, cited in Allen and Angliss 2011). The estimated annual rate of increase from 1978 to 2001 was 3.4 percent, during which time abundance doubled from approximately 5,000 to approximately 10,000 whales (George et al. 2004). The estimated rate of increase from 1978 to 2011 is 3.7 percent (Givens et al. 2013). Since 1968, there have been more than 250 seismic surveys conducted in the Alaskan Arctic by industry, academia, and the government (BOEM 2012, NGDC 2012). The highest levels of activity (seismic and exploration drilling) occurred in the early- to mid-1980s.

Separation distances. The 15 mile separation distance was an operational constraint that BOEM used to implement to reduce issues with data quality that has recently been removed. There is no scientific evidence to support that a 90 mile separation of survey vessels reduces the impacts to marine mammals. NMFS has dismissed this additional mitigation measure from further consideration. Section 4.5.2.4.18 contains a complete explanation of our rationale.

Detection-based measures. Proven mitigation measures are analyzed in this FEIS and contained in issued MMPA ITAs. Reverberation from seismic impulses in shallow water increases the ambient noise levels within 1 kilometer of the survey vessel, thus decreasing the efficacy of PAM within that range (Guerra et al 2011). PAM is not fully proven to work for active monitoring of a seismic operation (Martin and Lumsden 2010). As described in our analysis of additional mitigation measures in Section 4.5.2.4.17 of this FEIS, we note that our decision of whether to require real-time use of PAM systems to trigger shutdown should be made on a case by case basis in consideration of the continuing development of PAM systems and their ability to detect bowhead whales during operation, the specific environment/habitat that the airguns are operating in and its importance to particular species, and the availability and cost of the necessary equipment. Once PAM systems become available that prove useful for mitigation implementation, we would take certain factors of the seismic survey into consideration when deciding whether to require the use of such systems. Our analysis determined that it is appropriate to keep sound source verification tests as an additional mitigation measure (see Section 4.5.2.4.17).

Noise reduction. Industry and the public sector continue to actively investigate the use of mitigation measures to lessen the impacts of airguns in the water. Airgun silencers and bubble curtains are two such measures. The airgun silencer system has been tested only on low pressure airguns and is not a viable mitigation tool because it needs to be replaced after 100 shots (Spence et al. 2007). Bubble curtains have been tested under various circumstances and activity types in recent years; however, additional testing is needed before the technology could be fully implemented. NMFS and BOEM consider the potential of these devices in Section 2.3.5.4 of the FEIS. Please refer to that section for the full analysis.

Airgun during turns. NMFS has added this as an Additional Mitigation Measure in the FEIS. The analysis can be found in Section 4.5.2.4.17.

Temporary Threshold shift. NMFS utilizes the best available information in the EIS in its discussion of TTS. That general discussion can be found in Section 4.5.2.4.2 with additional species specific information contained in the following subsections. Regarding the assertion that NMFS fails to consider

some recent studies on threshold shift, as described in Section 4.2.6, the EIS considers NMFS' near-final updates to our acoustic guidance for injury thresholds. This new guidance references the current best available science and utilizes cumulative energy metrics to assess the effects of received sound on marine mammal hearing. As further described in Section 4.2.6, NMFS conducted a comparison using the new thresholds and some assumptions about the operational parameters of the seismic surveys expected to be conducted in the Arctic and found that, generally speaking, impacts from auditory injury would not likely be beyond those that would have been projected using the old thresholds. Therefore, NMFS suggests it is unlikely that PTS will occur to individuals of most species, but there could be some small number of individuals that incur acoustic injury, which is more likely for mysticetes.

.

Issue 12F - Vessel Restrictions

Summary of Comments

A variety of comments supported restrictions on vessels to prevent ship strikes and avoid disturbance of whales during critical periods:

- Vessel restrictions and other measures need to be implemented to mitigate ship strikes.
- Vessels should be prohibited from sensitive areas with high levels of wildlife presence that are determined to be key habitat for feeding, breeding, or calving.
- Ship routes should be clearly defined, including a process for annual review to update and re-route shipping around these sensitive areas.
- Speed restrictions may also need to be considered if re-routing is not possible.
- NMFS should require use of real-time PAM in migratory corridors and other sensitive areas to alert ships to the presence of whales, primarily to reduce ship-strike risk.
- Make MMOs (PSOs) mandatory on the vessels.
- One commenter expressed concern about the ability to regulate increasing ship activity (including pleasure craft) and its impact on marine mammals.
- Recommended measures include:
    - Reduce speed to 9 knots or less when transiting the Beaufort Sea within 274 m of whales or when visibility is reduced.
    - Reduce speed to 5 knots or less in the Beaufort Sea when weather or darkness reduce visibility.
    - Avoid direction changes within 274 m of whales.
    - Use shipping routes to avoid areas with high densities of marine mammals.

Other comments felt the restrictions would curtail or constrain industry activities:

- Restricting operators to one rig per sea would severely curtail exploration and unlawfully restrict operators.
- Restricting the number of source vessels is unwarranted and inefficient.

Response to Comments

Mitigation measures to prevent ship strikes and avoid disturbance of whales by OCS-related vessels, such as the above measures suggested by the commenters, have been analyzed in the EIS as either standard or

additional mitigation measures. Some of the measures suggested above may be included by industry as an integral part of the proposed activities. NMFS and BOEM are unable to establish official shipping routes, as that is the responsibility of the U.S. Coast Guard. However, the speed and routing mitigation measures analyzed in the EIS have proven effective at reducing the likelihood of ship strikes of marine mammals in the region.

As described in Section 2.4.3 of the FEIS, NMFS does not restrict an operator to only one rig or source vessel per sea per season. Rather, if an operator utilizes two rigs or source vessels simultaneously in a sea in a season, then that counts as two separate exploratory drilling programs or seismic survey programs for analysis purposes under each alternative. The definition of "program" is used only to simplify the analysis contained in the EIS. It does not affect the way BOEM issues G&G permits for seismic surveys or applications for permits to drill for exploratory drilling, and it does not limit the number of drilling rigs a single company may employ at one time per sea under an approved EP.

Issue 12G - Aerial Surveys

Summary of Comments

One comment asserted the EIS does not list aerial surveys as a standard or additional mitigation measure for either the Beaufort or Chukchi Sea. There is no reasonable scientific basis for this. NMFS should include aerial surveys as a possible mitigation measure along with a discussion of the peer review panel's concerns regarding this issue.

Two comments disputed the feasibility or safety of aerial surveys as a monitoring tool:

- Aerial overflights are infeasible and risky and should not be required as a monitoring tool:
    - Such mitigation requirements are put forward only in an effort to support the 120 dB observation zones, which are both scientifically unjustified and infeasible to implement.
    - Such over flights pose a serious safety risk. Requiring them as a condition of operating in the Arctic conflicts with the statutory requirements of OCSLA, which mandates safe operations.
- The assertion by industry regarding the overall safety of conducting fixed-wing aircraft monitoring flights in the Arctic, especially in the Chukchi Sea, should be reviewed in light of the multiple aerial surveys that are now being conducted there (e.g., COMIDA and Shell are planning to implement an aerial monitoring program extending 37 kilometers from the shore, as it has for a number of years).

Response to Comments

In the past, NMFS required aerial surveys in the Beaufort and Chukchi Seas in order to implement specific mitigation measures. Those mitigation measures were analyzed in the SEIS as Additional Mitigation Measure A5. That analysis indicated that the measures have not been effective. While aerial overflights have not proven effective to implement real-time mitigation measures, they have been used in varying forms as a component of applicants' monitoring plans to increase our understanding of marine mammal species in the region. While monitoring is an ever evolving component of the MMPA process, NMFS encourages applicant's to continue to consider such methods in their proposals, and NMFS will continue to work with the oil and gas industry on crafting the most effective monitoring plans possible.

The aerial surveys in the Chukchi Sea (e.g., ASAMM and the joint industry aerial monitoring program) are vastly different from the overflights that would be needed for continuous monitoring for purposes of real-time mitigation during operations. The aerial survey programs being conducted by BOEM/NMFS and industry are "sampling programs" to collect baseline information. These surveys are typically one or two transects per day, compared to the 24/7 overflights required for mitigation

monitoring. As the commenter stated, the aerial survey programs typically go out 37 kilometers (23 miles) from shore. However, the current leases occur more than 97 kilometers (60 miles) from the Chukchi Sea coast.

Issue 12H - Subsistence Mitigation

Summary of Comments

Several comments asserted the need for communication centers, plans of cooperation, and other mitigation measures to protect bowhead and beluga whale hunts:

- There should be communication centers in the villages during bowhead and beluga hunting if subsistence hunters find this useful and desirable. This would enable real-time reporting.
- Plans of Cooperation (POCs) and CAAs are effective tools to ensure that meaningful consultations continue to take place. NMFS should ensure that POCs and CAAs continue to be available to facilitate interaction between the oil and gas industry and local communities. NMFS should be explicit in how the CAA process is integrated into the process of reviewing site specific industry proposals and should require offshore operators to enter into a CAA with AEWC for the following reasons:
    - Affected communities depend on the CAA process to provide a voice in management of offshore activities.
    - Through the CAA process, whaling captains use their traditional knowledge to determine whether and how oil and gas activities can be conducted consistent with our subsistence activities.
    - Promotes a community-based, collaborative model for making decisions, which is much more likely to result in consensus and reduce conflict.
    - Promotes the objectives of OCSLA, which provides for the "expeditious and orderly development [of the OCS], subject to environmental safeguards ...”
    - Serves the objectives of the MMPA, which states that the primary objective of management of marine mammals “should be to maintain the health and stability of the marine ecosystem”.
    - The CAA is an adaptive process that enables NMFS to address new information and changing circumstances.
- The requirement for CAAs (or more comprehensive plans of cooperation) should be formalized in the EIS and involve all potentially affected communities and co-management groups.
- CAAs need to be expanded to include other subsistence species, such as beluga whales, not just bowheads.
- Standard mitigation measures are needed to protect autumn bowhead hunting at Barrow, Wainwright, and possibly at Point Lay and Point Hope and subsistence hunting of beluga whales at Point Lay and Wainwright and seal and walrus hunting along the Chukchi Sea coasts.
- Justification for why beluga hunting in the Chukchi Sea in summer (late June-mid August) is not protected is needed.
- Only grant permits and allow work when whaling is not occurring.
- There needs to be some mechanism for communicating changes in industry’s operational plans, particularly as they affect subsistence harvests.

One comment suggested that mitigation measures which would mandate portions of CAAs could supersede the authority of NMFS with broad impacts to operations. Another asked that all alternatives include measures to protect subsistence.

Response to Comments

Section 101(a)(5) of the MMPA requires NMFS to make a finding of "no unmitigable adverse impact" on the availability of marine mammal species or stocks for taking for subsistence uses prior to issuing an MMPA ITA. When assessing the potential impacts of an applicant's activities on marine mammal subsistence hunts, NMFS considers whether mitigation measures are needed to ensure no unmitigable adverse impact. NMFS has included several standard and additional mitigation measures in the analysis of the EIS to reduce impacts to subsistence, including the use of communication centers as a standard mitigation measure. A measure to protect fall bowhead whale hunts at Barrow was included in the SEIS as an additional mitigation measure. After further evaluation, the measure has been included in the FEIS as a standard mitigation measure.

NMFS is committed to continuing to work to improve the POC process required by the MMPA implementing regulations in 50 CFR 216.104. A full discussion of both current practices and how NMFS intends to continue to improve and adapt these processes can be found in Section 5.4.1 of the FEIS.

Issue 12I – Monitoring and Reporting

Summary of Comments

One general comment asserted the MMO (PSO) program is not very effective. Only MMOs who are ethical and work hard observe the marine mammals, and there is no oversight to make sure the MMOs are actually working. Many other comments suggested additional monitoring or evaluation to improve effectiveness and compliance, as follows:

- Use additional best practices for monitoring and maintaining safety zones around active airgun arrays and other high-intensity underwater noise sources as set forth in Weir and Dolman (2007) and Parsons et al. (2009).
- Active Acoustic Monitoring should be further studied, but it is not yet ready to be imposed as a mitigation measure.
- Because NMFS is already requiring Passive Acoustic Monitoring (PAM) as a monitoring or mitigation requirement during NMFS' regulation of offshore seismic and sonar, and in conjunction with Navy sonar, we recommend that NMFS emphasize the availability and encourage the use of PAMGUARD in all NMFS' actions requiring or recommending the use of PAM. PAMGUARD is an open source, highly tested, and well documented version of PAM that is an acceptable method of meeting any PAM requirements or recommendations.
- NMFS should include additional mitigation measures to verify compliance with mitigation measures and work with BOEM and industry to improve the quality and usefulness of mitigation and monitoring measures:
    - Track and enforce each operator's implementation of mitigation and monitoring measures to ensure that they are executed as expected; provide guidance to operators regarding the estimation of the number of takes during the course of an activity (e.g., seismic survey) that guidance should be sufficiently specific to ensure that take estimates are accurate and include realistic estimates of precision and bias;
    - Provide additional justification for the determination that the mitigation and monitoring measures that depend on visual observations would be sufficient to detect,

with a high level of confidence, all marine mammals within or entering identified mitigation zones;

- Work with protected species observers, observer service providers, the Fish and Wildlife Service, and other stakeholders to establish and implement standards for protected species observers to improve the quality and usefulness of information collected during exploration activities;
- Establish requirements for analysis of data collected by protected species observers to ensure that those data are used both to estimate potential effects on marine mammals and to inform the continuing development of mitigation and monitoring measures;
- Require operators to make the data associated with monitoring programs (e.g., species information, locations, types and location of vessel activity) publicly available for evaluation by independent researchers;
- Require operators to gather the necessary data and work with NMFS and BOEM to assess the effectiveness of soft-starts as a mitigation measure; and
- Require operators to suspend operations immediately if a dead or seriously injured marine mammal is found in the vicinity of the operations and the death or injury could be attributed to the applicant's activities any suspension should remain in place until NMFS has reviewed the situation and determined that further deaths or serious injuries are unlikely or has issued regulations authorizing such takes under section 101(a)(5)(A) of the Act.
- Require industry to forward fund monitoring.
- Require companies to collaborate on a comprehensive monitoring plan.

- PSO/MMOs should monitor all species.
- More meaningful monitoring and mitigation measures that should be more fully considered and implemented in the programmatic plans include:
  - Considerations of time and area restrictions based on known sensitive periods/areas;
  - Sustained acoustic monitoring, both autonomous and real-time, of key habitat areas to assess species presence and cumulative noise exposure with direct federal involvement and oversight;
  - Support or incentives for research to develop and apply metrics for a population's health, such as measures of vital rates, prey availability, ranging patterns, and body condition;
  - Specified spatial-temporal separation zones between intense acoustic events; and
  - Requirements or incentives for the reduction of acoustic footprints of intense noise sources.
  - NMFS should employ a suite of real-time monitoring methods (e.g., aerial and acoustic monitoring).
- Another Standard Mitigation Measure should be developed with regards to marine mammal monitoring during darkness and inclement weather. This should require more efficient and appropriate protocols. If more appropriate monitoring methods cannot be developed, NMFS should not allow for seismic surveys during times when monitoring is severely limited.

- Although considered important, one commenter stated that NMFS should note that the ability to detect marine mammals in darkness or poor conditions is limited and likely to remain so during the time period of the EIS.
- Unmanned flights should also be investigated for monitoring, as recommended by NMFS' Open Water Peer Review Panel.
- NMFS should consider requiring aerial monitoring and/or fixed hydrophone arrays to reduce the risk of near-source injury and monitor for impacts.
- NMFS should work with other agencies to develop and maintain a web-based list of monitoring priorities and data gaps.
- NMFS should continue to use line transects to estimate take.
- A long-term, comprehensive monitoring program is needed and should include:
    - A multi-disciplinary approach;
    - An identified set of goals that includes metrics for evaluating efficacy of mitigation; and
    - A 10-year monitoring strategy with oversight and evaluation by a science-based steering committee.
- NMFS and BOEM need to develop stipulations for measuring and assessing acoustic impacts on marine mammals that cannot be detected by PSOs (e.g., they are "over the horizon"). This includes large zones, such as the 120 dB zone.
- Research and monitoring cannot be just industry controlled.

One comment asserted that under conditions when exploitation is determined to be acceptable, monitoring and mitigation plans on a wide range of temporal scales should become both a standard requirement and industry practice. These must be designed in a manner specific to the nature of the operation and the environment to minimize the risks of both acute impacts (i.e., direct, short-term, small-scale harm as predicted from estimates of noise exposure on individuals) and to measure/minimize chronic effects (i.e., cumulative, long-term, large-scale adverse effects on populations as predicted from contextually mediated behavioral responses or the loss of acoustic habitat).

One commenter stated that the current monitoring and reporting requirements are ineffective, so suggesting new requirements is unreasonable and unsupported. The currently used "peer review" panel consists of scientists and regulators, not peers of the applicants.

A last comment on monitoring suggested that NMFS should not require monitoring measures to be designed to accomplish or contribute to what are in fact research goals. NMFS and others should work together to develop a research program targeting key research goals in a prioritized manner following appropriate scientific method, rather than attempting to meet these goals through monitoring associated with activities.

Draft 90-day reports for ITAs should be submitted within seven days to the Office of Protected Resources.

Response to Comments

NMFS distinguishes between two types of monitoring. Mitigation monitoring is monitoring that is necessary for the successful implementation of mitigation. For example, monitoring that detects when animals enter an exclusion zone is mitigation monitoring. This type of monitoring is evaluated along with the associated mitigation measure in the context of the "least practicable adverse impact" standard discussed above. Separately, there is a requirement that all MMPA authorizations NMFS issues include requirements for monitoring that will help us better understand the affected species or the impacts of the

covered activity on those species. We believe there are a lot of different types of information that can be collected and reported to meet this requirement. No single particular thing is required, but the information should contribute to a better understanding of the species or the impacts, which may mean studies that increase understanding of the occurrence or marine mammals, the exposure or response of marine mammals to the activity, or the further consequences to the individuals of those responses or a better understanding of mitigation effectiveness or habitat impacts. Studies that meet the monitoring requirements can range from comparatively simple monitoring to more complex efforts that end up in peer-reviewed articles. It depends on the question that an applicant decides to answer with their monitoring and the amount of resources committed to the effort, which should be commensurate to the level of anticipated effects.

NMFS concurs with the comment that active acoustic monitoring requires further study and should not be imposed yet as a mitigation measure. We do not consider implementation of active acoustic monitoring as either a standard or additional mitigation measure in the FEIS. NMFS analyzes the potential of PAM in the additional mitigation measure section. That analysis can be found in Section 4.5.2.4.17. At this time, we recommend requiring it on a case by case basis.

BSEE is responsible for monitoring for and enforcing compliance with requirements on OCS activities. In addition, NMFS, BOEM, USFWS, and BSEE jointly monitor ongoing OCS activities for compliance with and effectiveness of required mitigation measures during active operations throughout the open-water season. The interagency team employs an adaptive management approach to mitigation of adverse effects from permitted and authorized OCS activities. Regarding the effectiveness of individual monitors, NMFS requires minimum qualifications for PSOs, including previous experience, and there is typically also a senior PSO with more experience aboard. While NMFS cannot be onboard every vessel to monitor the effectiveness of individual PSOs, there are multiple mechanisms in place to support responsible procedures, including resume checks by NMFS, multiple PSOs on at all times, data reporting standards, and opportunities for adaptive management.

NMFS currently includes a measure in issued ITAs requiring the operator to report injured or dead marine mammals in the operational area. The measure outlines procedures for when operations may need to be suspended immediately and when operations can continue after the sighting and reporting of such animals.

Section 5.3.2 of the FEIS outlines potential improvements for MMPA ITA monitoring and reporting plans. In November 2014, NMFS convened a workshop to discuss implementation of a forward-looking MMPA Monitoring Strategy to comprehensively address the monitoring specifically required by Section 101(a)(5) of the MMPA when ITAs are issued for oil and gas activities in the Arctic and to help better understand the aggregate impacts of energy development activities. The primary goal of the workshop was to identify and begin prioritizing specific key questions that future monitoring can be designed to answer that will fill critical information gaps to best inform future MMPA and ESA analyses and decisions involving marine mammals and their habitats. Additionally, the regular annual Peer Review serves as a systematic mechanism to regularly work to improve the quality and usefulness of mitigation and monitoring measures. This process is discussed in detail in Chapter 5 but is informed by company report outs from previous years and descriptions of proposed future monitoring. The Peer Review results in formal recommendations for improvement to NMFS that are addressed in the record and typically result in some form of improvement in the given year.

NMFS analyzed a full suite of both standard and additional mitigation measures in Chapter 4 of the FEIS. The analysis indicated that several of the measures identified in this comment issue category should remain as either standard or additional mitigation measures. Those analyses are contained in Sections 4.5.2.4.16, 4.5.2.4.17, 4.5.3.2.3, and 4.5.3.2.5 of the FEIS. The analysis for measures considered but not carried forward for consideration for future implementation are contained in Sections 4.5.2.4.18 and 4.5.3.2.7 of the FEIS.

NMFS' current implementing regulations for Section 101(a)(5) of the MMPA require applicants to submit a report 90 days after completion of activities. It is impractical to change this requirement to seven days because data cannot be processed, analyzed, and reported in such a short timeframe. Such a requirement would lead to rushed reports with unverified data and information.

Issue 12J - Adaptive Management

Summary of Comments

A number of comments argued for various forms of adaptive management or processes in place to adjust to changing circumstances, information, or evaluations of effectiveness:

- The most effective means of creating mitigation that works is to start small and focused and reassess after a couple of seasons to determine what works and what does not work. Mitigation measures could then be adjusted to match reality.
- There should be a mechanism by which the public can be apprised of and provide input on the efficacy of mitigation efforts. Suggestions include:
    - Create a forum similar to the Open Water meetings.
    - Put out a document about the assumptions upon which all these NEPA documents and permits are based and assess mitigation: Are they working, how did they work, what were the problems and challenges, where do we need to focus attention.
    - Include dates if something unusual happened that season that would provide an opportunity to contact NOAA or BOEM.
    - This would just help us to again refine our mitigation recommendations in the future.
- Adaptive management should be used, instead of arbitrary closure dates. To set firm dates for closures does not take into account what is actually happening. An area should not be closed if there are no animals there.
- Specific dates are listed for the time/area closures proposed in the alternatives, but dates for closures need to be flexible to adjust for changes in migration; fixed dates are very difficult to change.
- NMFS needs to clarify the use of adaptive management:
    - In the EIS the term is positioned toward the use of adaptive management to further restrict activities, and it does not leave room for adaptive management to reduce restrictions.
    - If monitoring shows undetectable or limited impacts, an adaptive management strategy should allow for decreased restrictions on oil and gas exploration. The conditions under which decreased restrictions would occur should be plainly stated in the discussion of adaptive management.
    - If adaptive management is used, then additional requirements are needed regarding how quickly industry data need to be analyzed and how they would be used.
- NMFS should create a system where as new and better information becomes available there is opportunity to add and adjust areas to protect important habitat.
- One approach for protecting beluga hunting at Point Lay would be to implement adaptive management; whereby, ships and drill rigs would not come within 60 miles of the community of Point Lay until the beluga hunt is completed.

- Enhanced transparency of industry's monitoring programs and data would help NMFS/BOEM meet objectives of using adaptive management.

Response to Comments

Section 5.5 of the FEIS outlines the strategy NMFS would employ for using adaptive management. NMFS intends to use the strategy outlined in this document to refine mitigation measures as newer scientific information becomes available without the need to automatically necessitate a revised NEPA analysis. NMFS will continuously consider adaptive management as the agency executes the ITA program. One example would be the ability to revise dates for the time/area closures as newer information becomes available regarding use of the closures by marine mammal species and subsistence hunters.

BSEE verifies that the requisite environmental monitoring, mitigation, and reporting procedures are being met. NMFS, BOEM, USFWS, and BSEE jointly monitor ongoing OCS activities for compliance with and effectiveness of required mitigation measures. The interagency team employs an adaptive management approach to mitigation of adverse effects from permitted and authorized OCS activities.

NMFS, BOEM, USFWS, and BSEE conduct post-activity reviews of environmental compliance monitoring and mitigation effectiveness. One goal of this review is to evaluate whether NMFS/BOEM decisions on monitoring, mitigation, and reporting are meeting required results, and if not, to re-evaluate and make changes that would ensure desired outcomes are met by implementing Adaptive Management procedures. Another goal of the post-activity review is to improve future site-specific monitoring and mitigation requirements and to incorporate information on compliance, mitigation, and monitoring efforts into future programmatic and site-specific environmental analyses.

Issue 12K - Standard Mitigation Measures

Summary of Comments

Several comments addressed issues with specific standard mitigation measures:

- Standard Mitigation Measure A3. It is not practical or reasonable to require PSOs on all vessels, especially small boats that lack space for observers (comment on SEIS).
- Standard Mitigation Measure A5 should be deleted as it is essentially the same as Standard Mitigation Measure A4, which needs clarification (comment on SEIS)
- Standard Mitigation Measures B1 and D3 have identical requirements regarding aircraft operations and appear to apply to the same activities, so they should be deleted from one or the other (comment on DEIS).
- Standard Mitigation Measure C4 should be deleted. All exploration drilling programs are required by regulation to have oil spill response plans. Stating regulatory requirements is not a mitigation measure (comment on DEIS).
- Mitigation Measure D2. There should be no requirement for communications center operations during periods when industry is not allowed to operate and by definition there is not possibility for industry impact on the hunt (comment on SEIS).
- Mitigation Measure A6 needs to be clarified:
    - If the purpose is to establish a shutdown zone, it is unwarranted because the nature of drilling operations is such that they cannot sporadically be shut down or ramped up and down (comment on DEIS).
    - If the purpose is the collection of research data, then it should be handled as part of the BOEM research program (comment on DEIS).

  - More details are needed regarding reasons to require PSOs on drill rigs (comment on SEIS).

- Mitigation Measure D1. It is not clear if the closure begins on August 25 or on the first day of the hunt (comment on SEIS).
- Use of a "mitigation airgun" during turns between survey lines and/or allowing ramp-ups from a mitigation airgun during reduced visibility have been standard tools and requirements during recent surveys, but were not included in the SEIS. Inclusion of this must be clarified (comment on SEIS).
- Standard mitigation measures should be incorporated into all permits issued by NMFS and BOEM (comment on DEIS).
- A power-down, delay, or shut-down procedure should be implemented for all activities when a marine mammal enters the Level A harassment zone (comment on SEIS).
- The SEIS fails to mention the standard mitigation measures for OBC seismic operations. Would these be assessed case-by-case and aligned with what was previously implemented?

NMFS would need to revise the Standard Mitigation Measures to account for the new acoustic criteria.

Response to Comments

In the FEIS, NMFS included a Standard Mitigation Measure that requires PSOs on all seismic source vessels, icebreakers, and dedicated monitoring vessels. We include the use of PSOs on drill rigs as an Additional Mitigation Measure. We recognize that some of the smaller support vessels may not have room for PSOs and therefore have not included those vessels in the list of vessels that would be required to have PSOs aboard.

Standard Mitigation Measure A5 from the SEIS has been combined with Standard Mitigation Measure A4 in the FEIS, and additional clarification has been provided in the analysis. Similarly, Standard Mitigation Measure D3 from the SEIS has been combined with Standard Mitigation Measure B1 in the FEIS to remove the redundancy.

Standard Mitigation Measure C4 only appeared in the 2011 DEIS but not in the 2013 SEIS or the FEIS. In the DEIS that measure required oil spill response plans as part of the MMPA process. However, DOI regulations require the submission of an oil spill response plan or else the application is deemed incomplete. This is already an operational requirement; therefore, it did not make sense to include it as an MMPA ITA mitigation measure as well.

Regarding Standard Mitigation Measure D2, the purpose section of this measure states that communication centers would be in operation when industry operations are occurring. There would not be an expectation to utilize the communication centers during periods when industry is not operating.

The measure identified as Standard Mitigation Measure A6 in the SEIS has been moved to the additional mitigation measure section in the FEIS. NMFS concurs with the commenter that in most cases, PSOs would not need to monitor shutdown zones on the drilling rig, as the rigs often do not emit sounds loud enough to require shutdowns. However, there may be value in collecting important monitoring information required under Section 101(a)(5) of the MMPA. Upon receipt of an application, NMFS would review the entire program and determine if other platforms are more appropriate for collecting the monitoring data.

The text in the FEIS for Standard Mitigation Measure D1 states that the closure begins on August 25.

We added an additional mitigation measure to the FEIS regarding the use of a mitigation airgun during turns between survey lines and for allowing ramp-ups during periods of reduced visibility.

The intention of the Standard Mitigation Measures analyzed in this FEIS is that they would be included in all MMPA ITAs for the applicable activities identified for each measure.

Power-downs, delayed starts, or shutdowns are included in the suite of Standard Mitigation Measures and must be implemented when marine mammals enter the applicable Level A harassment zones.

The mitigation measures which would be applicable during OBC/OBN seismic surveys are identified in the FEIS.

It is not necessary to modify the standard mitigation measures addressed in this EIS to account for new acoustic injury guidance. First, acoustic thresholds are used to help characterize and quantify acoustic effects on marine mammals. While they should inform mitigation measures, they are not necessarily tied to them in any specific way. Next, as noted previously, NMFS compared the application of the older acoustic injury thresholds to the newer (near-final) thresholds (using the conservative method presented in the guidance for when full modeling capacity is not available) and found that by and large, using the newer thresholds will result in even smaller numbers of potential injury to most taxa than the application of the old thresholds, with potentially slightly larger numbers of mysticetes. This means that the mitigation zones assessed to avoid injury in this EIS will be generally equal in their protective value to those that might be derived from the new injury thresholds, if not slightly more so for mid and high frequency species. Additionally, the 180-dB mitigation zone has proven generally practicable for applicant implementation for years. Last, the guidance is not final yet, and NMFS has indicated the intent to include an allowance for a transition time in which would-be applicants can work to incorporate the new data into applications but may not need to fully revise applications that have already been drafted. This EIS articulates an adaptive management strategy that will very specifically allow for the incorporation of this new information into the subsequent development (after EIS finalization) of more appropriate mitigation measures, if appropriate.

Issue 12L - Additional Mitigation Measures

Summary of Comments

Several comments expressed general concerns with the additional mitigation measures:

- NMFS should not automatically add Additional Mitigation Measures to an alternative without first assessing the impact without Additional Mitigation Measures to determine whether they are needed (comment on DEIS).
- The additional mitigation measures are too restrictive and could result in serving as the No Action Alternative (comment on DEIS).
- Additional mitigation measures are unwarranted and impractical and should be relegated to a single action alternative that is not selected in the ROD (comment on SEIS).
- The additional mitigation measures far exceed the scope of NMFS' authority (comment on DEIS).
- There is no need for the Additional Mitigation Measures in the EIS and they should be removed:
    - Potential impacts of oil and gas exploration activities under the Standard Mitigation Measures, BOEM lease stipulations, and existing industry practices, are already negligible (comment on DEIS).
    - Analysis of the effectiveness of the Additional Mitigation Measures in reducing any impacts (especially for marine mammals and subsistence) was not established in the DEIS, so there is no justification for their implementation (comment on DEIS).

- The negative impacts these measures would have on industry and on the expeditious development of resources in the OCS as mandated by OCSLA are significant and were not described, quantified, or seriously considered in the EIS (comment on SEIS).
- Any Additional Mitigation Measure carried forward must be clarified and made practicable, and further analysis must be conducted and presented in the FEIS to explain why they are needed, how they were developed (including a scientific basis), what conditions would trigger their implementation and how they would affect industry and the ability of BOEM to meet its OCSLA mandate of making resources available for expeditious development (comment on SEIS).
- NMFS failed to demonstrate the need for most if not all of the Additional Mitigation Measures identified in the DEIS, especially Additional Mitigation Measures A4, B1 (time/area closures), C3, D1, D5, D6, and D8 (comment on DEIS).
- NMFS has failed to fully evaluate and document the costs associated with their implementation. The benefits would not be commensurate with the costs of implementation (comment on DEIS).
- There is no statutory basis for implementing additional mitigation on activities that are currently adequately mitigated (comment on SEIS).
- The uncertainty as to whether or when additional mitigation measures would be implemented is problematic for operators seeking permits and planning activities (comment on SEIS).

Many other comments on the DEIS and SEIS identified problems with or commented on specific additional mitigation measures, as follows:

- Additional Mitigation Measure A1 is problematic and should not be required:
  - Sound source verification tests take time, are expensive, and can expose people to risks.
  - Modeling should eventually be able to produce a reliable estimate of the seismic source emissions and propagation, so sound source verification tests should not be required before the start of every seismic survey in the Arctic as the modeling should be able to produce a reliable estimate of the seismic source emissions and propagation.
  - This should be eliminated unless NMFS is planning to require the same measurements for all vessels operating in the Beaufort and Chukchi Seas.
  - Sound source verification for vessels has no value because there are no criteria for shut down or other mitigation associated with vessel sounds.
  - The proposed requirement is unnecessary and of questionable benefit. Decisions for new verification tests should be on a case-by-case basis.
  - Sound source verification does not produce reliable or repeatable results.
  - Clarification is needed regarding what constitutes a new area or a new location.
- Additional Mitigation Measure A1. Sound source verification should be a standard requirement.
- Additional Mitigation Measure A1. NMFS and BOEM should include 95 percent confidence intervals as recommended by the Peer Review Panel.
- Additional Mitigation Measure A2. Efficacy of night vision devices is unknown, so if required to use them, there should be an experimental component to monitoring and evaluating usefulness.

- Additional Mitigation Measure A2 is unnecessary and irrelevant to the surveys only conducted during daylight hours.
- Additional Mitigation Measure A3 lacks a basic description of the measure and must be deleted or clarified as:
    - NMFS provides no further information in the DEIS with regard to what conditions or situations would meet or fail to meet visibility requirements.
    - NMFS also does not indicate what exploration activities would be affected by such limitations.
    - Operators cannot assess the potential effects of such mitigation on their operations and lease obligations, or its practicability, without these specifics.
    - NMFS certainly cannot evaluate the need or efficacy of the mitigation measure without these details.
    - It is neither practicable nor reasonable to require observers on all support vessels, especially on Ocean Bottom Cable seismic operations, where support vessels often include small boats without adequate space for observers.
    - Cetaceans are not at significantly greater risk of harm when a soft-start is initiated in poor visibility conditions.
    - Avoidance behavior should be given greater consideration.
    - This would render most seismic surveys economically infeasible.
    - There is no scientific justification for this measure.
    - It is unclear how the requirement to limit seismic operations in low visibility would be implemented.
    - Components of this measure have previously been applied on a case-by-case basis. There is no reason to change that.
    - Text must be changed to clarify apparent conflicts between Additional Mitigation Measures A2 and A3.
- Additional Mitigation Measure A4: There are limitations to current PAM technology, but its use may improve monitoring results in some situations and should be used during certain conditions, with these caveats:
    - A period of confidence in the current PAM capabilities, understanding of limitations, and experienced operator capacity-building is needed before requiring PAM as a mandatory monitoring tool during seismic operations.
    - Basic training criteria, such as that specified by many countries for PSOs, should be developed and required for PAM operators.
    - Minimum requirements for PAM equipment (including capabilities of software and hardware) should be considered.
    - NMFS/BOEM should require operators to develop and demonstrate this technique.
    - Active and Passive Acoustic Monitoring differ greatly and should not be grouped and evaluated together.
- Additional Mitigation Measure A4 is impractical as the technology is not yet proven effective and the limitations are not adequately assessed.

- Additional Mitigation Measure A4: there is no indication as to when these systems would be required.
- Additional Mitigation Measure A5 provisions are unclear, unjustified, and impractical:
    - The justification for believing that biologically significant effects to individuals or the bowhead population would occur from exposure of four or more bowhead cow/calf pairs to >120 dB pulsed sounds is not provided or referenced.
    - The amount of time and effort required to monitor for four or more bowhead cow/calf pairs within the 120 dB seismic sound level area take away from better defining the distances and/or sound level thresholds at which more substantial impacts may be occurring.
    - Would the referenced 4 or more cow/calf pairs have to be actually observed within the area to trigger mitigation actions or would mitigation be required if survey data corrected for sightability biases using standard line-transect protocols suggested 4 or more were present?
    - If a mitigation measure for aggregations of 12 or more whales were to be included there needs to be scientific justification for the number of animals required to trigger the mitigation action.
    - NMFS acknowledges that this measure has not been effective and should not be considered further, then states it is worth considering case-by-case. This measure should be deleted.
    - Guidance is needed to ensure aerial survey methods are appropriate for detecting cow/calf pairs.
- Additional Mitigation Measure B-1 precludes all activities until the close of the Kaktovik and Nuiqsut fall bowhead hunts. Furthermore, in the last 10 years no bowhead whales have been taken after the third week of September in either the Nuiqsut or Kaktovik hunts so proposing closure to extend well into October is unjustified. The measure should be deleted for the reasons outlined above. If not, then start and end dates of the closure period must be clarified; hard dates should be provided for the start and end of the closure or the closure should be tied to actual hunts.
- Additional Mitigation Measure B2 was unnecessarily rejected by NMFS.
- NMFS should not rely on industry to ensure efforts are not duplicated.
- NMFS' position that they do not have legal authority to implement this measure is based on incorrectly reading OCSLA. The MMPA does not restrict types of mitigation.
- Additional Mitigation Measure B2 proposes restrictions that are unnecessary, impractical, and must be deleted or clarified:
    - The likelihood of redundant or duplicative surveys is small to non-existent. A new survey is conducted only if the value of the additional information to be provided would exceed the cost of acquisition.
    - The restriction is based on the false premise that surveys, which occur in similar places and times, are the same. A new survey may be warranted by its use of new technology, a better image, a different target zone, or a host of other considerations.

- Implementing such a requirement poses several large problems. First, who would decide what is redundant and by what criteria? Second, recognizing the intellectual property and commercial property values, how would the agencies protect that information? Any proposal that the companies would somehow be able to self-regulate is infeasible and potentially illegal given the various anti-trust statutes. A government agency would likely find it impossible to set appropriate governing technical and commercial criteria, and would end up stifling the free market competition that has led to technological innovations and success in risk reduction.
- This already done by industry in some cases, but as a regulatory requirement it is very vague and needs clarification.
- The five year time period is too long. If the measure is retained, the time period should be changed to one year.

- Additional Mitigation Measure B3 should not be established, particularly at these distances, because it is both unwarranted from an environmental protection perspective and unnecessary given how seismic companies already have an incentive for separation. It should also not be considered as an EIS project area-wide measure. It is impractical and not supported by science.
  - The basis for the distances is premised on use of sound exposure levels that are indicative of harm. Use of the 160 dB standard would establish a propagation distance of 9-13 kilometers. The distance in the mitigation measure therefore seems excessive and no scientific basis was provided.
  - NMFS has justified the 120 dB threshold based on concerns of continuous noise sources, not impulsive sound sources such as seismic surveys.
  - The argument that overlapping sound fields could mask cetacean communication has already been judged to be a minor concern. NMFS has noted, "in general, NMFS expects the masking effects of seismic pulses to be minor, given the normally intermittent nature of seismic pulses." (76 *Federal Register* at 6438, February 4, 2011).
  - The mitigation measure is prohibitively restrictive, and it is unclear what, if any, mitigation of impacts this measure would result.
  - NMFS should only impose limitations of the proximity of seismic surveys to each other (or to specific habitat areas) when and where they are applicable to known locations where biologically significant impacts might occur. There is no evidence that such important feeding areas occur within the EIS area other than just east of Point Barrow.
  - It should only be used at specific times and locations and after a full evaluation of the likelihood of overlap of seismic sound and/or disturbance impacts has actually taken place. Simply assuming that seismic sound might overlap and be additive in nature is incorrect.
  - The conclusion that sound levels are additive is flawed and should not be used to justify this mitigation measure.
- Additional Mitigation Measure B3 fails to recognize that only the timing and not the spatial extent of survey effort would be affected. NMFS should institute this as a precautionary measure despite lack of evidence regarding impacts of overlapping sound sources.
- NMFS must clarify if and how non-detection based measures (Additional Mitigation Measures B-all) apply to other types of surveys (e.g., ice gouge, strudel scour, baseline studies).

- Additional Mitigation Measure C1 needs to be more clearly defined (or deleted), as it is redundant and nearly impossible and impractical for industry to implement.
    - Steering around a loosely aggregated group of animals is nearly impossible as PSOs often do not notice such a group until a number of sightings have occurred and the vessel is already within the higher density patch. At that point it likely does more harm than good trying to steer away from each individual or small group of animals as it would only take the vessel towards another individual or small group.
    - This measure contains requirements that are already requirements, such as Standard Mitigation Measures B1 and D3, such as a minimum altitude of 457 m.
    - The mitigation measure requires the operator to adhere to USFWS mitigation measures. Why is a measure needed to have operators follow another agency's mitigation measures which already would have the force of law? Additional mitigation beyond that required by USFWS is unnecessary.
    - The measure states that there is a buffer zone around polar bear sea ice critical habitat which is false.
- Additional Mitigation Measure C2 should be discussed in more detail, clarified, or deleted in the FEIS.
    - Shipping routes or shipping lanes of this sort are established and enforced under the regulatory authority of the U.S. Coast Guard. While NOAA or BOEM could establish restricted areas, they could not regulate shipping routes.
    - With this mitigation measure in place, successful exploration cannot be conducted in the Chukchi Sea.
    - Not only would lease holders be unable to conduct seismic and shallow hazard surveys on some leases, but essential geophysical surveys for pipelines to shore, such as ice gouge surveys, strudel scour surveys, and bathymetric surveys could not be conducted.
    - Important habitats to avoid need to be identified.
- Additional Mitigation Measure C3. No scientific justification is provided for ensuring reduced, limited, or zero discharge. There is also no documentation that marine mammals are impacted by discharge streams. NMFS needs to explain in the FEIS how NOAA's recommendations can justify being more stringent than EPA's permit conditions, limitations, and requirements. There are no scientific reports that indicate any of these discharges have any effect on marine mammals and anything beyond a negligible effect on habitat.
- Additional Mitigation Measure C3 should be specified the anticipated reduction levels associated with and applied to marine vessel traffic supporting operations as well as drill ships.
- Additional Mitigation Measure C4: The purpose, intent, and description need to be clarified. In Section 2.5.4 of the DEIS it was stated that NPDES permitting effectively regulates/handles discharges from operations. Zero discharge was removed from further analysis. The Additional Mitigation Measure focusing on zero discharge should also be removed. It is not clear how NOAA would have authority to regulate discharge that is under the authority of the EPA.
- Additional Mitigation Measures C5 and C6. Using trained seal-lair sniffing dogs may not always be feasible. This should be modified to allow for alternative options, such as local hunters.
- Additional Mitigation Measures C5 and C6 present serious problems. Seal sniffing dogs would likely disrupt seals, could transfer disease to seals, and could attract polar bears.

- To avoid confusion, Additional Mitigation Measure C5 should explicitly state that it would only be potentially applicable to IHAs for on-ice seismic activities.
- Additional Mitigation Measure D1: The measure needs to be clarified as to the dates, what areas would be impacted/closed and justified and/or modified accordingly:
    - It is not clear if this restriction is focused on the nearshore Chukchi Sea or on all areas.
    - The logic of restrictions on vessels due to whales avoiding those areas may justify restrictions in the nearshore areas, but it is not clear how this logic would justify closing the entire Chukchi offshore areas to vessel traffic if open water exists.
    - If a more specific exclusion area (e.g., within 30 miles of the coast) would be protective of beluga whale migration routes, it should be considered instead of closing the Chukchi Sea to transiting vessels.
    - It is not scientifically supported to close the entire Chukchi Sea to vessel traffic when the stated intent is to avoid disrupting the subsistence hunt of beluga whales during their migration along or near the coast near Point Lay.
    - Transits should be allowed, provided that they do not interfere with the hunt.
    - Transits far offshore should be allowed, and transits that are done within the conditions established through a CAA should be allowed.
    - Prohibiting movement of drilling vessels and equipment outside of the barrier islands would unreasonably limit the entire drilling season to less than two months.
    - Movement of drilling vessels and related equipment in a manner that avoids impacts to subsistence users should be allowed on a case-by-case basis and as determined through mechanisms such as the CAA not through inflexible EIS mitigation requirements.
    - BOEM (2011b) has previously concluded that oil and gas activities in the Chukchi Sea would not overlap in space with Point Lay beluga hunting activities, and therefore would have no effect on Point Lay beluga subsistence resources. Given that the entire Lease Sale 193 area does not overlap geographically with Point Lay subsistence activities, it is reasonable to draw the same conclusion for activities of other lease holders in the Chukchi Sea as well.
    - This measure also prohibits all geophysical activity within 60 mi of the Chukchi coastline. No reason is offered. The mitigation measure would prohibit lease holders from conducting shallow hazards surveys and other geophysical surveys on and between leases. Such surveys are needed for design and engineering.
    - Oil and gas vessels are only a fraction of the vessel traffic in the area.
    - Reducing the exclusion area from anywhere in the Chukchi Sea to an area within 8 km is appropriate.
- Additional Mitigation Measure D2 has practical limitations that would hinder compliance. If agencies determine that risks warrant restrictions, then they should be applied to all other vessels in the area.
- Additional Mitigation Measures D3, D4, D5, D6, and D8 need clarification about how the real-time reporting would be handled:
    - If there is the expectation that industry operations could be shut down quickly and restarted quickly, the proposal is not feasible. Real-time triggers impose significant operational challenges.

  - Who would conduct the monitoring for whales?
  - How and to whom would reporting be conducted?
  - How whale presence would be determined and who would make the determination must be clarified in this measure.
  - Who determines where/when conflicts arise?
  - Industry already uses Subsistence Advisors and Comm Centers, so new measures are not needed.
- Additional Mitigation Measure D3 should be eliminated or clarified. Geographic boundaries must be clearly stated, as well as how and by whom whale presence would be determined.
- Additional Mitigation Measure D4 should be consistent with surrounding mitigation measures that consider start dates of bowhead whale hunting closed areas based on real-time reporting of whale presence and hunting activity rather than a fixed date.
- Additional Mitigation Measure D5: Geographic units are described in terms of the coastal zone. Since Alaska has no Coastal Zone Management Programs, areas should be described in relation to state and federal waters.
- Additional Mitigation Measure D6: geographical boundaries of the closed area need to be identified. This measure is also unnecessary since Subsistence Advisors and Communication Centers are already used.
- Additional Mitigation Measure D7 must be deleted or clarified:
  - The transit restrictions are not identified, nor are the conditions under which the transit might be allowed.
  - Some hunting of marine mammals in the Chukchi Sea occurs year round making this measure impracticable.
- Additional Mitigation Measure D8 needs to be clarified as to whether it refers to the spring or fall hunts or both. As written, it precludes the entire open water season.
- Additional Mitigation Measure D8 should be a standard mitigation measure.
- Additional Mitigation Measures D1-8: Six of these eight measures are unprecedented, based on past measures included in IHAs and CAAs. NMFS should not interfere with the CAA negotiation process by including these measures in the SEIS.

One comment on the SEIS recommends that NMFS include all of the additional mitigation measures in Alternatives 5 and 6 into the FEIS and make them standard. Another suggested that measures removed from further consideration not be rejected.

DTAGS should be removed from further consideration as a mitigation measure since its use could increase exposure by fish to sound energy (comment on SEIS).

One commenter on the SEIS recommended implementing all of the following additional measures:

- Use in-situ measurements to verify the size of Level A and B harassment zones for all sound sources (seismic surveys, sub-bottom profilers, vertical seismic profiling, vertical cable surveys, drilling, icebreaking, support aircraft and vessels, etc.)
- Establish and monitor respective Level B harassment zones (i.e., 160 and 120 dB) for impulsive and continuous sources.

- Cease operations when the Level A harassment zone is obscured by poor sighting conditions (i.e., during periods of fog, high sea states, or inclement weather, darkness).
- Use passive (or active) acoustic monitoring, in addition to visual monitoring, to increase detection capabilities.
- Use Big Eyes and reticulated and/or laser range finding binoculars to detect and estimate locations of marine mammals within Level A and B harassment zones and to document activities, behavior, and movements of marine mammals within these harassment zones.
- Use night-vision devices (e.g., forward-looking infrared, thermal imaging) to enhance detection capabilities in low visibility conditions or darkness.
- Specify that aircraft and vessels avoid groups of ice seals by 0.8 km.
- For 2D or 3D seismic surveys, in-ice surveys, site clearance, and shallow hazards surveys: specify ramp-up procedures; restrict seismic surveys from operating within 145 km of one another; restrict the number of surveys to minimize duplicative efforts; do not initiate of continue seismic activities if (1) an aggregation of bowhead whales or gray whales (12 or more whales of any age/sex class that appear to be engaged in a non-migratory, significant biological behavior (e.g., feeding, socializing)) is observed within the 160-dB or (2) a female-calf pair of either species is observed within the 120-dB harassment zone.
- For on-ice seismic surveys: conduct activities at least 152 m from any observed ringed seal lair; prohibit placing any energy source over, on, or near a ringed seal lair; use trained seal-lair sniffing dogs in areas where water depths exceed 3 m to locate seal structures in work areas and camp sites before starting activities; and use trained seal-lair sniffing dogs to survey the ice road and establish a route where no seal structures are present.

Response to Comments

NMFS appropriately considers a range of mitigation measures in the EIS even if some of the analyzed activities may not have significant impacts on the affected resources. Per NEPA regulations, mitigation measures must be considered even for impacts that by themselves would not be considered "significant." (NEPA's Forty Most Asked Questions 19a; 40 CFR 1502.14(f), 1502.16(h), and 1508.14). Additionally, one of the main purposes of the EIS is to support NMFS' MMPA decision-making, which includes the need to apply measures to ensure the "least practicable adverse impact" on the species and their habitat for each individual authorization that we issue. Information may support the idea that some measures will reduce impacts and be practicable for any individual conducting a certain type of activity (these measures will be designated as standard), while the success and practicability of other measures may depend on project-specific information that will not be available until the future time at which an application is submitted (these measures are designated as additional).

The EIS analysis accounts for those mitigation measures already established through applicable law, regulation, and policy. The EIS also identifies potential mitigation measures and analyzes their effectiveness in reducing environmental impacts, as well as their practicability for implementation. The need for these mitigation measures only arises in the context of specific proposed actions. If in the future a project proponent requests an ITA from NMFS, and NMFS' project-specific analysis indicates a potential for adverse effects, then NMFS may reference back to this EIS for analysis of which mitigation measures would be appropriate. NMFS enhanced the analysis of the additional mitigation measures from the DEIS in both the SEIS and this FEIS. For each additional mitigation measure contained in the FEIS, we included a rationale for this designation and considerations for how the additional mitigation measure may be applied to future MMPA ITAs. Additionally, our analysis contains information regarding the practicability for applicant implementation of each measure.

Please refer to Sections 4.5.2.4.17 and 4.5.3.2.5 to see the analyses for all Additional Mitigation Measures analyzed in the FEIS. The analysis for each measure identifies the purpose of the measure, the applicable activities for when it would be implemented, the science, support for reduction of adverse impacts, and likelihood of effectiveness of each measure, the history of measure implementation, practicability, and rationale and considerations for future implementation. These sections address many of the comments raised here.

Generally speaking, where commenters made recommendations on specific mitigation measures with an adequate justification, they were added in for consideration in the mitigation section of the FEIS. In the FEIS, NMFS considered but did not carry forward the following additional mitigation measures that were identified by the following lettering and numbering schemes in the DEIS and SEIS: B2; B3; C1; D3; D5; D6; and D7.

The additional mitigation measures identified as C5 and C6 in the DEIS and SEIS have been combined with Standard Mitigation Measure A4 in the FEIS. We recognize that using trained seal-lair sniffing dogs may not always be feasible. Therefore, the measure states that another comparable method may be used to locate the seal structures. The additional mitigation measure identified as D1 in the DEIS and SEIS is now Standard Mitigation Measure D4. However, the restriction is lifted after July 1, and the restricted area more clearly defined to within 8 km (5 mi) of the Chukchi Sea coastline. The real-time reporting requirement for all of the additional mitigation measures in the "D category" in the DEIS and SEIS have either been moved to the considered but not carries forward category or altered to remove the real-time shutdown component. We recognize that there are considerable logistics and planning involved for shutting down for a marine mammal subsistence hunt and recognize that set dates make implementation more practicable. In Section 5.5 of the FEIS, we discuss how shutdown dates for subsistence hunting may shift in the future based on changes in marine mammal presence through our adaptive management strategy.

NMFS does not consider the use of DTAGS as a mitigation measure in the EIS.

Issue 12M - New Mitigation

Summary of Comments

New potential mitigation measures were described by many comments:

- A specially equipped, oceangoing platform(s) is needed to carry out the prevention, diagnosis, and treatment of disease in marine animals, including advanced action to promote population recovery of threatened and endangered species, to restore marine ecosystems health, and to enhance marine animal welfare. Response to marine environmental disasters and incidents; in particular oil spills.
- Trained dogs are the most effective means of finding ringed seal dens and breathing holes in Kotzebue Sound so should be used to clear path for on-ice roads or other on-ice activities.
- The EIS fails to address the third step in the mitigation hierarchy which is to compensate for unavoidable and incidental take. NMFS should provide a clear framework for compensatory mitigation activities.
- The mitigation measures need to include clear avoidance measures and a description of offsets that would be used to protect and/or restore marine mammal habitat if take occurs. The sensitivity of the resource (e.g., the resource is irreplaceable and where take would either cause irreversible impact to the species or its population or where mitigation of the take would have a low probability of success), and not the level of activity, should dictate the location of avoidance areas. NMFS should consider adding an Avoidance Measures section to Appendix A (Note commenter is referring to Draft EIS).

- If explosives are used, there needs to be mitigation to ensure that the explosives are accounted for.
- NMFS should consider using an independent panel to review survey designs. For example, an independent peer review panel has been established to evaluate survey design of the Central Coastal California Seismic Imaging Project, which is aimed at studying fault systems near the Diablo Canyon nuclear power plant. See California Public Utilities Commission, Application of Pacific Gas and Electric Company for Approval of Ratepayer Funding to Perform Additional Seismic Studies Recommended by the California Energy Commission: Decision Granting the Application, available at docs.cpuc.ca.gov/PUBLISHED/FINAL_DECISION/122059-09.htm.
- The rationale for not including mitigation limiting activities in low-visibility conditions, which can reduce the risk of ship-strikes and near-field noise exposures, as standard mitigation is flawed, and this measure needs to be included:
    - It suggests that the restriction could extend the duration of a survey and thus the potential for cumulative disturbance of wildlife; but this concern would not apply to activities in migratory corridors, since target species like bowhead whales are transient.
    - While it suggests that the requirement would be expensive to implement, it does not consider the need to reduce ship-strike risk in heavily-used migratory corridors in order to justify authorization of an activity under the IHA process.
    - This requirement should be standardized for all activities involving moving vessels that occur in bowhead whale migratory corridors during the latter parts of the open-water season (i.e., September-October); and for all transits of support vessels in all areas at all times.
- For exploratory drilling operations in the Beaufort Sea west of Cross Island, no drilling equipment or related vessels used for at-sea oil and gas operations shall be moved onsite at any location outside the barrier islands west of Cross Island until the close of the bowhead whale hunt in Barrow. This measure would prevent exploration of offshore leases west of Cross Island during the open water season and would require refunding of lease purchase and investment by companies that are no longer allowed to explore their leases.
- NMFS should consider for mitigation a requirement that seismic survey vessels use the lowest practicable source levels, minimize horizontal propagation of the sound signal, and/or minimize the density of track lines consistent with the purposes of the survey. Accordingly, the agencies should consider establishing a review panel, potentially overseen by both NMFS and BOEM, to review survey designs with the aim of reducing their wildlife impacts.
- Another Standard Mitigation Measure should be developed with regards to marine mammal monitoring during darkness and inclement weather. This should require more efficient and appropriate protocols. If more appropriate monitoring methods cannot be developed, NMFS should not allow for seismic surveys during times when monitoring is severely limited.
- A requirement that all vessels undergo measurement for their underwater noise output per American National Standards Institute/Acoustical Society of America standards (S12.64); that all vessels undergo regular maintenance to minimize propeller cavitation, which is the primary contributor to underwater ship noise; and/or that all new vessels be required to employ the best ship quieting designs and technologies available for their class of ship.
- NMFS should require that industry signs a CAA with the relevant marine mammal co-management organizations

- Mitigation and monitoring measures concerning the introduction of non-native species need to be identified and analyzed.
- NMFS should recommend an interagency research program on oil spill response in the Arctic and seek appropriations from the Oil Spill Liability Trust Fund to carry out the program as soon as possible.
- The Outer Continental areas are considered by Alaska Natives as the nursery grounds for the salmon species of Alaska—when they are "out to sea" and it is known that that they go to the Bristol Bay, the Chukchi, the Beaufort Seas; these are special nursery areas and should have the strongest possible protections.
- NMFS could mitigate the risk ice poses by including seasonal operating restrictions in the FEIS and preferred alternative.
- Quieter alternative technologies should be required in areas newly opened to oil and gas activities.
- Positive environmental consequences of some industry activities and technologies are not adequately considered, especially alternative technologies and consideration of what the benefits of better imaging of the subsurface provides in terms of potentially reducing the number of wells to maximize safe production.
- In the case of seismic surveys, improvements to analysis and processing methods would allow for the use of less powerful survey sources reducing the number of air-gun blasts. Better planning and coordination of surveys along with data sharing would help to reduce the number and lengths of surveys by avoiding duplication and minimizing survey noise. Requirements should be set in place for data collection, presence of adequate marine mammal observers, and use of PAM to avoid surveys when and where marine mammals are present.
- Aircraft overflight regulations for pinnipeds should be increased to 3,000 feet to avoid disturbance of animals on terrestrial and ice haulouts. Spotted seals and walrus are the most sensitive to overflights. This is particularly important for helicopter traffic as pinnipeds are more sensitive to this type of platform.
- Include permanent closure areas in the FEIS.
- Exclude subsistence use areas from proposed activity in the Beaufort and Chukchi seas.
- Limit the number or projects simultaneously occurring in an area.
- One commenter recommended several mitigation measures:
    - Authorize an in-season adjustment in the size of the Level A and B harassment zones only if they are determined to be inadequate in size (i.e., in-situ adjustments that would reduce the size of the zone(s) should not be authorized);
    - Report injured and dead marine mammals to NMFS and local stranding network using NMFS' phased approach and suspending activities, if appropriate; and
    - Submit field and technical reports and a final comprehensive report to NMFS;

Response to Comments

As noted several times already in this response to comment document, Section 101(a)(5) of the MMPA requires NMFS to prescribe the permissible methods of taking and "other means of effecting the least practicable adverse impact (i.e., mitigation) on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such

species or stocks for subsistence uses." Several of the mitigation measures suggested in the comment letters either fall outside the scope of the proposed action or are not appropriate based on the language of the MMPA. The least practicable adverse impact requirement does not include compensation considerations. Therefore, the comment suggesting that NMFS consider the "third step in the mitigation hierarchy which is to compensate for unavoidable and incidental take" is not applicable here. Other measures suggested here are already considered and analyzed in some form in the FEIS.

The time/area closures considered and analyzed in the EIS to protect marine mammals during important life functions, their habitats, and subsistence hunting grounds address the comment regarding avoidance areas. The analysis in the FEIS describes the importance of each area and the appropriate times to restrict activities to meet the closure purpose. Buffer zones are also considered to increase the avoidance area and level of protection in the area. Alternative 5 analyzes the inclusion of permanent time/area closures.

Explosives are not considered, analyzed, or recommended for authorization in this EIS. Therefore, no mitigation measures are needed to ensure that explosives are accounted for in the analysis.

We added an Additional Mitigation Measure to the FEIS regarding exploratory drilling operations west of Cross Island. This is now Additional Mitigation Measure D2. Additional Mitigation Measures A2 and A3 in the FEIS address the concerns raised by commenters regarding conducting seismic surveys and marine mammal monitoring during darkness and inclement weather.

BOEM and BSEE regulations require operators to use the Best Available and Safest Technologies. Questions of practicability or minimization of source levels or horizontal propagation of the sound signal is project-specific. BOEM and BSEE evaluate all aspects of a proposed action under NEPA, which may include a review of the concerns noted here. BOEM also evaluates each project as it is submitted according to OCSLA regulations and NEPA. Additionally, NMFS reviews each proposed action under the MMPA, ESA, and NEPA, taking into consideration mitigation measures to reduce impacts to marine mammals, their habitats, and the availability of marine mammals for subsistence uses. Establishing an independent panel to review survey designs as applications are received would be redundant to the already established regulatory processes for application review. BOEM and NMFS encourage operators to continue exploring methods to reduce sound input into the marine environment. The FEIS analyzes potential technologies; however, none are yet commercially available or ready for use on a large scale. Additionally, the alternative technologies discussed in the FEIS are not proven to effectively replace the types of seismic data collected using airguns at this time.

NMFS and BOEM continue to support and encourage studies and R&D for ship quieting technologies. However, questions of vessel design and maintenance would fall under the purview of the U.S. Coast Guard. Concerns regarding the introduction of non-native species are addressed in measures required by the U.S. Coast Guard for ballast water under the National Invasive Species Act and the EPA's Vessel General Permits. Recent analyses of some project-specific actions in the U.S. Arctic Ocean indicate the anticipated level of effect would be negligible, given compliance with U.S. Coast Guard and EPA regulations.

NMFS and BOEM do not have the authority to require private agreements between third parties, such as CAAs, although we do encourage companies to participate in this process because of the successful mechanisms it has used for years to ensure regular productive dialogue. NMFS conducts a rigorous analysis under the MMPA process to ensure the proposed activity does not have an unmitigable adverse impact on the availability of marine mammals for taking for subsistence uses. Section 5.4.1 of the FEIS describes the methods that are required and those that are supported by NMFS in making this determination.

Additional Mitigation Measure A1 in the FEIS describes the purposes of the sound source verification tests, including refinement to Level A and B harassment zones. NMFS currently includes a measure in ITAs that require operators to report injured and dead marine mammals to NMFS and the local stranding

network using a phased approach and suspending activities, if appropriate. NMFS' MMPA ITA implementing regulations require the submission of technical reports at the conclusion of the field season.

ISSUE #13. OIL SPILLS

A number of comments expressed concerns regarding oil spills – their potential to occur, their effects on the environment, as well as the efficacy of response techniques.

Issue 13A - Occurrence

Summary of Comments:

Some comments took exception to the idea that oil spills are low probability events, even in the exploration phase. It was asserted that oil spills would become more likely during the development stage. NMFS should therefore assume a spill and plan accordingly. Conversely, one comment asserted that a VLOS does not seem reasonably foreseeable and should not be evaluated in the EIS.

Related comments pointed out the poor safety and environmental compliance records of industry. Commenters expressed concern that compliance records should be evaluated in the operating assumptions upon which the EIS is based and in the stated likelihood of a spill, leak, or accident.

Response of Comments:

It is recognized that the frequency for a VLOS on the OCS from a well control incident is very low. From 1964-2014 there has been one very large oil spill during exploratory and development/production operations on more than 41,000 wells. In BOEM's Draft Programmatic EIS for the OCS Oil and Gas Leasing Program for the 2017-2022 period, data indicate a frequency of 2.05×10^{-5} incidents per well for an oil spill of 10,000,000 bbl or greater. Assigning accurate frequency rates to rare events is difficult. Section 4.10.3 of the FEIS characterized the frequency of large and very large oil spills from loss of well control, although absolute quantification remains difficult given the relatively limited number of historical observations for both loss of well control and large (≥1,000 bbl) pollution events. Reliance on historical data presents its own set of challenges as the historical data may represent a trend associated with a different regulatory regime or different industry practices from the past. Quantitative risk assessment becomes most practical at the well design phase, much later in the phased OCSLA process, when the combined reliability of primary and secondary barriers or barrier-failure modes can be analyzed within in a quantitative risk assessment approach. At the exploration and development phase, worst case discharge is also calculated on a site-specific basis and can be useful in determining the potential scale of effects. USDOI, BOEM and BSEE are actively participating in and funding a suite of new studies to help characterize the frequency of such events (USDOI, BOEM, 2011). NMFS has incorporated by reference and summarized a VLOS or Catastrophic Discharge Event in Section 4.10 of the FEIS.

Issue 13B - Scenario

Summary of Comments:

A comment asks that the EIS explain how non-Arctic analogs of oil spills are related to the Arctic (i.e. what criteria are used?) and also highlight the USGS (2011) Data Gap Report's recommendations for continuous updating of estimates.

Meanwhile, several comments provide a more holistic critique of the oil spill analysis, stating:

- Discussion of oil spills has not been worked into the alternatives.
- No overall risks to the environment are stated.
- There should be more analysis of severity of spills in different areas.
- Modeling of shoreline oiling is inadequate.

- Impacts to whales may be of higher magnitude due to important feeding areas and spring lead systems.
- Recovery rates for spilled oil should be reevaluated.
- There are no site-specific details.
- The trajectory model needs to be more precise.
- A range of representative oils should be used for scenarios not just for light-weight oil.
- Explain the parameters of real world constraints and of the VLOS.
- The analysis of black carbon in the VLOS section itself is not sufficient.

Response to Comments:

VLOS Parameters. Few offshore VLOS events are well documented. The EIS considers standard constraints and parameters including flow, duration, and weathering. A range of oils are evaluated—from North Slope Crude to Alpine Crude—which represents the range of representative oils anticipated offshore in the Beaufort and Chukchi Seas.

The percentage of trajectories is described in USDOI, BOEMRE (2011), Appendix B, page B10:

> A long duration VLOS would consist of a spill occurring continuously for up to 74 days and therefore is more like a batch spill launched every day or so. There would be multiple trajectories over time with each trajectory launched regularly as the well continued to flow. Each trajectory would bring some fraction of the oil spill to that specific resource or location. The multiple trajectories representing a VLOS would change how the conditional probabilities are interpreted. The conditional probabilities would represent how many trajectories come to that location described as percent trajectories (number of trajectories contacting/total number of trajectories launched). For example, if 1,000 trajectories are launched and 500 of the trajectories contact that location, then 50percent of the trajectories would bring oil to that location.

Non-Arctic vs. Arctic. Fault trees were used to transform historical spill statistics for non-Arctic regions to predictive spill-occurrence estimates for the Beaufort and Chukchi Seas program areas (Bercha Group Inc., 2006, 2008a, b, 2011). The Bercha Group, Inc. (2008) fault-tree analysis focused on Arctic effects as well as the variance in non-Arctic effects, such as spill size and spill frequency. Arctic effects were treated as a modification of existing spill causes as well as unique spill causes. Modification of existing spill causes included those that also occur in other OCS regions but at a different frequency, such as trawling accidents. Unique spill causes included events that occur only in the Arctic, such as ice gouging, strudel scour, upheaval buckling, thaw settlement, and other for pipelines. For platforms, unique spill causes included ice force, low temperature, and other factors.

The measures of uncertainty calculated were expanded beyond Arctic effects in each fault-tree event to include the non-Arctic variability in spill size, spill frequency, and facility parameters, including wells drilled, number of platforms, and subsea wells and subsea pipeline length. The inclusion of these types of variability— effects, non-Arctic data and facility parameters—is intended to provide a realistic estimate of spill-occurrence indicators and their resultant variability.

BOEM completed a report titled Oil Spill Occurrence Rates for Offshore Oil Spills which was published in conjunction with the 5-Year Final Proposed Program. In addition BOEM, Alaska OCS Region contracted for a study titled, *Update of Alternative Oil Spill Occurrence Estimators*, which includes updating GOM and Pacific OCS statistics (Bercha Group Inc. 2013). The BOEM Alaska OCS Region has contracted for a study titled, *Loss of Well Control Occurrence and Size Estimators for the Alaska OCS*.

Fault-tree analysis is a method for estimating the spill rate resulting from the interactions of other events. The top event is defined as the failure under investigation. In this case, it is either a large pipeline or

platform spill. A series of events that lead to the top event are described and connected by logic gates. Logic gates define the mathematical operations between events.

Two general fault trees are constructed, one for large pipeline spills and one for large platform spills. The pipeline fault-tree events included corrosion, third-party impact, operation impact, mechanical failure, and natural hazards—unknown and Arctic. The sub-resultant events that make up Arctic include upheaval buckling, ice strudel scour, ice scour, thaw settlement, and other. Platform events include a process facility release, a storage tank release, structural failure, hurricane or storm, collision, and Arctic. The sub-resultant events that make up the Arctic included ice force, low temperature, and others.

General critique. The oil spill analysis considers a very large spill. A very large spill is a very unlikely event in which the small changes in the estimated level of activity under each alternative would not change the frequency of occurrence. The EIS uses an appropriate level of oil-spill trajectory analysis which estimates contacts to land segments, grouped land segments, boundary segments and environmental resource areas including the entire coastline from various site specific areas within each planning area over three seasons and six time periods. The environmental resource areas include important feeding areas and the spring lead systems. Conservatively, the oil-spill trajectory model does not include spill containment or response. Any successful or partially successful spill containment or response could lower the percent trajectories contacting. BOEM is committed to the continuous improvement of oil-spill trajectory analysis estimates and NEPA analyses. BOEM uses the results of new meteorological, oceanographic and ice modeling studies to fulfill that commitment. In addition the information collected through the Environmental Studies Program is used for model validation and sensitivity testing.

Issue 13C - Effects

Summary of Comments:

Many comments expressed concerns regarding the potential impacts of a large or very large oil spill. It is stated that:

- An oil spill in the Arctic environment would be devastating to numerous biological systems, habitats, communities, and people.
- Effects of an oil spill would be long-lasting; petroleum products cause malformation in fish, physical effects and/or death in marine mammals and birds, and remain in the benthos for at least 25 years.
- Native communities would be heavily impacted if a spill occurred and depriving them of subsistence resources.
- Oiled ice would melt more rapidly.
- There is too little known about Arctic marine ecosystem and wildlife to know what the effects would be. The EIS requires additional analysis on how marine mammals would be impacted by direct contact, direct ingestion or indirect ingestion and long-term incorporation of hydrocarbons in the fatty tissues of marine mammals and/or on their fur.

Inter-agency action should occur to ensure compliance with NMFS statutory mandates to prevent catastrophic harm to marine mammals and other endangered species. Several comments took issue with specific portions of the analysis of effects of very large oil spills:

- The conclusion that pinnipeds and walrus would only experience minor to moderate impacts during a very large oil spill is peculiar since NMFS is considering ringed and bearded seals and USFWS is considering walrus to be listed under the ESA.

- The effects of a VLOS could have on seal populations is understated because: it is much more likely that seals would be attracted to spill and cleanup areas; ringed and bearded seals feed and/or travel in portions of the water column where oil would likely become entrained; a spill would affect numerous animals no matter where it occurred; food sources would be heavily impacted; and more than one subpopulation could be affected.

Comments also recommend that the EIS analyze:

- The probability of impacts to polar bears if oil reached the lead edge between the shorefast ice and pack ice zones, a critical foraging area especially during spring.
- Adverse effects from dispersants.
- Effects of a spill on indigenous people on the Canadian side of the border, as well as waters surrounding the Arctic.

Response to Comments:

A Very Large Oil Spill (VLOS) would certainly have serious effects on the biological systems, habitats, communities, and people of the Arctic. It is also readily apparent that the Arctic presents some unique circumstances with respect to oil and gas activities. The *Deepwater Horizon* oil spill was a profound demonstration of the potential outcomes of such a VLOS event, and the potential effects of such an event in the Arctic are discussed at length in Sections 4.10.4 and 4.10.5 of the FEIS.

Conditions at potential drill sites in the Beaufort and Chukchi Seas are very different from those in the Gulf of Mexico (shallower water depths and lower formation pressures in the Beaufort and Chukchi Seas), which reduces the likelihood of such a catastrophic event. Also, new rules and rulemaking procedures, along with new and revised Notices to Lessees were developed following the *Deepwater Horizon* event to help further reduce the likelihood of a VLOS. These are discussed in detail in Section 4.10.1 of the FEIS.

The analysis in the EIS by no means understates the potentially devastating effects of a VLOS. The analysis in Section 4.10.6.11 for marine mammals asserts that a catastrophic discharge event would impact marine mammals from direct contact, inhalation, and ingestion, and these effects would be significant, causing a multitude of acute and chronic effects. If the area and duration of a spill was such that it contaminated ice leads or polynyas in the spring, it could have devastating effects on whales. As bearded and ringed seals loosely congregate around polynyas and lead systems during winter, a spill in these areas could have serious effects on local ringed and bearded seal sub-populations.

Potential impacts of a VLOS on polar bears are described in the Draft EIS to be of medium to high intensity. Permanent habitat loss, reproductive impairment, and death are all possible outcomes discussed in the EIS, and the suggestion is made that population level impacts are possible as well. A VLOS is a very unlikely event, but it is well-accepted that depending on the timing, location, and duration of a VLOS in the Arctic, effects could be significant for biological systems and human communities.

Issue 13D - Spill Response

Summary of Comments:

Many comments asserted that a large spill in the extreme conditions of the Arctic would be difficult or impossible to clean up. It is stated that current cleanup methods are ineffective, and effective methods must be developed before exploration and development is allowed to proceed. Related comments request:

- Development of an oil spill response gap analysis for existing Arctic oil and gas operations.

- Mitigation measures need to reflect the possibility of an oil spill and lead to a least likely impact. Identify areas to be protected first in case a spill does occur.
- Specification of proven technology that could operate outside the open-water season.
- A determination as to whether certain vessels like the drillship *Discoverer* can complete a relief well during late season conditions and describe proposed capping systems developed by industry. The EIS needs to be updated as it does not reflect the latest regulatory requirements instituted by BOEM and BSEE for the 2012 open water season where Shell was required to provide information on the specifications and location of a relief drill rig.
- The USGC should be involved developing mitigation measures for tank vessels that are involved as ancillary vessels during response efforts as these vessels carry petrochemicals.
- Acknowledgment of an oil spill response gap, especially in 30 to 70 percent ice cover. The EIS should acknowledge that detection and tracking of oil under ice is limited and would complicate recovery efforts.
- The EIS should be amended to consider the full range of pollutants generated by oil spills and their potential for far ranging migration. One commenter noted that a spill incident could include a severe oil fire or entail in-situ burning as a mitigation measure and the EIS needs to evaluate the soot effects with potential dioxin components. They noted that soot can migrate over much wider areas than a spill itself, creating harmful effects to species on the ice surface and in the water. No analysis of burning oil has been conducted for such oil fires in the Arctic environment.
- The effect of dispersants used in response efforts was not analyzed and should be evaluated in the EIS. New studies show the increased toxicity of oil combined with dispersants effects pelagic and benthic organisms due to dispersal in the water column.
- One commenter proposed testing oil spill response mechanisms in the Arctic to broaden the understating of spill response in ice conditions.
- Spill response assets should be contracted and in place and capable of timely deploying the appropriate technology for mechanical recovery of oil spills in the marine environment in the event of a release. The EIS is unclear as to where spill response vessels and aircraft to support response efforts would originate from. Transit times would prevent a timely response. Aircraft for spill response would need special modifications to be able to operate in the Arctic due the extreme temperatures and the distances from aircraft facilities to the Chukchi lease holdings. The EIS is unclear where spill response workers would be housed.
- Until there is long-term methodology for timely recovery of oil spills, NMFS should not allow BOEM, BSEE or the USGC to permit any of these activities in the Arctic environment.
- Regarding regulatory oversight and spill mitigation methodology, the process of waiving the Oil Pollution Act of 1990 compliance in remote areas needs to be evaluated in the EIS with regard contracting to spill response assets. The Department of the Interior was encouraged by one commenter to make technical, regulatory, oversight, and policy changes prior to proceeding with Arctic Ocean oil and gas drilling.

Response to Comments:

Oil spill response options in Arctic environments would vary depending on seasonal oceanographic and meteorological conditions. Therefore, oil-spill response strategies and tactics for cold climates must be designed to deal with a mix of open water and ice conditions that could occur throughout any portion of the operating period. Different environmental conditions prevalent in the Arctic and sub- Arctic may, in part, impede or facilitate different response windows and methods (Bjerkemo, 2011; USDOI, MMS

2009). For example, ice can serve as a natural oil boom and dampen surface waves, while cold weather slows the rate of oil evaporation, making it easier to burn (Bjerkemo, 2011). Shore ice may also provide a physical barrier, allowing oil to concentrate in greater thickness, limiting shore contact and promoting in situ burning (Bjerkemo, 2011). However, spill removal companies have testified that icy waters actually make traditional techniques (booming and skimming) significantly less effective (CRRC, 2009). A spill during the fall freeze-up would be the most dangerous time for a spill, and even chemical response methods would be limited (Nuka and Pearson 2010).

The Arctic is sparsely populated and infrastructure is not abundant. Thus, the ability to appropriately respond to incidents remains a concern (USGS 2011). Ice-free seasons are relatively short (around four months a year), and ice state may influence the ability to drill a relief well. Further, the relatively shallow Arctic depths could result in more contact potential in the event of a catastrophic spill. Should spilled oil persist in the water column, there is concern that oil could become trapped in ice. A substantial government and industry-sponsored investment in oil spill response research in varying ice states using different methods has occurred in the past few decades (Dickins, 2011; USDOI, MMS, 2009). Recent research in the Arctic focuses on high-capacity mechanical recovery systems for varying ice types and states; on improving techniques for surface and subsurface dispersant application in cold water environments and in drift and pack ice; on ignition techniques and oil-herder applications to improve the efficacy of in situ burning, fate, and biodegradation studies of dispersed oil in cold water environments; and on detecting, surveying and tracking spilled oil under ice and within ice matrix (OGP JIP 2012; Dickins, 2011; Kanocz and Johnsen, 2011; Potter et al. 2012).

A substantial body of work is ongoing in light of the Deepwater Horizon event including improving prevention, containment, and response through independent review and both government and industry regulation and research as outlined in USDOI, BOEM (2012).

ISSUE #14. OTHER COMMENTS

There were some single comments that did not neatly fit into one of the issue categories or exceeded the scope of proposed action. Several commenters suggested specific edits to be incorporated into the FEIS. Commenters also provided documents or suggested new materials to incorporate into the FEIS. They are summarized here.

Issue 14A – Other Comments

Summary of Comments

Other comments included energy policy, alternative energy, and development and production. While such issues are of national importance, they exceed the scope and decisions made in this EIS process. Nonetheless, these are important baseline issues for which responses have been provided below.

- One commenter stated that the Arctic should be declared a sanctuary for wildlife.
- Another commenter said the document does not adequately consider the benefits of high-quality imaging of the subsurface which could reduce the number of wells drilled.
- NMFS needs to assess the impact of offshore coastal development in light of the fact that Alaska lacks a coastal management program, since the state lacks the program infrastructure to effectively work on coastal development issues.
- Regarding the potential for disasters, comments suggested that the technology used by industry is obsolete, and they are not capable of drilling safely in the Arctic. The potential pollution and environmental disasters that could result from oil & gas activities would impact humans and the rest of the food chain. BOEM should significantly increase the liability and financial responsibility of Arctic operators.
- Commenters expressed concern about the scope of the EIS. NMFS should explain how they determined that the need for a stable domestic energy supply is outside the scope of the EIS. Another comment argued that this issue is not outside the scope of the EIS and pointed out that the Executive Summary specifically mentions anticipated increasing energy needs in the U.S.
- Comments acknowledged that safe development of oil and gas resources is critical for U.S. energy policy and for the Alaska economy and expressed concern that the EIS as written would preclude future development, thus undermining the Obama Administration's priority of reducing dependence on foreign energy and developing oil and gas deposits in the US.
- Several comments expressed preference for alternative energy (non-OCS or non-oil and gas) means of meeting national energy demands and providing the supply of energy. One comment called for a shift to small-scale clean energy alternatives. Another insisted there is no need to develop the Arctic OCS because the Keystone Pipeline and leases in the National Petroleum Reserve would provide oil that could be needed by the US.
- Some comments reached ahead in the OCSLA process to address several aspects of development and production. In particular it was noted that the 'need' for the EIS presupposes the extraction of hydrocarbons from the Arctic and makes the extraction of discovered hydrocarbons inevitable by stating that NMFS and BOEM would tier from this EIS to support future permitting decisions if such activities fall outside the scope of the EIS.

Response to Comments

The EIS evaluates the potential effects of a reasonable level of activities for the timeframe of the EIS. Should the level of activity exceed the level analyzed in the EIS, NMFS and BOEM would complete additional NEPA analyses.

BOEM has recognized the issue of the benefits of high-quality imaging of the subsurface as an agency and is taking steps to address this issue by updating its Notice To Lessees (NTLs) for Shallow Hazards Surveys and Archaeological Surveys. These new NTLs describe performance based metrics requiring larger swaths of data to be collected in the initial surveys. By collecting the additional information, BOEM and the operators both benefit by having a larger primary data set. A larger primary data set allows the operator to relocate a well location without having to collect additional data on another portion of their lease. BOEM also benefits by incorporating these data into a comprehensive database of the OCS to encourage science-based decision-making for each project.

The EIS contains a complete analysis of potential impacts from the proposed action on the human environment, including coastal resources. As explained in Chapter 1 of the EIS, Arctic oil and gas drilling standards have been updated and are continuing to be updated in order to develop a system using the best available technology and safety standards. The EIS analyzes the potential impacts to the human environment in the event of an oil spill (small or large).

Following the Macondo incident (Deepwater Horizon), BOEM increased the limits of liability from $75 million to $134 million, the maximum allowed under current Federal law.

An Alternative Energy alternative would not meet the purpose and need of this EIS, which addresses MMPA incidental take authorizations specifically for oil and gas exploration activities. Alternative energy to meet the nation's energy needs is a programmatic issue, which is addressed by BOEM at the 5-Year Oil and Gas Leasing Program stage. BOEM administers OCS leasing, exploration, and development as mandated by the OCSLA. Congress amended OCSLA in 1978 to provide for the "expedited exploration and development of the Outer Continental Shelf . . ." 43 U.S.C. 1802(1). While renewable energy sources currently play a role in meeting energy demands in this country, and would continue to do so in the future, such sources could not replace the energy supplied by oil and gas in the OCS. Information on the OCS Renewable Energy Program is available at: http://www.boemre.gov/offshore/RenewableEnergy/index.htm.

Analysis of potential development and production on the OCS of the U.S. Ocean is not part of the proposed action for the current analysis, which is specifically focused on exploration activities. OCS development and production is addressed in the cumulative analyses as appropriate. Should development and production be proposed in the Beaufort Sea or Chukchi Sea OCS, BOEM and NMFS would prepare proposal-specific NEPA documentation. In addition, proposed development and production would require reinitiating consultation with both NMFS and USFWS under the Endangered Species Act.

Issue 14B – Editorial, Out of Scope, Comment Noted

Summary of Comments

Comments suggesting specific edits to the text of the EIS were identified. Comments that were considered out of scope and non-substantive were assigned to this issue category.

Response to Comments

Many of the comments received were of a grammatical nature. For example, suggested word changes, spelling corrections, requests for clarification, questions on citations, etc. Where appropriate, revisions were made to the text. A great number of comments were identical form letters or slight variations of form letters. Substantive comments in these form letters are included in the summaries mentioned above. Comments that offered a general opinion or simply recommend specific decisions are summarized for

consideration by federal decision makers but are not specifically responded to in the FEIS. Comments also included concerns and issues that are clearly outside the scope of the EIS. These comments are not responded to herein.

Issue 14C – Requests to Incorporate Specific Studies

Summary of Comments

Many of the comments received included requests to review and incorporate specific scientific studies into the EIS. Some commenters provided these references with their comments.

Response to Comments

Where appropriate, additional scientific studies were reviewed, and revisions were made to the text.

Appendix 1
Submission and Comment Index

Unique Submission Index

Form Letter Submission Index

Commenter	Category Comments
Sierra Club with 12,991 signatures	Issue 2I, Issue 4A, Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C
National Resource Defense Council with 36,445 signatures	Issue 4A, Issue 7D, Issue 13C
National Resource Defense Council – Petition with 62,587 signatures	Issue 2N, Issue 2I, Issue 10, Issue 12B
PEW with 10,664 signatures	Issue 2I, Issue 3B, Issue 4H, Issue 7A, Issue 11A
World Wildlife Fund with 22,212 signatures	Issue 2N, Issue 3B, Issue 10, Issue 11A
Earthjustice with 56,053 signatures	Issue 2I, Issue 2N, Issue 4C, Issue 7A
Ocean Conservancy with 6,404 signatures	Issue 2I, Issue 3B, Issue 4C, Issue 4H, Issue 11A, Issue 13D
Earthjustice with 688 signatures	Issue 2N, Issue 4C, Issue 10

Unique Submission Index

Commenter	Comments
Abramaitis, Loretta	Issue 10, Issue 13C
Adams, Jim Audubon Alaska	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Aiken, Johnny AEWC	Issue 10, Issue 11B, Issue 11D, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12G, Issue 12H, Issue 14B, Issue 14C, Issue 2I, Issue 2K, Issue 2N, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4F, Issue 4H, Issue 7A, Issue 7D, Issue 8A
Allen, Amanda	Issue 14B
Allyn, Cathy	Issue 14B
Anchorage, Public Meeting Anchorage Public Meeting on DEIS 2012	Issue 1, Issue 10, Issue 11A, Issue 11B, Issue 11C, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12J, Issue 12L, Issue 13C, Issue 13D, Issue 14A, Issue 2A, Issue 2B, Issue 2E, Issue 2F, Issue 2G, Issue 2I, Issue 2L, Issue 2M, Issue 2N, Issue 3B, Issue 3I, Issue 4A, Issue 4C, Issue 4E, Issue 4F, Issue 4G, Issue 4H, Issue 5A, Issue 7A, Issue 7F, Issue 8A, Issue 8C, Issue 9B
Anchorage Public Meeting, Anchorage Public Meeting on SEIS 2013	Issue 1, Issue 10, Issue 12D, Issue 12H, Issue 13C, Issue 13D, Issue 2A, Issue 2B, Issue 2C, Issue 2E, Issue 2I, Issue 2L, Issue 2M, Issue 2N, Issue 3A, Issue 3B, Issue 4G, Issue 4H, Issue 7H, Issue 8A
Anderson, Sam	Issue 14B
Armon, Carolin Onboard Tours Whales	Issue 12I, Issue 3I, Issue 4A, Issue 7H
Artemis, Diana	Issue 14B
Asmutis-Silvia, Regina Whale & Dophin Conservation	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Bach, Susan	Issue 1
Barr, Bradley	Issue 1
Barrow, Public Meeting Barrow Public Meeting on DEIS 2012	Issue 1, Issue 10, Issue 11B, Issue 11C, Issue 12A, Issue 12C, Issue 12D, Issue 12F, Issue 12H, Issue 12I, Issue 13C, Issue 13D, Issue 14B, Issue 2I, Issue 2L, Issue 3B, Issue 3G, Issue 6A, Issue 6B, Issue 7A, Issue 8A, Issue 8B, Issue 8C
Barrow Public Meeting, Barrow Public Meeting on SEIS 2013	Issue 1, Issue 10, Issue 11B, Issue 11C, Issue 11D, Issue 12D, Issue 12H, Issue 12I, Issue 13C, Issue 3B, Issue 3I, Issue 4G, Issue 4H, Issue 6A, Issue 6B, Issue 7A, Issue 7D, Issue 8A, Issue 8B
Baumeister, Lynn	Issue 14B
Bednar, Marek	Issue 14B

Commenter	Comments
Beers, Chuck	Issue 14B
Bemis, Evalyn	Issue 14B
Bethune, Claudette	Issue 14B
Blizzard, Phil	Issue 14B
Boone, James	Issue 10, Issue 12C, Issue 12D, Issue 13D, Issue 2I
Bouwmeester, Hanneke	Issue 3B, Issue 7A
Bradley, Amy	Issue 7H
Bramblett, Jim	Issue 14B
Branning, Megan	Issue 14B
Breinholt, Michelle	Issue 14B
Brooks, Steve	Issue 14B
Brower, Charlotte North Slope Borough	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12C, Issue 12H, Issue 12I, Issue 12J, Issue 12L, Issue 12M, Issue 13B, Issue 13C, Issue 13D, Issue 14B, Issue 14C, Issue 2I, Issue 4E, Issue 4H, Issue 6B, Issue 7A, Issue 7B, Issue 7D, Issue 7E, Issue 7F, Issue 8B
Brower, Charlotte North Slope Borough	Issue 10, Issue 11B, Issue 11C, Issue 12C, Issue 12D, Issue 12E, Issue 12H, Issue 12I, Issue 12J, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2L, Issue 4A, Issue 4H, Issue 5D, Issue 7A, Issue 7D, Issue 7F, Issue 8B
Brown, David Conocophillips	Issue 11A, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12L, Issue 2A, Issue 2B, Issue 2E, Issue 2G, Issue 2I, Issue 2M, Issue 2N, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 7A, Issue 8D
Brown, David ConocoPhillips	Issue 12L, Issue 2A, Issue 2B, Issue 2E, Issue 2H, Issue 2I, Issue 2N, Issue 3A, Issue 4B, Issue 5A
Bruce-Munro, Jane	Issue 14B
Burnell Gutsell, Anneke-Reeve	Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C, Issue 2I
Butler, David	Issue 1
Cagle, Andy	Issue 13C, Issue 4A, Issue 6C
Calcote, Delice Alaska Inter-Tribal Council	Issue 10, Issue 11C, Issue 11D, Issue 12M, Issue 13C, Issue 13D, Issue 14B, Issue 2E, Issue 2L, Issue 3G, Issue 4A
Capozzelli, J	Issue 10, Issue 12B, Issue 13D, Issue 2C, Issue 4F, Issue 5E, Issue 7A, Issue 7H
Carpenter, Jeremy	Issue 10, Issue 2I, Issue 2N, Issue 4C
Carter, Jaan	Issue 14B
Caswell, Helen	Issue 14B
Catala, Pierre	Issue 14B
Cathy Giessel, Sen.	Issue 2B, Issue 2F
Charvat, Jan	Issue 14B

Commenter	Comments
Childs, Jefferson	Issue 11A, Issue 12M, Issue 14B, Issue 14C, Issue 2E, Issue 2I, Issue 2L, Issue 3H, Issue 4D, Issue 4H, Issue 6C, Issue 7A, Issue 7F, Issue 7G, Issue 7H
Cirigliano, Leslie	Issue 10, Issue 2N
Clark, Christopher Cornell University	Issue 10, Issue 11C, Issue 12B, Issue 12I, Issue 14C, Issue 5E, Issue 7A
Clarke, Chris	Issue 14A, Issue 4A
Clausen, Karin Aarhus University	Issue 14B, Issue 14C
Clithero, Kerry	Issue 14B
Collin, Denise	Issue 14B
Colucci, Juanita	Issue 14B
Connor, Bob	Issue 2N, Issue 3C
Cortese, Andrea	Issue 14B
Cummings, Terry	Issue 13D, Issue 4A, Issue 7D, Issue 8A
Dandicat, Minximal	Issue 10, Issue 2N
danger, nick	Issue 14A
Davis, William	Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C, Issue 2I
de Silva, Shermin	Issue 2N, Issue 7A
Dee, Laurice	Issue 14B
Doherty, Pat	Issue 14B
Duenez, Esmeralda	Issue 14B
Duerr, D.J.	Issue 12A, Issue 2L
Durso, Mark	Issue 14B
Eaise, Florence	Issue 14B
Edwardson, George ICAS	Issue 10, Issue 12A, Issue 12D, Issue 12F, Issue 12L, Issue 12M, Issue 13A, Issue 13C, Issue 13D, Issue 14B, Issue 14C, Issue 3B, Issue 3F, Issue 3G, Issue 4A, Issue 4C, Issue 4H, Issue 6A, Issue 6C, Issue 7D, Issue 7E, Issue 8A, Issue 8B
Elbring, Judy	Issue 14B
Epstein, Lois N. The Wilderness Society	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Evan, Joan	Issue 14B
Filer, Judy	Issue 10
Flocken, Jeffrey International Fund for Animal Welfare	Issue 10, Issue 11A, Issue 11D, Issue 12D, Issue 12E, Issue 12F, Issue 12L, Issue 12M, Issue 13C, Issue 13D, Issue 4A, Issue 4H, Issue 7A

Commenter	Comments
Flores, E.	Issue 14B
Fogels, Ed Alaska Department of Natural Resources	Issue 11A, Issue 12A, Issue 12D, Issue 12J, Issue 12L, Issue 13B, Issue 13D, Issue 14A, Issue 14B, Issue 14C, Issue 2A, Issue 2E, Issue 2F, Issue 2K, Issue 2M, Issue 3E, Issue 3H, Issue 3I, Issue 4C, Issue 4E, Issue 4G, Issue 5B, Issue 6B, Issue 8E, Issue 9A, Issue 9B
Foster, Dolly	Issue 1
Gagliardi, Joe ION Geophysical Corporation	Issue 10, Issue 12D, Issue 12E, Issue 12L, Issue 14B, Issue 2F, Issue 2H, Issue 2M, Issue 2N, Issue 4C, Issue 4E, Issue 4G, Issue 7A, Issue 7H, Issue 9B
Gagliardi, Joseph ION Geophysical Corporation	Issue 12D, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2H, Issue 2M, Issue 4E, Issue 4G, Issue 5D
Garrett, Megan	Issue 14B
Gelston, Andy	Issue 10, Issue 2N, Issue 4C
Gemutliche, Jeff	Issue 14A
Gifford, Debbie	Issue 14B
Glenn, Richard Arctic Slope Regional Corporation	Issue 10, Issue 12C, Issue 12H, Issue 13C, Issue 14A, Issue 14B, Issue 2A, Issue 2N, Issue 5D, Issue 9B
Golden, Jill	Issue 10, Issue 2I, Issue 2N, Issue 4C
Goldsmith, David	Issue 14B
Goulart, Monica	Issue 14B
Gray, Horace	Issue 1
Gregg, Tamara	Issue 14A, Issue 7D
Grotenrath, Sara	Issue 14B
Grove, Paul	Issue 10
Gurney, David Ocean Protection Coalition	Issue 13A, Issue 13C, Issue 13D, Issue 4A, Issue 7A
H. (initial only) -	Issue 14B
Harbour, Dave	Issue 2F, Issue 9B
Hardy, Brettny Earthjustice	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Harris, Mark	Issue 10, Issue 11A, Issue 4C, Issue 7A
Hartsig, Andrew Ocean Conservancy	Issue 10, Issue 11B, Issue 11C, Issue 11D, Issue 12C, Issue 12D, Issue 12M, Issue 13C, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2I, Issue 2L, Issue 3B, Issue 4C, Issue 4H, Issue 7E, Issue 8A
Hartsig, Andrew Ocean Conservancy	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue

Commenter	Comments
	3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Hawley, Millie Native Village of Kivalina	Issue 11B, Issue 3G, Issue 8A
Hayden, Tess APU	Issue 11A, Issue 11D, Issue 2L, Issue 3B
Heiman, Marilyn Pew Charitable Trusts	Issue 10, Issue 11B, Issue 11C, Issue 11D, Issue 12J, Issue 12M, Issue 14C, Issue 3B, Issue 4H, Issue 7A, Issue 7E, Issue 8A
Heiman, Marilyn The Pew Environmental Group	Issue 10, Issue 11B, Issue 11C, Issue 11D, Issue 12C, Issue 12D, Issue 12M, Issue 13C, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2I, Issue 2L, Issue 3B, Issue 4C, Issue 4H, Issue 7E, Issue 8A
Hicks, Katherine	Issue 14A, Issue 2N
Hof, Justin	Issue 4A
Hoff, Forest	Issue 14B
Holmes, Mary	Issue 14B
Howells, Dan Greenpeace	Issue 10, Issue 13C, Issue 14B, Issue 14C, Issue 2I, Issue 3A, Issue 3C, Issue 3G, Issue 4A, Issue 4B, Issue 4C, Issue 8A, Issue 8B, Issue 9A, Issue 9B
Hughes, Layla World Wildlife Fund	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Hughes, Robert	Issue 3B, Issue 7A
Hujar, Michelle	Issue 14B
ICAS G2G Minutes, Barrow G2G Meeting on 2013 SEIS	Issue 1, Issue 12H, Issue 2B, Issue 2L, Issue 3I, Issue 4C, Issue 4E, Issue 7E, Issue 7F, Issue 8A
Jasny, Michael Natural Resources Defense Council	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Jasny, Michael Natural Resources Defense Council	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Jean, Barbara	Issue 14B

Commenter	Comments
Jennings, Timothy US Fish & Wildlife Service	Issue 14B, Issue 14C, Issue 3A
Johnson, Luke National Ocean Industries Association	Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12G, Issue 12H, Issue 12I, Issue 12J, Issue 12K, Issue 12L, Issue 12M, Issue 14A, Issue 14B, Issue 14C, Issue 2D, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3D, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5D, Issue 7A, Issue 9A, Issue 9B
Kaltenstein, John Friends of the Earth	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Kasper, Arlo	Issue 5E
Kearns, Michael National Ocean Industries Association	Issue 1, Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12D, Issue 12G, Issue 12K, Issue 12L, Issue 14A, Issue 14B, Issue 14C, Issue 2A, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3B, Issue 3I, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 7A, Issue 7E, Issue 7F, Issue 8A, Issue 9B
Keegan, Mark	Issue 14A, Issue 14B
Kerr, Frederick	Issue 14B
Kesich, John	Issue 14B, Issue 7A
Kivalina, Public Meeting Kivalina Public Meeting	Issue 1, Issue 13C, Issue 3G
Koeneman, Richard	Issue 14B
Kotzebue, Public Meeting Kotzebue Public Meeting 2012 Meeting for DEIS	Issue 10, Issue 11B, Issue 11C, Issue 12I, Issue 12J, Issue 14A, Issue 14B, Issue 7A, Issue 8A, Issue 8B
Kotzebue Public Meeting, Kotzebue Public Meeting for 2013 SEIS	Issue 1, Issue 10, Issue 11B, Issue 11C, Issue 11D, Issue 12F, Issue 12I, Issue 13C, Issue 13D, Issue 3B, Issue 7A, Issue 9B
Kovacs, William L. U.S. Chamber of Commerce	Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12G, Issue 12H, Issue 12I, Issue 12J, Issue 12K, Issue 12L, Issue 12M, Issue 14A, Issue 14B, Issue 14C, Issue 2D, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3D, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5D, Issue 7A, Issue 9A, Issue 9B
Krause, C E	Issue 14B
Krause, Danielle	Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C, Issue 2I
Krucker, Kathy	Issue 14B

Commenter	Comments
Kuna, Tom	Issue 14A, Issue 2I, Issue 2N, Issue 4C, Issue 7A
Kunkel, Patricia	Issue 14B
Lakosh, Tom	Issue 1, Issue 13C, Issue 13D, Issue 14A, Issue 14B, Issue 14C, Issue 2E, Issue 2H, Issue 3A, Issue 4C
Lambertsen, Richard	Issue 12M
Landis, Jesse	Issue 14B
Landis, Mad	Issue 14B
Larson, Shawna Pacific Environment	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Lawrence, Richard	Issue 14A
Leavitt, Price ICAS GtoG Meeting	Issue 11C, Issue 12M, Issue 3G, Issue 8A, Issue 8B, Issue 9B
Leavitt, Sr., Price Alaska Eskimo Whaling Commission	Issue 10, Issue 11B, Issue 12A, Issue 12D, Issue 12H, Issue 12J, Issue 12K, Issue 14B, Issue 2I, Issue 3A, Issue 3B, Issue 4A, Issue 4F, Issue 7A, Issue 7D, Issue 8A
Lehman, Cliff	Issue 14B
Lehman, Loretta	Issue 14B
Leise, Tanya	Issue 14B
Lent, Rebecca J. Marine Mammal Commission	Issue 10, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12F, Issue 12H, Issue 12I, Issue 12K, Issue 12L, Issue 12M, Issue 13C, Issue 14C, Issue 2B, Issue 2I, Issue 2K, Issue 2L, Issue 2M, Issue 3A, Issue 3B, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4H, Issue 5D, Issue 7A, Issue 8A
Lish, Chris	Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C, Issue 2I, Issue 4A
Lish, Chris	Issue 10, Issue 11A, Issue 11D, Issue 12B, Issue 12D, Issue 2I, Issue 2N, Issue 3B, Issue 4C, Issue 4F, Issue 6C, Issue 7A
Lloyd, Evan	Issue 14B
Locascio, Julie	Issue 14B
Lopez, Irene	Issue 10, Issue 11A, Issue 3B
Lopez, Irene	Issue 4A
Lupton, Betty	Issue 14B
Macrander, Michael Shell Alaska Venture (comments on DEIS)	Issue 10, Issue 11A, Issue 11C, Issue 12B, Issue 12D, Issue 12E, Issue 12I, Issue 12K, Issue 12L, Issue 12M, Issue 14B, Issue 14C, Issue 2A, Issue 2E, Issue 2F, Issue 2G, Issue 2H, Issue 2I, Issue 2M, Issue 2N, Issue 3A, Issue 3D, Issue 3E, Issue 3F, Issue

Commenter	Comments
	3I, Issue 4B, Issue 4C, Issue 4D, Issue 4E, Issue 4G, Issue 4H, Issue 5A, Issue 5B, Issue 5C, Issue 5D, Issue 6B, Issue 6C, Issue 7A, Issue 7F, Issue 7H, Issue 9B
Mann, David Loggerhead Instruments	Issue 10, Issue 11C, Issue 12B, Issue 12I, Issue 14C, Issue 5E, Issue 7A
Marlene, Chamberlain	Issue 10, Issue 2I, Issue 2N, Issue 4C
Mavrovouniotis, Michael	Issue 10, Issue 12A, Issue 2N
May, Cyril	Issue 14B
Mayer, Michael Earthjustice	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
McCoy, Hazel	Issue 2I, Issue 2N, Issue 4C
Mcneill, A.	Issue 14B
McQueen, Leslie	Issue 14B
Mecum, Brianne Oceana	Issue 10, Issue 11A, Issue 11C, Issue 12A, Issue 12C, Issue 12D, Issue 12J, Issue 13D, Issue 14B, Issue 14C, Issue 2L, Issue 3I, Issue 4A, Issue 6A, Issue 6B, Issue 7A, Issue 7C, Issue 7H
Meller, Liat	Issue 14A, Issue 7A
Miller, Pamela Northern Alaska Environmental Center	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Miller, Pamela A. Northern Alaska Environmental Center	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Miller, Patrick University of St. Andrews	Issue 10, Issue 11C, Issue 12B, Issue 12I, Issue 14C, Issue 5E, Issue 7A
Miller, Peter	Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C, Issue 2I
Modiano, Alby U.S. Oil & Gas Association	Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12G, Issue 12H, Issue 12I, Issue 12J, Issue 12K, Issue 12L, Issue 12M, Issue 14A, Issue 14B, Issue 14C, Issue 2D, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3D, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5D, Issue 7A, Issue 9A, Issue 9B

Commenter	Comments
Molyneaux, Mary	Issue 10, Issue 2N
Moore, Bill Statoil USA E&P Inc.	Issue 12D, Issue 12E, Issue 14B, Issue 14C, Issue 2A, Issue 2G, Issue 2I, Issue 2N, Issue 4G, Issue 5A, Issue 7E
Moriarty, Kara Alaska Oil and Gas Association	Issue 1, Issue 11A, Issue 12D, Issue 12E, Issue 12F, Issue 12I, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2A, Issue 2B, Issue 2E, Issue 2F, Issue 2H, Issue 2I, Issue 2M, Issue 3B, Issue 4B, Issue 4C, Issue 4G, Issue 7A, Issue 7E
Moriarty, Kara Alaska Oil and Gas Association	Issue 11A, Issue 12D, Issue 12E, Issue 12L, Issue 14B, Issue 2A, Issue 2B, Issue 2E, Issue 2F, Issue 2G, Issue 2I, Issue 2N, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 7A
Mortimer, Ian	Issue 14B
Mottishaw, Petra	Issue 10, Issue 11C, Issue 14A, Issue 2I
Moy, Cary	Issue 2I, Issue 2N, Issue 4C
Murkowski, Lisa U.S. Senate Committee on Energy and Natural Resources	Issue 12D, Issue 2F, Issue 2M, Issue 5A, Issue 5C
Murray, Susan Oceana	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Murray, Susan Oceana	Issue 14C
Myers, Eric F. Audubon Alaska	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Nappe, Judith	Issue 14A, Issue 6C
Naylor, Noah Northwest Arctic Borough	Issue 1, Issue 12A, Issue 12I, Issue 12L, Issue 12M, Issue 2B, Issue 4A, Issue 8A
Noblin, Rebecca Center for Biological Diversity	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Noblin, Rebecca Center for Biological Diversity	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B,

Commenter	Comments
	Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Nowacek, Douglas P. Duke University	Issue 10, Issue 11C, Issue 12B, Issue 12I, Issue 14C, Issue 5E, Issue 7A
O'Leary, Anne	Issue 5E, Issue 6C
Okleasik, Ukallaysaaq Tom Native Village of Kotzebue, Kotzebue IRA	Issue 12J, Issue 14B, Issue 4A
Olemaun, Thomas Native Village of Barrow GtoG meeting	Issue 1, Issue 10, Issue 11C, Issue 2L, Issue 3B, Issue 3G, Issue 4A, Issue 7A, Issue 8A
Osborne, Kathy	Issue 14B
Perkins, Debbie	Issue 14B
Perkins, Stephen	Issue 14B
Petty, Brian International Association of Drilling Contractors	Issue 1, Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12D, Issue 12G, Issue 12K, Issue 12L, Issue 14A, Issue 14B, Issue 14C, Issue 2A, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3B, Issue 3I, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 7A, Issue 7E, Issue 7F, Issue 8A, Issue 9B
Petty, Brian International Association of Drilling Contractors	Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12G, Issue 12H, Issue 12I, Issue 12J, Issue 12K, Issue 12L, Issue 12M, Issue 14A, Issue 14B, Issue 14C, Issue 2D, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3D, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5D, Issue 7A, Issue 9A, Issue 9B
Phipps, Jonny	Issue 14B
Pintabutr, America May World Wildlife Fund	Issue 4A
Pohl, Mary	Issue 14B
Point Hope, Public Meeting Point Hope Public Meeting	Issue 1, Issue 11C, Issue 12B, Issue 13D, Issue 2M, Issue 8A, Issue 8B, Issue 8D, Issue 9B
Point Lay, Government to Government Meeting Native Village of Point Lay	Issue 10, Issue 12L, Issue 13C, Issue 7E, Issue 8A
Portman, Carl Resource Development Council	Issue 11A, Issue 12A, Issue 12B, Issue 12D, Issue 12E, Issue 12L, Issue 14A, Issue 2A, Issue 2E, Issue 2F, Issue 2H, Issue 2I, Issue 2M, Issue 2N, Issue 3B, Issue 4C, Issue 4E, Issue 5A, Issue 9B
Powers, Amy	Issue 14B

Commenter	Comments
Priest, Patricia	Issue 14B
Public, Jean	Issue 11A
Public, Jean	Issue 14B, Issue 2L, Issue 6B, Issue 7A, Issue 7D, Issue 7F, Issue 7G
Public, Jean	Issue 1, Issue 11A, Issue 7A, Issue 7F, Issue 7G, Issue 8A
Public, Jean	Issue 12B, Issue 4A, Issue 7A
Public, Jean	Issue 1, Issue 7A, Issue 9B
Public, Jean	Issue 13D, Issue 14A, Issue 4A
Public, Jean	Issue 14B, Issue 8B
Public, Jean	Issue 1
Racano, Joey Ocean Outfall Group	Issue 14B, Issue 14C
Radford, Andy American Petroleum Institute	Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12G, Issue 12H, Issue 12I, Issue 12J, Issue 12K, Issue 12L, Issue 12M, Issue 14A, Issue 14B, Issue 14C, Issue 2D, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3D, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5D, Issue 7A, Issue 9A, Issue 9B
Ragen, Timothy J. Marine Mammal Commission	Issue 10, Issue 11A, Issue 11D, Issue 12B, Issue 12C, Issue 12I, Issue 14B, Issue 2F, Issue 2I, Issue 2L, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4H, Issue 5D, Issue 7A
Raichel, Diana	Issue 10
Randall, Jeff	Issue 1, Issue 10, Issue 2M, Issue 4H, Issue 8A
Randelia, Cyrus	Issue 10, Issue 13A, Issue 13D, Issue 14B
Ranger, Richard American Petroleum Institute	Issue 1, Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12D, Issue 12G, Issue 12K, Issue 12L, Issue 14A, Issue 14B, Issue 14C, Issue 2A, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3B, Issue 3I, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 7A, Issue 7E, Issue 7F, Issue 8A, Issue 9B
Reed, Amanda The Nature Conservancy	Issue 10, Issue 11C, Issue 11D, Issue 12D, Issue 12M, Issue 13C, Issue 13D, Issue 14B, Issue 14C, Issue 2L, Issue 3A, Issue 3I, Issue 7E
Reichert, Robyn	Issue 14B
Reichgott, Christine EPA Region 10	Issue 14C, Issue 3I, Issue 4C, Issue 8A
Reichgott, Christine US EPA, Region 10	Issue 14C
Reiner, Erica	Issue 12A, Issue 2I, Issue 3C
Rennacker, Ann	Issue 13D
Richard, Chris	Issue 14B

Commenter	Comments
Richardson, Alan	Issue 14B
Ritzman, Dan Sierra Club	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Ritzman, Dan Sierra Club	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Robinson, Tina Cultural REcyclists	Issue 10, Issue 13C, Issue 2E, Issue 4A, Issue 6C
Rosin, Lawrence	Issue 14B
Rosin, Lawrence	Issue 14B
Rossen, Van	Issue 14B
Rossin, Linda	Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C, Issue 2I
Savitz, Joel	Issue 14B
Schalavin, Laurel	Issue 14A
Schorg, Marcie	Issue 7C, Issue 9B
Schousboe, Ellen	Issue 14B
Schwartz, Rhona	Issue 14B
Shane, Christiansen B.	Issue 14B
Shapiro, Amy Jo	Issue 4C
Shears, Robert	Issue 11D, Issue 7E
Sherman, sanford	Issue 14B
Shimizu, Michele	Issue 14B
Shockey, Diane	Issue 14B, Issue 2I
Shogan, Cindy Alaska Wilderness League	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Shogan, Cindy Alaska Wilderness League	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A

Commenter	Comments
Simon, Lorali	Issue 12A, Issue 12D, Issue 12E, Issue 12H, Issue 2F, Issue 4E
Skeet Black, Lester	Issue 12D, Issue 14A, Issue 9B
Slaiby, Peter Shell Alaska	Issue 10, Issue 11A, Issue 12B, Issue 12D, Issue 12I, Issue 12K, Issue 12L, Issue 12M, Issue 13A, Issue 14A, Issue 14B, Issue 14C, Issue 2B, Issue 2E, Issue 2F, Issue 2H, Issue 2I, Issue 2M, Issue 3A, Issue 3D, Issue 3I, Issue 4A, Issue 4B, Issue 4C, Issue 4D, Issue 4E, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5E, Issue 6A, Issue 6B, Issue 7A, Issue 7F, Issue 7G, Issue 9B
Slaughter, Scott Center for Regulatory Effectivness	Issue 12B, Issue 12I, Issue 12L, Issue 14B, Issue 14C, Issue 7A, Issue 7D
Slobod, Karen	Issue 14B
Smith, Diane	Issue 14B
Smith, Tammy	Issue 2I, Issue 2N, Issue 4C
Snyder, Sharon	Issue 10
Southall, Brandon SEA Inc.	Issue 10, Issue 11C, Issue 12B, Issue 12I, Issue 14C, Issue 5E, Issue 7A
Stannard, Tim	Issue 14B
Steitz, Jim	Issue 3B, Issue 6C, Issue 7A
Stocker, Michael Ocean Conservation Research	Issue 10, Issue 11C, Issue 11D, Issue 12A, Issue 12B, Issue 12E, Issue 13A, Issue 14A, Issue 14C, Issue 2E, Issue 7A, Issue 7B, Issue 7D, Issue 7F, Issue 8C
Stocker, Michael Ocean Conservation Research	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Stocker, Michael Ocean Conservation Research	Issue 10, Issue 11D, Issue 12E, Issue 13A, Issue 14B, Issue 14C, Issue 2A, Issue 2E, Issue 2I, Issue 4A, Issue 5A, Issue 7A, Issue 7F
Stocker, Michael Ocean Conservation Research	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Stoutamyer, Carla	Issue 10, Issue 12C, Issue 12D, Issue 2I
Sullivan, Daniel AK Dept Natural Resources	Issue 1, Issue 11D, Issue 12D, Issue 12L, Issue 14A, Issue 14B, Issue 14C, Issue 2A, Issue 2F, Issue 2H, Issue 2M, Issue 3H, Issue 3I, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 6A, Issue 6B, Issue 9A, Issue 9B
Tanner, Charlotte	Issue 14B
Thorson, Scott	Issue 14A, Issue 2N, Issue 4E

Commenter	Comments
Thunen, Erif	Issue 14B
Tiedje, Tanya	Issue 14B
Tozzi, Jim Center for Regulatory Effectiveness	Issue 1, Issue 12I, Issue 14C, Issue 2I, Issue 3A, Issue 3B, Issue 5E
Trachsel, John	Issue 14B
Tracy, Cynthia	Issue 14B
Tsoflias, Sarah International Association of Geophysical Contractors	Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12G, Issue 12H, Issue 12I, Issue 12J, Issue 12K, Issue 12L, Issue 12M, Issue 14A, Issue 14B, Issue 14C, Issue 2D, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3D, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5D, Issue 7A, Issue 9A, Issue 9B
Tsoflias, Sarah International Association of Geophysical Contractors	Issue 1, Issue 10, Issue 11A, Issue 12A, Issue 12B, Issue 12D, Issue 12G, Issue 12K, Issue 12L, Issue 14A, Issue 14B, Issue 14C, Issue 2A, Issue 2E, Issue 2F, Issue 2I, Issue 2N, Issue 3A, Issue 3B, Issue 3I, Issue 4B, Issue 4C, Issue 4E, Issue 4G, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 7A, Issue 7E, Issue 7F, Issue 8A, Issue 9B
Vale, Karen World Society for the Protection of Animals	Issue 13C, Issue 13D, Issue 2I, Issue 4A, Issue 7A, Issue 7D
Vesely, Sakura	Issue 14B
Virnig, Angela	Issue 2N
Vishanoff, Jonathan	Issue 13D, Issue 8B
Voegelin, dom	Issue 14B
Volk, Sara	Issue 14B
Wainwright, Public Meeting	Issue 1, Issue 12A, Issue 14A, Issue 14B, Issue 8C
Walker, Willie	Issue 10, Issue 11C, Issue 12C, Issue 12D, Issue 13C, Issue 2I
Weaver, Sierra Defenders of Wildlife	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Webb, Mary	Issue 14A
Weibel, Annemarie	Issue 13B, Issue 4A, Issue 7A
Whiting, Alex Kotzebue IRA GtoG Meeting	Issue 10, Issue 12B, Issue 12C, Issue 12D, Issue 12H, Issue 12J, Issue 13C, Issue 13D, Issue 4A, Issue 6C, Issue 8B
Whiting, Alex	Issue 1, Issue 12C, Issue 12D, Issue 12E, Issue 12H, Issue 12M,

Commenter	Comments
Native Village of Kotzebue IRA (2012)	Issue 13B, Issue 14B, Issue 14C, Issue 3G, Issue 4C, Issue 4E, Issue 4H, Issue 5B, Issue 6B, Issue 6C, Issue 7D, Issue 7H
Whiting, Alex Native Village of Kotzebue, Kotzebue IRA	Issue 12J, Issue 14B, Issue 4A
Whitney, Judy	Issue 7D
Whittington-Evans, Nicole The Wilderness Society	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12F, Issue 12G, Issue 12I, Issue 12M, Issue 13B, Issue 13D, Issue 14B, Issue 14C, Issue 2B, Issue 2C, Issue 2I, Issue 2J, Issue 2L, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4A, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 5A, Issue 5C, Issue 5D, Issue 5E, Issue 6A, Issue 6C, Issue 7A, Issue 7B, Issue 7C, Issue 7D, Issue 7E, Issue 7F, Issue 7G, Issue 7H, Issue 8A, Issue 8B, Issue 9A
Williams, Margaret World Wildlife Fund	Issue 10, Issue 12A, Issue 12D, Issue 12L, Issue 14B, Issue 14C, Issue 2I, Issue 2L, Issue 2N, Issue 3B, Issue 4A, Issue 4C, Issue 4H, Issue 5E, Issue 7A, Issue 7H
Williams, Margaret D. World Wildlife Fund	Issue 10, Issue 11A, Issue 11C, Issue 11D, Issue 12A, Issue 12D, Issue 12E, Issue 12K, Issue 12L, Issue 14B, Issue 14C, Issue 2C, Issue 2H, Issue 2I, Issue 2J, Issue 2L, Issue 2N, Issue 3B, Issue 4C, Issue 4D, Issue 4G, Issue 4H, Issue 7A
Wimberly, Lee	Issue 14B
Winter, Chris AEWC	Issue 10, Issue 11B, Issue 11D, Issue 12A, Issue 12B, Issue 12C, Issue 12D, Issue 12E, Issue 12G, Issue 12H, Issue 14B, Issue 14C, Issue 2I, Issue 2K, Issue 2N, Issue 3A, Issue 3B, Issue 3D, Issue 3I, Issue 4F, Issue 4H, Issue 7A, Issue 7D, Issue 8A
Wittmaack, Christiana	Issue 13C, Issue 13D, Issue 4A, Issue 7E, Issue 8B
Zobian, Stewart	Issue 14B

APPENDIX B

Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (NOAA NMFS 2016)

Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing

Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-OPR-55
July 2016

Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing

Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts

Office of Protected Resources
National Marine Fisheries Service
Silver Spring, MD 20910

NOAA Technical Memorandum NMFS-OPR-55
July 2016

U.S. Department of Commerce
Penny S. Pritzker, Secretary

National Oceanic and Atmospheric Administration
Kathryn D. Sullivan, Administrator

National Marine Fisheries Service
Eileen Sobeck, Assistant Administrator for Fisheries

Recommended citation:

National Marine Fisheries Service. 2016. Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept. of Commer., NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.

Copies of this report may be obtained from:

Office of Protected Resources
National Oceanic and Atmospheric Administration
1315 East-West Highway, F/PR2
Silver Spring, MD 20910

Or online at:

http://www.nmfs.noaa.gov/pr/publications/techmemos.htm

Photo Credits:

Bearded seal (*Erignathus barbatus*), Phocid pinniped Photo: John Jansen (NOAA)

North Atlantic right whales (*Eubalaena glacialis*), Low-frequency cetacean Photo: NOAA

Bottlenose dolphin (*Tursiops truncatus*), Mid-frequency cetacean Photo: Allison Henry (NOAA)

Dall's porpoise (*Phocoenoides dalli*), High-frequency cetacean Photo: Kate Stafford (NOAA)

California sea lion (*Zalophus californianus*), Otariid pinniped Photo: Sharon Melin (NOAA)

TABLE OF CONTENTS

LIST OF TABLES v

LIST OF FIGURES VI

ABBREVIATIONS, ACRONYMS, AND SYMBOLS VIII

EXECUTIVE SUMMARY 1

TECHNICAL GUIDANCE FOR ASSESSING THE EFFECTS OF ANTHROPOGENIC SOUND ON MARINE MAMMAL HEARING 6

I. INTRODUCTION 6

1.1 NEED FOR TECHNICAL GUIDANCE AND UPDATED UNDERWATER ACOUSTIC THRESHOLDS 7

1.1.1 Acoustic thresholds within the Context of an Effects Analysis 8

1.2 ADDRESSING UNCERTAINTY AND DATA LIMITATIONS 8

1.2.1 Assessment Framework 8

1.2.2 Data Standards 9

II. NMFS' ACOUSTIC THRESHOLDS FOR ONSET OF PERMANENT THRESHOLD SHIFTS IN MARINE MAMMALS 10

2.1 MARINE MAMMAL HEARING GROUPS 10

2.1.1 Application of Marine Mammal Hearing Groups 12

2.2 MARINE MAMMAL AUDITORY WEIGHTING FUNCTIONS 13

2.2.1 Use of Auditory Weighting Functions in Assessing Susceptibility to Noise-Induced Hearing Loss 14

2.2.2 Marine Mammal Auditory Weighting Functions 14

2.2.3 Derivation of Function Parameters 18

2.2.4 Application of Marine Mammal Auditory Weighting Functions for PTS Onset Acoustic thresholds 23

2.3 PTS ONSET ACOUSTIC THRESHOLDS 24

2.3.1 Impulsive and Non-Impulsive Acoustic Thresholds 26

2.3.2 Metrics 27

2.3.3 Development of PTS Onset Acoustic Thresholds 31

III. UPDATING OF ACOUSTIC TECHNICAL GUIDANCE AND ACOUSTIC THRESHOLDS 36

3.1 PROCEDURE AND TIMELINE FOR UPDATING THE TECHNICAL GUIDANCE 36

APPENDIX A: FINNERAN TECHNICAL REPORT 37

EXECUTIVE SUMMARY 39

I. INTRODUCTION 43

1.1 OVERVIEW 43

1.2 IMPULSE VS. NON-IMPULSIVE NOISE 43

1.3 NOISE-INDUCED THRESHOLD SHIFTS 43

1.4 AUDITORY WEIGHTING FUNCTIONS 44

1.5 TAP PHASE 3 WEIGHTING FUNCTIONS AND TTS/PTS THRESHOLDS 44

II. WEIGHTING FUNCTIONS AND EXPOSURE FUNCTIONS 46

III. METHODOLOGY TO DERIVE FUNCTION PARAMETERS 51

IV. MARINE MAMMAL SPECIES GROUPS 53
4.1 LOW-FREQUENCY (LF) CETACEANS 53
4.2 MID-FREQUENCY (MF) CETACEANS 53
4.3 HIGH-FREQUENCY (HF) CETACEANS 53
4.4 SIRENIANS 53
4.5 PHOCIDS 54
4.6 OTARIIDS AND OTHER NON-PHOCID MARINE CARNIVORES 54

V. COMPOSITE AUDIOGRAMS 56

VI. EQUAL LOUDNESS DATA 64

VII. EQUAL LATENCY DATA 65

VIII. TTS DATA 66
8.1 NON-IMPULSIVE (STEADY-STATE) EXPOSURES – TTS 66
8.2 NON-IMPULSIVE (STEADY-STATE) EXPOSURES – PTS 68
8.3 IMPULSIVE EXPOSURES 69

IX. TTS EXPOSURE FUNCTIONS FOR SONARS 78
9.1 LOW- AND HIGH-FREQUENCY EXPONENTS 78
9.2 FREQUENCY CUTOFFS 78
9.3 GAIN PARAMETERS 80

X. PTS EXPOSURE FUNCTIONS FOR SONARS 87

XI. TTS/PTS EXPOSURE FUNCTIONS FOR EXPLOSIVES 88

XII. SUMMARY 91

APPENDIX A1. ESTIMATING A LOW-FREQUENCY CETACEAN AUDIOGRAM 96
A1.1. BACKGROUND 96
A1.2. AUDIOGRAM FUNCTIONAL FORM AND REQUIRED PARAMETERS 97
A1.3. ESTIMATING AUDIOGRAM PARAMETERS 99

XIII. REFERENCES 102

APPENDIX B: RESEARCH RECOMMENDATIONS FOR IMPROVED ACOUSTIC THRESHOLDS 111

I. SUMMARY OF RESEARCH RECOMMENDATIONS 112
1.1 LOW-FREQUENCY CETACEAN HEARING 112
1.2 HEARING DIVERSITY AMONG SPECIES AND AUDITORY PATHWAYS 112
1.3 REPRESENTATIVENESS OF CAPTIVE INDIVIDUALS 113
1.3.1 Impacts of Age on Hearing 113
1.4 ADDITIONAL TTS MEASUREMENTS WITH MORE SPECIES AND/OR INDIVIDUALS 114
1.5 SOUND EXPOSURE TO MORE REALISTIC SCENARIOS 115
1.5.1 Frequency and Duration of Exposure 115
1.5.2 Multiple Sources 115
1.5.3 Possible Protective Mechanisms 116
1.5.4 Long-Term Consequences of Exposure 117
1.6 IMPACTS OF NOISE-INDUCED THRESHOLD SHIFTS ON FITNESS 118
1.7 BEHAVIOR OF MARINE MAMMALS UNDER EXPOSURE CONDITIONS WITH THE POTENTIAL TO CAUSE HEARING IMPACTS 119
1.8 CHARACTERISTICS OF SOUND ASSOCIATED WITH NIHL AND IMPACTS OF PROPAGATION 120

1.9 NOISE-INDUCED THRESHOLD SHIFT GROWTH RATES AND RECOVERY 120
1.10 METRICS AND TERMINOLOGY 121
1.11 EFFECTIVE QUIET 121
1.12 TRANSLATING BIOLOGICAL COMPLEXITY INTO PRACTICAL APPLICATION 122

APPENDIX C: PEER REVIEW PROCESS AND PUBLIC COMMENT PERIOD 123

I. PEER REVIEW PROCESS 123
1.1 INITIAL PEER REVIEW (ASSOCIATED WITH 2013 DRAFT TECHNICAL GUIDANCE) 124
1.2 SECOND PEER REVIEW (REVIEW OF THE FINNERAN TECHNICAL REPORT) 124
1.2.1 Follow-Up to Second Peer Review 125
1.3 THIRD PEER REVIEW (REVIEW OF TRANSITION RANGE METHODOLOGY) 126
1.4 CONFLICT OF INTEREST DISCLOSURE 127

II. PUBLIC COMMENT PERIODS 127
2.1 INITIAL PUBLIC COMMENT PERIOD (ASSOCIATED WITH 2013 DRAFT TECHNICAL GUIDANCE) 128
2.1.1 Summary of Public Comments Received 128
2.2 SECOND PUBLIC COMMENT PERIOD (ASSOCIATED WITH 2015 DRAFT TECHNICAL GUIDANCE) 129
2.2.1 Summary of Public Comments Received 129
2.3 THIRD PUBLIC COMMENT PERIOD (ASSOCIATED WITH 2016 PROPOSED CHANGES FROM DRAFT TECHNICAL GUIDANCE) 130
2.3.1 Summary of Public Comments Received 131

APPENDIX D: ALTERNATIVE METHODOLOGY 133

I. INTRODUCTION 133

II. WEIGHTING FACTOR ADJUSTMENT ASSOCIATED WITH SEL_{CUM} ACOUSTIC THRESHOLDS 133
2.1 APPLICATION FOR NARROWBAND SOUNDS 134
2.2 APPLICATION FOR BROADBAND SOUNDS 136
2.2.1 Special Considerations for Broadband Source 137

III. MODELING CUMULATIVE SOUND EXPOSURE LEVELS 138
3.1 MORE SOPHISTICATED MODELS 139
3.2 LESS SOPHISTICATED MODELS 139
3.2.1 Mobile Sources 140
3.2.2 Stationary Sources 146

APPENDIX E: GLOSSARY 147

LITERATURE CITED 156

LIST OF TABLES

Table ES1: Marine mammal hearing groups. 3
Table ES2: Summary of weighting and exposure function parameters. 3
Table ES3: Summary of PTS onset acoustic thresholds. 4
Table 1: Marine mammal hearing groups. 12
Table 2: Summary of data available for deriving composite audiograms. 20

Table 3: Summary of weighting and exposure function parameters.....22
Table 4: Summary of PTS onset acoustic thresholds.....26
Table 5: Available underwater marine mammal threshold shift studies.....32
Table 6: TTS onset auditory acoustic thresholds for non-impulsive sounds. 33
Table AE-1. Summary of weighting function parameters and TTS/PTS thresholds.. 40
Table A1. Species group designations auditory weighting functions. 55
Table A2. References, species, and individual subjects used to derive the composite audiograms. 58
Table A3. Composite audiogram parameters values……..…….. 59
Table A4. Normalized composite audiogram parameters values.....59
Table A5. Frequency of best hearing and the magnitude of the low-frequency slope derived from composite audiograms and equal latency contours. 63
Table A6. Summary of marine mammal TTS growth data and onset exposure levels.....75
Table A7. Differences between composite threshold values and TTS onset values at the frequency of best hearing for the in-water marine mammal species groups.....81
Table A8. Weighting function and TTS exposure function parameters.....82
Table A9. TTS and PTS thresholds for explosives and other impulsive sources.....90
Table A10. Summary of weighting function parameters and TTS/PTS thresholds.....92
Table B1: Summary of currently available marine mammal data..... 111
Table B2: Additional factors for consideration in association with PTS onset acoustic thresholds……..116
Table C1: Initial peer review panel (Associated with 2013 Draft Guidance)..... 124
Table C2: Second peer review panel (Review of the Finneran Technical Report)..... 125
Table C3: Third peer review panel (Review of Transition Range Methodology)..... 127
Table D1: Applicability of weighting factor adjustments for frequencies associated with broadband sounds……...137

LIST OF FIGURES

Figure ES1: Auditory weighting functions for low-frequency, mid-frequency, and high-frequency cetaceans… 5
Figure ES2: Underwater auditory weighting functions for otariid and phocid pinnipeds..... ……..5
Figure 1: Auditory weighting functions for low-frequency, mid-frequency, and high-frequency cetaceans.....15
Figure 2: Underwater auditory weighting functions for otariid and phocid pinnipeds.....16
Figure 3: Illustration of function parameter in both auditory weighting functions and exposure functions.....18
Figure 4: Resulting normalized composite audiograms for low-frequency, mid-frequency, and high-frequency cetaceans and phocid and otariid pinnipeds.....19
Figure AE-1. Navy Phase 3 weighting functions for all species groups.....40
Figure AE-2. TTS and PTS exposure functions for sonars and other (non-impulsive) active acoustic sources.....41
Figure AE-3. TTS and PTS exposure functions for explosives, impact pile driving, air guns, and other impulsive sources.....42
Figure A1. Examples of weighting function and exposure function…… 47

Figure A2. Influence of parameter values on the resulting shapes of the weighting functions and exposure functions....48
Figure A3. Navy Phase 2 weighting function for the mid-frequency cetacean group....49
Figure A4. Comparison of Otariid, Mustelid, and Odobenid psychophysical hearing thresholds measured underwater. 54
Figure A5. Thresholds and composite audiograms for the six species groups....60
Figure A6. Normalized thresholds and composite audiograms for the six species groups. 61
Figure A7. Composite audiograms for the various species groups, derived with the original data and normalized data 62
Figure A8. Underwater marine mammal equal latency contours are available for *Phocoena phocoena* and *Tursiops truncatus* 65
Figure A9. TTS measured using behavioral and AEP methods do not necessarily agree, with marine mammal studies reporting larger TTS obtained using AEP methods. 67
Figure A10. TTS growth data for mid-frequency cetaceans obtained using behavioral methods..71
Figure A11. TTS growth data for mid-frequency cetaceans obtained using AEP methods. 72
Figure A12. TTS growth data for high-frequency cetaceans obtained using behavioral and AEP methods. 73
Figure A13. TTS growth data for pinnipeds obtained using behavioral methods....74
Figure A14. The cutoff frequencies....79
Figure A15. Effect of ⊿*T* adjustment on the TTS exposure functions for the mid-frequency cetaceans and high-frequency cetaceans....79
Figure A16. Relationship between Δ*T* and the resulting mean-squared error between the exposure functions and onset TTS data. 80
Figure A17. Exposure functions....83
Figure A18. Mid-frequency cetacean exposure function, composite audiogram, and Phase 2 exposure functions compared to mid-frequency cetacean TTS data.. 84
Figure A19. High-frequency cetacean TTS exposure function, composite audiogram, and Phase 2 exposure functions compared to high-frequency cetacean TTS data. 85
Figure A20. Phocid (underwater) exposure function, composite audiogram, and Phase 2 exposure functions compared to phocid TTS data. 86
Figure A21. Navy Phase 3 weighting functions for marine mammal species groups exposed to underwater sound 91
Figure A22. TTS and PTS exposure functions for sonars and other (non-impulsive) active acoustic sources....94
Figure A23. TTS and PTS exposure functions for explosives, impact pile driving, air guns, and other impulsive sources. 95
Figure A1.1. Relationship between estimated threshold, low-frequency term, and high-frequency term. 99
Figure A1.2. Comparison of proposed LF cetacean thresholds to those predicted by anatomical and finite-element models. 101
Figure D1: Example illustrating concept of weighting factor adjustment.... 135
Figure D2: Simple example illustrating concept of weighting factor adjustment on isopleths .. 136
Figure D3: Example weighting function illustrating where the use of weighting function adjustments are and are not appropriate for broadband sources. 138
Figure D4: Illustration of concept for mobile sources.... 142
Figure E1. Example audiogram. 147

ABBREVIATIONS, ACRONYMS, AND SYMBOLS

a	Low-frequency exponent
ABR	Auditory Brainstem Response
AEP	Auditory Evoked Potentials
AM	Amplitude Modulated
ANSI	American National Standards Institute
b	High-frequency exponent
C	Weighting function gain (dB)
CT	Computerized Tomography
D	Duty Cycle
dB	Decibel
PK	Peak sound level
DPOAE	Distortion product otoacoustic emission
$E(f)$	Exposure function
E_0	Exposure Threshold
EEH	Equal Energy Hypothesis
EQL	Equal Loudness
ES	Executive Summary
ESA	Endangered Species Act
f_0	Best hearing (kHz)
f_1	Low-frequency cutoff (kHz)
f_2	High-frequency cutoff (kHz)
h	hour
HF	High-frequency
HISA	Highly Influential Scientific Assessment
Hz	Hertz
ISI	Influential Scientific Information
IQG	Information Quality Guidelines
ITA	Incidental Take Authorizations
K	Exposure function gain (dB)
kHz	Kilohertz
LF	Low-frequency
L_{pk}	Peak sound pressure level
$L_{pk,flat}$	Peak sound pressure level (unweighted)
$L_{E,24h}$	Sound exposure level, cumulative 24h
MF	Mid-frequency
min	Minutes
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MSA	Magnuson-Stevens Fishery Conservation and Management Act
MSE	Mean-squared error
m	meter
ms	Milliseconds
NIHL	Noise-induced Hearing Loss
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
NOS	National Ocean Service
NRC	National Research Council
NS2	National Standard 2
OMB	Office of Management and Budget
ONMS	Office of National Marine Sanctuaries
OPR	Office of Protected Resources
OSHA	Occupational Safety and Health Administration
OW	Otariids in water
p_0	Sound Pressure Level
Pa	Pascals

π	pi
PTS	Permanent Threshold Shift
PW	Phocids in water
R	Range
R_0	"Safe Distance"
R^2	Goodness of fit
RMS	Root Mean Square
S	Source Factor
S_E	Energy Source Factor
s	Seconds
s	Distance from source
s_0	Slope
SEL	Sound exposure level
SEL_{cum}	Cumulative sound exposure level
SL	Source Level
SL_E	Energy Source Level
s_0	Slope (dB/decade)
SPL	Sound Pressure Level
SSC-PAC	SPAWAR Systems Center Pacific
τ	1/repetition rate
TAP	U.S. Navy's Tactical Training Theater Assessment and Planning Program
TS	Threshold Shift
TTS	Temporary Threshold Shift
µPa	Micropascal
μPa^2-s	Micropascal squared second
USFWS	U.S. Fish and Wildlife Service
v	Velocity (transit speed)
$W(f)$	Weighting function
WFA	Weighting factor adjustments

EXECUTIVE SUMMARY

This document provides technical guidance for assessing the effects of underwater anthropogenic (human-made) sound on the hearing of marine mammal species under the jurisdiction of the National Marine Fisheries Service (NMFS) and was completed in collaboration with the National Ocean Service (NOS), Office of National Marine Sanctuaries. Specifically, it identifies the received levels, or acoustic thresholds, at which individual marine mammals are predicted to experience changes in their hearing sensitivity (either temporary or permanent) for acute, incidental exposure to underwater anthropogenic sound sources. This is the first time NMFS has presented this information in a single, comprehensive document. This Technical Guidance is intended for use by NMFS analysts/managers and other relevant action proponents/stakeholders, including other federal agencies, when seeking to determine whether and how their activities are expected to result in potential impacts to marine mammal hearing via acoustic exposure. This document outlines the development of NMFS' acoustic thresholds and describes how they will be updated in the future.

NMFS has compiled, interpreted, and synthesized the scientific literature, including a recent Technical Report by Dr. James Finneran (U.S. Navy-SPAWAR Systems Center Pacific (SSC-PAC)) (Finneran 2016; Appendix A of this Technical Guidance), to produce acoustic thresholds for onset of temporary (TTS) and permanent threshold shifts (PTS) (Table ES2) that update those currently in use by NMFS. Updates include a protocol for estimating PTS onset acoustic thresholds for impulsive (e.g., airguns, impact pile drivers) and non-impulsive (e.g., tactical sonar, vibratory pile drivers) sound sources, the formation of marine mammal hearing groups (low- (LF), mid- (MF), and high- (HF) frequency cetaceans, and otariid (OW) and phocid (PW) pinnipeds; Table ES1), and the incorporation of marine mammal auditory weighting functions (Figures ES1 and ES2) into the derivation of PTS acoustic thresholds. These acoustic thresholds are presented using dual metrics of cumulative sound exposure level (SEL_{cum}) and peak sound level (PK) for impulsive sounds and SEL_{cum} for non-impulsive sounds.

While the Technical Guidance's acoustic thresholds are more complex than those used to date in most cases by NMFS, they reflect the current state of scientific knowledge regarding the characteristics of sound that have the potential to impact marine mammal hearing sensitivity. Given the specific nature of these updates, it is not possible to generally or directly compare the updated acoustic thresholds presented in this document with the thresholds they will replace because outcomes will depend on project-specific specifications. NMFS recognizes that the implementation of marine mammal weighting functions and the SEL_{cum} metric represent new factors for consideration, which may extend beyond the capabilities of some action proponents. Thus, NMFS has developed alternative tools for those who cannot fully incorporate these factors (See Appendix D and Technical Guidance's companion User Spreadsheet[1]).

These updated PTS acoustic thresholds do not represent the entirety of a comprehensive analysis of the effects of a proposed action, but rather serve as one tool (along with, e.g.,

[1] Located at: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

behavioral impact thresholds, auditory masking assessments, evaluations to help understand the ultimate effects of any particular type of impact on an individual's fitness, population assessments, etc.) to help evaluate the effects of a proposed action and make the relevant findings required by NOAA's various statutes.

This Technical Guidance is classified as a Highly Influential Scientific Assessment (HISA) by the President's Office of Management and Budget (OMB). As such, independent peer review was required prior to broad public dissemination by the Federal Government. Details of the three peer reviews, associated with the Technical Guidance, are within this document (Appendix C).

This document is organized so that the most pertinent information can be found easily in the main body. Additional details are provided in the appendices. Section I introduces the document. NMFS' updated acoustic thresholds for onset of PTS for marine mammals exposed to underwater sound are presented in Section II. NMFS' plan for periodically updating acoustic thresholds is presented in Section III. More details on the development of acoustic thresholds, the peer review and public comment process, research recommendations, alternative methodology, and a glossary of acoustic terms are found in the appendices.

The following Tables and Figures summarize the three main aspects of the Technical Guidance: 1) Marine mammal hearing groups (Table ES1), 2) Marine mammal auditory weighting functions (Figures ES1 and ES2; Table ES2), and PTS onset acoustic thresholds (Table ES3).

Table ES1: Marine mammal hearing groups.

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

***** Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).

Table ES2: Summary of weighting and exposure function parameters.*

Hearing Group	*a*	*b*	f_1 (kHz)	f_2 (kHz)	*C* (dB)	*K* (dB)
Low-frequency (LF) cetaceans	1.0	2	0.2	19	0.13	179
Mid-frequency (MF) cetaceans	1.6	2	8.8	110	1.20	177
High-frequency (HF) cetaceans	1.8	2	12	140	1.36	152
Phocid pinnipeds (PW) (underwater)	1.0	2	1.9	30	0.75	180
Otariid pinnipeds (OW) (underwater)	2.0	2	0.94	25	0.64	198

* Equations associated with Technical Guidance's weighting (*W(f)*) and exposure functions (*E(f)*):

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}$$

$$E(f) = K - 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{\left[1+(f/f_1)^2\right]^a\left[1+(f/f_2)^2\right]^b}\right\}$$

Table ES3: Summary of PTS onset acoustic thresholds.

	PTS Onset Acoustic Thresholds* (Received Level)	
Hearing Group	**Impulsive**	**Non-impulsive**
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	*Cell 4* $L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	*Cell 5* $L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	*Cell 6* $L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	*Cell 8* $L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	*Cell 10* $L_{E,OW,24h}$: 219 dB

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 1μPa²s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

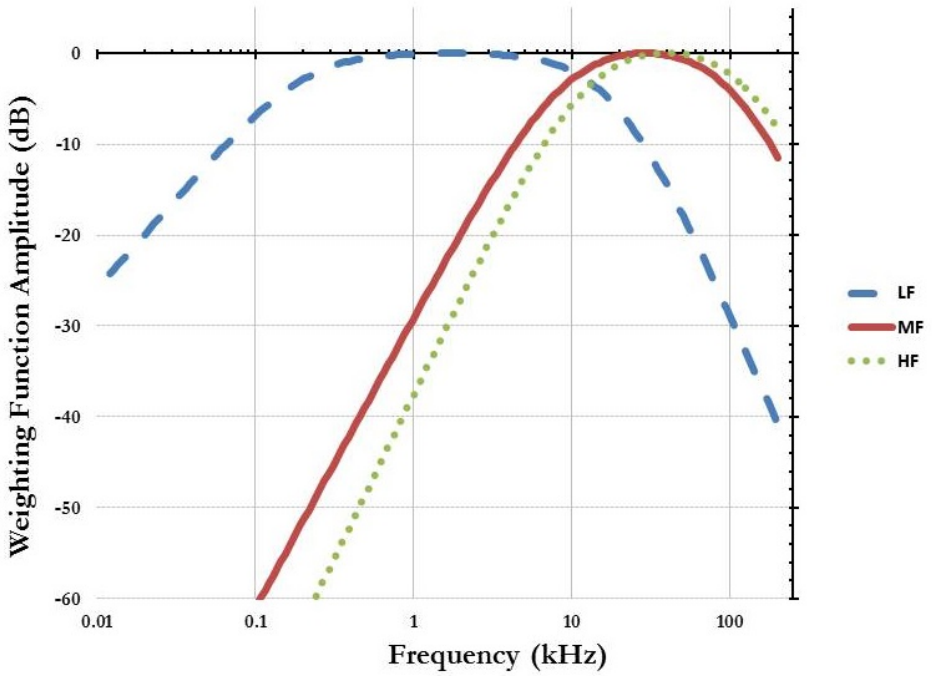


Figure ES1: Auditory weighting functions for low-frequency (LF), mid-frequency (MF), and high-frequency (HF) cetaceans.

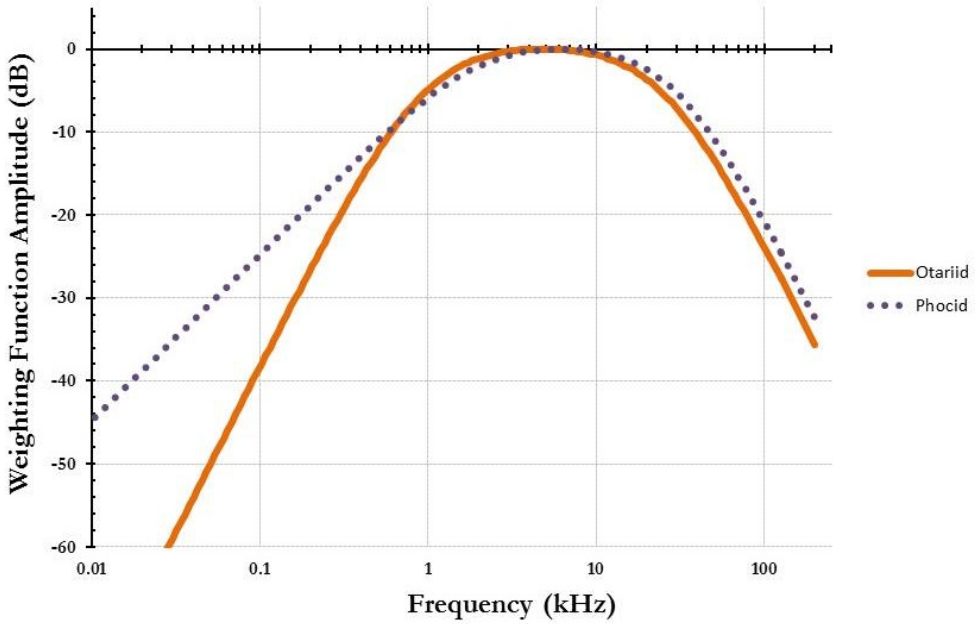


Figure ES2: Underwater auditory weighting functions for otariid (OW) and phocid (PW) pinnipeds.

TECHNICAL GUIDANCE FOR ASSESSING THE EFFECTS OF ANTHROPOGENIC SOUND ON MARINE MAMMAL HEARING

UNDERWATER ACOUSTIC THRESHOLDS FOR ONSET OF PERMANENT AND TEMPORARY THRESHOLD SHIFTS

I. INTRODUCTION

This document provides technical guidance[2] for assessing the effects of anthropogenic (human-made) sound on the hearing of marine mammal species under the jurisdiction[3] of the National Marine Fisheries Service (NMFS) and was completed in collaboration[4] with the National Ocean Service (NOS), Office of National Marine Sanctuaries. Specifically, it identifies the received levels, or acoustic thresholds, at which individual marine mammals are predicted to experience changes in their hearing sensitivity for acute, incidental exposure to all underwater anthropogenic sound sources. This Technical Guidance is intended for use by NMFS analysts/ managers and other relevant action proponents/stakeholders, including other federal agencies, when seeking to determine whether and how their activities are expected to result in impacts to marine mammal hearing via acoustic exposure. This document outlines NMFS' updated acoustic thresholds, describing in detail threshold development (via Appendix A), and how they will be revised and updated in the future.

The acoustic thresholds presented in this document do not represent the entirety of an effects analysis, but rather serve as one tool among others (e.g., behavioral impact thresholds, auditory masking assessments, evaluations to help understand the effects of any particular type of impact on an individual's fitness, population assessments, etc.), to help evaluate the effects of a proposed action and make findings required by NOAA's various statutes.

---

[2] This Technical Guidance does not create or confer any rights for or on any person, or operate to bind the public. An alternative approach that has undergone independent peer review may be proposed (by federal agencies or prospective action proponents) and used if case-specific information/data indicate that the alternative approach is likely to produce a more accurate estimate of auditory impact for the project being evaluated; and if NMFS determines the approach satisfies the requirements of the applicable statutes and regulations.

[3] http://www.nmfs.noaa.gov/pr/species/mammals/. This document does not pertain to marine mammal species under the U.S. Fish and Wildlife Service's (USFWS) jurisdiction (e.g., walrus, polar bears, West Indian manatees, sea otters). However, since marine mammal audiogram data are limited, a decision was made to include all available datasets from in-water groups, including sirenian datasets (Gerstein et al. 1999; Mann et al. 2009), to derive composite audiogram parameters and threshold of best hearing for LF cetaceans (see Appendix A_1). Additionally, audiogram data from a single Pacific walrus (Kastelein et al. 2002) and a single sea otter (Ghoul and Reichmuth 2014) were included in the derivation of the composite audiogram for OW pinnipeds.

[4] Draft versions of this document referred to it as a joint document by NOS and NMFS. However, this final version more accurately identifies it as a NMFS-directed effort/document that was completed in association with NOS.

Note: This document does not directly address mitigation and monitoring measures[5] that may be associated with particular activities, nor does it set forth requirements to conduct sound source verification studies.

This Technical Guidance is classified as a Highly Influential Scientific Assessment (HISA)[6] by the President's Office of Management and Budget (OMB); as such, independent peer review was required before it could be disseminated more broadly by the Federal Government. As such, the Technical Guidance underwent three independent peer reviews (details provided in Appendix C). NMFS also sought informal input from key federal agencies regarding various aspects of this document in early stages of its development.

1.1 NEED FOR TECHNICAL GUIDANCE AND UPDATED UNDERWATER ACOUSTIC THRESHOLDS

Prior to this Technical Guidance, NMFS has primarily relied on two generic acoustic thresholds for assessing auditory impacts (i.e., permanent threshold shift [PTS] onset) for most underwater sound sources: one for cetaceans (RMS SPL 180 dB), and one for pinnipeds (RMS SPL 190 dB). These generic thresholds were developed in the late 1990s using the best information available (e.g., NOAA 1998; HESS 1999). Other sound sources, like tactical sonar and underwater explosives, have relied on more recently developed acoustic thresholds (e.g., Finneran and Jenkins 2012; NOAA 2014). Since the adoption of these original generic thresholds, the understanding of the effects of noise on marine mammal hearing has greatly advanced (e.g., Southall et al. 2007; Finneran 2015; Erbe et al. 2016) making it necessary to more comprehensively examine the current state of science and the acoustic thresholds.

For this document, NMFS has compiled, interpreted, and synthesized the scientific literature on the impacts of sound on marine mammal hearing, including the recent Finneran Technical Report (Finneran 2016; Appendix A of this Technical Guidance), to produce updated underwater acoustic thresholds for the onset of TTS and PTS. These acoustic thresholds update those currently in use by NMFS estimating PTS onset from all sources, as well as those currently in use for estimating TTS[7] onset from underwater detonations. The

[5] Mitigation and monitoring requirements associated with an MMPA authorization or ESA consultation or permit are independent management decisions made in the context of the proposed activity and comprehensive effects analysis, and are beyond the scope of the Technical Guidance. NMFS acknowledges exclusion zones and monitoring zones often correspond to acoustic thresholds but that is not a legal requirement, and the updated thresholds may make such a simple correlation more challenging. The Technical Guidance can be used to inform the development of mitigation or monitoring.

[6] Its dissemination could have a potential impact of more than $500 million in any one year on either the public or private sector; or that the dissemination is novel, controversial, or precedent-setting; or that it has significant interagency interest (OMB 2005). The decision to designate the Technical Guidance as a HISA was based on the latter part of OMB's definition (i.e., precedent-setting).

[7] TTS onset thresholds are found in Appendix A, Table A10.

Technical Guidance's acoustic thresholds are more complex reflecting the current state of scientific knowledge regarding marine mammal hearing and the characteristics of sound that have the potential to impact marine mammal hearing sensitivity.

This is the first time NMFS has presented this information in a single, comprehensive document, which can be used by NMFS analysts/managers and other relevant action proponents/stakeholders, including other federal agencies, when seeking to determine whether and how their activities are expected to result in auditory impacts to marine mammals via acoustic exposure.

1.1.1 Acoustic thresholds within the Context of an Effects Analysis

The Technical Guidance's acoustic thresholds do not represent the entirety of an effects analysis, but rather serve as one tool to help evaluate the effects of sound produced during a proposed action on marine mammals and make findings required by NOAA's various statutes. In a regulatory context, NMFS uses acoustic thresholds to help assess and quantify "take" and to conduct more comprehensive effects analyses under several statutes.

Specifically, the Technical Guidance will be used in conjunction with sound source characteristics, environmental factors that influence sound propagation, anticipated marine mammal occurrence and behavior near the activity, as well as other available activity-specific factors, to estimate the number and types of takes of marine mammals. This document only addresses acoustic thresholds for auditory impact (i.e., does not address or make recommendations associated with sound propagation or marine mammal occurrence or density).

1.2 ADDRESSING UNCERTAINTY AND DATA LIMITATIONS

Inherent data limitations occur in many instances when assessing acoustic effects on marine mammal hearing. Data limitations, which make it difficult to account for uncertainty and variability, are not unique to assessing the effects of anthropogenic sound on marine mammals and are commonly encountered by resource managers (Ludwig et al. 1993; Francis and Shotton 1997; Harwood and Stokes 2003; Punt and Donovan 2007). Southall et al. (2007) and Finneran (2016) acknowledged the inherent data limitations when making recommendations for criteria to assess the effects of noise on marine mammals, including data available from a limited number of species, a limited number of individuals within a species, and/or limited number of sound sources. Both Finneran (2016) and Southall et al. (2007) applied certain extrapolation procedures to estimate effects that had not been directly measured but that could be reasonably approximated using existing information and reasoned logic. The Technical Guidance articulates where NMFS has faced such uncertainty and variability in the development of its acoustic thresholds.

1.2.1 Assessment Framework

NMFS' approach applies a set of assumptions to address uncertainty in predicting potential auditory effects of sound on individual marine mammals. One of these assumptions includes

the use of "representative" or surrogate individuals/species for establishing PTS onset acoustic thresholds for species where little to no data exists. The use of representative individuals/species is done as a matter of practicality (i.e., it is unlikely that adequate data will exist for the all marine mammal species found worldwide or that we will be able to account for all sources of variability at an individual level) but is also scientifically based (i.e., taxonomy, hearing group). As new data become available for more species, this approach can be reevaluated. NMFS recognizes that additional applicable data may become available to better address many of these issues (e.g., uncertainty, surrogate species, etc.).[8] As these new data become available, NMFS has an approach for updating this document (see Section III).

1.2.2 Data Standards

In assessing potential acoustic effects on marine mammals, as with any such issue facing the agency, standards for determining applicable data need to be articulated. Specifically, NOAA has Information Quality Guidelines[9] (IQG) for "ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by the agency" (with each of these terms defined within the IQG). Further, the IQG stipulate that "To the degree that the agency action is based on science, NMFS will use (a) the best available science and supporting studies (including peer-reviewed science and supporting studies when available), conducted in accordance with sound and objective scientific practices, and (b) data collected by accepted methods or best available methods."

The National Research Council (NRC 2004) provided basic guidelines for National Standard 2 (NS2) in section 301 of the Magnuson-Stevens Fishery Conservation and Management Act, which states that "Conservation and management measures shall be based upon the best scientific information available" (NOAA 2013). They recommended that data underlying the decision-making and/or policy-setting process be: 1) relevant, 2) inclusive, 3) objective, 4) transparent and open, 5) timely, 6) verified and validated, and 7) peer reviewed.[10] Although NRC's guidelines (NRC 2004) were not written specifically for marine mammals and this particular issue, they do provide a means of articulating minimum data standards. NMFS considered this in assessing acoustic effects on marine mammals. Use of the NRC Guidelines does not preclude development of acoustic-specific data standards in the future.

---

[8] NMFS is aware that the authors of Southall et al. (2007) are in the process of updating their original publication and recognizes that when this updated publication becomes available, it may suggest alternative means for predicting an auditory weighting function and acoustic thresholds for LF cetaceans. Accordingly, NMFS may re-evaluate our methodology for LF cetaceans when this updated Southall et al. publication becomes available.

[9] http://www.st.nmfs.noaa.gov/science-quality-assurance/national-standards/ns2_revisions.

[10] NMFS also requires Peer Review Plans for Highly Influential Scientific Assessments (HISA) and Influential Scientific Information (ISI).

II. NMFS' ACOUSTIC THRESHOLDS FOR ONSET OF PERMANENT THRESHOLD SHIFTS IN MARINE MAMMALS

The Technical Guidance advances NMFS' assessment ability based upon the compilation, interpretation, and synthesis of the scientific literature. This document provides thresholds for the onset of PTS based on characteristics defined at the acoustic source. No direct measurements of marine mammal PTS have been published; PTS onset acoustic thresholds have been extrapolated from marine mammal TTS measurements (i.e., using growth rates from terrestrial and marine mammal data). PTS onset acoustic thresholds, for all sound sources are divided into two broad categories: 1) impulsive and 2) non-impulsive. Acoustic thresholds are also presented as dual metric acoustic thresholds using cumulative sound exposure level ($SEL_{cum,}$) and peak sound pressure (PK) metrics for impulsive sounds. As dual metrics, NMFS considers onset of PTS to have occurred when either one of the two metrics is exceeded. For non-impulsive sounds, thresholds are provided using the SEL_{cum} metric. Additionally, to account for the fact that different species groups use and hear sound differently, marine mammals are sub-divided into five broad hearing groups (i.e., LF, MF, HF, PW, and OW) and acoustic thresholds in the SEL_{cum} metric incorporate auditory weighting functions.

2.1 MARINE MAMMAL HEARING GROUPS

Current data (via direct behavioral and electrophysiological measurements) and predictions (based on inner ear morphology, modeling, behavior, vocalizations, or taxonomy) indicate that not all marine mammal species have equal hearing capabilities, in terms of absolute hearing sensitivity and the frequency band of hearing (Richardson et al. 1995; Wartzok and Ketten 1999; Southall et al. 2007; Au and Hastings 2008). Hearing has been directly measured in some odontocete and pinniped species[11] (see reviews in Southall et al. 2007; Erbe et al. 2016; Finneran 2016). Direct measurements of mysticete hearing are lacking.[12] Thus, hearing predictions for mysticetes are based on other methods including: anatomical studies and modeling (Houser et al. 2001; Parks et al. 2007; Tubelli et al. 2012; Cranford and Krysl 2015[13]); vocalizations[14] (see reviews in Richardson et al. 1995; Wartzok and Ketten 1999; Au and Hastings 2008); taxonomy; and behavioral responses to sound (Dahlheim and Ljungblad 1990; see review in Reichmuth 2007).

---

[11] Hearing measurements both in air and underwater have been collected for pinniped species.

[12] There was an unsuccessful attempt to directly measure hearing in a stranded gray whale calf by Ridgway and Carder 2001.

[13] Note: The modeling of Cranford and Krsyl (2015) predicts that the primary mechanism for hearing in LF cetaceans is bone conduction. Additionally, this predictive model was based on the skull geometry of a newborn fin whale.

[14] Studies in other species indicate that perception of frequencies may be broader than frequencies produced (e.g., Luther and Wiley 2009).

To better reflect marine mammal hearing capabilities, Southall et al. (2007) recommended that marine mammals be divided into hearing groups (Table 1). NMFS made the following modifications to the hearing groups proposed in Southall et al. (2007)[15]:

- Division of pinnipeds into PW and OW hearing groups: NMFS subdivided pinnipeds into their two families: Phocidae and Otariidae. Based on a review of the literature, phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä et al. 2006; Kastelein et al. 2009a; Reichmuth et al. 2013). Phocid ears are anatomically distinct from otariid ears in that phocids have larger, more dense middle ear ossicles, inflated auditory bulla, and larger sections of the inner ear (i.e., tympanic membrane, oval window, and round window), which make them more adapted for underwater hearing (Terhune and Ronald 1975; Schusterman and Moore 1978; Kastak and Schusterman 1998; Hemilä et al. 2006; Mulsow et al. 2011; Reichmuth et al. 2013).

- Recategorizatin of hourglass (*Lagenorhynchus cruciger*) and Peale's (*L. australis*) dolphins from MF cetacean to HF cetacean hearing group:[16] Echolocation data (Kyhn et al. 2009; Kyhn et al. 2010; Tougaard and Kyhn. 2010) indicate that the hourglass and Peale's dolphin produce sounds (i.e., higher mean peak frequency) similar to other narrow band high-frequency cetaceans, such as porpoises, *Kogia*, and *Cephalorhynchus*, and are distinctly different from other *Lagenorhynchus* species. Genetic data also suggest these two species are more closely related to *Cephalorhynchus* species (May-Collado and Agnarsson 2006). Thus, based on this information, NMFS has decided to move these two species from MF cetaceans to HF cetaceans.

[15] NMFS considered dividing LF cetaceans into two separate groups (i.e., some species may have better low frequency hearing than others, like blue and fin whales; Clark and Ellison 2004), but decided there was not enough data to support such a division at this time. NMFS also considered separating sperm whales from other MF cetaceans, but there are not enough data are available to stipulate exactly how this should be done. Sperm whale placement within MF cetaceans is considered appropriate based on Ketten (2000), which classified sperm whales as having Type I cochlea, similar to other MF cetaceans.

[16] In March 2016, NMFS also proposed moving the white-beaked dolphin (*L. albirostris*) to the HF cetacean hearing group. However, upon re-evaluation, it was decided this move was not fully supported (i.e., move not supported to the level of that of the other two species in this family).

Table 1: Marine mammal hearing groups.

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

***** Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007) and PW pinniped (approximation).

NMFS' modification results in marine mammal hearing groups being defined in this Technical Guidance as depicted in Table 1. Table 1 defines a generalized hearing range each hearing group. This generalized hearing range was determined based on the ~65 dB[17] threshold from the normalized composite audiograms (Figure 4). For LF cetaceans and PW pinnipeds, the ~65 dB threshold resulted in a lower bound that was considered too low to be biologically plausible for these two groups. Instead, for LF cetaceans the lower frequency limit from Southall et al. 2007 was used, while for PW pinnipeds 50 Hz was chosen as a reasonable approximation for the lower frequency limit (relative to otariid pinnipeds)[18].

2.1.1 Application of Marine Mammal Hearing Groups

The application of marine mammal hearing groups occurs throughout the Technical Guidance in two ways. First, acoustic thresholds are divided by hearing group to acknowledge that not all marine mammal species have identical hearing or susceptibility to noise-induced hearing loss (NIHL). Outside the generalized hearing range, the risk of auditory impacts from sounds is considered highly unlikely or very low[19] (the exception

[17] In humans, functional hearing range is typically defined as 60 dB above the hearing threshold at greatest hearing sensitivity. To account for uncertainty associated with marine mammal hearing, NMFS based the Technical Guidance's generalized hearing range on 65 dB.

[18] Understanding of low-frequency pinniped hearing is limited (i.e., few studies have direct measurements of hearing below 100 Hz).

[19] Animals are able to detect sounds beyond their generalized hearing range by non-auditory mechanisms. However, typically, these sounds have to be extremely loud and would be considered uncomfortable (Wartzok

would be if a sound above/below this range has the potential to cause physical injury, i.e., lung or gastrointestinal tract injury from underwater explosives).

Second, marine mammal hearing groups are used in the establishment of marine mammal auditory weighting functions discussed next.

2.2 MARINE MAMMAL AUDITORY WEIGHTING FUNCTIONS

The ability to hear sounds varies across a species' hearing range. Most mammal audiograms have a typical "U-shape," with frequencies at the bottom of the "U" being those to which the animal is more sensitive, in terms of hearing (i.e. the animal's best hearing range; for example audiogram, see Glossary, Figure F1). Auditory weighting functions best reflect an animal's ability to hear a sound (and do not necessarily reflect how an animal will perceive and behaviorally react to that sound). To reflect higher hearing sensitivity at particular frequencies, sounds are often weighted. For example, A-weighting for humans deemphasize frequencies below 1 kHz and above 6 kHz based on the inverse of the idealized (smoothed) 40-phon equal loudness hearing function across frequencies, standardized to 0 dB at 1 kHz (e.g., Harris 1998). Other types of weighting functions for humans (e.g., B, C, D) deemphasize different frequencies to different extremes (e.g., flattens equal-loudness perception across wider frequencies with increasing received level; for example, C-weighting is uniform from 50 Hz to 5 kHz; ANSI 2011).

Auditory weighting functions have been proposed for marine mammals, specifically associated with PTS acoustic thresholds expressed in the SEL_{cum} [20] metric, which take into account what is known about marine mammal hearing (Southall et al. 2007; Erbe et al. 2016). The Finneran Technical Report (Finneran 2016), recently developed updated marine mammal auditory weighting functions that reflect new data on:

- Marine mammal hearing (e.g., Sills et al. 2014; Sills et al. 2015; Cranford and Krysl, 2015; Kastelein et al. 2015c)

- Marine mammal equal latency contours (e.g., Reichmuth 2013; Wensveen et al. 2014; Mulsow et al. 2015

- Effects of noise on marine mammal hearing (e.g., Kastelein et al. 2012a; Kastelein et al. 2012b; Finneran and Schlundt 2013; Kastelein et al. 2013a; Kastelein et al. 2013b; Popov et al. 2013; Kastelein et al. 2014a; Kastelein et al. 2014b; Popov et al.

---

and Ketten 1999). If a sound is on the edge of a hearing group's generalized hearing range and there is the potential for exposure to high sound pressure levels, then one should consider the potential for detection beyond normal auditory pathways.

[20] Auditory weighting functions are not to be applied to PTS or TTS onset acoustic thresholds expressed as the PK metric (i.e., PK thresholds are flat or unweighted within the generalized hearing range). For more information, please see Section 2.3.2.2.

2014; Finneran et al. 2015; Kastelein et al., 2015a; Kastelein et al. 2015b; Popov et al. 2015).

This recent update reflects a transition from auditory weighting functions that have previously been more similar to human dB(C) functions (i.e., M-weighting from Southall et al. 2007) to that more similar to human dB(A) functions. Updated marine mammal auditory weighting functions also provide a more consistent approach/methodology for all hearing groups.

Upon evaluation, NMFS determined that the proposed methodology in Finneran 2016 reflects the scientific literature and incorporated it directly into this Technical Guidance (Appendix A) following an independent peer review (see Appendix C for details on peer review and link to Peer Review Report).

2.2.1 Use of Auditory Weighting Functions in Assessing Susceptibility to Noise-Induced Hearing Loss

Auditory weighting functions are used for human noise standards to assess the overall hazard of noise on hearing. Specifically, human auditory weighting functions provide a "rating that indicates the injurious effects of noise on human hearing" (OSHA 2013). Thus, while these functions are based on regions of equal loudness and best hearing, in the context of human risk assessments, as well as their use in the Technical Guidance, they are meant to reflect the susceptibility of the ear to noise-induced threshold shifts (TSs). Regions of enhanced susceptibility to noise may not perfectly mirror a species' region of best hearing (e.g., TTS measurements from bottlenose dolphin, belugas, and Yangtze finless porpoise support this). Thus, within the Technical Guidance, auditory weighting functions are meant to assess risk of NIHL and do not necessarily encompass the entire range of best hearing for every species within the hearing group.

2.2.2 Marine Mammal Auditory Weighting Functions

Updated frequency-dependent marine mammal auditory weighting functions were derived using data on hearing ability (composite audiograms), effects of noise on hearing, and data on equal latency (Finneran 2016[21]). Separate functions were derived for each marine mammal hearing group (Figures 1 and 2).

[21] Wright 2015 provides a critique of this methodology. For NMFS' response associated with this critique, see the Federal Register notice associated with the finalized Technical Guidance, specifically the section responding to public comments.

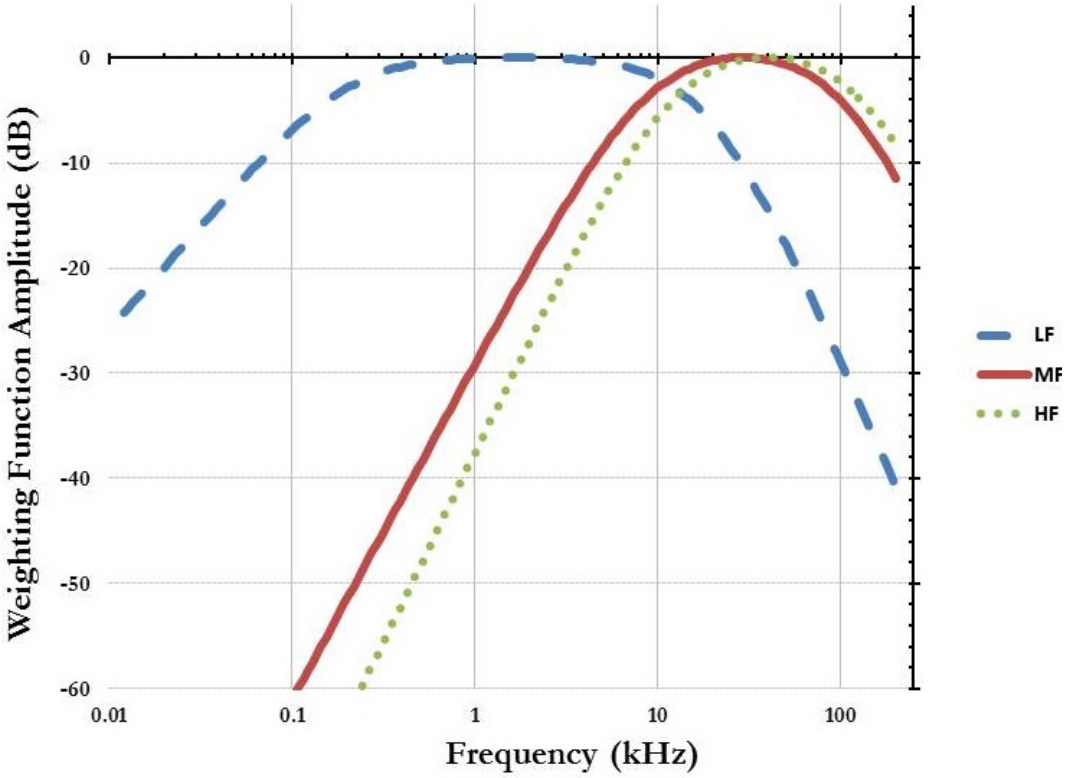


Figure 1: Auditory weighting functions for low-frequency (LF), mid-frequency (MF), and high-frequency (HF) cetaceans.

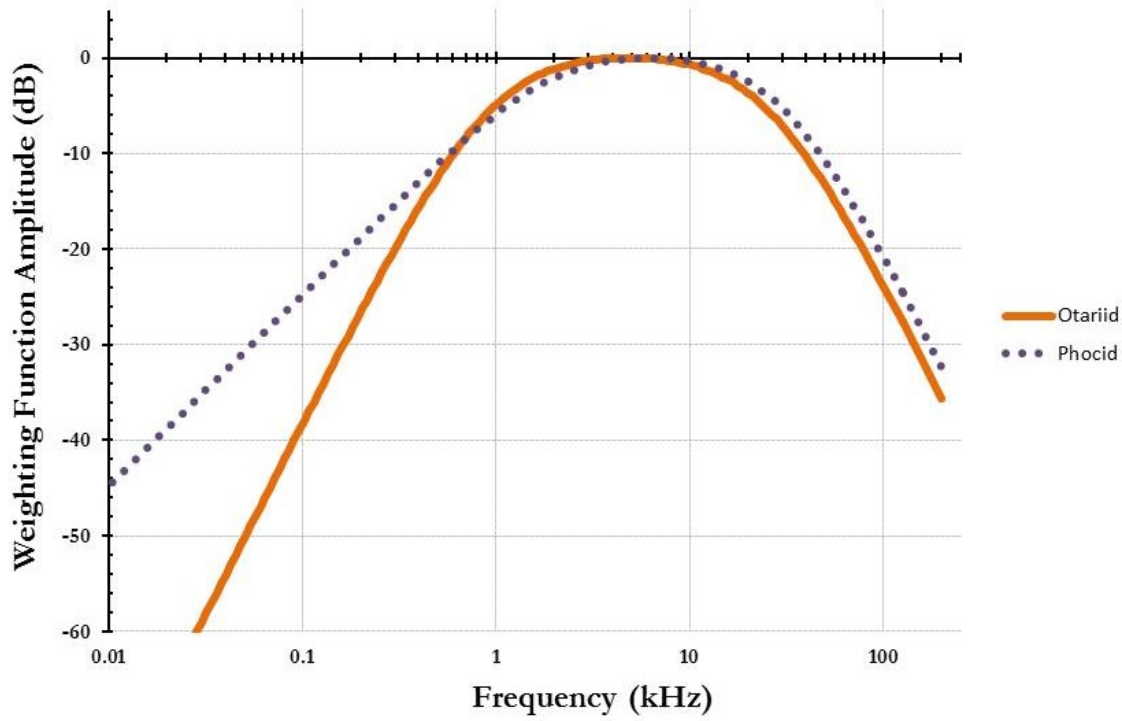


Figure 2: Underwater auditory weighting functions for otariid (OW) and phocid (PW) pinnipeds.

The overall shape of the auditory weighting functions is based on a generic band-pass filter described by Equation 1:

$$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a\,[1+(f/f_2)^2]^b}\right\}\text{dB} \qquad \textbf{Equation 1}$$

where $W(f)$ is the weighting function amplitude in decibels (dB) at a particular frequency (f) in kilohertz (kHz). The function shape is determined by the following weighting function parameters:

- Low-frequency exponent (a): This parameter determines the rate at which the weighting function amplitude declines with frequency at the lower frequencies. As the frequency decreases, the change in amplitude becomes linear with the logarithm of frequency with a slope of $20a$ dB/decade.

- High-frequency exponent (*b*): Rate at which the weighting function amplitude declines with frequency at the upper frequencies. As the frequency increases, the change in amplitude becomes linear with the logarithm of frequency with a slope of $20b$ dB/decade.

- Low-frequency cutoff (f_1): This parameter defines the lower limit of the band-pass filter (i.e., the lower frequency where weighting function amplitude begins to roll off or decline from the flat, central portion of the function). This parameter is directly dependent on the value of the low-frequency exponent (*a*).

- High-frequency cutoff (f_2): This parameter defines the upper limit the band-pass filter (i.e., the upper frequency where weighting function amplitude begins to roll off or decline from the flat, central portion of the function). This parameter is directly dependent on the value of the high-frequency exponent (*b*).

- Weighting function gain(*C*): This parameter determines the vertical position of the function and is adjusted to set the maximum amplitude of the weighting function to 0 dB.

Finneran (2016) illustrates the influence of each parameter value on the shape of the weighting function (Appendix A, Figure A2).

In association with auditory weighting functions are exposure functions that illustrate how auditory weighting functions relate to auditory acoustic thresholds. Exposure functions (Equation 2) are the inversion of Equation 1:

$$E(f) = K - 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{\left[1+(f/f_1)^2\right]^a\left[1+(f/f_2)^2\right]^b}\right\} \text{ dB}$$

Equation 2

where $E(f)$ is the acoustic exposure as a function of frequency (f) and the gain parameter constant (K), which is adjusted to set the minimum value of the curve to the weighted PTS/TTS onset auditory threshold. All other parameters are the same as those in Equation 1. Figure 3 illustrates how the various weighting parameters relate to one another in both the auditory weighting and exposure functions.

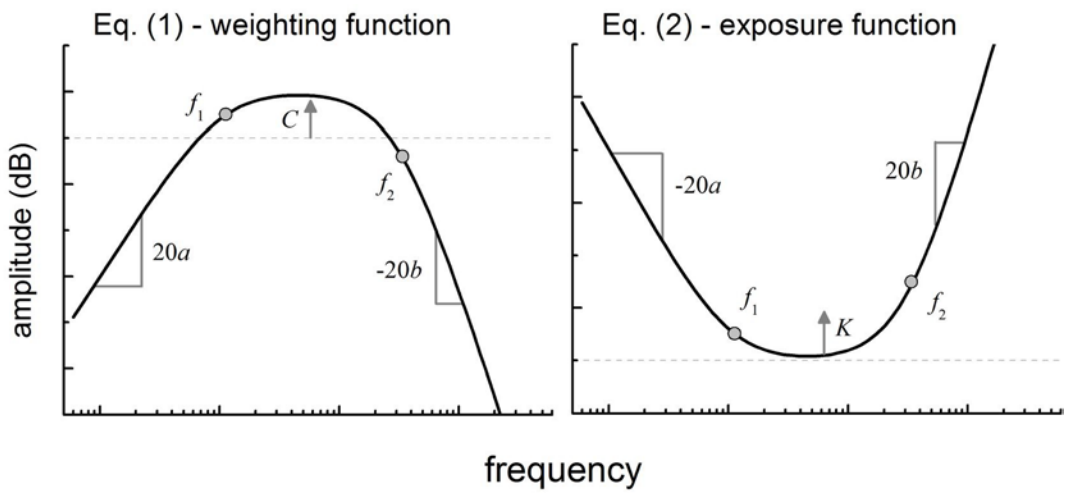


Figure 3: Illustration of function parameter in both auditory weighting functions and exposure functions (from Finneran 2016). Reference to Equations 1 and 2 match those in the Technical Guidance.

Finneran (2016) (Appendix A, Figures A-22 and A-23) provides a comparison of these updated auditory weighting functions with previously derived weighting functions (Finneran and Jenkins 2012 used in Navy Phase 2 Analysis).

2.2.3 Derivation of Function Parameters

Numeric values associated with weighting function parameters were derived from available data from audiograms (measured and predicted), equal latency contours, and marine mammal TTS data using the following steps from Finneran (2016):

1. Derivation of marine mammal composite audiograms (original and normalized) for each hearing group (Resulting normalized composite audiogram: Figure 4; Data sources: Table 2).

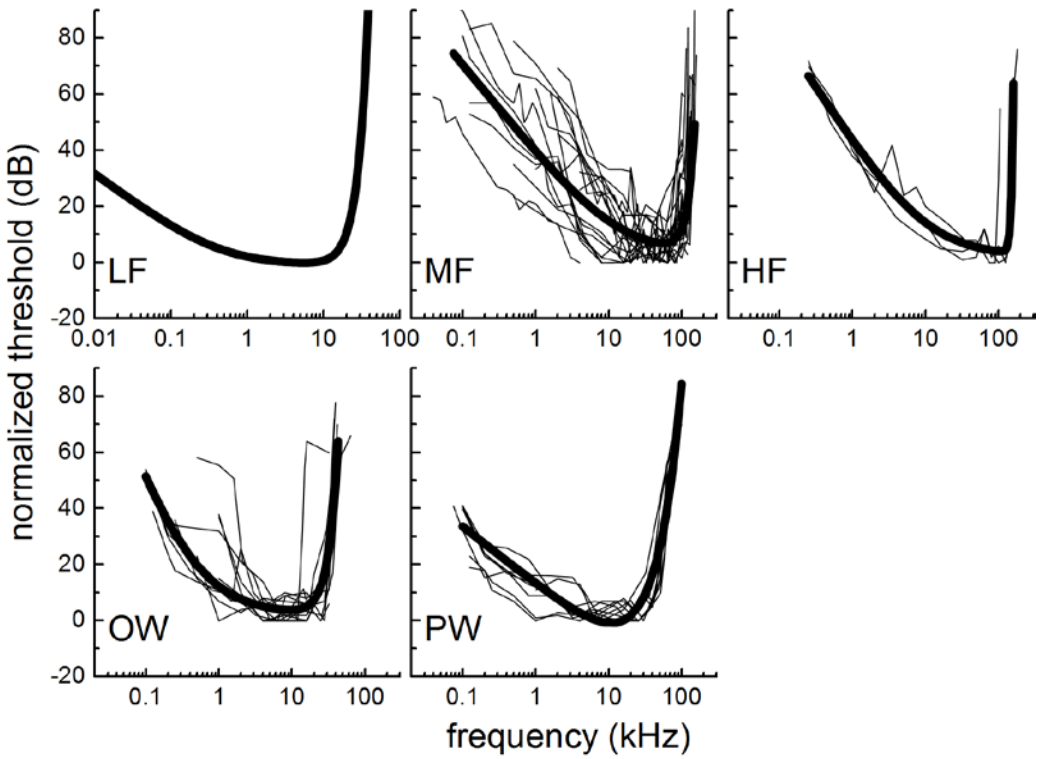


Figure 4: **Resulting normalized composite audiograms for low-frequency (LF), mid-frequency (MF), and high-frequency (HF) cetaceans and phocid (PW) and otariid (OW) pinnipeds (from Finneran 2016). For resulting original composite audiogram, see Appendix A, Figure A5.**

Table 2: Summary of data available for deriving composite audiograms.†

Hearing Group	Species (number of individuals)	References
Mid-Frequency (MF) cetaceans	Beluga (9)	White et al. 1978; Awbrey et al. 1988; Johnson et al. 1989; Ridgway et al. 2001; Finneran et al. 2005b
	Bottlenose dolphin (6)	Johnson 1967; Ljungblad et al. 1982; Lemonds 1999; Brill et al. 2001;Schlundt et al. 2008; Finneran et al. 2010a
	False killer whale (1)	Thomas et al. 1988
	Killer whale (2)	Szymanski et al. 1999
	Risso's dolphin (1)	Nachtigall et al. 1995
	Pacific white-sided dolphin (1)	Tremel et al. 1996
	Striped dolphin (1)	Kastelein et al. 2003
	Tucuxi (1)	Sauerland and Dehnhardt 1998
High-frequency (HF) cetaceans	Amazon River dolphin (1)	Jacobs and Hall 1972
	Harbor porpoise (3)	Kastelein et al. 2010; Kastelein et al. 2015c
Phocid pinnipeds (underwater)	Harbor seal (4)	Terhune 1988; Kastelein et al. 2009b; Reichmuth et al. 2013
	Northern elephant seal (1)	Kastak and Schusterman 1999
	Ringed seal (1)	Sills et al. 2015
	Spotted seal (2)	Sills et al. 2014
Otariid pinnipeds* (underwater)	California sea lion (4)	Mulsow et al. 2012; Reichmuth and Southall 2012; Reichmuth et al. 2013
	Northern fur seal (3)	Moore and Schusterman 1987; Babushina et al. 1991
	Steller sea lion (2)	Kastelein et al. 2005a

† More details on individual subjects are available in Appendix A (Table A2). Some datasets were excluded due to subjects having high-frequency hearing loss or aberrant audiograms. These included subjects from: Møhl 1968; Andersen 1970; Hall and Johnson 1972; Terhune and Ronald 1972; Terhune and Ronald 1975; Thomas et al. 1990; Wang et al. 1992; Babushina 1997; Kastak et al. 2002; Finneran et al. 2005 (Turner); Yuen et al. 2005; Finneran et al. 2007a; Sills et al. 2015 (Natchek). Decisions to exclude data were based on comparison of the individual published audiograms and ambient noise characteristics to those for other individuals of the same or closely related species. The most common reasons for excluding an individual's data were abnormal audiograms featuring high-frequency hearing loss (typically seen in older animals) or "notches" in the audiogram, or data collected in the presence of relatively high ambient noise that resulted in elevated thresholds. Excluding these data ensured that the composite audiograms were not artificially elevated, which could result in unrealistically high acoustic thresholds.

* The otariid pinniped (underwater)hearing group's composite audiogram contains data from a single Pacific walrus (*Odobenus rosmarus*) from Kastelein et al. 2002 and a single sea otter (*Enhydra lutris nereis*) from Ghoul and Reichmuth 2014, which are species under the jurisdiction of the USFWS. However, since marine mammal audiogram data are limited, a decision was made to include all available datasets from in-water groups to derive composite audiograms for this hearing group. For frequencies below 30 kHz, the difference in the composite audiogram with and without these data are < 2 dB. For comparison, see Appendix A, Figure A4.

In deriving marine mammal composite audiograms, NMFS established an informal data hierarchy in terms of assessing these types of data. Specifically, audiograms obtained via behavioral methodologies were determined to provide the most representative (sensitive) presentation of hearing ability (Finneran et al. 2007a), followed by auditory evoked potential (AEP) data,[22] and lastly by mathematical/anatomical models for species where no data are available (i.e., LF cetaceans). Thus, the highest quality data available for a specific hearing group were used.[23]

For LF cetaceans, only two studies were available for consideration (i.e., predicted audiogram for a humpback whale from Houser et al. 2001 and fin whale from Cranford and Krysl 2015), which alone was not enough to derive a predicted audiogram for this entire hearing group. Thus, an alternative approach was used to derive a composite audiogram[24] and associated weighting function for LF cetaceans (i.e., composite audiogram parameters had to be predicted; For specifics, on this process, see Appendix A_1).

2. The low-frequency exponent (a) was defined using the smaller of the low-frequency slope from either the composite audiogram or the lower-frequency slope of the equal latency contours (if available) and then divided by twenty ($s_0/20$). This results in the slope matching the shallower slope of the audiogram.

3. The high-frequency exponent (b) was set equal to two to match the previously derived marine mammal auditory weighting functions from Finneran and Jenkins (2012), since no new TTS measurements were available at higher frequencies and equal latency data at these frequencies are considered highly variable.

4. Low- (f_1) and high-frequency cutoffs (f_2) were defined as the frequencies below and above the frequency of best hearing (f_0) from original data, where the threshold

[22] Despite not directly including AEP audiograms in the development of a hearing groups' composite audiogram, these date were evaluated to ensure species were placed within the appropriate hearing group and to ensure a species where only AEP data are available were within the bounds of the composite audiogram for that hearing group. Furthermore, AEP TTS data are presented within the Technical Guidance for comparative purposes alongside TTS data collected by behavioral methods illustrating that the AEP TTS data are within the bounds (the majority of the time above) of those collected by behavioral methods.

[23] Behavioral techniques for obtaining audiograms measure perception of sound by a receiver, while AEP methods measure only neural activity (Jewett and Williston 1971) (i.e., two methodologies are not necessarily equivalent). As a result, behavioral techniques consistently produce lower thresholds than those obtained by AEPs (e.g., Szymanski et al. 1999; Yuen et al. 2005; Houser and Finneran 2006). Currently, there are no means established for "correcting" AEP data so that it may be more comparable to those obtained via behavioral methods (Heffner and Heffner 2003; Finneran 2015; Sisneros et al. 2016; Erbe et al. 2016).

[24] During the third public comment period on the Technical Guidance in March 2016, ambient noise levels from Clark and Ellison 2004 were offered by a group of subject matter experts as additional scientific support to NMFS' LF cetacean weighting function (for direct comparison to NOAA's 2016 LF cetacean weighting function see: https://www.regulations.gov/#!documentDetail;D=NOAA-NMFS-2013-0177-0155).

values were ΔT above the threshold at f_0. These two parameters reflect the hearing group's most susceptible frequency range.

5. To determine ΔT, the exposure function amplitude was calculated for MF and HF cetaceans examining ΔT values ranging from zero to 20 dB. Then, the K gain parameter was adjusted to minimize the mean-squared error (MSE) between the function amplitude (original and normalized composite audiograms) and MF and HF cetacean TTS data. The value of ΔT resulting the lowest MSE was eleven for both the normalized and original data. This value was used for other hearing groups.

6. Hearing groups where TTS data are available (i.e., MF and HF cetaceans and PW and OW pinniped) were used to define K (Step 4 above). For LF cetaceans, where data were not available, TTS onset was estimated by assuming the numeric difference between auditory threshold (Figure 4, original data) and TTS onset at the frequency of best hearing (f_0) would be similar across hearing groups. For LF cetaceans auditory threshold had to be predicted, since no data exist (For specifics on methodology, see Appendix A, Table A7).

7. The weighting function parameter (C) was determined by substituting parameters a, b, f_1, and f_2 in Equation 1 and setting the peak amplitude of the function to zero.

For each hearing group, the resulting numeric values associated with these parameters and resulting weighted TTS onset threshold for non-impulsive sources (SEL_{cum} metric) are listed in Table 3 and resulting weighting functions are depicted in Figures 1 and 2.

Table 3: Summary of weighting and exposure function parameters.

Hearing Group	a	b	f_1 (kHz)	f_2 (kHz)	C (dB)	K (dB)	Weighted TTS onset threshold* (SEL_{cum})
Low-frequency (LF) cetaceans	1.0	2	0.2	19	0.13	179	179 dB
Mid-frequency (MF) cetaceans	1.6	2	8.8	110	1.20	177	178 dB
High-frequency (HF) cetaceans	1.8	2	12	140	1.36	152	153 dB
Phocid pinnipeds (PW) (underwater)	1.0	2	1.9	30	0.75	180	181 dB
Otariid pinnipeds (OW) (underwater)	2.0	2	0.94	25	0.64	198	199 dB

* Determined from minimum value of exposure function and the weighting function at its peak (i.e., mathematically equivalent to $K + C$).

Note: Appendix A, Figure A17 illustrates that the resulting exposure functions (and subsequent weighting functions) are broader than the composite audiograms or audiogram from an individual species. This is important to note because the weighting/exposure functions are derived not just from data associated with the composite audiogram but also account for available TTS onset data.

2.2.4 Application of Marine Mammal Auditory Weighting Functions for PTS Onset Acoustic Thresholds

The application of marine mammal auditory weighting functions emphasizes the importance of making measurements and characterizing sound sources in terms of their overlap with biologically-important frequencies (e.g., frequencies used for environmental awareness, communication or the detection of predators or prey), and not only the frequencies of interest or concern for the completion of the sound-producing activity (i.e., context of sound source).

If the frequencies produced by a sound source are outside a hearing group's most susceptible hearing range (where the weighting function amplitude is 0), sounds at those frequencies must have a higher sound pressure level to produce a similar threshold shift (i.e., PTS onset) as sounds with frequencies in the hearing group's most susceptible hearing range. Because auditory weighting functions take into account a hearing group's differing susceptibility to frequencies, the implementation of these functions typically results in smaller isopleths[25] for frequencies where the group is less susceptible. Additionally, if the sound source produces frequencies completely outside the generalized hearing range of a given hearing group (i.e., has no harmonics/subharmonics that are capable of producing sound within the hearing range of a hearing group), then the likelihood of the sound causing hearing loss is considered low.[26]

Marine mammal auditory weighting functions should be used in conjunction with corresponding SEL_{cum} PTS onset acoustic thresholds. If the use of the full auditory weighting function is not possible by an action proponent (i.e., consider weighting function over multiple frequencies for broadband source), NMFS has provided an alternative tool based on a simpler weighting function (See Appendix D).

---

[25] Note: Acoustic thresholds associated with a hearing group do not change depending on how much a sound may overlap a group's most susceptible frequency range. Instead, weighting functions affect exposure modeling/analysis via the resulting size of the isopleth (area) associated with the threshold based on how susceptible that particular hearing group is to the sound being modeled. For example, a hearing group could have different size isopleths associated with the same threshold, if one sound was within its most susceptible frequency range and the other was not (i.e., sound in most susceptible hearing range will result in larger isopleth compared to sound outside the most susceptible hearing range).

[26] The potential for sound to damage beyond the level the ear can perceive exists (Akay 1978), which is why the acoustic thresholds also include the PK metric, which are flat or unweighted within the generalized hearing range of a hearing group.

Tougaard et al. (2015) reviewed the impacts of using auditory weighting functions and various considerations when applying them during the data evaluation and implementation stages (e.g., consequences of using too broad or too narrow of a filter) and suggested some modifications (correction factors) to account for these considerations. However, there are no data to support doing so (i.e., selection would be arbitrary). Moreover, various conservative factors have been accounted for in the development of weighting functions and acoustic thresholds: A 6 dB threshold shift was used to represent TTS onset; the methodology does not incorporate exposures where TTS did not occur; and the potential for recovery is not accounted for. Additionally, the means by which NMFS is applying auditory weighting functions is supported and consistent with what has been done for humans (i.e., A-weighted thresholds used in conjunction with A-weighting during implementation).

2.2.4.1 Measuring and Maintaining Full Spectrum for Future Analysis

Marine mammal auditory weighting functions should be applied after sound field measurements[27] have been obtained (i.e., post-processing; auditory weighting functions should not be applied beforehand), with the total spectrum of sound preserved for later analysis (i.e., if weighting functions are updated or if there is interest in additional species, then data can still be used). Additionally, it is important to consider measurements that encompass the entire frequency band that a sound source may be capable of producing (i.e., sources often produce sounds, like harmonics/subharmonics, beyond the frequency/band of interest; e.g., Deng et al. 2014; Hastie et al. 2014).

2.3 PTS ONSET ACOUSTIC THRESHOLDS

Available data from humans and other terrestrial mammals indicate that a 40 dB threshold shift approximates PTS onset (see Ward et al. 1958; Ward et al. 1959; Ward 1960; Kryter et al. 1966; Miller 1974; Ahroon et al. 1996; Henderson et al. 2008). Southall et al. (2007) also recommended this definition of PTS onset.

PTS onset acoustic thresholds for marine mammals have not been directly measured and must be extrapolated from available TTS onset measurements. Thus, based on cetacean measurements from TTS studies (see Southall et al. 2007; Finneran 2015; Finneran 2016 found in Appendix A of this Technical Guidance) a threshold shift of 6 dB is considered the minimum threshold shift clearly larger than any day-to-day or session-to-session variation[28] in a subject's normal hearing ability and is typically the minimum amount of threshold shift that can be differentiated in most experimental conditions (Finneran et al. 2000; Schlundt et

[27] Note: Sound field measurements refers to actual field measurements, which are not a requirement of this Technical Guidance, and not to exposure modeling analyses, where it may be impractical due to data storage and cataloging restraints.

[28] Similarly, for humans, NIOSH (1998) regards the range of audiometric testing variability to be approximately 5 dB.

al. 2000; Finneran et al. 2002). Thus, NMFS has set the onset of TTS at the lowest level that exceeds recorded variation (i.e., 6 dB).

There are different mechanisms (e.g., anatomical, neurophysiological) associated with TTS vs. PTS onset, making the relationship between these types of TSs not completely direct. Nevertheless, the only data available for marine mammals, currently and likely in the future, will be from TTS studies (i.e., unlike for terrestrial mammals where direct measurements of PTS exist). Thus, TTS represents the best information available from which PTS onset can be estimated.

The acoustic thresholds presented in Table 4 update all NMFS acoustic thresholds for PTS onset. The acoustic thresholds consist of both an acoustic threshold and weighting function for the SEL_{cum} metric (weighting functions are considered not appropriate for PK metric).

Table 4: Summary of PTS onset acoustic thresholds.

	PTS Onset Thresholds* (Received Level)	
Hearing Group	**Impulsive**	**Non-impulsive**
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	*Cell 4* $L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	*Cell 5* $L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	*Cell 6* $L_{E,HF,24h}$: 173 dB
Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	*Cell 8* $L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	*Cell 10* $L_{E,OW,24h}$: 219 dB

* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 1μPa²s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.

NMFS recognizes that the implementation of marine mammal weighting functions represents a new factor for consideration that may exceed the capabilities of some action proponents. Thus, NMFS has developed alternative tools for those who cannot fully apply weighting functions associated with the SEL_{cum} metric (See Appendix D).

2.3.1 Impulsive and Non-Impulsive Acoustic Thresholds

This Technical Guidance divides sources into impulsive and non-impulsive based on physical characteristics at the source, with impulsive sound having physical characteristics

making them more injurious[29] (e.g., high peak sound pressures and rapid rise times) than non-impulsive sound sources (terrestrial mammal data: Buck et al. 1984; Dunn et al. 1991; Hamernik et al. 1993; Clifford and Rogers 2009; marine mammal data: reviewed in Southall et al. 2007 and Finneran 2016 that appears as Appendix A of this Technical Guidance).

The characteristics of the sound at a receiver, rather than at the source, are the relevant consideration for determining potential impacts. However, understanding these physical characteristics in a dynamic system with receivers moving over space and time is difficult. Nevertheless, it is known that as sound propagates from the source the characteristics of impulsive sounds that make them more injurious start to dissipate due to effects of propagation (e.g., time dispersion/time spreading; Urick 1983; Sertlek et al. 2014).

For the purposes of this Technical Guidance,[30] sources are divided and defined as the following:

- Impulsive: produce sounds that are typically transient, brief (less than 1 second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI 1986; NIOSH 1998; ANSI 2005).

- Non-impulsive: produce sounds that can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent) and typically do not have a high peak sound pressure with rapid rise/decay time that impulsive sounds do (ANSI 1995; NIOSH 1998).

Note: The term "impulsive" in this document relates specifically to NIHL and specifies the physical characteristics of an impulsive sound source, which likely gives them a higher potential to cause auditory TTS/PTS. This definition captures how these sound types may be more likely to affect auditory physiology and is not meant to reflect categorizations associated with behavioral disturbance.

2.3.2 Metrics

2.3.2.1 Cumulative Sound Exposure Level (SEL_{cum}) Metric

The SEL_{cum} metric takes into account both received level and duration of exposure (ANSI 2013), both factors that contribute to NIHL. Often this metric is normalized to a single sound exposure of one second. NMFS intends for the SEL_{cum} metric to account for the *accumulated* exposure (i.e., SEL_{cum} cumulative exposure over the duration of the activity within a 24-h period).

[29] Exposure to impulsive sounds more often lead to mechanical damage of the inner ear, as well as more complex patterns of hearing recovery (e.g., Henderson and Hamernik 1986; Hamernik and Hsueh 1991).

[30] If there is a source where it is unclear how it should be defined, consider the most applicable definition and consult with NMFS.

The recommended application of the SEL_{cum} metric is for individual activities/sources. It is not intended for accumulating sound exposure from multiple activities occurring within the same area or over the same time or to estimate the impacts of those exposures to an animal occurring over various spatial or temporal scales. Current data available for deriving acoustic thresholds using this metric are based on exposure to only a single source and may not be appropriate for situations where exposure to multiple sources is occurring. As more data become available, the use of this metric can be re-evaluated, in terms of appropriateness, for application of exposure from multiple activities occurring in space and time.

Equal Energy Hypothesis

One assumption made when applying the SEL_{cum} metric is the equal energy hypothesis (EEH), where it is assumed that sounds of equal SEL_{cum} produce an equal risk for hearing loss (i.e., if the SEL_{cum} of two sources are similar, a sound from a lower level source with a longer exposure duration may have similar risks to a shorter duration exposure from a higher level source). As has been shown to be the case with humans and terrestrial mammals (Henderson et al. 1991), the EEH does not always accurately describe all exposure situations for marine mammals due the inherent complexity of predicting TSs (e.g., Kastak et al. 2007; Mooney et al. 2009a; Mooney et al. 2009b; Finneran et al. 2010a; Finneran et al. 2010b; Finneran and Schlundt 2010; Kastelein et al. 2012b; Kastelein et al. 2013b; Kastelein et al. 2014a; Popov et al. 2014).

Factors like sound level (e.g., overall level, sensation level, or level above background), duration, duty cycle (intermittent versus continuous exposure; potential recovery between intermittent periods), number of transient components (short duration and high amplitude), and/or frequency (especially in relation to hearing sensitivity) often are also important factors associated with TSs (e.g., Buck et al. 1984; Clark et al. 1987; Ward 1991; Lataye and Campo 1996). This is especially the case for exposure to impulsive sound sources (Danielson et al. 1991; Henderson et al. 1991; Hamernik et al. 2003), which is why acoustic thresholds in this Technical Guidance are also expressed as a PK metric (see next section). However, in many cases the EEH approach functions reasonably well as a first-order approximation, especially for higher-level, short-duration sound exposures such as those that are most likely to result in TTS in marine mammals[31] (Finneran 2015). Additionally, no currently supported alternative method to accumulate exposure is available. If alternative methods become available, they can be evaluated and considered when the Technical Guidance is updated.

Recommended Accumulation Period

To apply the SEL_{cum} metric, accumulation time must be specified. Generally, it is predicted that most receivers will minimize the amount of time they remain in the closest ranges to a sound source/activity. Exposures at the closest point of approach are the primary exposures

[31] When possible, it is valuable for action proponents to indicate the exposure conditions under which these acoustic thresholds are likely to be exceeded.

contributing to a receiver's accumulated level (Gedamke et al. 2011). Additionally, several important factors determine the likelihood and duration a receiver is expected to be in close proximity to a sound source (i.e., overlap in space and time between the source and receiver). For example, accumulation time for fast moving (relative to the receiver) mobile sources is driven primarily by the characteristics of source (i.e., speed, duty cycle). Conversely, for stationary sources, accumulation time is driven primarily by the characteristics of the receiver (i.e., swim speed and whether transient or resident to the area where the activity is occurring). NMFS recommends a baseline accumulation period of 24 hours, but acknowledges that there may be specific exposure situations where this accumulation period requires adjustment (e.g., if activity lasts less than 24 hours or for situations where receivers are predicted to experience unusually long exposure durations[32]).

After sound exposure ceases or between successive sound exposures, the potential for recovery from hearing loss exists, with PTS resulting in incomplete recovery and TTS resulting in complete recovery. Predicting recovery from sound exposure can be quite complicated. Currently, recovery in wild marine mammals cannot be accurately quantified. However, Finneran et al. (2010a) and Finneran and Schlundt (2013) proposed a model that approximates recovery in bottlenose dolphins and whose applicability to other species and other exposure conditions has yet to be determined. In the development of the Technical Guidance's acoustic thresholds, NMFS assumes for intermittent, repeated exposure that there is no recovery between subsequent exposures, although it has been demonstrated in terrestrial mammals (Clark et al. 1987; Ward 1991) and more recently in a marine mammal studies (Finneran et al. 2010b; Kastelein et al. 2014a; Kastelein et al. 2015b), that there is a reduction in damage and hearing loss with intermittent exposures.

Existing NMFS acoustic thresholds have only accounted for proximity of the sound source to the receiver, but acoustic thresholds in this Technical Guidance (i.e., expressed as SEL_{cum}) now take into account the duration, as well as level of exposure. NMFS recognizes that accounting for duration of exposure, although supported by the scientific literature, adds a new factor, as far as application of this metric to real-world activities and that not all action proponents may have the ability to easily apply this additional component.

NMFS does not provide specifications necessary to perform exposure modeling and relies on the action proponent to determine the model that best represents their activity. However, NMFS acknowledges that different action proponents may have different capabilities and levels of modeling sophistication. NMFS has provided a simple means of approximating exposure for applicants that are unable to apply various factors into their model (See Appendix D).

[32] For example, where a resident population could be found in a small and/or confined area (Ferguson et al. 2015) and/or exposed to a long-duration activity with a large sound source, or where a continuous stationery activity is nearby an area where marine mammals congregate, like a pinniped pupping beach.

2.3.2.2 Peak Sound Pressure Level (PK) Metric[33]

Sound exposure containing transient components (e.g., short duration and high amplitude; impulsive sounds) can create a greater risk of causing direct mechanical fatigue to the inner ear (as opposed to strictly metabolic) compared to sounds that are strictly non-impulsive (Henderson and Hamernik 1986; Levine et al. 1998; Henderson et al. 2008). Often the risk of damage from these transients does not depend on the duration of exposure. This is the concept of "critical level," where damage switches from being primarily metabolic to more mechanical and short duration of impulse can be less than the ear's integration time, leading to the potential to damage beyond the level the ear can perceive (Akay 1978).

Human noise standards recognize and provide separate acoustic thresholds for impulsive sound sources using the PK metric (Occupational Safety and Health Administration (OSHA) 29 CFR 1910.95; Starck et al. 2003). Thus, SEL_{cum} is not an appropriate metric to capture all the effects of impulsive sounds (i.e., often violates EEH; NIOSH 1998), which is why instantaneous PK level has also been chosen as part of NMFS' dual metric acoustic thresholds for impulsive sounds.[34] Auditory weighting is not considered appropriate with the PK metric, as direct mechanical damage associated with sounds having high peak sound pressures typically does not strictly reflect the frequencies an individual species hears best (Ward 1962; Saunders et al. 1985; ANSI 1986; DOD 2004; OSHA 29 CFR 1910.95). Thus, this Technical Guidance is recommends that the PK thresholds be considered unweighted/flat-weighted within the entire frequency band of a hearing group.

2.3.2.3 Comparison Among Metrics

NMFS' existing acoustic thresholds were expressed as root-mean-square sound pressure level (RMS SPL), which is a different metric from the PK and SEL_{cum} that are being recommended for the PTS onset acoustic thresholds in this Technical Guidance. Thus, NMFS recommends caution when comparing prior acoustic thresholds to those presented in this document (i.e., metrics are not directly comparable). For example, a RMS SPL threshold of 180 dB is not equal to a PK threshold of 180 dB. Further, the SEL_{cum} metric incorporates exposure duration and is an energy level with a different reference value (re: $1\mu Pa^2$-s). Thus, it is not directly comparable to other metrics that describe sound pressure levels (re: 1 μPa)[35].

---

[33] Note: Peak sound pressure level should not be confused with *maximum* root mean square sound pressure level.

[34] For non-impulsive sounds, the SEL_{cum} threshold will likely to result in the largest isopleth, compared to the PK threshold. Thus, for the majority of non-impulsive sounds, the consideration of the PK threshold is unnecessary. However, if a non-impulsive sound has the potential of exceeding the PK threshold associated with impulsive sounds, these thresholds should be considered (i.e., dual metrics).

Recently, publications on how to estimate PK from SEL for seismic airguns and offshore impact pile drivers may be useful to applicants (Galindo-Romero et al. 2015; Lippert et al. 2015).

[35] For more information and illustrations on metrics, see Discovery of Sound in the Sea: http://www.dosits.org/science/advancedtopics/signallevels/.

2.3.3 Development of PTS Onset Acoustic Thresholds

The development of the PTS onset acoustic thresholds consisted of the following procedure described in Finneran 2016 (Appendix A[36]):

1. Identification of available data on marine mammal hearing and noise-induced hearing loss (e.g., Southall et al. 2007; Finneran 2015; Finneran 2016 references listed in available reports/publications).

2. Methodology to derive marine mammal auditory weighting functions (described in more detail in Section 2.2.3 and Appendix A).

3. Evaluation and summary of currently available published data (32 studies found in Table 5) on hearing loss associated with sound exposure in marine mammals.
    - Because no published measurements exist on PTS in marine mammals, TTS onset measurements and associated acoustic thresholds were evaluated and summarized to extrapolate to PTS onset acoustic thresholds.

    - Studies divided into the following categories:
        - Temporal Characteristics: Impulsive and Non-impulsive

        - Marine Mammal Hearing Groups: LF Cetaceans, MF Cetaceans, HF Cetaceans, PW Pinnipeds, and OW Pinniped

[36] Wright 2015 provides a critique of this methodology. For NMFS' response to this critique, see the Federal Register notice associated with the finalized Technical Guidance, specifically the section responding to public comments.

Table 5: Available underwater marine mammal threshold shift studies.

References in Chronologic Order+	Sound Source (Sound Source Category)	Sound-Exposed Species (number of individuals^)
Kastak et al. 1999	Octave-band noise (non-impulsive)	California sea lion (1), northern elephant seal (1), & harbor seal (1)
Finneran et al. 2000	Explosion simulator (impulsive)*	Bottlenose dolphin (2) & beluga (1)
Schlundt et al. 2000	Tones (non-impulsive)	Bottlenose dolphin (5) & beluga (2)
Finneran et al. 2002	Seismic watergun (impulsive)	Bottlenose dolphin (1) & beluga (1)
Finneran et al. 2003	Arc-gap transducer (impulsive)*	California sea lion (2)
Nachtigall et al. 2003	Octave-band noise (non-impulsive)	Bottlenose dolphin (1)
Nachtigall et al. 2004	Octave-band noise (non-impulsive)	Bottlenose dolphin (1)
Finneran et al. 2005a	Tones (non-impulsive)	Bottlenose dolphin (2)
Kastak et al. 2005	Octave-band noise (non-impulsive)	California sea lion (1), northern elephant seal (1), & harbor seal (1)
Finneran et al. 2007a	Tones (non-impulsive)	Bottlenose dolphin (1)
Lucke et al. 2009	Single airgun (impulsive)	Harbor porpoise (1)
Mooney et al. 2009a	Octave-band noise (non-impulsive)	Bottlenose dolphin (1)
Mooney et al. 2009b	Mid-frequency sonar (non-impulsive)	Bottlenose dolphin (1)
Finneran et al. 2010a	Tones (non-impulsive)	Bottlenose dolphin (2)
Finneran et al. 2010b	Tones (non-impulsive)	Bottlenose dolphin (1)
Finneran and Schlundt 2010	Tones (non-impulsive)	Bottlenose dolphin (1)
Popov et al. 2011a	Half-octave band noise (non-impulsive)	Yangtze finless porpoise (2)
Popov et al. 2011b	Half-octave band noise (non-impulsive)	Beluga (1)
Kastelein et al. 2012a	Octave-band noise (non-impulsive)	Harbor seal (2)
Kastelein et al. 2012b	Octave-band noise (non-impulsive)	Harbor porpoise (1)
Finneran and Schlundt 2013	Tones (non-impulsive)	Bottlenose dolphin (2)
Popov et al. 2013	Half-octave band noise (non-impulsive)	Beluga (2)
Kastelein et al. 2013a	Octave-band noise (non-impulsive)	Harbor seal (1)
Kastelein et al. 2013b	Tone (non-impulsive)	Harbor porpoise (1)
Popov et al. 2014	Half-octave band noise (non-impulsive)	Beluga (2)
Kastelein et al. 2014a	1-2 kHz sonar (non-impulsive)	Harbor porpoise (1)
Kastelein et al. 2014b	6.5 kHz tone (non-impulsive)	Harbor porpoise (1)
Kastelein et al. 2015a	Impact pile driving (impulsive)	Harbor porpoise (1)
Kastelein et al. 2015b	6-7 kHz sweeps (non-impulsive)	Harbor porpoise (1)
Finneran et al. 2015*	Single airgun producing shots (impulsive)*	Bottlenose dolphin (3)
Popov et al. 2015	Half-octave band noise (non-impulsive)	Beluga (1)
Kastelein et al. 2016*	Impact pile driving (impulsive)	Harbor porpoise (2)

+Peer reviewed studies available and evaluated as of 31 May 2016.
^Note: Some individuals have been used in multiple studies.
*No incidents of temporary threshold shift were recorded in study.

4. Determination of TTS onset threshold by individual (RLs, in both PK and SEL_{cum} metrics) based on methodology from Finneran 2016 for impulsive and non-impulsive sounds (Full detail in Appendix A).

- Non-impulsive sounds:
  - Only TTS data from behavioral studies were used, since studies using AEP methodology typically result in larger thresholds shifts (e.g., up to 10 dB difference, Finneran et al. 2007a) and are considered to be non-representative (as illustrated in Appendix A, Figure A9)

  - TTS onset derived on a per individual basis by combining available data to create single TTS growth curve (e.g., dB TTS/dB noise) by frequency as a function of $SEL_{cum.}$

  - TTS onset was defined as the SEL_{cum} value from the growth curve interpolated at a value of TTS = 6 dB. Only datasets where data were available with a threshold shift (TS) above and below 6 dB were used to define TTS onset (i.e., extrapolation was not performed on datasets not meeting this criterion).

  - Interpolation was used to estimate SEL_{cum} necessary to induce 6 dB of TTS by hearing group (Appendix A, Figures A10-A13). Note: Appendix A, Figures A18-A20 illustrate available marine mammal TTS data in relation to the composite audiogram and exposure function.

  - Finally, weighted thresholds for TTS onset were determined by the minimum value of the exposure function (Equation 2), which is mathematically equivalent to $K + C$ (Table 6).

Table 6: TTS onset auditory acoustic thresholds for non-impulsive sounds.

Hearing Group	K (dB)	C (dB)	Weighted TTS onset acoustic threshold (SEL_{cum})
Low-frequency (LF) cetaceans	179	0.13	179 dB
Mid-frequency (MF) cetaceans	177	1.20	178 dB
High-frequency (HF) cetaceans	152	1.36	153 dB
Phocid pinnipeds (underwater)	180	0.75	181 dB
Otariid pinnipeds (underwater)	198	0.64	199 dB

- Impulsive sounds:
  - Available TTS data for impulsive sources were weighted based on weighting functions for the appropriate hearing group (MF and HF cetaceans only from two studies: Finneran et al. 2002; Lucke et al. 2009).

  - For hearing groups, where impulsive TTS onset data did not exist (LF cetaceans and PW and OW pinnipeds), Finneran (2015) derived impulsive TTS onset acoustic thresholds using the relationship between non-impulsive TTS onset thresholds and impulsive TTS onset thresholds for MF and HF cetaceans (i.e., similar to what was presented in Southall et al. 2007). Using the mean/median of these data resulted in an 11 dB relationship, which was used as a surrogate for the other hearing groups (i.e., non-impulsive TTS threshold was 11 dB higher than impulsive TTS threshold).

  - A similar approach was investigated for the PK threshold, resulting in a 45 dB relationship, which was considered unrealistic (approaching cavitation level of water; Southall et al. 2007). Upon further consideration, the auditory system's dynamic range was determined a more appropriate methodology for estimating PK sound pressure acoustic thresholds.[37]

    The dynamic range methodology assumes that the PK TTS onset acoustic threshold for MF and HF cetaceans defines the upper end of those hearing groups' dynamic range (i.e., PK threshold: 224 dB for MF cetaceans and PK threshold: 196 dB for HF cetaceans), with the threshold of audibility derived from the frequency of best hearing (f_0) from the composite audiogram (i.e., 54 dB for MF cetaceans and 48 dB for HF cetaceans) defining the lower end of the groups' dynamic range.

    This results in a dynamic range of 170 dB for MF cetaceans and 148 dB for HF cetaceans. The median/mean dynamic range from these two hearing groups (i.e., 159 dB) is used as the surrogate dynamic range for LF cetaceans (best hearing at f_0= 54 dB; Resulting in a PK TTS threshold of 213 dB); PW pinnipeds (best hearing at f_0=53 dB; Resulting in a PK TTS threshold of 212 dB); and OW pinnipeds (best hearing at f_0=67 dB; Resulting in a PK TTS threshold of 226 dB).

[37] Dynamic range is used in human noise standards to define the PK acoustic threshold for impulsive sounds (e.g., 140 dB from OSHA 29 CFR 1910.95). For the purposes of this Technical Guidance, the intent is to relate the threshold of audibility and TTS onset level, not the threshold of pain, as dynamic range is typically defined (Yost 2007).

5. Extrapolation for PTS onset threshold (in both PK and SEL metrics) based on data from humans and terrestrial mammals, with the assumption that the mechanisms associated with noise-induced TS in marine mammals is similar, if not identical, to that recorded in terrestrial mammals.

- Non-impulsive sounds:
    - PTS onset acoustic thresholds were estimated using TTS growth rates based on those marine mammal studies where 20 dB or more of a TS was induced. This was done to estimate more accurately PTS onset, since using growth rates based on smaller TSs are often shallower than compared to those inducing greater TSs (See Appendix A, Figures A10-A13).

    - PTS onset was derived using the same methodology as TTS onset, with PTS onset defined as the SEL_{cum} value from the fitted curve at a TTS of 40 dB.

    - Offset between TTS and PTS onset acoustic thresholds were examined and ranged from 13 to 37 dB (mean/median: 25/25 dB for cetacean data). Thus, based on these data, a conservative 20 dB offset was chosen to estimate PTS onset thresholds from TTS onset thresholds for non-impulsive sources (i.e., 20 dB was added to K to determine PTS onset, assuming the shape of the PTS exposure function is identical to the TTS exposure function for that hearing group).

- Impulsive sounds: Based on limited available marine mammal impulsive data, the relationships previously derived in Southall et al. (2007), which relied upon terrestrial mammal growth rates (Henderson and Hamernik 1982; Henderson and Hamernik 1986; Price and Wansack 1989; Levine et al. 1998; Henderson et al. 2008), was used to predict PTS onset:
    - Resulting in an approximate 15 dB difference between TTS and PTS onset acoustic thresholds in the SEL_{cum} metric.

    - Southall et al. (2007) recommended a 6 dB of TTS/dB of noise growth rate for PK acoustic thresholds. This recommendation was based on several factors, including ensuring that the PK acoustic threshold did not unrealistically exceed the cavitation threshold of water. Resulting in an approximate 6 dB difference between TTS and PTS onset thresholds in the PK metric.

III. UPDATING OF ACOUSTIC TECHNICAL GUIDANCE AND ACOUSTIC THRESHOLDS

Research on the effects of anthropogenic sound on marine mammals has increased dramatically in the last decade and will likely continue to increase in the future. As such, the Technical Guidance will be reviewed periodically and updated as appropriate to reflect the compilation, interpretation, and synthesis of the scientific literature.

NMFS' initial approach for updating current acoustic thresholds for protected marine species consisted of providing acoustic thresholds for underwater PTS onset for marine mammals via this document. As more data become available, acoustic thresholds may be established for additional protected marine species, such as sea turtles and marine fishes. As with this document, public review and outside peer review will be integral to the process.

3.1 PROCEDURE AND TIMELINE FOR UPDATING THE TECHNICAL GUIDANCE

NMFS will continue to monitor and evaluate new data as they become available and periodically convene staff from our various offices, regions, and science centers to update the Technical Guidance as appropriate (anticipating updates to occur on a three to five year cycle). In addition to evaluating new, relevant scientific studies, NMFS will also periodically re-examine basic concepts and definitions (e.g., hearing groups, PTS, TTS, weighting functions), appropriate metrics, temporal and spatial considerations, and other relevant topics. Updates will be posted at http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm

Since the methodology for deriving composite audiograms and associated marine mammal auditory weighting functions, as well as TTS thresholds is data driven, any new information that becomes available has the potential to cause some amount of change for that specific hearing group but also other hearing groups, if they rely on surrogate data. It may not be feasible to make changes every time a new data point becomes available. Instead, NMFS will periodically examine new data to date and consider the impacts of those studies on the Technical Guidance to determine what revisions/updates may be appropriate. At the same time, there may be special circumstances that merit evaluation of data on a more accelerated timeline (e.g., LF cetacean data that could result in significant changes to the current Technical Guidance).

APPENDIX A: FINNERAN TECHNICAL REPORT

The entire Finneran Technical Report (Finneran 2016), regarding methodology for deriving auditory weighting functions and acoustic thresholds for marine mammal species under NMFS' jurisdiction, is included for reference in Appendix A. Its contents have not been modified by NMFS, other than adding "A" before figures and tables to denote Appendix A and be consistent with the other appendices in the Technical Guidance.

Note: Literature cited in this section are included at the end of this Appendix (i.e., not all references found in this Appendix are included in the Literature Cited for the Technical Guidance). Additionally, terminology, symbols, and abbreviations used in this appendix may not match those used elsewhere in the Technical Guidance.

Since the final Finneran Technical Report was received an additional TTS study became available (Kastelein et al. 2016). Information regarding this study is added as a footnote by NMFS.

TECHNICAL REPORT XXXX
May 2016

Auditory weighting functions and TTS/PTS exposure functions for marine mammals exposed to underwater noise

J. J. Finneran
SSC Pacific

SSC Pacific

EXECUTIVE SUMMARY

The US Navy's Tactical Training Theater Assessment and Planning (TAP) Program addresses environmental challenges that affect Navy training ranges and operating areas. As part of the TAP process, acoustic effects analyses are conducted to estimate the potential effects of Navy activities that introduce high-levels of sound or explosive energy into the marine environment. Acoustic effects analyses begin with mathematical modeling to predict the sound transmission patterns from Navy sources. These data are then coupled with marine species distribution and abundance data to determine the sound levels likely to be received by various marine species. Finally, criteria and thresholds are applied to estimate the specific effects that animals exposed to Navy-generated sound may experience.

This document describes the rationale and steps used to define proposed numeric thresholds for predicting auditory effects on marine mammals exposed to active sonars, other (non-impulsive) active acoustic sources, explosives, pile driving, and air guns for Phase 3 of the TAP Program. Since the derivation of TAP Phase 2 acoustic criteria and thresholds, important new data have been obtained related to the effects of noise on marine mammal hearing. Therefore, for Phase 3, new criteria and thresholds for the onset of temporary and permanent hearing loss have been developed, following a consistent approach for all species of interest and utilizing all relevant, available data. The effects of noise frequency on hearing loss are incorporated by using auditory weighting functions to emphasize noise at frequencies where a species is more sensitive to noise and de-emphasize noise at frequencies where susceptibility is low.

Marine mammals were divided into six groups for analysis: low-frequency cetaceans (group LF: mysticetes), mid-frequency cetaceans (group MF: delphinids, beaked whales, sperm whales), high-frequency cetaceans (group HF: porpoises, river dolphins), sirenians (group SI: manatees), phocids in water (group PW: true seals), and otariids and other non-phocid marine carnivores in water (group OW: sea lions, walruses, otters, polar bears).

For each group, a frequency-dependent weighting function and numeric thresholds for the onset of temporary threshold shift (TTS) and permanent threshold shift (PTS) were derived from available data describing hearing abilities of and effects of noise on marine mammals. The resulting weighting function amplitudes are illustrated in Figure AE-1; Table AE-1 summarizes the parameters necessary to calculate the weighting function amplitudes. For Navy Phase 3 analyses, the onset of TTS is defined as a TTS of 6 dB measured approximately 4 min after exposure. PTS is assumed to occur from exposures resulting in 40 dB or more of TTS measured approximately 4 min after exposure. Exposures just sufficient to cause TTS or PTS are denoted as "TTS onset" or "PTS onset" exposures.

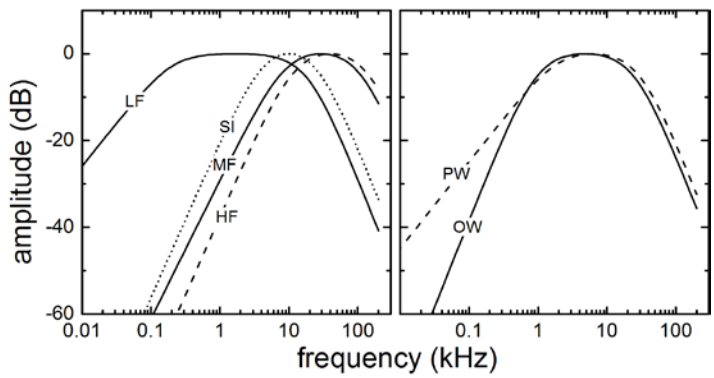


Figure AE-1. Navy Phase 3 weighting functions for all species groups. Parameters required to generate the functions are provided in Table AE-1.

Table AE-1. Summary of weighting function parameters and TTS/PTS thresholds. SEL thresholds are in dB re 1 μPa²s and peak SPL thresholds are in dB re 1 μPa.

$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{\left[1+(f/f_1)^2\right]^a\left[1+(f/f_2)^2\right]^b}\right\}$						Non-impulsive		Impulse			
						TTS threshold	PTS threshold	TTS threshold		PTS threshold	
Group	*a*	*b*	f_1 (kHz)	f_2 (kHz)	*C* (dB)	SEL (weighted)	SEL (weighted)	SEL (weighted)	peak SPL (unweighted)	SEL (weighted)	peak SPL (unweighted)
LF	1	2	0.20	19	0.13	179	199	168	213	183	219
MF	1.6	2	8.8	110	1.20	178	198	170	224	185	230
HF	1.8	2	12	140	1.36	153	173	140	196	155	202
SI	1.8	2	4.3	25	2.62	186	206	175	220	190	226
OW	2	2	0.94	25	0.64	199	219	188	226	203	232
PW	1	2	1.9	30	0.75	181	201	170	212	185	218

To compare the Phase 3 weighting functions and TTS/PTS thresholds to those used in TAP Phase 2 analyses, both the weighting function shape and the weighted threshold values must be taken into account; the weighted thresholds by themselves only indicate the TTS/PTS threshold at the most susceptible frequency (based on the relevant weighting function). In contrast, the TTS/PTS *exposure functions* incorporate both the shape of the weighting function and the weighted threshold value, they provide the best means of comparing the frequency-dependent TTS/PTS thresholds for Phase 2 and 3. Figures AE-2 and AE-3 compare the TTS/PTS exposure functions for non-impulsive sounds (e.g., sonars) and impulsive sounds (e.g., explosions), respectively, used in TAP Phase 2 and Phase 3.

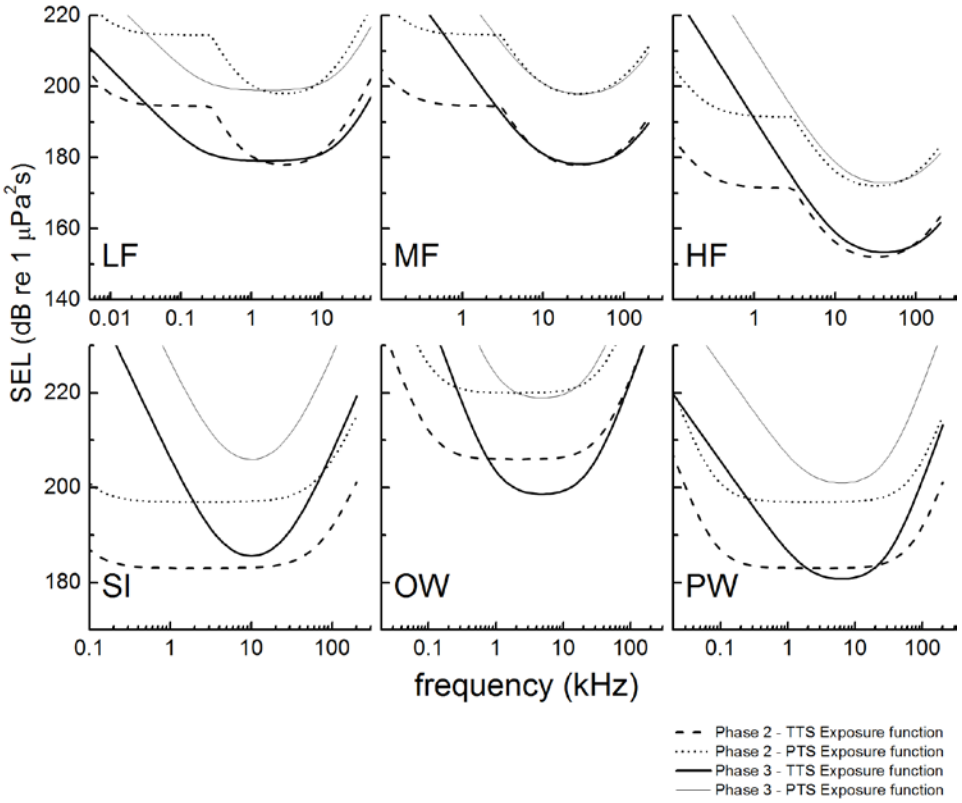


Figure AE-2. TTS and PTS exposure functions for sonars and other (non-impulsive) active acoustic sources. Heavy solid lines — Navy Phase 3 TTS exposure functions (Table AE-1). Thin solid lines — Navy Phase 3 PTS exposure functions (Table AE-1). Dashed lines — Navy Phase 2 TTS exposure functions. Short dashed lines — Navy Phase 2 PTS exposure functions.

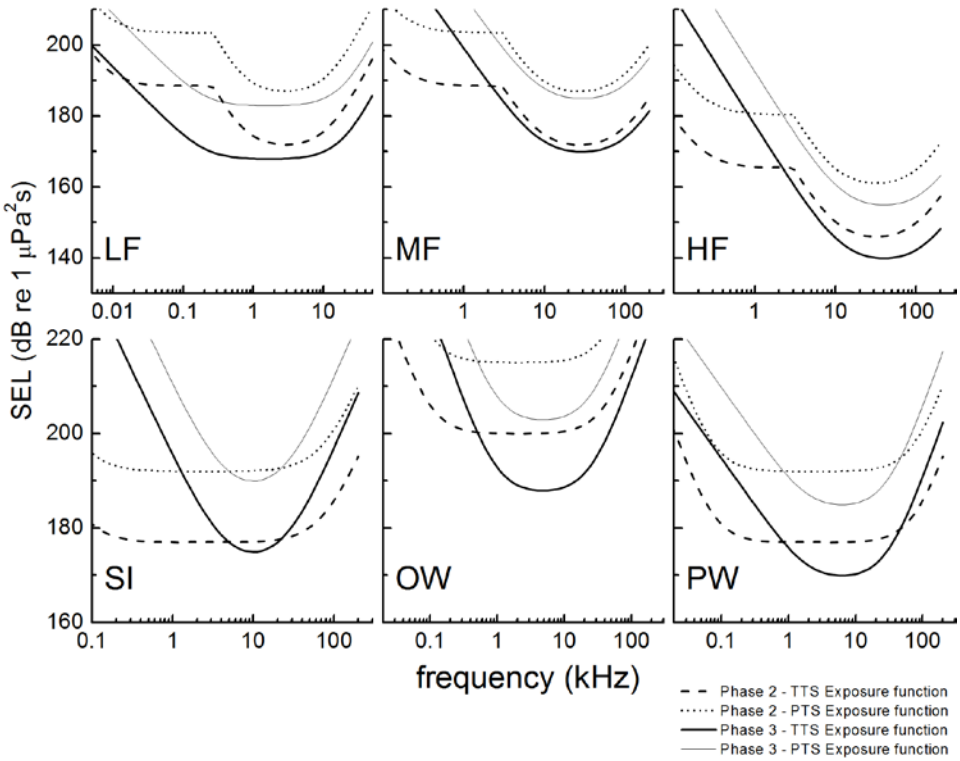


Figure AE-3. TTS and PTS exposure functions for explosives, impact pile driving, air guns, and other impulsive sources. Heavy solid lines — Navy Phase 3 TTS exposure functions (Table AE-1). Thin solid lines — Navy Phase 3 PTS exposure functions (Table AE-1). Dashed lines — Navy Phase 2 TTS exposure functions. Short dashed lines — Navy Phase 2 PTS exposure functions.

The most significant differences between the Phase 2 and Phase 3 functions include: (1) Thresholds at low frequencies are generally higher for Phase 3 compared to Phase 2. This is because the Phase 2 weighting functions utilized the "M-weighting" functions at lower frequencies, where no TTS existed at that time. Since derivation of the Phase 2 weighting functions, additional data have been collected to support the use of new functions more similar to human auditory weighting functions. (2) Impulsive TTS/PTS thresholds near the region of best hearing sensitivity are lower for Phase 3 compared to Phase 2.

I. INTRODUCTION

1.1 OVERVIEW

The US Navy's Tactical Training Theater Assessment and Planning (TAP) Program addresses environmental challenges that affect Navy training ranges and operating areas. As part of the TAP process, acoustic effects analyses are conducted to estimate the potential effects of Navy training and testing activities that introduce high-levels of sound or explosive energy into the marine environment. Acoustic effects analyses begin with mathematical modeling to predict the sound transmission patterns from Navy sources. These data are then coupled with marine species distribution and abundance data to determine sound levels likely to be received by various marine species. Finally, criteria and thresholds are applied to estimate the specific effects that animals exposed to Navy-generated sound may experience.

This document describes the rationale and steps used to define proposed numeric thresholds for predicting auditory effects on marine mammals exposed to underwater sound from active sonars, other (non-impulsive) active acoustic sources, explosives, pile driving, and air guns for Phase 3 of the TAP Program. The weighted threshold values and auditory weighting function shapes are summarized in Section 12.

1.2 IMPULSE VS. NON-IMPULSIVE NOISE

When analyzing the auditory effects of noise exposure, it is often helpful to broadly categorize noise as either impulse noise — noise with high peak sound pressure, short duration, fast rise-time, and broad frequency content — or non-impulsive (i.e., steady-state) noise. When considering auditory effects, sonars, other coherent active sources, and vibratory pile driving are considered to be non-impulsive sources, while explosives, impact pile driving, and air guns are treated as impulsive sources. Note that the terms non-impulsive or steady-state do not necessarily imply long duration signals, only that the acoustic signal has sufficient duration to overcome starting transients and reach a steady-state condition. For harmonic signals, sounds with duration greater than approximately 5 to 10 cycles are generally considered to be steady-state.

1.3 NOISE-INDUCED THRESHOLD SHIFTS

Exposure to sound with sufficient duration and sound pressure level (SPL) may result in an elevated hearing threshold (i.e., a loss of hearing sensitivity), called a noise-induced threshold shift (NITS). If the hearing threshold eventually returns to normal, the NITS is called a temporary threshold shift (TTS); otherwise, if thresholds remain elevated after some extended period of time, the remaining NITS is called a permanent threshold shift (PTS). TTS and PTS data have been used to guide the development of safe exposure guidelines for people working in noisy environments. Similarly, TTS and PTS criteria and thresholds form the cornerstone of Navy analyses to predict auditory effects in

marine mammals incidentally exposed to intense underwater sound during naval activities.

1.4 AUDITORY WEIGHTING FUNCTIONS

Animals are not equally sensitive to noise at all frequencies. To capture the frequency-dependent nature of the effects of noise, *auditory weighting functions* are used. Auditory weighting functions are mathematical functions used to emphasize frequencies where animals are more susceptible to noise exposure and de-emphasize frequencies where animals are less susceptible. The functions may be thought of as frequency-dependent filters that are applied to a noise exposure before a single, weighted SPL or sound exposure level (SEL) is calculated. The filter shapes are normally "band-pass" in nature; i.e., the function amplitude resembles an inverted "U" when plotted versus frequency. The weighting function amplitude is approximately flat within a limited range of frequencies, called the "pass-band," and declines at frequencies below and above the pass-band.

Auditory weighting functions for humans were based on *equal loudness contours* — curves that show the combinations of SPL and frequency that result in a sensation of equal loudness in a human listener. Equal loudness contours are in turn created from data collected during loudness comparison tasks. Analogous tasks are difficult to perform with non-verbal animals; as a result, equal loudness contours are available for only a single marine mammal (a dolphin) across a limited range of frequencies (2.5 to 113 kHz) (Finneran and Schlundt, 2011). In lieu of performing loudness comparison tests, reaction times to tones can be measured, under the assumption that reaction time is correlated with subjective loudness (Stebbins, 1966; Pfingst et al., 1975). From the reaction time vs. SPL data, curves of equal response latency can be created and used as proxies for equal loudness contours.

Just as human damage risk criteria use auditory weighting functions to capture the frequency-dependent aspects of noise, US Navy acoustic impact analyses use weighting functions to capture the frequency-dependency of TTS and PTS in marine mammals.

1.5 TAP PHASE 3 WEIGHTING FUNCTIONS AND TTS/PTS THRESHOLDS

Navy weighting functions for TAP Phase 2 (Finneran and Jenkins, 2012) were based on the "M-weighting" curves defined by Southall et al. (2007), with additional high-frequency emphasis for cetaceans based on equal loudness contours for a bottlenose dolphin (Finneran and Schlundt, 2011). Phase 2 TTS/PTS thresholds also relied heavily on the recommendations of Southall et al. (2007), with modifications based on preliminary data for the effects of exposure frequency on dolphin TTS (Finneran, 2010; Finneran and Schlundt, 2010) and limited TTS data for harbor porpoises (Lucke et al., 2009; Kastelein et al., 2011).

Since the derivation of TAP Phase 2 acoustic criteria and thresholds, new data have been obtained regarding marine mammal hearing (e.g., Dow Piniak et al., 2012; Martin et al., 2012; Ghoul and Reichmuth, 2014; Sills et al., 2014; Sills et al., 2015), marine mammal equal latency contours (e.g., Reichmuth, 2013; Wensveen et al., 2014; Mulsow et al., 2015), and the effects of noise on marine mammal hearing (e.g., Kastelein et al., 2012b; Kastelein et al., 2012a; Finneran and Schlundt, 2013; Kastelein et al., 2013a; Kastelein et al., 2013b; Popov et al., 2013; Kastelein et al., 2014b; Kastelein et al., 2014a; Popov et al., 2014; Finneran et al., 2015; Kastelein et al., 2015c; Kastelein et al., 2015b; Popov et al., 2015). As a result, new weighting functions and TTS/PTS thresholds have been developed for Phase 3. The new criteria and thresholds are based on all relevant data and feature a consistent approach for all species of interest.

Marine mammals were divided into six groups for analysis. For each group, a frequency-dependent weighting function and numeric thresholds for the onset of TTS and PTS were derived from available data describing hearing abilities and effects of noise on marine mammals. Measured or predicted auditory threshold data, as well as measured equal latency contours, were used to influence the weighting function shape for each group. For species groups for which TTS data are available, the weighting function parameters were adjusted to provide the best fit to the experimental data. The same methods were then applied to other groups for which TTS data did not exist.

II. WEIGHTING FUNCTIONS AND EXPOSURE FUNCTIONS

The shapes of the Phase 3 auditory weighting functions are based on a generic band-pass filter described by

$$W(f) = C + 10\log_{10}\left\{\frac{\left(f/f_1\right)^{2a}}{\left[1+\left(f/f_1\right)^2\right]^a\left[1+\left(f/f_2\right)^2\right]^b}\right\}, \qquad \text{(A1)}$$

where $W(f)$ is the weighting function amplitude (in dB) at the frequency f (in kHz). The shape of the filter is defined by the parameters C, f_1, f_2, a, and b (Figs. A1 and A2, left panels):

C *weighting function gain* (dB). The value of C defines the vertical position of the curve. Changing the value of C shifts the function up/down. The value of C is often chosen to set the maximum amplitude of W to 0 dB (i.e., the value of C does not necessarily equal the peak amplitude of the curve).

f_1 *low-frequency cutoff* (kHz). The value of f_1 defines the lower limit of the filter pass-band; i.e., the lower frequency at which the weighting function amplitude begins to decline or "roll-off" from the flat, central portion of the curve. The specific amplitude at f_1 depends on the value of a. Decreasing f_1 will enlarge the pass-band of the function (the flat, central portion of the curve).

f_2 *high-frequency cutoff* (kHz). The value of f_2 defines the upper limit of the filter pass-band; i.e., the upper frequency at which the weighting function amplitude begins to roll-off from the flat, central portion of the curve. The amplitude at f_2 depends on the value of b. Increasing f_2 will enlarge the pass-band of the function.

a *low-frequency exponent* (dimensionless). The value of a defines the rate at which the weighting function amplitude declines with frequency at the lower frequencies. As frequency decreases, the change in weighting function amplitude becomes linear with the logarithm of frequency, with a slope of $20a$ dB/decade. Larger values of a result in lower amplitudes at f_1 and steeper rolloffs at frequencies below f_1.

b *high-frequency exponent* (dimensionless). The value of b defines the rate at which the weighting function amplitude declines with frequency at the upper frequencies. As frequency increases, the change in weighting function amplitude becomes linear with the logarithm of frequency, with a slope of $-20b$ dB/decade. Larger values of b result in lower amplitudes at f_2 and steeper rolloffs at frequencies above f_2.

If a = 2 and b = 2, Eq. (A1) is equivalent to the functions used to define Navy Phase 2 Type I and EQL weighting functions, M-weighting functions, and the human C-weighting function (American National Standards Institute (ANSI), 2001; Southall et al., 2007; Finneran and Jenkins, 2012). The change from fixed to variable exponents for Phase 3 was done to allow the low- and high-frequency rolloffs to match available experimental data. During implementation, the weighting function defined by Eq. (A1) is used in conjunction with a weighted threshold for TTS or PTS expressed in units of SEL.

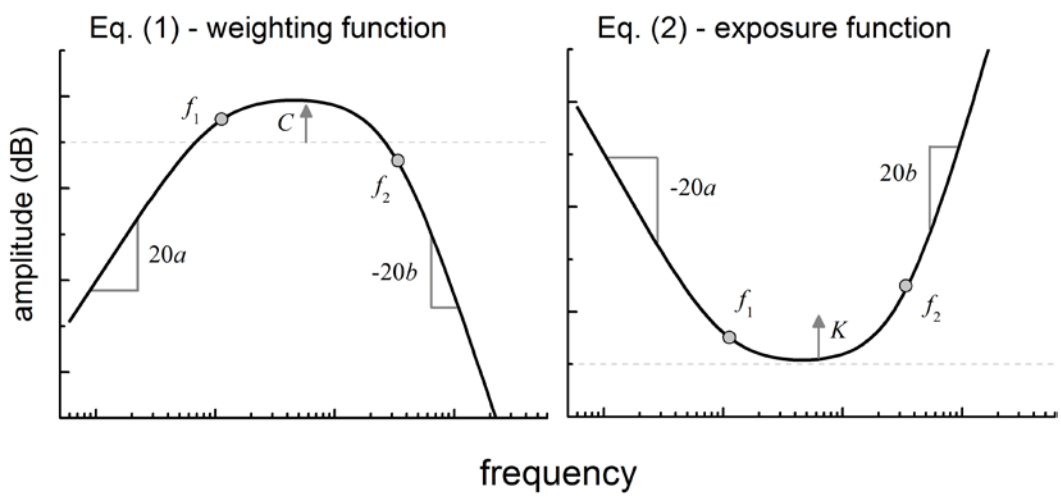


Figure A1. Examples of (left) weighting function amplitude described by Eq. (A1) and (right) exposure function described by Eq. (A2). The parameters f_1 and f_2 specify the extent of the filter pass-band, while the exponents a and b control the rate of amplitude change below f_1 and above f_2, respectively. As the frequency decreases below f_1 or above f_2, the amplitude approaches linear-log behavior with a slope magnitude of 20a or 20b dB/decade, respectively. The constants C and K determine the vertical positions of the curves.

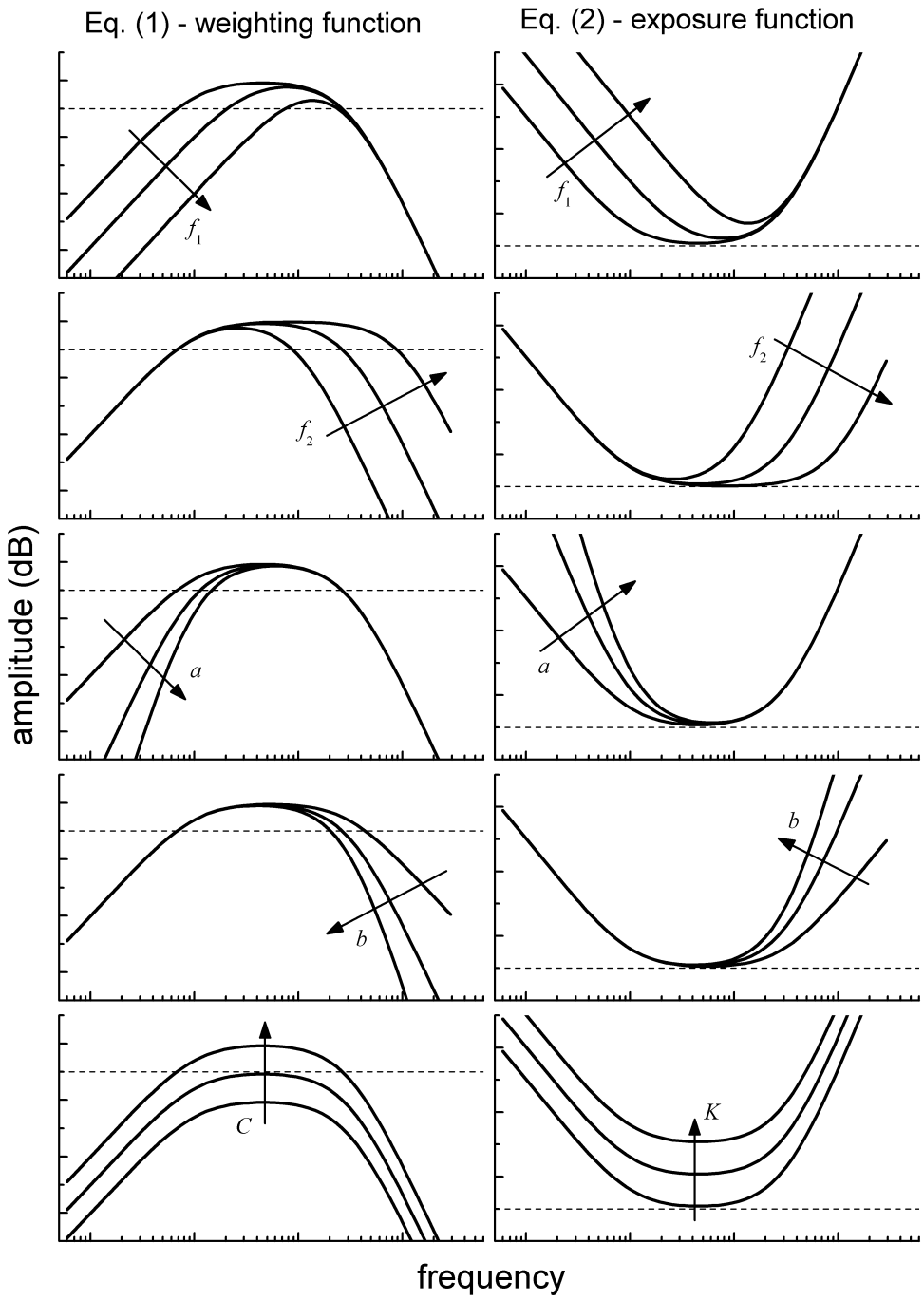


Figure A2. Influence of parameter values on the resulting shapes of the weighting functions (left) and exposure functions (right). The arrows indicate the direction of change when the designated parameter is increased.

For developing and visualizing the effects of the various weighting functions, it is helpful to invert Eq. (A1), yielding

$$E(f) = K - 10\log_{10}\left\{\frac{\left(f/f_1\right)^{2a}}{\left[1+\left(f/f_1\right)^2\right]^a\left[1+\left(f/f_2\right)^2\right]^b}\right\}, \qquad \text{(A2)}$$

where $E(f)$ is the acoustic exposure as a function of frequency f, the parameters f_1, f_2, a, and b are identical to those in Eq. (A1), and K is a constant. The function described by Eq. (A2) has a "U-shape" similar to an audiogram or equal loudness/latency contour (Figs. A1 and A2, right panels). If K is adjusted to set the minimum value of $E(f)$ to match the weighted threshold for the onset of TTS or PTS, Eq. (A2) reveals the manner in which the exposure necessary to cause TTS or PTS varies with frequency. Equation (A2) therefore allows the frequency-weighted threshold values to be directly compared to TTS data. The function defined by Eq. (A2) is referred to as an *exposure function*, since the curve defines the acoustic exposure that equates to TTS or PTS as a function of frequency. To illustrate the relationship between weighting and exposure functions, Fig. A3 shows the Navy Phase 2 weighting function [Eq. (A1), left panel] and TTS exposure function [Eq. (A2), right panel] for mid-frequency cetaceans exposed to sonars.

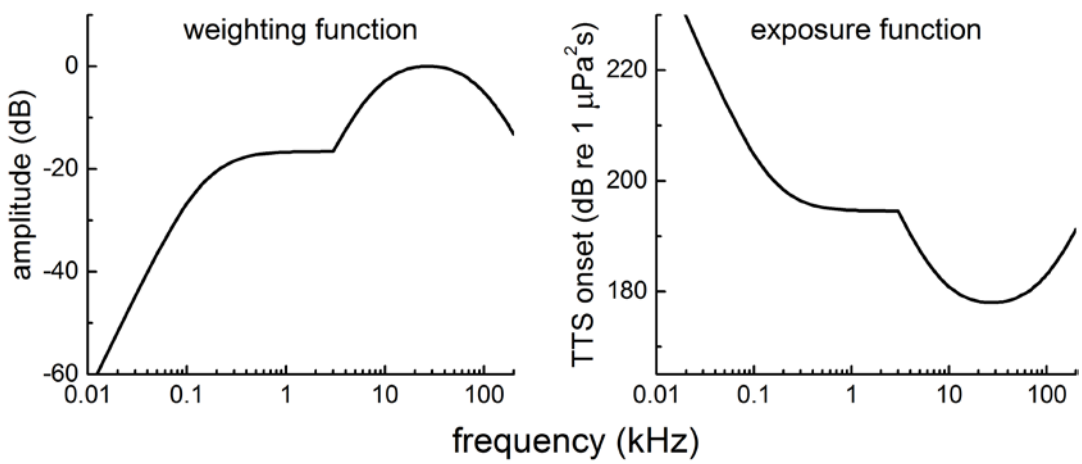


Figure A3. **(left panel) Navy Phase 2 weighting function for the mid-frequency cetacean group. This function was used in conjunction with a weighted TTS threshold of 178 dB re 1 μPa²s. For narrowband signals, the effective, weighted TTS threshold at a particular frequency is calculated by adding the weighting function amplitude at that frequency to the weighted TTS threshold (178 dB re 1 μPa²s). To visualize the frequency-dependent nature of the TTS threshold, the weighting function is inverted and the minimum value set equal to the weighted TTS threshold. This is illustrated in the right panel, which shows the SEL required for TTS onset as a function of frequency. The advantage of this representation is that it may be directly compared to TTS onset data at different exposure frequencies.**

The relationships between Eqs. (A1) and (A2) may be highlighted by defining the function $X(f)$ as

$$X(f) = 10\log_{10}\left\{\frac{\left(f/f_1\right)^{2a}}{\left[1+\left(f/f_1\right)^2\right]^a\left[1+\left(f/f_2\right)^2\right]^b}\right\}. \tag{A3}$$

The peak value of $X(f)$ depends on the specific values of f_1, f_2, a, and b and will not necessarily equal zero. Substituting Eq. (A3) into Eqs. (A1) and (A2) results in

$$W(f) = C + X(f) \tag{A4}$$

and

$$E(f) = K - X(f), \tag{A5}$$

respectively. The maximum of the weighting function and the minimum of the exposure function occur at the same frequency, denoted f_p. The constant C is defined so the weighting function maximum value is 0 dB; i.e., $W(f_p) = 0$, so

$$W(f_p) = 0 = C + X(f_p). \tag{A6}$$

The constant K is defined so that the minimum of the exposure function [i.e., the value of $E(f)$ when $f = f_p$] equals the weighted TTS or PTS threshold, T_{wgt}, so

$$E(f_p) = T_{wgt} = K - X(f_p). \tag{A7}$$

Adding Eqs. (A6) and (A7) results in

$$T_{wgt} = C + K. \tag{A8}$$

The constants C, K, and the weighted threshold are therefore not independent and any one of these parameters can be calculated if the other two are known.

III. METHODOLOGY TO DERIVE FUNCTION PARAMETERS

Weighting and exposure functions are defined by selecting appropriate values for the parameters C, K, f_1, f_2, a, and b in Eqs. (A1) and (A2). Ideally, these parameters would be based on experimental data describing the manner in which the onset of TTS or PTS varied as a function of exposure frequency. In other words, a weighting function for TTS should ideally be based on TTS data obtained using a range of exposure frequencies, species, and individual subjects within each species group. However, at present, there are only limited data for the frequency-dependency of TTS in marine mammals. Therefore, weighting and exposure function derivations relied upon auditory threshold measurements (audiograms), equal latency contours, anatomical data, and TTS data when available.

Although the weighting function shapes are heavily influenced by the shape of the auditory sensitivity curve, the two are not identical. Essentially, the auditory sensitivity curves are adjusted to match the existing TTS data in the frequency region near best sensitivity (step 4 below). This results in "compression" of the auditory sensitivity curve in the region near best sensitivity to allow the weighting function shape to match the TTS data, which show less change with frequency compared to hearing sensitivity curves in the frequency region near best sensitivity.

Weighting and exposure function derivation consisted of the following steps:

1. Marine mammals were divided into six groups based on auditory, ecological, and phylogenetic relationships among species.

2. For each species group, a representative, composite audiogram (a graph of hearing threshold vs. frequency) was estimated.

3. The exponent a was defined using the smaller of the low-frequency slope from the composite audiogram or the low-frequency slope of equal latency contours. The exponent b was set equal to two.

4. The frequencies f_1 and f_2 were defined as the frequencies at which the composite threshold values are ΔT-dB above the lowest threshold value. The value of ΔT was chosen to minimize the mean-squared error between Eq. (2) and the non-impulsive TTS data for the mid- and high-frequency cetacean groups.

5. For species groups for which TTS onset data exist, K was adjusted to minimize the squared error between Eq. (A2) and the steady-state (non-impulsive) TTS onset data. For other species, K was defined to provide the best estimate for TTS onset at a representative frequency. The minimum value of the TTS exposure function (which is not necessarily equal to K) was then defined as the weighted TTS threshold.

6. The constant *C* was defined to set the peak amplitude of the function defined by Eq. (A1) to zero. This is mathematically equivalent to setting C equal to the difference between the weighted threshold and *K* [see Eq. (A8)].

7. The weighted threshold for PTS was derived for each group by adding a constant value (20 dB) to the weighted TTS thresholds. The constant was based on estimates of the difference in exposure levels between TTS onset and PTS onset (i.e., 40 dB of TTS) obtained from the marine mammal TTS growth curves.

8. For the mid- and high-frequency cetaceans, weighted TTS and PTS thresholds for explosives and other impulsive sources were obtained from the available impulse TTS data. For other groups, the weighted SEL thresholds were estimated using the relationship between the steady-state TTS weighted threshold and the impulse TTS weighted threshold for the mid- and high-frequency cetaceans. Peak SPL thresholds were estimated using the relationship between hearing thresholds and the impulse TTS peak SPL thresholds for the mid- and high-frequency cetaceans.

The remainder of this document addresses these steps in detail.

IV. MARINE MAMMAL SPECIES GROUPS

Marine mammals were divided into six groups (Table A1), with the same weighting function and TTS/PTS thresholds used for all species within a group. Species were grouped by considering their known or suspected audible frequency range, auditory sensitivity, ear anatomy, and acoustic ecology (i.e., how they use sound), as has been done previously (e.g., Ketten, 2000; Southall et al., 2007; Finneran and Jenkins, 2012).

4.1 LOW-FREQUENCY (LF) CETACEANS

The LF cetacean group contains all of the mysticetes (baleen whales). Although there have been no direct measurements of hearing sensitivity in any mysticete, an audible frequency range of approximately 10 Hz to 30 kHz has been estimated from observed vocalization frequencies, observed reactions to playback of sounds, and anatomical analyses of the auditory system. A natural division may exist within the mysticetes, with some species (e.g., blue, fin) having better low-frequency sensitivity and others (e.g., humpback, minke) having better sensitivity to higher frequencies; however, at present there is insufficient knowledge to justify separating species into multiple groups. Therefore, a single species group is used for all mysticetes.

4.2 MID-FREQUENCY (MF) CETACEANS

The MF cetacean group contains most delphinid species (e.g., bottlenose dolphin, common dolphin, killer whale, pilot whale), beaked whales, and sperm whales (but not pygmy and dwarf sperm whales of the genus Kogia, which are treated as high-frequency species). Hearing sensitivity has been directly measured for a number of species within this group using psychophysical (behavioral) or auditory evoked potential (AEP) measurements.

4.3 HIGH-FREQUENCY (HF) CETACEANS

The HF cetacean group contains the porpoises, river dolphins, pygmy/dwarf sperm whales, *Cephalorhynchus* species, and some *Lagenorhynchus* species. Hearing sensitivity has been measured for several species within this group using behavioral or AEP measurements. High-frequency cetaceans generally possess a higher upper-frequency limit and better sensitivity at high frequencies compared to the mid-frequency cetacean species.

4.4 SIRENIANS

The sirenian group contains manatees and dugongs. Behavioral and AEP threshold measurements for manatees have revealed lower upper cutoff frequencies and sensitivities compared to the mid-frequency cetaceans.

4.5 PHOCIDS

This group contains all earless seals or "true seals," including all Arctic and Antarctic ice seals, harbor or common seals, gray seals and inland seals, elephant seals, and monk seals. Underwater hearing thresholds exist for some Northern Hemisphere species in this group.

4.6 OTARIIDS AND OTHER NON-PHOCID MARINE CARNIVORES

This group contains all eared seals (fur seals and sea lions), walruses, sea otters, and polar bears. The division of marine carnivores by placing phocids in one group and all others into a second group was made after considering auditory anatomy and measured audiograms for the various species and noting the similarities between the non-phocid audiograms (Fig. A4). Underwater hearing thresholds exist for some Northern Hemisphere species in this group.

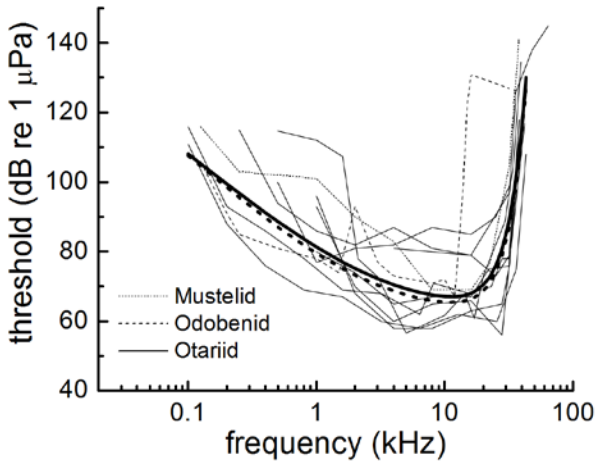


Figure A4. Comparison of Otariid, Mustelid, and Odobenid psychophysical hearing thresholds measured underwater. The thick, solid line is the composite audiogram based on data for all species. The thick, dashed line is the composite audiogram based on the otariids only.

Table A1. Species group designations for Navy Phase 3 auditory weighting functions.

Code	Name	Members
LF	Low-frequency cetaceans	Family Balaenidae (right and bowhead whales) Family Balaenopteridae (rorquals) Family Eschrichtiidae (gray whale) Family Neobalaenidae (pygmy right whale)
MF	Mid-frequency cetaceans	Family Ziphiidae (beaked whales) Family Physeteridae (Sperm whale) Family Monodontidae (Irrawaddy dolphin, beluga, narwhal) Subfamily Delphininae (white-beaked/white-sided/ Risso's/bottlenose/spotted/spinner/striped/common dolphins) Subfamily Orcininae (melon-headed whales, false/pygmy killer whale, killer whale, pilot whales) Subfamily Stenoninae (rough-toothed/humpback dolphins) Genus *Lissodelphis* (right whale dolphins) *Lagenorhynchus albirostris* (white-beaked dolphin) *Lagenorhynchus acutus* (Atlantic white-sided dolphin) *Lagenorhynchus obliquidens* (Pacific white-sided dolphin) *Lagenorhynchus obscurus* (dusky dolphin)
HF	High-frequency cetaceans	Family Phocoenidae (porpoises) Family Platanistidae (Indus/Ganges river dolphins) Family Iniidae (Amazon river dolphins) Family Pontoporiidae (Baiji/ La Plata river dolphins) Family Kogiidae (Pygmy/dwarf sperm whales) Genus *Cephalorhynchus* (Commersen's, Chilean, Heaviside's, Hector's dolphins) *Lagenorhynchus australis* (Peale's or black-chinned dolphin) *Lagenorhynchus cruciger* (hourglass dolphin)
SI	Sirenians	Family Trichechidae (manatees) Family Dugongidae (dugongs)
OW	Otariids and other non-phocid marine carnivores (water)	Family Otariidae (eared seals and sea lions) Family Odobenidae (walrus) *Enhydra lutris* (sea otter) *Ursus maritimus* (polar bear)
PW	Phocids (water)	Family Phocidae (true seals)

V. COMPOSITE AUDIOGRAMS

Composite audiograms for each species group were determined by first searching the available literature for threshold data for the species of interest. For each group, all available AEP and psychophysical (behavioral) threshold data were initially examined. To derive the composite audiograms, the following rules were applied:

1. For species groups with three or more behavioral audiograms (all groups except LF cetaceans), only behavioral (no AEP) data were used. Mammalian AEP thresholds are typically elevated from behavioral thresholds in a frequency-dependent manner, with increasing discrepancy between AEP and behavioral thresholds at the lower frequencies where there is a loss of phase synchrony in the neurological responses and a concomitant increase in measured AEP thresholds. The frequency-dependent relationship between the AEP and behavioral data is problematic for defining the audiogram slope at low frequencies, since the AEP data will systematically over-estimate thresholds and therefore over-estimate the low-frequency slope of the audiogram. As a result of this rule, behavioral data were used for all marine mammal groups.

   For the low-frequency cetaceans, for which no behavioral or AEP threshold data exist, hearing thresholds were estimated by synthesizing information from anatomical measurements, mathematical models of hearing, and animal vocalization frequencies (see Appendix A1).

2. Data from an individual animal were included only once at a particular frequency. If data from the same individual were available from multiple studies, data at overlapping frequencies were averaged.

3. Individuals with obvious high-frequency hearing loss for their species or aberrant audiograms (e.g., obvious notches or thresholds known to be elevated for that species due to masking or hearing loss) were excluded.

4. Linear interpolation was performed within the threshold data for each individual to estimate a threshold value at each unique frequency present in any of the data for that species group. This was necessary to calculate descriptive statistics at each frequency without excluding data from any individual subject.

5. Composite audiograms were determined using both the original threshold values from each individual (in dB re 1 μPa) and normalized thresholds obtained by subtracting the lowest threshold value for that subject.

Table A2 lists the individual references for the data ultimately used to construct the composite audiograms (for all species groups except the LF cetaceans). From these data,

the median (50th percentile) threshold value was calculated at each frequency and fit by the function

$$T(f) = T_0 + A\log_{10}\left(1 + \frac{F_1}{f}\right) + \left(\frac{f}{F_2}\right)^B, \tag{A9}$$

where $T(f)$ is the threshold at frequency f, and T_0, F_1, F_2, A, and B are fitting parameters. The median value was used to reduce the influence of outliers. The particular form of Eq. (A9) was chosen to provide linear-log rolloff with variable slope at low frequencies and a steep rise at high frequencies. The form is similar to that used by Popov et al. (2007) to describe dolphin audiograms; the primary difference between the two is the inclusion of two frequency parameters in Eq. (A9), which allows a more shallow slope in the region of best sensitivity. Equation (A9) was fit to the median threshold data using nonlinear regression (National Instruments LabVIEW 2015). The resulting fitting parameters and goodness of fit values (R^2) are provided in Tables 3 and 4 for the original and normalized data, respectively. Equation (A9) was also used to describe the shape of the estimated audiogram for the LF cetaceans, with the parameter values chosen to provide reasonable thresholds based on the limited available data regarding mysticete hearing (see Appendix A1 for details).

Figures A5 and A6 show the original and normalized threshold data, respectively, as well as the composite audiograms based on the fitted curve. The composite audiograms for each species group are compared in Fig. A6. To allow comparison with other audiograms based on the original threshold data, the lowest threshold for the low-frequency cetaceans was estimated to be 54 dB re 1 μPa, based on the median of the thresholds for the other in-water species groups (MF, HF, SI, OW, PW). From the composite audiograms, the frequency of lowest threshold, f_0, and the slope at the lower frequencies, s_0, were calculated (Table A5). For the species with composite audiograms based on experimental data (i.e., all except LF cetaceans), audiogram slopes were calculated across a frequency range of one decade beginning with the lowest frequency present for each group. The low-frequency slope for LF cetaceans was not based on a curve-fit but explicitly defined during audiogram derivation (see Appendix A1).

Table A2. References, species, and individual subjects used to derive the composite audiograms.

Group	Reference	Species	Subjects
MF	(Finneran et al., 2005b)	*Delphinapterus leucas*	Beethoven
	(Szymanski et al., 1999)	*Orcinus orca*	Yaka, Vigga
	(Nachtigall et al., 1995)	*Grampus griseus*	N/a
	(Kastelein et al., 2003)	*Stenella coeruleoalba*	Meyen
	(Lemonds, 1999)	*Tursiops truncatus*	Itsi Bitsy
	(Brill et al., 2001)	*Tursiops truncatus*	CAS
	(Ljungblad et al., 1982)	*Tursiops truncatus*	12-y male
	(Johnson, 1967)	*Tursiops truncatus*	Salty
	(Sauerland and Dehnhardt, 1998)	*Sotalia fluviatilis*	Paco
	(Johnson et al., 1989)	*Delphinapterus leucas*	2-y female
	(White et al., 1978)	*Delphinapterus leucas*	Edwina, Kojak
	(Awbrey et al., 1988)	*Delphinapterus leucas*	Kojak, female, male
	(Thomas et al., 1988)	*Pseudorca crassidens*	I'a nui hahai
	(Finneran et al., 2010b)	*Tursiops truncatus*	TYH
	(Schlundt et al., 2008)	*Tursiops truncatus*	WEN
	(Ridgway et al., 2001)	*Delphinapterus leucas*	MUK, NOC
	(Tremel et al., 1998)	*Lagenorhynchus obliquidens*	female
HF	(Jacobs and Hall, 1972)	*Inia geoffrensis*	male
	(Kastelein et al., 2002a)**	*Phocoena phocoena*	PpSH047
	(Kastelein et al., 2010)	*Phocoena phocoena*	Jerry
	(Kastelein et al., 2015a)	*Phocoena phocoena*	ID No. 04
SI	(Gaspard et al., 2012)	*Trichechus manatus*	Buffet, Hugh
	(Gerstein et al., 1999)	*Trichechus manatus*	Stormy, Dundee
OW	(Moore and Schusterman, 1987)	*Callorhinus ursinus*	Lori, Tobe
	(Babushina et al., 1991)	*Callorhinus ursinus*	N/a
	(Kastelein et al., 2002b)	*Odobenus rosmarus*	Igor
	(Mulsow et al., 2012)	*Zalophus californianus*	JFN
	(Reichmuth and Southall, 2012)	*Zalophus californianus*	Rio, Sam
	(Reichmuth et al., 2013)	*Zalophus californianus*	Ronan
	(Kastelein et al., 2005)	*Eumetopias jubatus*	EjZH021, EjZH022
	(Ghoul and Reichmuth, 2014)	*Enhydra lutris nereis*	Charlie
PW	(Kastak and Schusterman, 1999)	*Mirounga angustirostris*	Burnyce
	(Terhune, 1988)	*Phoca vitulina*	N/a
	(Reichmuth et al., 2013)	*Phoca vitulina*	Sprouts
	(Kastelein et al., 2009)	*Phoca vitulina*	01, 02
	(Sills et al., 2014)	*Phoca largha*	Amak, Tunu
	(Sills et al., 2015)	*Pusa hispida*	Nayak

** Corrected thresholds from Kastelein et al. (2010) were used.

Table A3. **Composite audiogram parameters values for use in Eq. (A9). For all groups except LF cetaceans, values represent the best-fit parameters from fitting Eq. (A9) to experimental threshold data. For the low-frequency cetaceans, parameter values for Eq. (A9) were estimated as described in Appendix A1.**

Group	T_0 (dB)	F_1 (kHz)	F_2 (kHz)	A	B	R^2
LF	53.19	0.412	9.4	20	3.2	–
MF	46.2	25.9	47.8	35.5	3.56	0.977
HF	46.4	7.57	126	42.3	17.1	0.968
SI	-40.4	3990	3.8	37.3	1.7	0.982
OW	63.1	3.06	11.8	30.1	3.23	0.939
PW	43.7	10.2	3.97	20.1	1.41	0.907

Table A4. **Normalized composite audiogram parameters values for use in Eq. (A9). For all groups except LF cetaceans, values represent the best-fit parameters after fitting Eq. (A9) to normalized threshold data. For the low-frequency cetaceans, parameter values for Eq. (A9) were estimated as described in Appendix A1.**

Group	T_0 (dB)	F_1 (kHz)	F_2 (kHz)	A	B	R^2
LF	-0.81	0.412	9.4	20	3.2	–
MF	3.61	12.7	64.4	31.8	4.5	0.960
HF	2.48	9.68	126	40.1	17	0.969
SI	-109	5590	2.62	38.1	1.53	0.963
OW	2.36	0.366	12.8	73.5	3.4	0.958
PW	-39.6	368	2.21	20.5	1.23	0.907

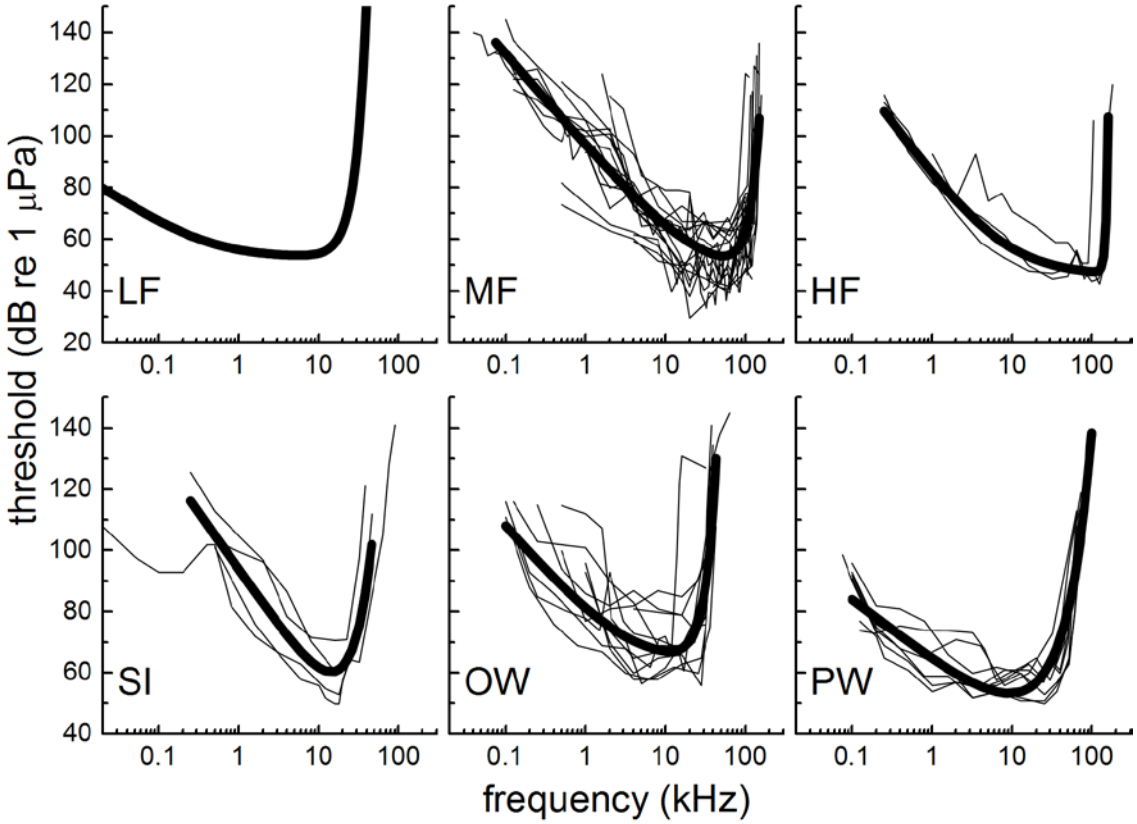


Figure A5. **Thresholds and composite audiograms for the six species groups. Thin lines represent the threshold data from individual animals. Thick lines represent either the predicted threshold curve (LF cetaceans) or the best fit of Eq. (A9) to experimental data (all other groups). Derivation of the LF cetacean curve is described in Appendix A1. The minimum threshold for the LF cetaceans was estimated to be 54 dB re 1 μPa, based on the median of the lowest thresholds for the other groups.**

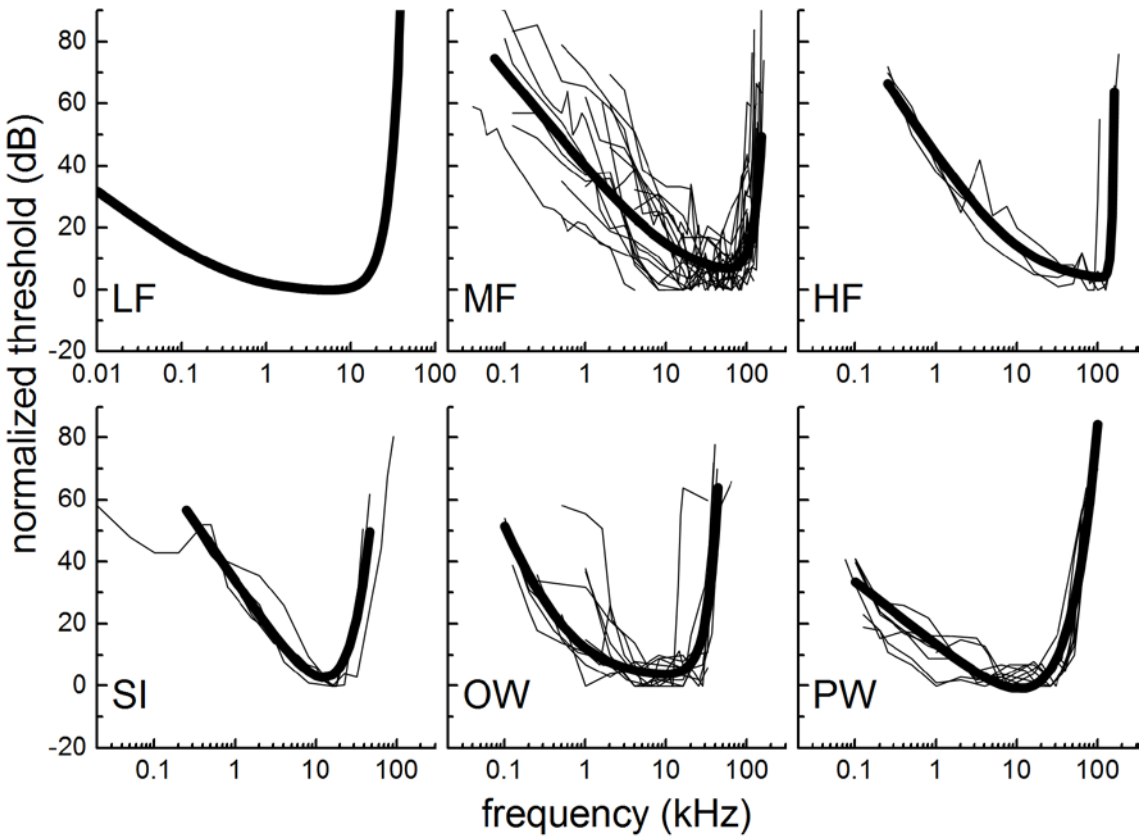


Figure A6. **Normalized thresholds and composite audiograms for the six species groups. Thin lines represent the threshold data from individual animals. Thick lines represent either the predicted threshold curve (LF cetaceans) or the best fit of Eq. (A9) to experimental data (all other groups). Thresholds were normalized by subtracting the lowest value for each individual data set (i.e., within-subject). Composite audiograms were then derived from the individually normalized thresholds (i.e., the composite audiograms were not normalized and may have a minimum value ≠ 0). Derivation of the LF cetacean curve is described in Appendix A1.**

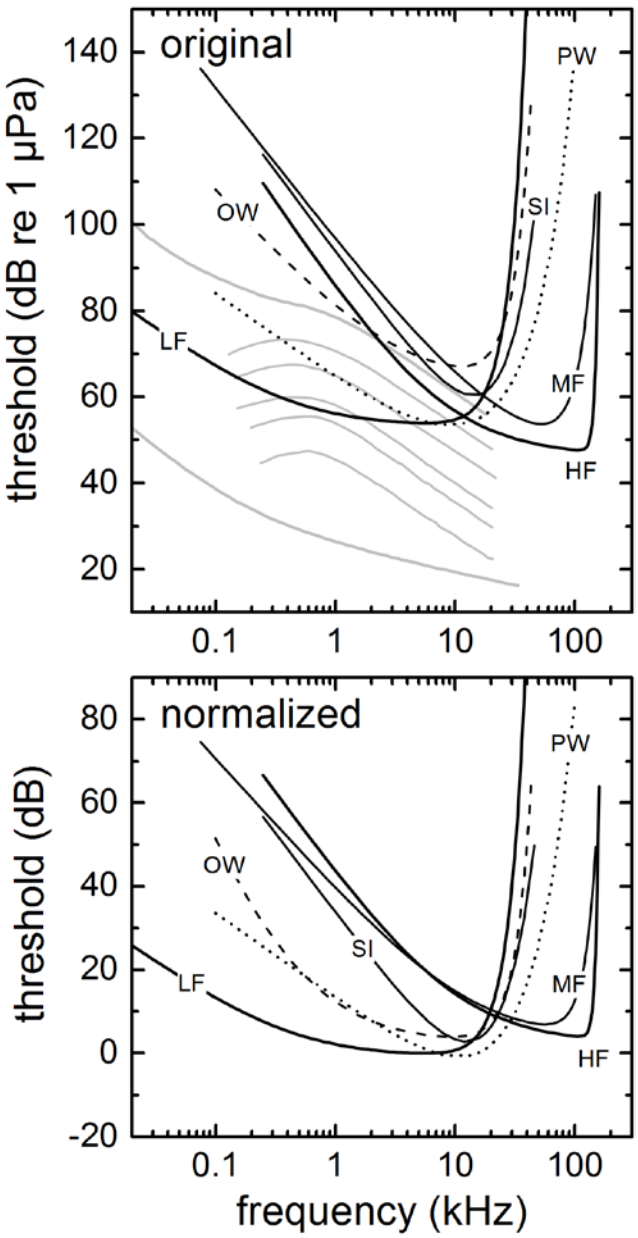


Figure A7. **Composite audiograms for the various species groups, derived with the original data (upper) and normalized data (lower). The gray lines in the upper left panel represent ambient noise spectral density levels (referenced to the left ordinate, in dB re 1 μPa^2/Hz) corresponding to the limits of prevailing noise and various sea-state conditions, from 0.5 to 6 (National Research Council (NRC), 2003).**

Table A5. Frequency of best hearing (f_0) and the magnitude of the low-frequency slope (s_0) derived from composite audiograms and equal latency contours. For the species with composite audiograms based on experimental data (i.e., all except LF cetaceans), audiogram slopes were calculated across a frequency range of one decade beginning with the lowest frequency present for each group. The low-frequency slope for LF cetaceans was not based on a curve-fit but explicitly defined during audiogram derivation (see Appendix A1). Equal latency slopes were calculated from the available equal latency contours (Fig. A8).

Group	Original data composite audiogram		Normalized data composite audiogram		Equal latency curves
	f_0 (kHz)	s_0 (dB/decade)	f_0 (kHz)	s_0 (dB/decade)	s_0 (dB/decade)
LF	5.6	20	5.6	20	—
MF	55	35	58	31	31
HF	105	37	105	36	50
SI	16	36	12	37	—
OW	12	27	10	39	—
PW	8.6	19	13	20	—

VI. EQUAL LOUDNESS DATA

Finneran and Schlundt (2011) conducted a subjective loudness comparison task with a bottlenose dolphin and used the resulting data to derive equal loudness contours and auditory weighting functions. The weighting functions agreed closely with dolphin TTS data over the frequency range 3 to 56 kHz (Finneran and Schlundt, 2013); however, the loudness data only exist for frequencies between 2.5 kHz and 113 kHz and cannot be used to estimate the shapes of loudness contours and weighting functions at lower frequencies.

VII. EQUAL LATENCY DATA

Reaction times to acoustic tones have been measured in several marine mammal species and used to derive equal latency contours and weighting functions (Fig. A8, Wensveen et al., 2014; Mulsow et al., 2015). Unlike the dolphin equal loudness data, the latency data extend to frequencies below 1 kHz and may be used to estimate the slopes of auditory weighting functions at lower frequencies.

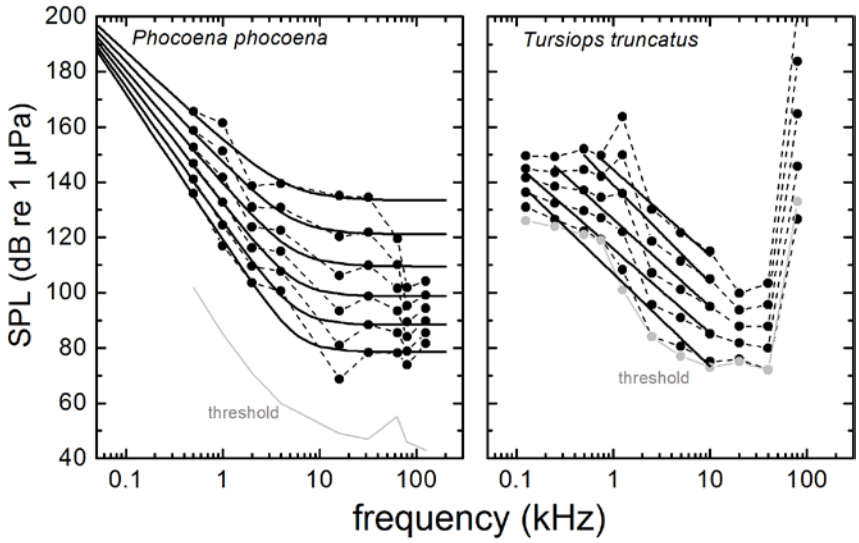


Figure A8. **Underwater marine mammal equal latency contours are available for *Phocoena phocoena* (Wensveen et al., 2014) and *Tursiops truncatus* (Mulsow et al., 2015). The slopes for the contours at low frequencies were obtained from the literature (*Phocoena phocoena*) or calculated from the best linear-log fits to the lower frequency data. The slope of the contour passing through an SPL approximately 40 dB above the threshold at f_0 was selected as the most appropriate based on: (1) human A-weighting, (2) observations that the relationship between equal latency and loudness can break down at higher sensation levels, and (3) for many data sets the slopes increase at higher SPLs rather than decrease as expected. The resulting slopes are listed in Table A5.**

VIII. TTS DATA

8.1 NON-IMPULSIVE (STEADY-STATE) EXPOSURES – TTS

For weighting function derivation, the most critical data required are TTS onset exposure levels as a function of exposure frequency. These values can be estimated from published literature by examining TTS as a function of SEL for various frequencies.

To estimate TTS onset values, only TTS data from psychophysical (behavioral) hearing tests were used. Studies have shown differences between the amount of TTS from behavioral threshold measurements and that determined using AEP thresholds (Fig. A9). TTS determined from AEP thresholds is typically larger than that determined behaviorally, and AEP-measured TTS of up to ~ 10 dB has been observed with no corresponding change in behavioral thresholds (e.g., Finneran et al., 2007). Although these data suggest that AEP amplitudes and thresholds provide more sensitive indicators (than behavioral thresholds) of the auditory effects of noise, Navy acoustic impact analyses use TTS both as an indicator of the disruption of behavioral patterns that are mediated by the sense of hearing and to predict when the onset of PTS is likely to occur. Navy analyses assume that exposures resulting in a NITS > 40 dB measured a few minutes after exposure will result in some amount of residual PTS. This is based on relationships observed in early human TTS studies utilizing psychophysical threshold measurements. To date, there have been no reports of PTS in a marine mammal whose initial behavioral threshold shift was 40 dB or less; however, behavioral shifts of 35 to 40 dB have required multiple days to recover, suggesting that these exposures are near those capable of resulting in PTS. In contrast, studies utilizing AEP measurements in marine mammals have reported TTSs of 45 dB that recovered in 40 min and 60 dB that recovered in < 24 h, suggesting that these exposures were not near those capable of resulting in PTS (Popov et al., 2013).

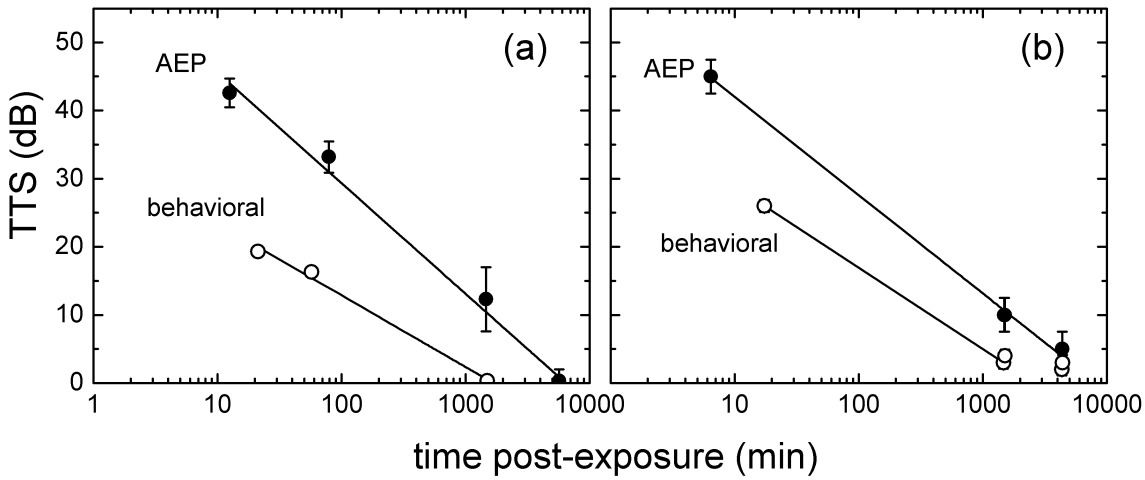


Figure A9. TTS measured using behavioral and AEP methods do not necessarily agree, with marine mammal studies reporting larger TTS obtained using AEP methods. For the data above, thresholds were determined using both techniques before and after the same noise exposure. Hearing thresholds were measured at 30 kHz. Behavioral thresholds utilized FM tones with 10% bandwidth. AEP thresholds were based on AM tones with a modulation frequency of 1.05 kHz. Noise exposures consisted of (a) a single, 20-kHz tone with duration of 64 s and SPL of 185 dB re 1 μPa (SEL = 203 dB re 1 μPa^{2}s) and (b) three 16-s tones at 20 kHz, with mean SPL = 193 dB re 1 μPa (cumulative SEL = 210 dB re 1 μPa^{2}s). Data from Finneran et al. (2007).

To determine TTS onset for each subject, the amount of TTS observed after exposures with different SPLs and durations were combined to create a single TTS growth curve as a function of SEL. The use of (cumulative) SEL is a simplifying assumption to accommodate sounds of various SPLs, durations, and duty cycles. This is referred to as an "equal energy" approach, since SEL is related to the energy of the sound and this approach assumes exposures with equal SEL result in equal effects, regardless of the duration or duty cycle of the sound. It is well-known that the equal energy rule will over-estimate the effects of intermittent noise, since the quiet periods between noise exposures will allow some recovery of hearing compared to noise that is continuously present with the same total SEL (Ward, 1997). For continuous exposures with the same SEL but different durations, the exposure with the longer duration will also tend to produce more TTS (e.g., Kastak et al., 2007; Mooney et al., 2009; Finneran et al., 2010b). Despite these limitations, however, the equal energy rule is still a useful concept, since it includes the effects of both noise amplitude and duration when predicting auditory effects. SEL is a simple metric, allows the effects of multiple noise sources to be combined in a meaningful way, has physical significance, and is correlated with most TTS growth data reasonably well — in some cases even across relatively large ranges of exposure duration (see Finneran, 2015). The use of cumulative SEL for Navy sources will always over-

estimate the effects of intermittent or interrupted sources, and the majority of Navy sources feature durations shorter than the exposure durations typically utilized in marine mammal TTS studies, therefore the use of (cumulative) SEL will tend to over-estimate the effects of many Navy sound sources.

Marine mammal studies have shown that the amount of TTS increases with SEL in an accelerating fashion: At low exposure SELs, the amount of TTS is small and the growth curves have shallow slopes. At higher SELs, the growth curves become steeper and approach linear relationships with the noise SEL. Accordingly, TTS growth data were fit with the function

$$t(L) = m_1 \log_{10}\left[1 + 10^{(L-m_2)/10}\right], \tag{A10}$$

where t is the amount of TTS, L is the SEL, and m_1 and m_2 are fitting parameters. This particular function has an increasing slope when $L < m_2$ and approaches a linear relationship for $L > m_2$ (Maslen, 1981). The linear portion of the curve has a slope of $m_1/10$ and an x-intercept of m_2. After fitting Eq. (10) to the TTS growth data, interpolation was used to estimate the SEL necessary to induce 6 dB of TTS — defined as the "onset of TTS" for Navy acoustic impact analyses. The value of 6 dB has been historically used to distinguish non-trivial amounts of TTS from fluctuations in threshold measurements that typically occur across test sessions. Extrapolation was not performed when estimating TTS onset; this means only data sets with exposures producing TTS both above and below 6 dB were used.

Figures A10 to A13 show all behavioral and AEP TTS data to which growth curves defined by Eq. (A10) could be fit. The TTS onset exposure values, growth rates, and references to these data are provided in Table A6.

8.2 NON-IMPULSIVE (STEADY-STATE) EXPOSURES – PTS

Since no studies have been designed to intentionally induce PTS in marine mammals (but see Kastak et al., 2008), onset-PTS levels for marine mammals must be estimated. Differences in auditory structures and sound propagation and interaction with tissues prevent direct application of numerical thresholds for PTS in terrestrial mammals to marine mammals; however, the inner ears of marine and terrestrial mammals are analogous and certain relationships are expected to hold for both groups. Experiments with marine mammals have revealed similarities between marine and terrestrial mammals with respect to features such as TTS, age-related hearing loss, ototoxic drug-induced hearing loss, masking, and frequency selectivity (e.g., Nachtigall et al., 2000; Finneran et al., 2005b). For this reason, relationships between TTS and PTS from marine and terrestrial mammals can be used, along with TTS onset values for marine mammals, to estimate exposures likely to produce PTS in marine mammals (Southall et al., 2007).

A variety of terrestrial and marine mammal data sources (e.g., Ward et al., 1958; Ward et al., 1959; Ward, 1960; Miller et al., 1963; Kryter et al., 1966) indicate that threshold

shifts up to 40 to 50 dB may be induced without PTS, and that 40 dB is a conservative upper limit for threshold shift to prevent PTS; i.e., for impact analysis, 40 dB of NITS is an upper limit for reversibility and that any additional exposure will result in some PTS. This means that 40 dB of TTS, measured a few minutes after exposure, can be used as a conservative estimate for the onset of PTS. An exposure causing 40 dB of TTS is therefore considered equivalent to PTS onset.

To estimate PTS onset, TTS growth curves based on more than 20 dB of measured TTS were extrapolated to determine the SEL required for a TTS of 40 dB. The SEL difference between TTS onset and PTS onset was then calculated. The requirement that the maximum amount of TTS must be at least 20 dB was made to avoid over-estimating PTS onset by using growth curves based on small amounts of TTS, where the growth rates are shallower than at higher amounts of TTS.

8.3 IMPULSIVE EXPOSURES

Marine mammal TTS data from impulsive sources are limited to two studies with measured TTS of 6 dB or more: Finneran et al. (2002) reported behaviorally-measured TTSs of 6 and 7 dB in a beluga exposed to single impulses from a seismic water gun (unweighted SEL = 186 dB re 1 μPa^2s, peak SPL = 224 dB re 1 μPa) and Lucke et al. (2009) reported AEP-measured TTS of 7 to 20 dB in a harbor porpoise exposed to single impulses from a seismic air gun [Fig. A12(f), TTS onset = unweighted SEL of 162 dB re 1 μPa^2s or peak SPL of 195 dB re 1 μPa]. The small reported amounts of TTS and/or the limited distribution of exposures prevent these data from being used to estimate PTS onset.

In addition to these data, Kastelein et al. (2015c)[38] reported behaviorally-measured mean TTS of 4 dB at 8 kHz and 2 dB at 4 kHz after a harbor porpoise was exposed to a series of impulsive sounds produced by broadcasting underwater recordings of impact pile driving strikes through underwater sound projectors. The exposure contained 2760 individual impulses presented at an interval of 1.3 s (total exposure time was 1 h). The average single-strike, unweighted SEL was approximately 146 dB re 1 μPa^2s and the cumulative (unweighted) SEL was approximately 180 dB re 1 μPa^2s. The pressure waveforms for the simulated pile strikes exhibited significant "ringing" not present in the original recordings and most of the energy in the broadcasts was between 500 and 800 Hz, near the resonance of the underwater sound projector used to broadcast the signal. As a result, some questions exist regarding whether the fatiguing signals were representative of underwater pressure signatures from impact pile driving.

Several impulsive noise exposure studies have also been conducted without measurable (behavioral) TTS. Finneran et al. (2000) exposed dolphins and belugas to single impulses

[38] Footnote added by NMFS: Since the NMFS received this version of the Finneran Technical Report, another TTS study became available (Kastelein et al. 2016). In this study, two harbor porpoises were exposed to playbacks of impact pile driving strikes. Neither individual had a TTS of 6 dB after exposure. Kastelein et al. 2016 estimated TTS onset to occur at SEL_{cum} 175 dB (unweighted).

from an “explosion simulator” (maximum unweighted SEL = 179 dB re 1 μPa^{2}s, peak SPL = 217 dB re 1 μPa) and Finneran et al. (2015) exposed three dolphins to sequences of 10 impulses from a seismic air gun (maximum unweighted cumulative SEL = 193 to 195 dB re 1 μPa^{2}s, peak SPL =196 to 210 dB re 1 μPa) without measurable TTS. Finneran et al. (2003) exposed two sea lions to single impulses from an arc-gap transducer with no measurable TTS (maximum unweighted SEL = 163 dB re 1 μPa^{2}s, peak SPL = 203 dB re 1 μPa). Reichmuth et al. (2016) exposed two spotted seals (*Phoca largha*) and two ringed seals (*Pusa hispida*) to single impulses from a 10 in^3 sleeve air gun with no measurable TTS (maximum unweighted SEL = 181 dB re 1 μPa^{2}s, peak SPL ~ 203 dB re 1 μPa).

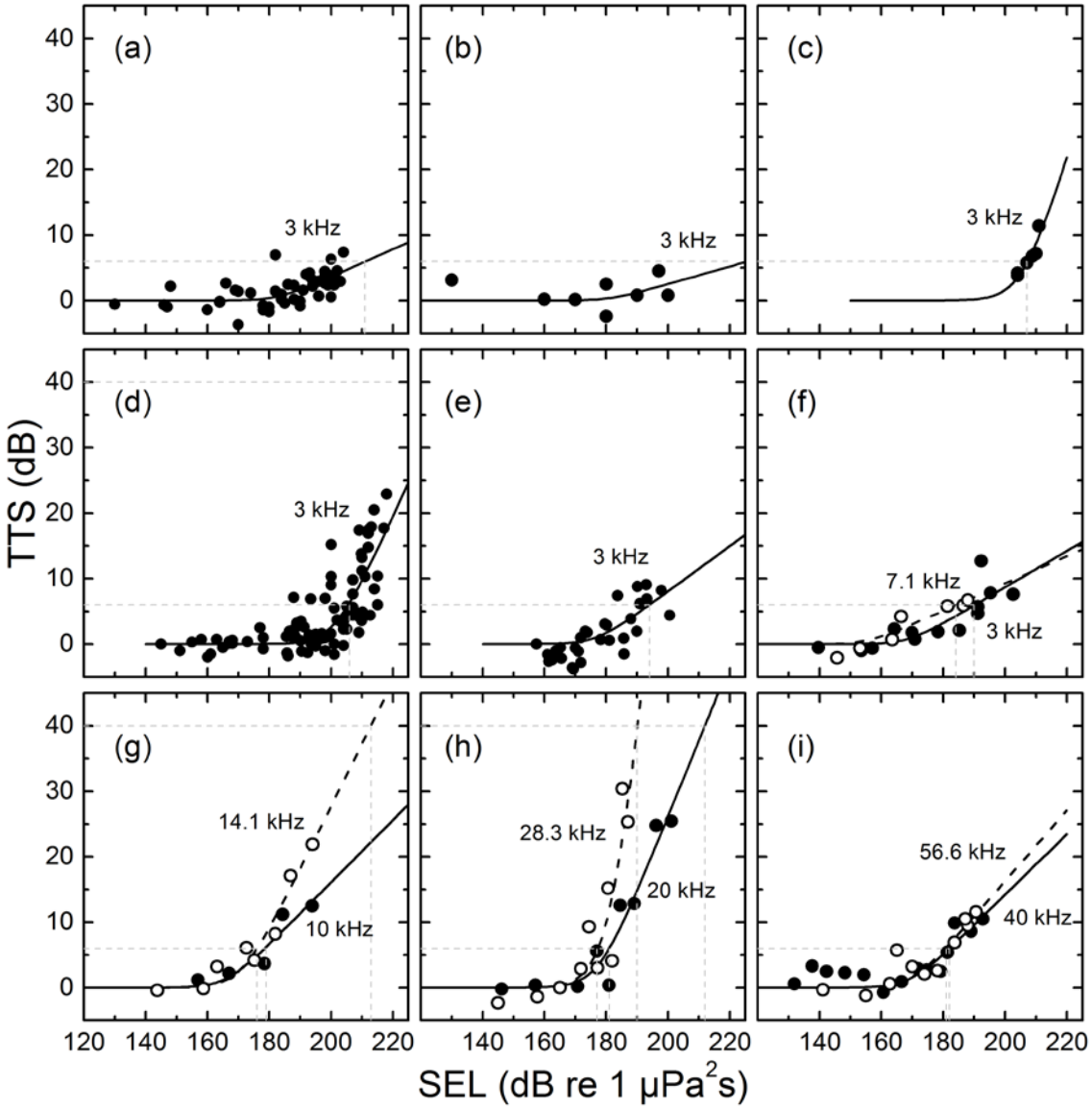


Figure A10. **TTS growth data for mid-frequency cetaceans obtained using behavioral methods. Growth curves were obtained by fitting Eq. (A10) to the TTS data as a function of SEL. Onset TTS was defined as the SEL value from the fitted curve at a TTS = 6 dB, for only those datasets that bracketed 6 dB of TTS. Onset PTS was defined as the SEL value from the fitted curve at a TTS = 40 dB, for only those datasets with maximum TTS > 20 dB. Frequency values within the panels indicate the exposure frequencies. Solid lines are fit to the filled symbols; dashed lines are fit to the open symbols. See Table A6 for explanation of the datasets in each panel. Frequencies listed in each panel denote the exposure frequency.**

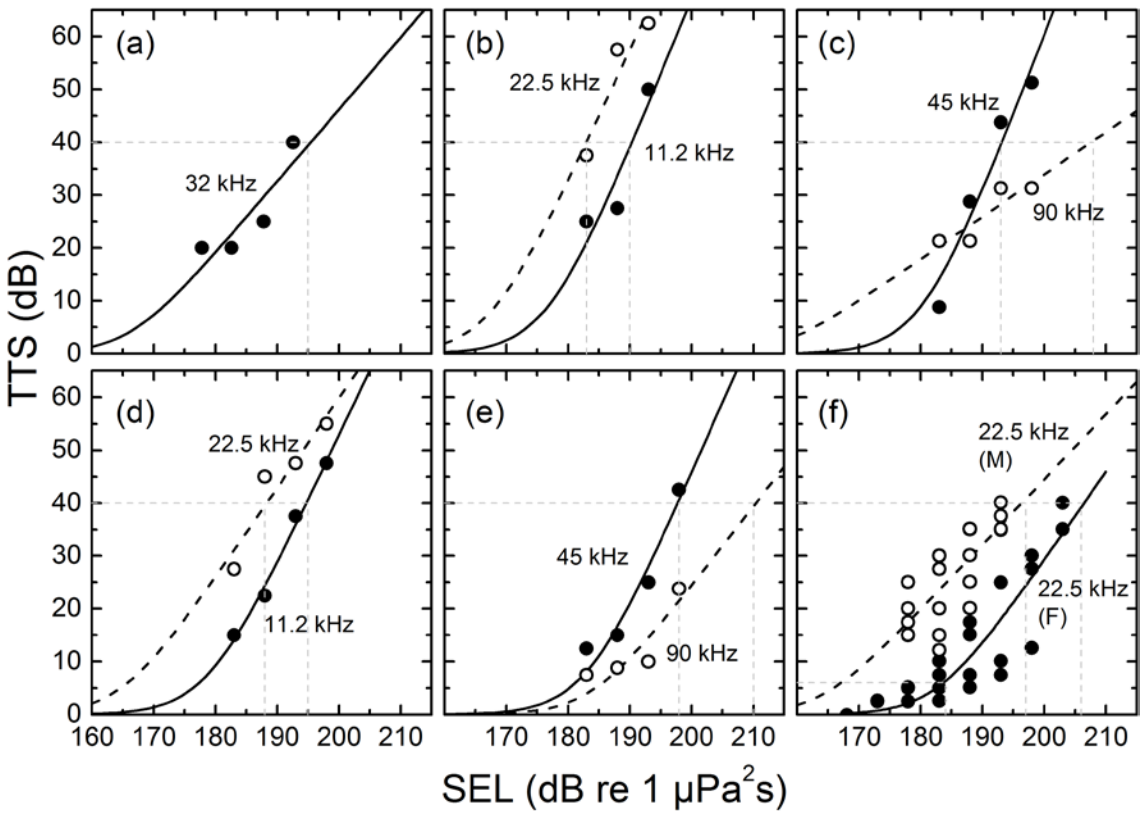


Figure A11. **TTS growth data for mid-frequency cetaceans obtained using AEP methods. Growth curves were obtained by fitting Eq. (A10) to the TTS data as a function of SEL. Onset TTS was defined as the SEL value from the fitted curve at a TTS = 6 dB, for only those datasets that bracketed 6 dB of TTS. Onset PTS was defined as the SEL value from the fitted curve at a TTS = 40 dB, for only those datasets with maximum TTS > 20 dB. Frequency values within the panels indicate the exposure frequencies. Solid lines are fit to the filled symbols; dashed lines are fit to the open symbols. See Table A6 for explanation of the datasets in each panel.**

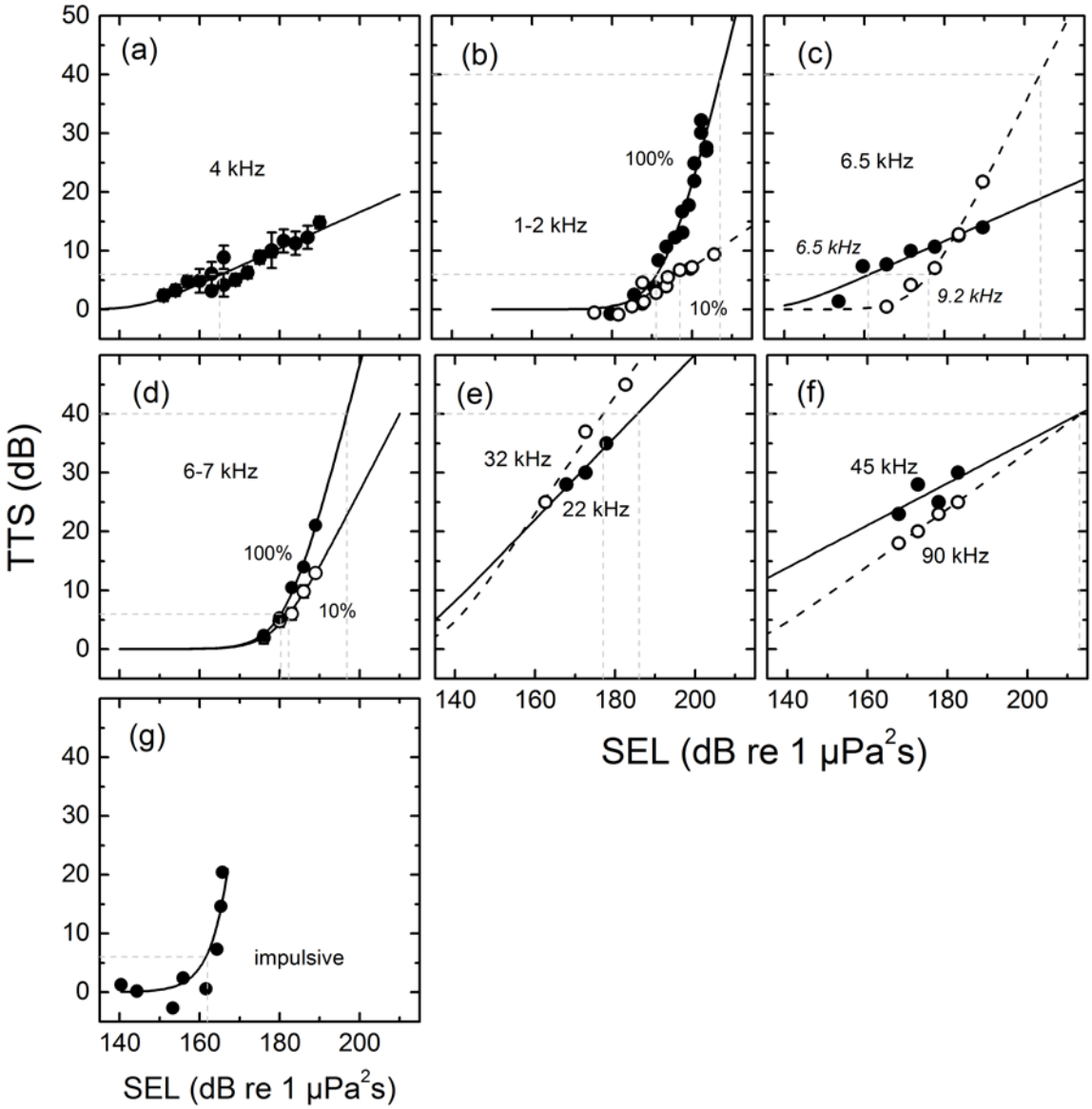


Figure A12. **TTS growth data for high-frequency cetaceans obtained using behavioral and AEP methods. Growth curves were obtained by fitting Eq. (A10) to the TTS data as a function of SEL. Onset TTS was defined as the SEL value from the fitted curve at a TTS = 6 dB, for only those datasets that bracketed 6 dB of TTS. Onset PTS was defined as the SEL value from the fitted curve at a TTS = 40 dB, for only those datasets with maximum TTS > 20 dB. The exposure frequency is specified in normal font; italics indicate the hearing test frequency. Percentages in panels (b), (d) indicate exposure duty cycle (duty cycle was 100% for all others). Solid lines are fit to the filled symbols; dashed lines are fit to the open symbols. See Table A6 for explanation of the datasets in each panel.**

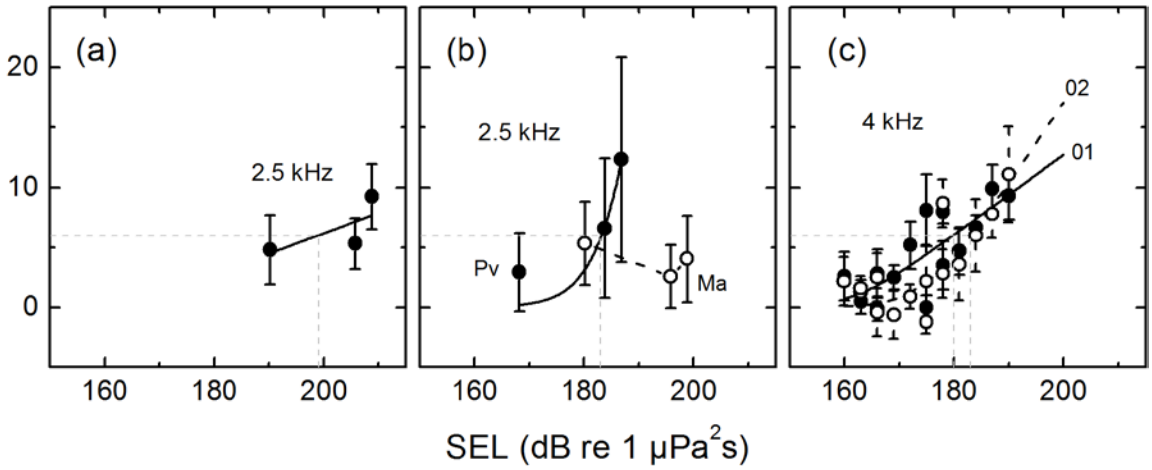


Figure A13. **TTS growth data for pinnipeds obtained using behavioral methods. Growth curves were obtained by fitting Eq. (A10) to the TTS data as a function of SEL. Onset TTS was defined as the SEL value from the fitted curve at a TTS = 6 dB, for only those datasets that bracketed 6 dB of TTS. Frequency values within the panels indicate the exposure frequencies. Numeric values in panel (c) indicate subjects 01 and 02. Solid lines are fit to the filled symbols; dashed lines are fit to the open symbols. See Table A6 for explanation of the datasets in each panel.**

Table A6. Summary of marine mammal TTS growth data and onset exposure levels. Only those data from which growth curves could be generated are included. TTS onset values are expressed in SEL, in dB re 1 μPa^{2}s. Tests featured continuous exposure to steady-state noise and behavioral threshold measurements unless otherwise indicated.

Group	Species	Subject	Freq. (kHz)	Min TTS (dB)	Max TTS (dB)	TTS Onset (dB SEL)	TTS growth rate (dB/dB)	PTS Onset (dB SEL)	TTS-PTS offset (dB)	Notes	Reference	Figure
MF	*Tursiops truncatus*	BEN	3	0	7	211*	0.21	—	—	TTS onset higher than subsequent test	(Finneran et al., 2005a)	10(a)
MF	*Tursiops truncatus*	NAY	3	0	5	—	0.13	—	—		(Finneran et al., 2005a)	10(b)
MF	*Tursiops truncatus*	BLU	3	4	11	207*	1.5	—	—	intermittent	(Finneran et al., 2010a)	10(c)
MF	*Tursiops truncatus*	BLU	3	0	23	206*	1.0	240	34	TTS onset higher than subsequent tests	(Finneran et al., 2010b)	10(d)
MF	*Tursiops truncatus*	TYH	3	0	9	194	0.35	—	—		(Finneran et al., 2010b)	10(e)
MF	*Tursiops truncatus*	BLU	3 7.1 10 14.1 20 28.3	0 0 1 0 0 0	13 7 13 22 25 30	190 184 179 176 181 177	0.28 0.21 0.48 0.95 1.2 4.5	— — — 213 212 190	— — — 37 31 13		(Finneran and Schlundt, 2013)	10(f) 10(f) 10(g) 10(g) 10(h) 10(h)
MF	*Tursiops truncatus*	TYH	40 56.6	0 0	11 12	182 181	0.46 1.1	— —	— —		(Finneran and Schlundt, 2013)	10(i) 10(i)
MF	*Delphinapterus leucas*	N/a	32	20	40	—	1.4	195	—	AEP	(Popov et al., 2011b)	11(a)

Group	Species	Subject	Freq. (kHz)	Min TTS (dB)	Max TTS (dB)	TTS Onset (dB SEL)	TTS growth rate (dB/dB)	PTS Onset (dB SEL)	TTS-PTS offset (dB)	Notes	Reference	Figure
MF	*Delphinapterus leucas*	female	11.2 22.5 45 90	25 38 9 21	50 63 51 31	— — — —	2.8 2.5 3.0 0.8	190 183 193 208	— — — —	AEP	(Popov et al., 2013)	11(b) 11(b) 11(c) 11(c)
MF	*Delphinapterus leucas*	male	11.2 22.5 45 90	15 28 13 8	48 55 42 24	— — — —	2.5 1.7 2.7 1.5	195 188 198 210	— — — —	AEP	(Popov et al., 2013)	11(d) 11(d) 11(e) 11(e)
MF	*Delphinapterus leucas*	female	22.5	0	40	184*	1.7	206	22	AEP	(Popov et al., 2014)	11(f)
MF	*Delphinapterus leucas*	male	22.5	12	40	—	1.2	197	—	AEP	(Popov et al., 2014)	11(f)
HF	*Phocoena phocoena*	02	4	2	15	165	0.3	—	—		(Kastelein et al., 2012a)	12(a)
HF	*Phocoena phocoena*	02	~1.5 ~1.5	0 0	32 7	191 197*	2.8 0.4	207 —	16 —	100% duty cycle 10% duty cycle	(Kastelein et al., 2014b)	12(b) 12(b)
HF	*Phocoena phocoena*	02	6.5 6.5	1 0	13 22	161 176*	0.3 1.3	— 204	— 28	6.5 kHz test freq. 9.2 kHz test freq.	(Kastelein et al., 2014a)	12(c) 12(c)
HF	*Phocoena phocoena*	02	~6.5 ~6.5	2 2	21 13	180* 182*	2.7 1.3	197 —	17 —	100% duty cycle 10% duty cycle	(Kastelein et al., 2015b)	12(d) 12(d)
HF	*Neophocaena phocaenoides*	male	22 32	28 25	35 45	— —	0.7 1.0	186 177	— —	AEP	(Popov et al., 2011a)	12(e)
HF	*Neophocaena phocaenoides*	female	45 90	23 18	30 25	— —	0.36 0.48	213 213	— —	AEP	(Popov et al., 2011a)	12(f)
HF	*Phocoena phocoena*	Eigil	impulse	0	20	162	**	—	—	AEP	(Lucke et al., 2009)	12(g)

Group	Species	Subject	Freq. (kHz)	Min TTS (dB)	Max TTS (dB)	TTS Onset (dB SEL)	TTS growth rate (dB/dB)	PTS Onset (dB SEL)	TTS-PTS offset (dB)	Notes	Reference	Figure
OW	*Zalophus californianus*	Rio	2.5	5	9	199	0.17	—	—		(Kastak et al., 2005)	13(a)
PW	*Phoca vitulina*	Sprouts	2.5	3	12	183	6.4	—	—		(Kastak et al., 2005)	13(b)
PW	*Mirounga angustirostris*	Burnyce	2.5	3	5	—	—	—	—		(Kastak et al., 2005)	13(b)
PW	*Phoca vitulina*	01	4	0	10	180	0.33	—	—		(Kastelein et al., 2012b)	13(c)
PW	*Phoca vitulina*	02	4	0	11	183*	0.68	—	—	TTS_{16}	(Kastelein et al., 2012b)	13(c)

* SELs not used in subsequent analyses to optimize ΔT or define K for TTS or PTS exposure functions. Reasons for exclusion include: (i) another data set resulted in a lower onset TTS at the same frequency, (ii) the data set featured a duty cycle less than 100%, (iii) TTS values were measured at times significantly larger than 4 min, (iv) data were obtained from AEP testing, or (v) a lower TTS onset was found at a different hearing test frequency (also see Notes).

** Distribution of data did not support an accurate estimate for growth rate (the standard error was four orders of magnitude larger than the slope estimate)

IX. TTS EXPOSURE FUNCTIONS FOR SONARS

Derivation of the weighting function parameters utilized the exposure function form described by Eq. (A2), so that the shapes of the functions could be directly compared to the TTS onset data (Table A6) when available. The function shapes were first determined via the parameters a, b, f_1, and f_2, then the gain constant K was determined for each group to provide the best fit to the TTS data or estimated TTS onset value at a particular frequency.

9.1 LOW- AND HIGH-FREQUENCY EXPONENTS (a, b)

The high-frequency exponent, b, was fixed at $b = 2$. This was done to match the previous value used in the Phase 2 functions, since no new TTS data are available at the higher frequencies and the equal latency data are highly variable at the higher frequencies.

The low-frequency exponent, a, was defined as $a = s_0/20$, where s_0 is the lower of the slope of the audiogram or equal latency curves (in dB/decade) at low frequencies (Table A5). This causes the weighting function slope to match the shallower slope of the audiogram or equal latency contours at low frequencies. In practice, the audiogram slopes were lower than the equal latency slopes for all groups except the mid-frequency cetaceans (group MF).

9.2 FREQUENCY CUTOFFS (f_1, f_2)

The frequency cutoffs f_1 and f_2 were defined as the frequencies below and above the frequency of best hearing (f_0, Table A5) where the composite audiogram thresholds values were ΔT-dB above the threshold at f_0 (Fig. A14). If $\Delta T = 0$, the weighting function shape would match the shape of the inverse audiogram. Values of $\Delta T > 0$ progressively "compress" the weighting function, compared to the audiogram, near the frequency region of best sensitivity. This compression process is included to match the marine mammal TTS data, which show less change in TTS onset with frequency than would be predicted by the audiogram in the region near best sensitivity.

To determine ΔT, the exposure function amplitude defined by Eq. (A2) was calculated for the mid- and high-frequency cetaceans using ΔT values that varied from 0 to 20 dB. For each ΔT value, the constant K was adjusted to minimize the mean-squared error between the function amplitude and the TTS data (Fig. A15). This process was performed using composite audiograms based on both the original and normalized threshold data. Fits were performed using only TTS data resulting from continuous exposures (100% duty cycle). If hearing was tested at multiple frequencies after exposure, the lowest TTS onset value was used.

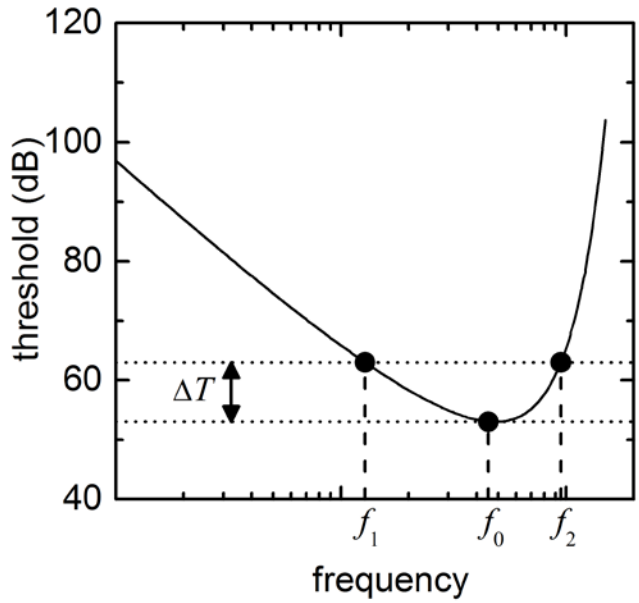


Figure A14. **The cutoff frequencies f_1 and f_2 were defined as the frequencies below and above f_0 at which the composite audiogram values were ΔT-dB above the threshold at f_0 (the lowest threshold).**

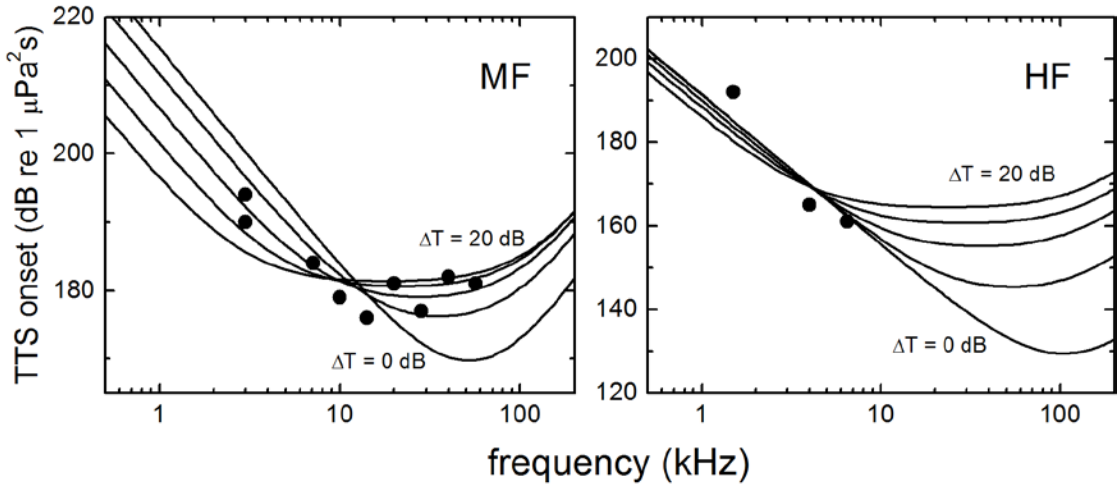


Figure A15. **Effect of ΔT adjustment on the TTS exposure functions for the mid-frequency cetaceans (left) and high-frequency cetaceans (right). To calculate the exposure functions, a and b were defined as $a = s_0/20$ and $b = 2$. ΔT was then varied from 0 to 20. At each value of ΔT, K was adjusted to minimize the squared error between the exposure function and the onset TTS data (symbols). As ΔT increases, f_1 decreases and f_2 increases, causing the pass-band of the function to increase and the function to "flatten".**

For the original and normalized data, the errors between the best-fit exposure functions and the TTS data for the MF and HF cetaceans were squared, summed, and divided by the total number of TTS data points (12). This provided an overall mean-squared error (MSE) for the original and normalized data as a function of ΔT (Fig. A16). The conditions (ΔT value and original/normalized threshold audiograms) resulting in the lowest MSE indicated the best fit of the exposure functions to the TTS data. For the MF and HF cetacean data, the lowest MSE occurred with the normalized threshold data with ΔT = 9 dB. **Therefore, f_1 and f_2 for the remaining species groups were defined using composite audiograms based on normalized thresholds with ΔT = 9 dB.**

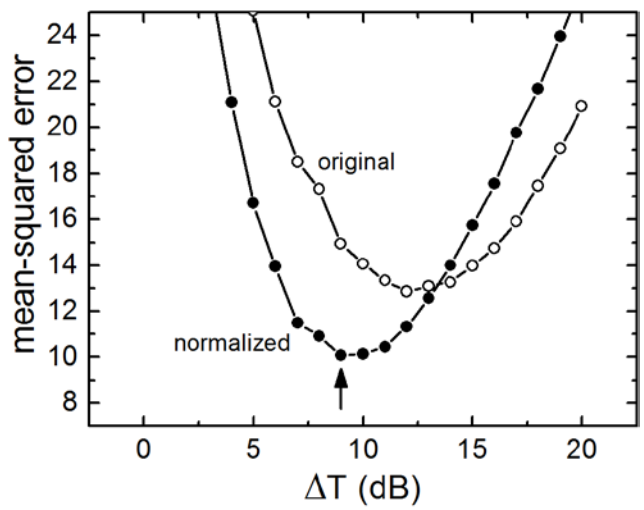


Figure A16. Relationship between ΔT and the resulting mean-squared error (MSE) between the exposure functions and onset TTS data. The MSE was calculated by adding the squared errors between the exposure functions and TTS data for the MF and HF cetacean groups, then dividing by the total number of TTS data points. This process was performed using the composite audiograms based on original and normalized threshold data and ΔT values from 0 to 20. The lowest MSE value was obtained using the audiograms based on normalized thresholds with ΔT = 9 dB (arrow).

9.3 GAIN PARAMETERS *K* AND *C*

The gain parameter *K* was defined to minimize the squared error between the exposure function and the TTS data for each species group. Note that *K* is not necessarily equal to the minimum value of the exposure function.

For the low-frequency cetaceans and sirenians, for which no TTS data exist, TTS onset at the frequency of best hearing (f_0) was estimated by assuming that, at the frequency of best hearing, the numeric difference between the auditory threshold (in dB SPL) and the onset

of TTS (in dB SEL) would be similar to that observed in the other species groups. Table A7 summarizes the onset TTS and composite threshold data for the MF, HF, OW, and PW groups. For these groups, the median difference between the TTS onset and composite audiogram threshold at f_0 was 126 dB. In the absence of data, the hearing threshold at f_0 for the LF group was set equal to the median threshold at f_0 for the other groups (MF, HF, SI, OW, PW, median = 54 dB re 1 μPa). The TTS onset value at f_0 is therefore 180 dB re 1 μPa^{2}s for the low-frequency cetaceans (Table A7). For the sirenians, the lowest threshold was 61 dB re 1 μPa, making the onset TTS estimate 187 dB re 1 μPa^{2}s (Table A7).

Table A7. Differences between composite threshold values (Fig. A5) and TTS onset values at the frequency of best hearing (f_0) for the in-water marine mammal species groups. The values for the low-frequency cetaceans and sirenians were estimated using the median difference (126) from the MF, HF, OW, and PW groups.

Group	f_0 (kHz)	Threshold at f_0 (dB re 1 μPa)	TTS onset at f_0 (dB re 1 μPa^{2}s)	Difference	Estimated difference	Estimated TTS onset at f_0 (dB re 1 μPa^{2}s)
LF	5.6	54			126	180
MF	55	54	179	125		
HF	105	48	156	108		
SI	16	61			126	187
OW	12	67	199	132		
PW	8.6	53	181	128		

Once K was determined, the weighted threshold for onset TTS was determined from the minimum value of the exposure function. Finally, the constant C was determined by substituting parameters a, b, f_1, and f_2 into Eq. (A1), then adjusting C so the maximum amplitude of the weighting function was 0 dB; this is equivalent to the difference between the weighted TTS threshold and K [see Eqs. (A3)–(A8)].

Table A8 summarizes the various function parameters, the weighted TTS thresholds, and the goodness of fit values between the TTS exposure functions and the onset TTS data. The various TTS exposure functions are presented in Figs. A17–A20.

Table A8. Weighting function and TTS exposure function parameters for use in Eqs. (A1) and (A2) for steady-state exposures. R^2 values represent goodness of fit between exposure function and TTS onset data (Table A6).

Group	*a*	*b*	f_1 (kHz)	f_2 (kHz)	*K* (dB)	*C* (dB)	Weighted TTS threshold (dB SEL)	R^2
LF	1	2	0.20	19	179	0.13	179	—
MF	1.6	2	8.8	110	177	1.20	178	0.825
HF	1.8	2	12	140	152	1.36	153	0.864
SI	1.8	2	4.3	25	183	2.62	186	—
OW	2	2	0.94	25	198	0.64	199	—
PW	1	2	1.9	30	180	0.75	181	0.557

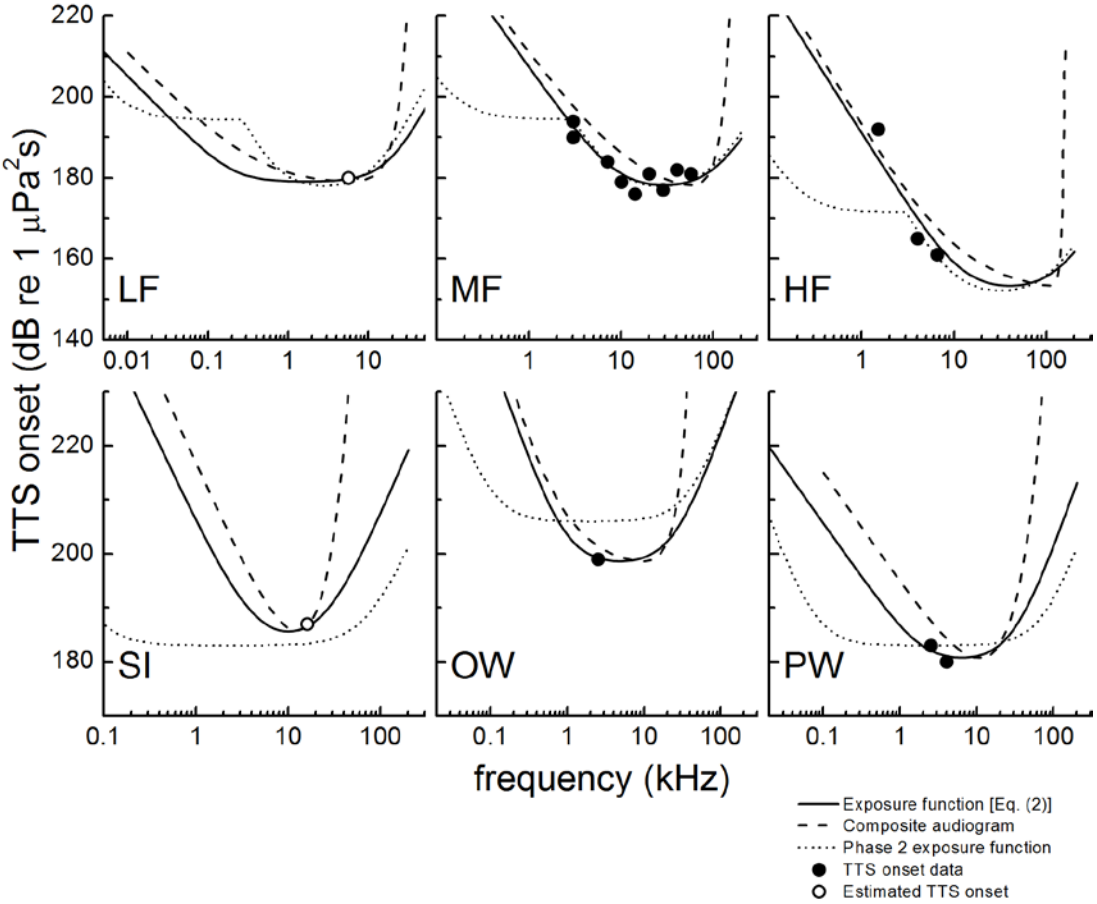


Figure A17. Exposure functions (solid lines) generated from Eq. (A2) with the parameters specified in Table A7. Dashed lines — (normalized) composite audiograms used for definition of parameters *a*, f_1, and f_2. A constant value was added to each audiogram to equate the minimum audiogram value with the exposure function minimum. Short dashed line — Navy Phase 2 exposure functions for TTS onset for each group. Filled symbols — onset TTS exposure data (in dB SEL) used to define exposure function shape and vertical position. Open symbols — estimated TTS onset for species for which no TTS data exist.

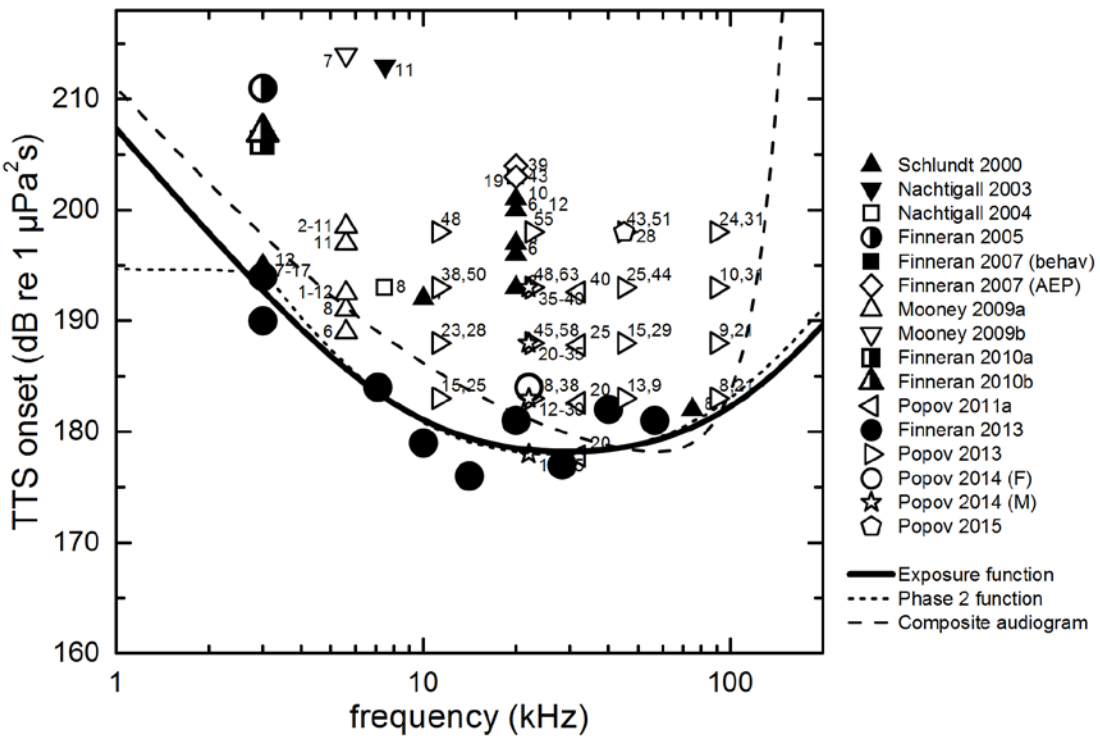


Figure A18. Mid-frequency cetacean exposure function, (normalized) composite audiogram, and Phase 2 exposure functions compared to mid-frequency cetacean TTS data. Large symbols with no numeric values indicate onset TTS exposures. Smaller symbols represent specific amounts of TTS observed, with numeric values giving the amount (or range) or measured TTS. Filled and half-filled symbols — behavioral data. Open symbols — AEP data.

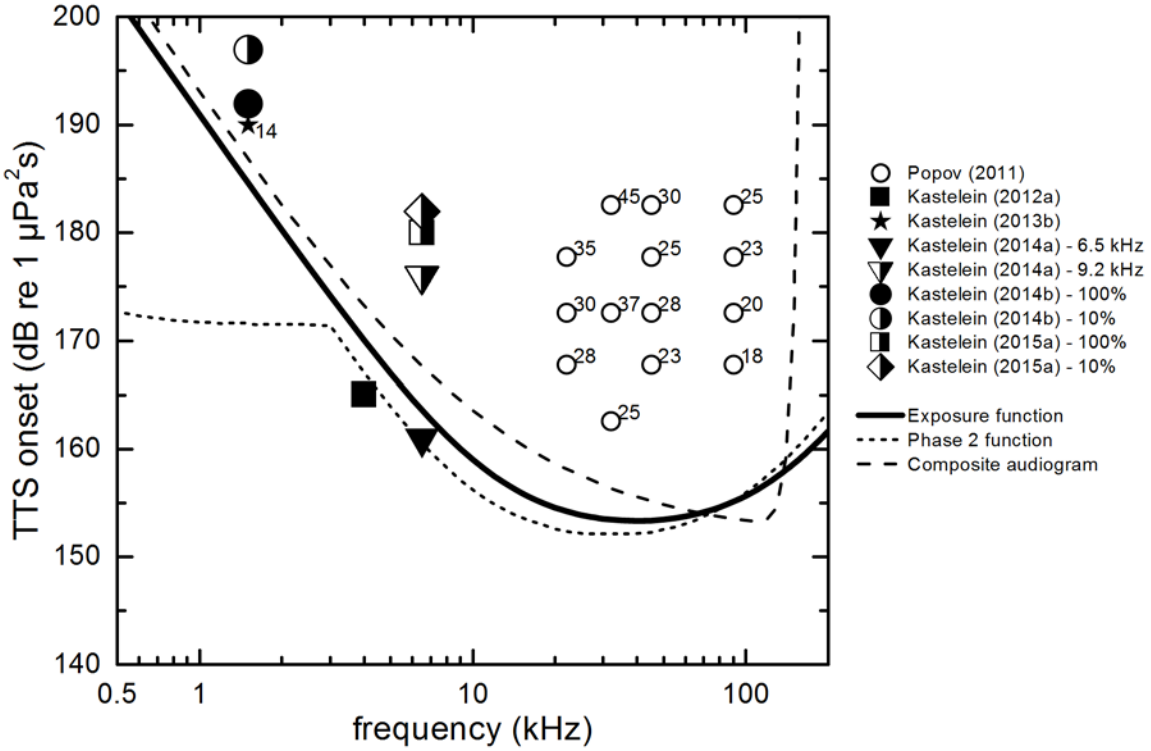


Figure A19. High-frequency cetacean TTS exposure function, (normalized) composite audiogram, and Phase 2 exposure functions compared to high-frequency cetacean TTS data. Large symbols with no numeric values indicate onset TTS exposures. Smaller symbols represent specific amounts of TTS observed, with numeric values giving the amount (or range) or measured TTS. Filled and half-filled symbols — behavioral data. Open symbols — AEP data.

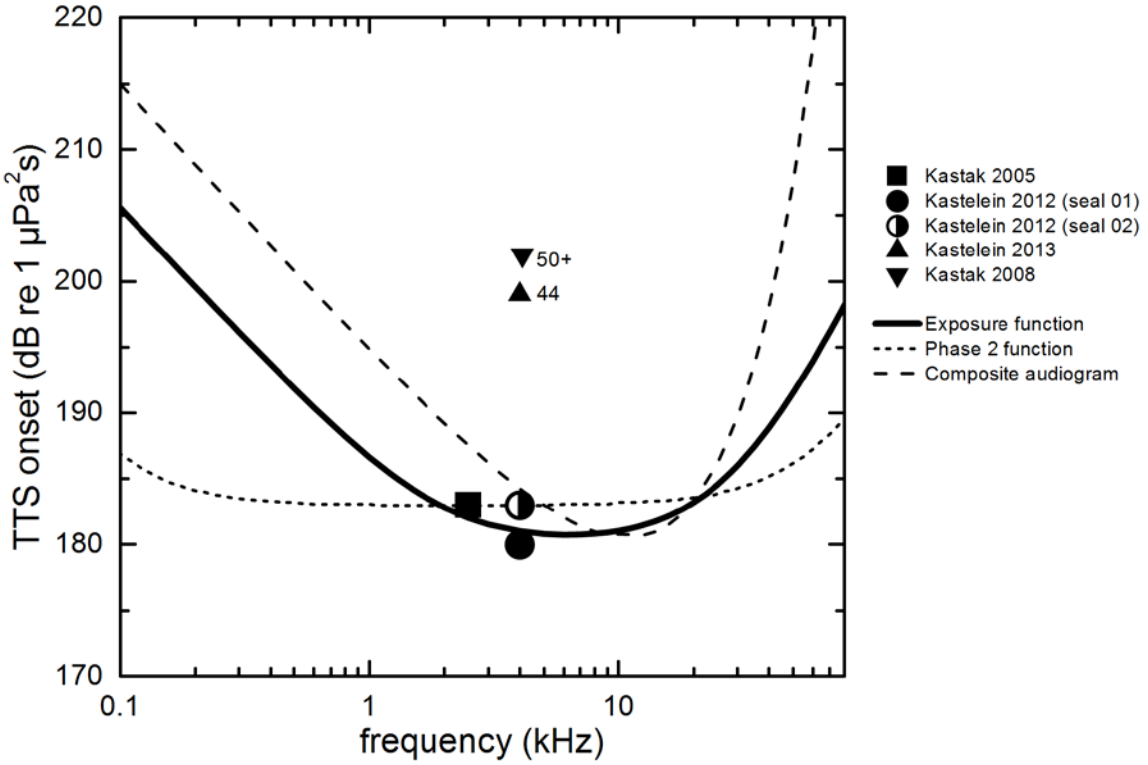


Figure A20. Phocid (underwater) exposure function, (normalized) composite audiogram, and Phase 2 exposure functions compared to phocid TTS data. Large symbols with no numeric values indicate onset TTS exposures. Smaller symbols represent specific amounts of TTS observed, with numeric values giving the amount (or range) or measured TTS.

X. PTS EXPOSURE FUNCTIONS FOR SONARS

As in previous acoustic effects analyses (Southall et al., 2007; Finneran and Jenkins, 2012), the shape of the PTS exposure function for each species group is assumed to be identical to the TTS exposure function for that group. Thus, definition of the PTS function only requires the value for the constant *K* to be determined. This equates to identifying the increase in noise exposure between the onset of TTS and the onset of PTS.

For Phase 2, Navy used a 20-dB difference between TTS onset and PTS onset for cetaceans and a 14-dB difference for phocids, otariids, odobenids, mustelids, ursids, and sirenians (Finneran and Jenkins, 2012). The 20-dB value was based on human data (Ward et al., 1958) and the available marine mammal data, essentially following the extrapolation process proposed by Southall et al. (2007). The 14-dB value was based on a 2.5 dB/dB growth rate reported by Kastak et al. (2007) for a California sea lion tested in air.

For Phase 3, a difference of 20 dB between TTS onset and PTS onset is used for all species groups. This is based on estimates of exposure levels actually required for PTS (i.e., 40 dB of TTS) from the marine mammal TTS growth curves (Table 6), which show differences of 13 to 37 dB (mean = 24, median = 22, n = 9) between TTS onset and PTS onset in marine mammals. These data show most differences between TTS onset and PTS onset are larger than 20 dB and all but one value are larger than 14 dB.

The value of *K* for each PTS exposure function and the weighted PTS threshold are therefore determined by adding 20 dB to the *K*-value for the TTS exposure function or the TTS weighted threshold, respectively (see Table A10).

XI. TTS/PTS EXPOSURE FUNCTIONS FOR EXPLOSIVES

The shapes of the TTS and PTS exposure functions for explosives and other impulsive sources are identical to those used for sonars and other active acoustic sources (i.e., steady-state or non-impulsive noise sources). Thus, defining the TTS and PTS functions only requires the values for the constant *K* to be determined.

Phase 3 analyses for TTS and PTS from underwater detonations and other impulsive sources follow the approach proposed by Southall et al. (2007) and used in Phase 2 analyses (Finneran and Jenkins, 2012), where a weighted SEL threshold is used in conjunction with an unweighted peak SPL threshold. The threshold producing the greater range for effect is used for estimating the effects of the noise exposure.

Peak SPL and SEL thresholds for TTS were based on TTS data from impulsive sound exposures that produced 6 dB or more TTS for the mid- and high-frequency cetaceans (the only groups for which data are available). The peak SPL thresholds were taken directly from the literature: 224 and 196 dB re 1 μPa, for the mid- and high-frequency cetaceans, respectively (Table A9). The SEL-based thresholds were determined by applying the Phase 3 weighting functions for the appropriate species groups to the exposure waveforms that produced TTS, then calculating the resulting weighted SELs. When this method is applied to the exposure data from Finneran et al. (2002) and Lucke et al. (2009), the SEL-based weighted TTS thresholds are 170 and 140 dB re 1 $\mu Pa^2 s$ for the mid- and high-frequency cetaceans, respectively (Table A9). Note that the data from Lucke et al. (2009) are based on AEP measurements and may thus under-estimate TTS onset; however, they are used here because of the very limited nature of the impulse TTS data for marine mammals and the likelihood that the high-frequency cetaceans are more susceptible than the mid-frequency cetaceans (i.e., use of the mid-frequency cetacean value is not appropriate). Based on the limited available data, it is reasonable to assume that the exposures described by Lucke et al. (2009), which produced AEP-measured TTS of up to 20 dB, would have resulted in a behavioral TTS of at least 6 dB.

The harbor porpoise data from Kastelein et al. (2015c) were not used to derive the high-frequency cetacean TTS threshold, since the largest observed TTS was only 4 dB. However, these data provide an opportunity to check the TTS onset proposed for the high-frequency cetacean group. Kastelein et al. (2015c) provide a representative frequency spectrum for a single, simulated pile driving strike at a specific measurement location. When the high-frequency cetacean weighting function is applied to this spectrum and the 1/3-octave SELs combined across frequency, the total weighted SEL for a single strike is found to be 114 dB re 1 $\mu Pa^2 s$. For 2760 impulses, the cumulative, weighted SEL would then be 148 dB re 1 $\mu Pa^2 s$. The average SEL in the pool was reported to be 9 dB lower than the SEL at the measurement position, thus the average, cumulative weighted SEL would be approximately 139 dB re 1 $\mu Pa^2 s$, which compares favorably to the high-frequency cetacean TTS threshold of 140 dB re 1 $\mu Pa^2 s$ derived from the Lucke et al. (2009) air gun data.

For species groups for which no impulse TTS data exist, the weighted SEL thresholds were estimated using the relationship between the steady-state TTS weighted threshold and the impulse TTS weighted threshold for the groups for which data exist (the mid- and high-frequency cetaceans):

$$G_s - G_i = \overline{C_s} - \overline{C_i}, \tag{A11}$$

where G indicates thresholds for a species group for which impulse TTS data are not available, $\overline{C}$ indicates the median threshold for the groups for which data exist, the subscript s indicates a steady-state threshold, and the subscript i indicates an impulse threshold (note that since data are only available for the mid- and high-frequency cetaceans the median and mean are identical). Equation (A11) is equivalent to the relationship used by Southall et al. (2007), who expressed the relationship as $\overline{C_s} - G_s = \overline{C_i} - G_i$. For the mid- and high-frequency cetaceans, the steady-state TTS thresholds are 178 and 153 dB re 1 μPa^{2}s, respectively, and the impulse TTS thresholds are 170 and 140 dB re 1 μPa^{2}s, respectively, making $\overline{C_s} - \overline{C_i}$ = 11 dB. Therefore, for each of the remaining groups the SEL-based impulse TTS threshold is 11 dB below the steady-state TTS threshold (Table A9).

To estimate peak SPL-based thresholds, Southall et al. (2007) used Eq. (A11) with peak-SPL values for the impulse thresholds and SEL-based values for the steady-state thresholds. For the mid- and high-frequency cetaceans, the steady-state (SEL) TTS thresholds are 178 and 153 dB re 1 μPa^{2}s, respectively, and the peak SPL, impulse TTS thresholds are 224 and 196 dB re 1 μPa, respectively, making $\overline{C_s} - \overline{C_i}$ = -44 dB. Based on this relationship, the peak SPL-based impulse TTS threshold (in dB re 1 μPa) would be 44 dB above the steady-state TTS threshold (in dB re 1 μPa^{2}s), making the peak SPL thresholds vary from 222 to 243 dB re 1 μPa. Given the limited nature of the underlying data, and the relatively high values for some of these predictions, for Phase 3 analyses impulsive peak SPL thresholds are estimated using a "dynamic range" estimate based on the difference (in dB) between the impulsive noise, peak SPL TTS onset (in dB re 1 μPa) and the hearing threshold at f_0 (in dB re 1 μPa) for the groups for which data are available (the mid- and high-frequency cetaceans). For the mid-frequency cetaceans, the hearing threshold at f_0 is 54 dB re 1 μPa and the peak SPL TTS threshold is 224 dB re 1 μPa, resulting in a dynamic range of 170 dB. For the high-frequency cetaceans, the hearing threshold at f_0 is 48 dB re 1 μPa and the peak SPL-based TTS threshold is 196 dB re 1 μPa, resulting in a dynamic range of 148 dB. The median dynamic range for the mid- and high-frequency cetaceans is therefore 159 dB (since there are only two values, the mean and median are equal). For the remaining species groups, the impulsive peak SPL-based TTS thresholds are estimated by adding 159 dB to the hearing threshold at f_0 (Table A9).

Since marine mammal PTS data from impulsive noise exposures do not exist, onset-PTS levels for impulsive exposures were estimated by adding 15 dB to the SEL-based TTS threshold and adding 6 dB to the peak pressure based thresholds. These relationships were derived by Southall et al. (2007) from impulse noise TTS growth rates in

chinchillas. The appropriate frequency weighting function for each functional hearing group is applied only when using the SEL-based thresholds to predict PTS.

Table A9. TTS and PTS thresholds for explosives and other impulsive sources. SEL thresholds are in dB re 1 μPa²s and peak SPL thresholds are in dB re 1 μPa.

Group	Hearing threshold at f_0	TTS threshold		PTS threshold	
	SPL (dB SPL)	SEL (weighted) (dB SEL)	peak SPL (dB SPL)	SEL (weighted) (dB SEL)	peak SPL (dB SPL)
LF	54	168	213	183	219
MF	54	170	224	185	230
HF	48	140	196	155	202
SI	61	175	220	190	226
OW	67	188	226	203	232
PW	53	170	212	185	218

XII. SUMMARY

Figure A21 illustrates the shapes of the various Phase 3 auditory weighting functions. Table A10 summarizes the parameters necessary to calculate the weighting function amplitudes using Eq. (A1).

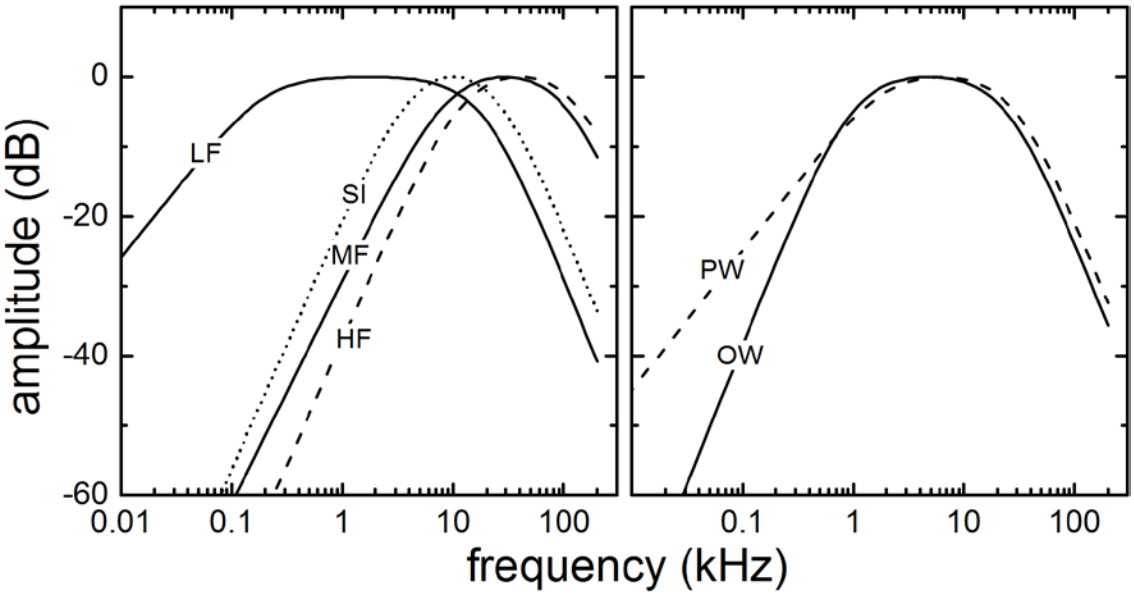


Figure A21. Navy Phase 3 weighting functions for marine mammal species groups exposed to underwater sound. Parameters required to generate the functions are provided in Table A10.

Table A10. Summary of weighting function parameters and TTS/PTS thresholds. SEL thresholds are in dB re 1 μPa²s and peak SPL thresholds are in dB re 1 μPa.

$W(f) = C + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{\left[1+(f/f_1)^2\right]^a\left[1+(f/\right.}\right.$						Non-impulsive		Impulse			
						TTS threshold	PTS threshold	TTS threshold		PTS threshold	
Group	*a*	*b*	f_1 (kHz)	f_2 (kHz)	*C* (dB)	SEL (weighted)	SEL (weighted)	SEL (weighted)	peak SPL (unweighted)	SEL (weighted)	peak SPL (unweighted)
LF	1	2	0.20	19	0.13	179	199	168	213	183	219
MF	1.6	2	8.8	110	1.20	178	198	170	224	185	230
HF	1.8	2	12	140	1.36	153	173	140	196	155	202
SI	1.8	2	4.3	25	2.62	186	206	175	220	190	226
OW	2	2	0.94	25	0.64	199	219	188	226	203	232
PW	1	2	1.9	30	0.75	181	201	170	212	185	218

To properly compare the TTS/PTS criteria and thresholds used by Navy for Phase 2 and Phase 3, both the weighting function shape and weighted threshold values must be taken into account; the weighted thresholds by themselves only indicate the TTS/PTS threshold at the most susceptible frequency (based on the relevant weighting function). Since the exposure functions incorporate both the shape of the weighting function and the weighted threshold value, they provide the best means of comparing the frequency-dependent TTS/PTS thresholds for Phase 2 and 3 (Figs A22 and A23).

The most significant differences between the Phase 2 and Phase 3 functions include the following:

(1) Thresholds at low frequencies are generally higher for Phase 3 compared to Phase 2. This is because the Phase 2 weighting functions utilized the "M-weighting" functions (Southall et al., 2007) at lower frequencies, where no TTS existed at that time. Since derivation of the Phase 2 thresholds, additional data have been collected (e.g., Kastelein et al., 2012a; Kastelein et al., 2013b; Kastelein et al., 2014b) to support the use of exposure functions that continue to increase at frequencies below the region of best sensitivity, similar to the behavior of mammalian audiograms and human auditory weighting functions.

(2) In the frequency region near best hearing sensitivity, the Phase 3 underwater thresholds for otariids and other marine carnivores (group OW) are lower than those used in Phase 2. In Phase 2, the TTS onset for the otariids was taken directly from the published literature (Kastak et al., 2005); for Phase 3, the actual TTS data from Kastak et al. (2005) were fit by a TTS growth curve using identical methods as those used with the other species groups.

(3) Impulsive TTS/PTS thresholds near the region of best hearing sensitivity are lower for Phase 3 compared to Phase 2.

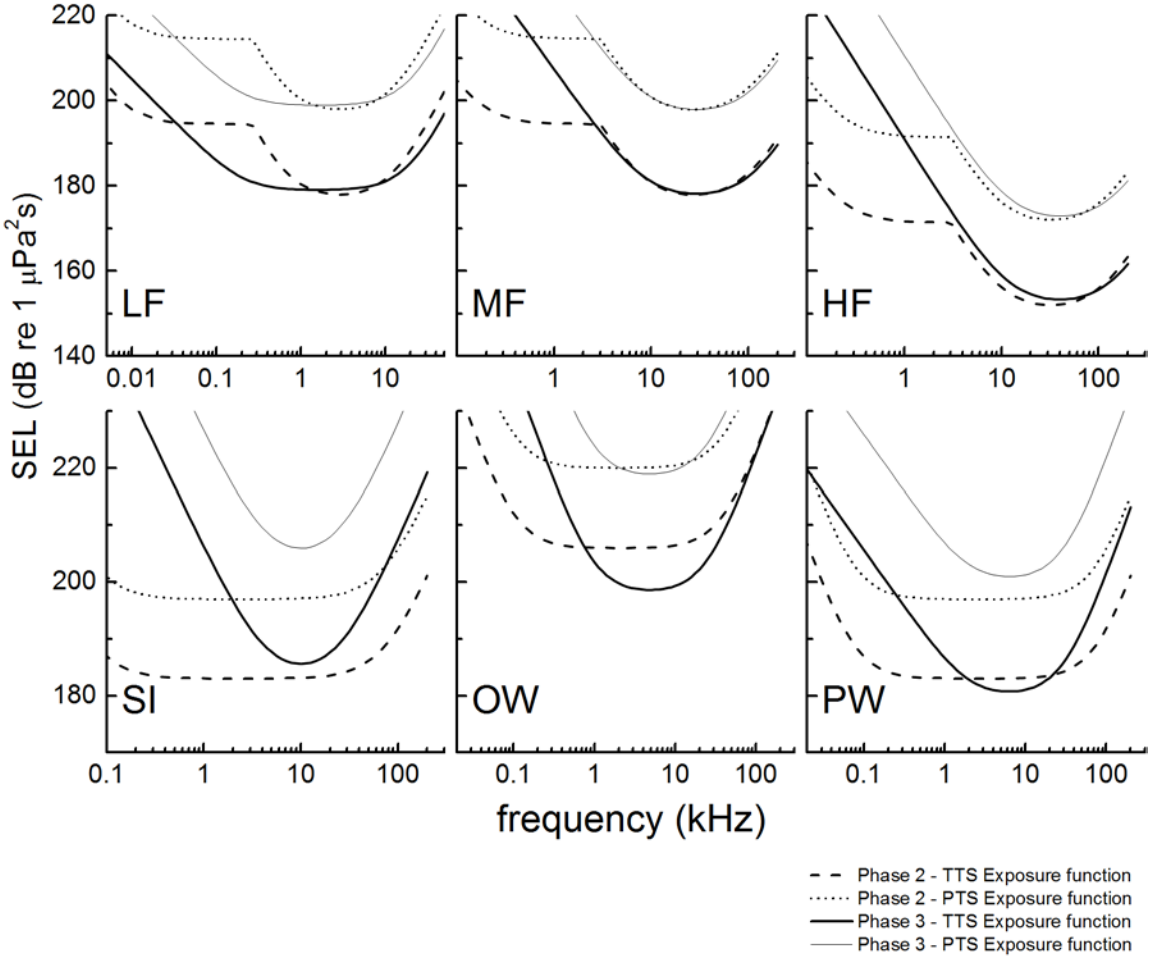


Figure A22. TTS and PTS exposure functions for sonars and other (non-impulsive) active acoustic sources. Heavy solid lines — Navy Phase 3 TTS exposure functions (Table A10). Thin solid lines — Navy Phase 3 PTS exposure functions for TTS (Table A10). Dashed lines — Navy Phase 2 TTS exposure functions. Short dashed lines — Navy Phase 2 PTS exposure functions.

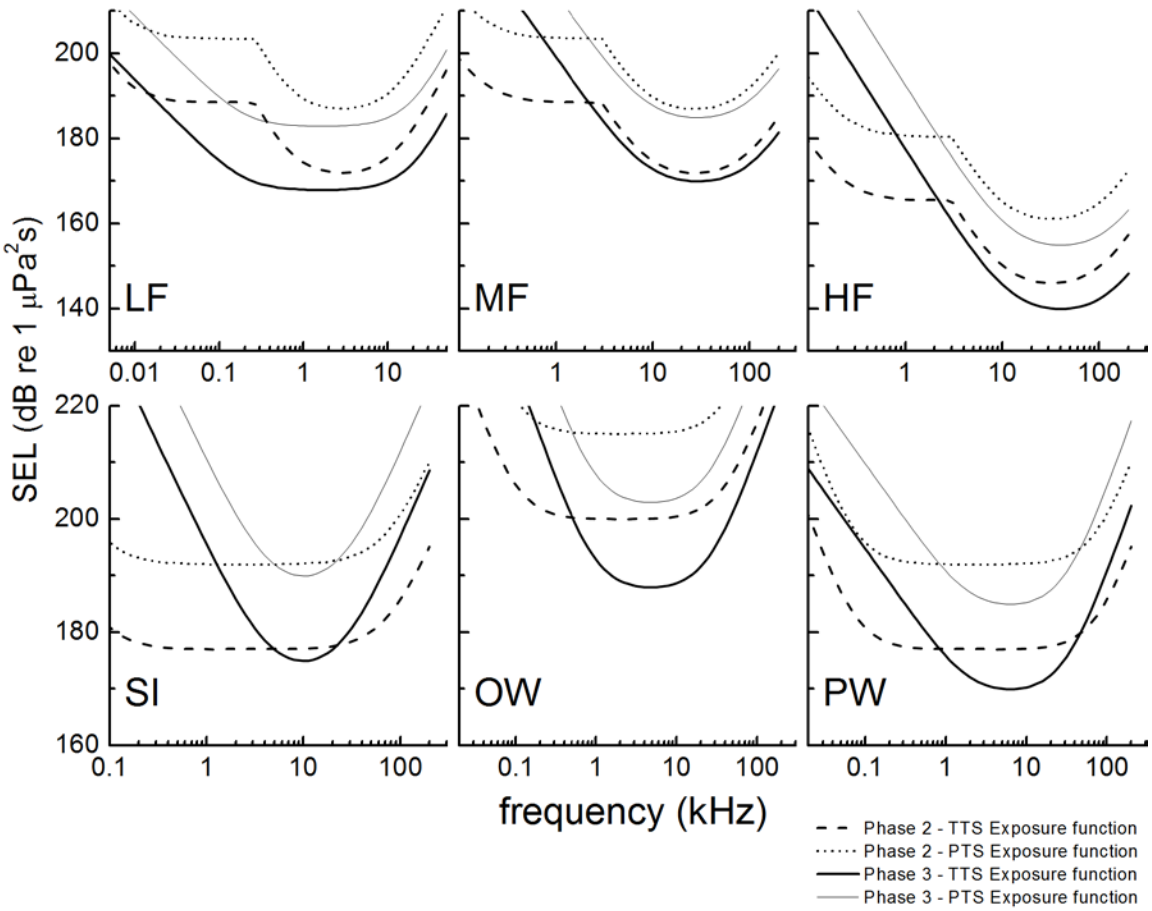


Figure A23. TTS and PTS exposure functions for explosives, impact pile driving, air guns, and other impulsive sources. Heavy solid lines — Navy Phase 3 TTS exposure functions (Table A10). Thin solid lines — Navy Phase 3 PTS exposure functions for TTS (Table A10). Dashed lines — Navy Phase 2 TTS exposure functions. Short dashed lines — Navy Phase 2 PTS exposure functions.

APPENDIX A1. ESTIMATING A LOW-FREQUENCY CETACEAN AUDIOGRAM

A1.1. BACKGROUND

Psychophysical and/or electrophysiological auditory threshold data exist for at least one species within each hearing group, except for the low-frequency (LF) cetacean (i.e., mysticete) group, for which no direct measures of auditory threshold have been made. For this reason, an alternative approach was necessary to estimate the composite audiogram for the LF cetacean group.

The published data sources available for use in estimating mysticete hearing thresholds consist of: cochlear frequency-place maps created from anatomical measurements of basilar membrane dimensions (e.g., Ketten, 1994; Parks et al., 2007); scaling relationships between inter-aural time differences and upper-frequency limits of hearing (see Ketten, 2000); finite element models of head-related and middle-ear transfer functions (Tubelli et al., 2012; Cranford and Krysl, 2015); a relative hearing sensitivity curve derived by integrating cat and human threshold data with a frequency-place map for the humpback whale (Houser et al., 2001); and measurements of the source levels and frequency content of mysticete vocalizations (see review by Tyack and Clark, 2000). These available data sources are applied here to estimate a mysticete composite audiogram. Given that these data are limited in several regards and are quite different from the type of data supporting composite audiograms in other species, additional sources of information, such as audiograms from other marine mammals, are also considered and applied to make conservative extrapolations at certain decision points.

Mathematical models based on anatomical data have been used to predict hearing curves for several mysticete species (e.g., Ketten and Mountain, 2009; Cranford and Krysl, 2015). However, these predictions are not directly used to derive the composite audiogram for LF cetaceans for two primary reasons:

> (1) There are no peer-reviewed publications that provide a complete description of the mathematical process by which frequency-place maps based on anatomical measurements were integrated with models of middle-ear transfer functions and/or other information to derive the predicted audiograms presented in several settings by Ketten/Mountain (e.g., Ketten and Mountain, 2009). As a result, the validity of the resulting predicted audiograms cannot be independently evaluated, and these data cannot be used in the present effort.
>
> (2) Exclusion of the Ketten/Mountain predicted audiograms leaves only the Cranford/Krysl predicted fin whale hearing curve (Cranford and Krysl, 2015). However, this curve cannot be used by itself to predict hearing thresholds for all mysticetes because:

(a) The Cranford/Krysl model is based on sound transmission through the head to the ear of the fin whale, but does not include the sensory receptors of the cochlea. There is therefore no way to properly predict the upper cutoff of hearing and the shape of the audiogram at frequencies above the region of best predicted sensitivity.

(b) The audiogram does not possess the typical shape one would expect for an individual with normal hearing based on measurements from other mammals. Specifically, the "hump" in the low-frequency region and the shallow roll-off at high frequencies do not match patterns typically seen in audiometric data from other mammals with normal hearing. Given these considerations, the proposed audiogram cannot be considered representative of all mysticetes without other supporting evidence. Although the specific numeric thresholds from Cranford and Krysl (2015) are not directly used in the revised approach explained here, the predicted thresholds are still used to inform the LF cetacean composite audiogram derivation.

Vocalization data also cannot be used to directly estimate auditory sensitivity and audible range, since there are many examples of mammals that vocalize below the frequency range where they have best hearing sensitivity, and well below their upper hearing limit. However, it is generally expected that animals have at least some degree of overlap between the auditory sensitivity curve and the predominant frequencies present in conspecific communication signals. Therefore vocalization data can be used to evaluate, at least at a general level, whether the composite audiogram is reasonable; i.e., to ensure that the predicted thresholds make sense given what we know about animal vocalization frequencies, source levels, and communication range.

The realities of the currently available data leave only a limited amount of anatomical data and finite element modeling results to guide the derivation of the LF cetacean composite audiogram, supplemented with extrapolations from the other marine mammal species groups where necessary and a broad evaluation of the resulting audiogram in the context of whale bioacoustics.

A1.2. AUDIOGRAM FUNCTIONAL FORM AND REQUIRED PARAMETERS

Navy Phase 3 composite audiograms are defined by the equation

$$T(f) = T_0 + A\log_{10}\left(1 + \frac{F_1}{f}\right) + \left(\frac{f}{F_2}\right)^B, \qquad \text{(A1.1)}$$

where $T(f)$ is the threshold at frequency f, and T_0, F_1, F_2, A, and B are constants. To understand the physical significance and influence of the parameters T_0, F_1, F_2, A, and B, Eq. (A1.1) may be viewed as the sum of three individual terms:

$$T(f) = T_0 + L(f) + H(f), \tag{A1.2}$$

where

$$L(f) = A\log_{10}\left(1 + \frac{F_1}{f}\right), \tag{A1.3}$$

and

$$H(f) = \left(\frac{f}{F_2}\right)^B. \tag{A1.4}$$

The first term, T_0, controls the vertical position of the curve; i.e., T_0 shifts the audiogram up and down.

The second term, $L(f)$, controls the low-frequency behavior of the audiogram. At low frequencies, when $f < F_1$, Eq. (A1.3) approaches

$$L(f) = A\log_{10}\left(\frac{F_1}{f}\right), \tag{A1.5}$$

which can also be written as

$$L(f) = A\log_{10} F_1 - A\log_{10} f. \tag{A1.6}$$

Equation (A.6) has the form of $y(x) = b - Ax$, where $x = \log_{10} f$; i.e., Eq. (A.6) describes a linear function of the logarithm of frequency. This means that, as frequency gets smaller and smaller, Eq. (A.3) — the low-frequency portion of the audiogram function — approaches a linear function with the logarithm of frequency, and has a slope of $-A$ dB/decade. As frequency increases towards F_1, $L(f)$ asymptotically approaches zero.

The third term, $H(f)$, controls the high-frequency behavior of the audiogram. At low frequencies, when $f << F_2$, Eq. (A1.4) has a value of zero. As f increases, $H(f)$ exponentially grows. The parameter F_2 defines the frequency at which the thresholds begin to exponentially increase, while the factor B controls the rate at which thresholds increase. Increasing F_2 will move the upper cutoff frequency to the right (to higher frequencies). Increasing B will increase the "sharpness" of the high-frequency increase.

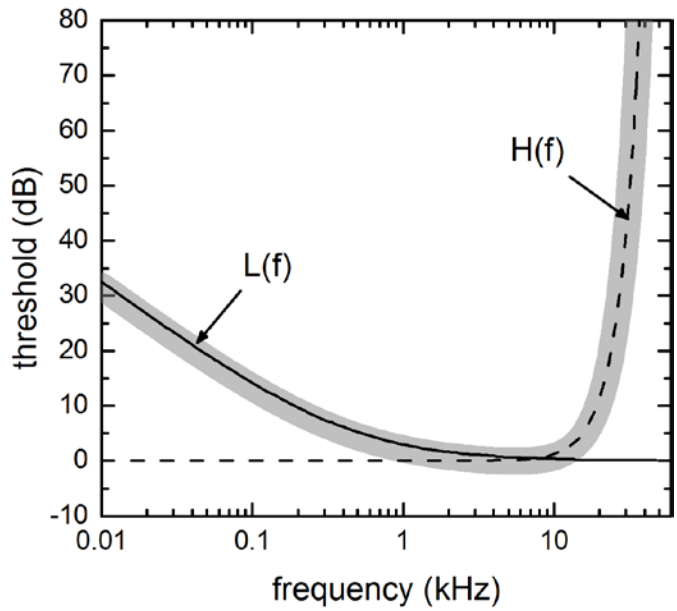


FIGURE A1.1. Relationship between estimated threshold, T(f), (thick, gray line), low-frequency term, L(f), (solid line), and high-frequency term, H(f), (dashed line).

A1.3. ESTIMATING AUDIOGRAM PARAMETERS

To derive a composite mysticete audiogram using Eq. (A1.1), the values of T_0, F_1, F_2, A, and B must be defined. The value for T_0 is determined by either adjusting T_0 to place the lowest threshold value to zero (to obtain a normalized audiogram), or to place the lowest expected threshold at a specific SPL (in dB re 1 μPa). For Navy Phase 3 analyses, the lowest LF cetacean threshold is defined to match the median threshold of the in-water marine mammal species groups (MF cetaceans, HF cetaceans, sirenians, otariids and other marine carnivores in water, and phocids in water; median = 54 dB re 1 μPa). The choices for the other parameters are informed by the published information regarding mysticete hearing.

The constant A is defined by assuming a value for the low-frequency slope of the audiogram, in dB/decade. Most mammals for which thresholds have been measured have low-frequency slopes ~30 to 40 dB/decade. However, finite element models of middle ear function in fin whales (Cranford and Krysl, 2015) and minke whales (Tubelli et al., 2012) suggest lower slopes, of ~25 or 20 dB/decade, respectively. **We therefore conservatively assume that A = 20 dB/decade.**

To define F_1, we first define the variable T' as the maximum threshold tolerance within the frequency region of best sensitivity (i.e., within the frequency range of best sensitivity, thresholds are within T' dB of the lowest threshold). Further, let f' be the lower frequency bound of the region of best sensitivity. When $f = f'$, $L(f) = T'$, and Eq. (A1.3) can then be solved for F_1 as a function of f', T', and A:

$$F_1 = f'\left(10^{T'/A} - 1\right). \quad \text{(A1.7)}$$

Anatomically-based models of mysticete hearing have resulted in various estimates for audible frequency ranges and frequencies of best sensitivity. Houser et al. (2001) estimated best sensitivity in humpback whales to occur in the range of 2 to 6 kHz, with thresholds within 3 dB of best sensitivity from ~1.4 to 7.8 kHz. For right whales, Parks et al. (2007) estimated the audible frequency range to be 10 Hz to 22 kHz. For minke whales, Tubelli et al. (2012) estimated the most sensitive hearing range, defined as the region with thresholds within 40 dB of best sensitivity, to extend from 30 to 100 Hz up to 7.5 to 25 kHz, depending on the specific model used. Cranford and Krysl (2015) predicted best sensitivity in fin whales to occur at 1.2 kHz, with thresholds within 3-dB of best sensitivity from ~1 to 1.5 kHz. Together, these model results broadly suggest best sensitivity (thresholds within ~3 dB of the lowest threshold) from ~1 to 8 kHz, and thresholds within ~40 dB of best sensitivity as low as ~30 Hz and up to ~25 kHz.

Based on this information, we assume LF cetacean thresholds are within 3 dB of the lowest threshold over a frequency range of 1 to 8 kHz, therefore T' = 3 dB and f' = 1 kHz, resulting in $\boldsymbol{F_1}$ **= 0.41 kHz** [Eq. (A1.7)]. In other words, we define F_1 so that thresholds are ≤ 3 dB relative to the lowest threshold when the frequency is within the region of best sensitivity (1 to 8 kHz).

To define the high-frequency portion of the audiogram, the values of B and F_2 must be estimated. To estimate B for LF cetaceans, we take the median of the B values from the composite audiograms for the other in-water marine mammal species groups (MF cetaceans, HF cetaceans, sirenians, otariids and other marine carnivores in water, and phocids in water). **This results in B = 3.2 for the LF cetaceans.** Once B is defined, F_2 is adjusted to achieve a threshold value at 30 kHz of 40 dB relative to the lowest threshold. **This results in F_2 = 9.4 kHz. Finally, T_0 is adjusted to set the lowest threshold value to 0 dB for the normalized curve, or 54 dB re 1 µPa for the non-normalized curve; this results in T_0 = -0.81 and 53.19 for the normalized and non-normalized curves, respectively.**

The resulting composite audiogram is shown in Fig. A1.2. For comparison, predicted audiograms for the fin whale (Cranford and Krysl, 2015), and humpback whale (Houser et al., 2001) are included. The LF cetacean composite audiogram has lowest threshold at 5.6 kHz, but the audiogram is fairly shallow in the region of best sensitivity, and thresholds are within 1 dB of the lowest threshold from ~1.8 to 11 kHz, and within 3 dB of the lowest threshold from ~0.75 to 14 kHz. Low-frequency (< ~500 Hz) thresholds are considerably lower than those predicted by Cranford and Krysl (2015). High-frequency thresholds are also substantially lower than those predicted for the fin whale, with thresholds at 30 kHz only 40 dB above best hearing thresholds, and those at 40 kHz approximately 90 dB above best threshold. The resulting LF composite audiogram appears reasonable in a general sense relative the predominant frequencies present in mysticete conspecific vocal communication signals. While some species (e.g., blue whales) produce some extremely low (e.g., 10 Hz) frequency call components, the majority of mysticete social calls occur in the few tens of Hz to few kHz range,

overlapping reasonably well with the predicted auditory sensitivity shown in the composite audiogram (within ~0 to 30 dB of predicted best sensitivity). A general pattern of some social calls containing energy shifted below the region of best hearing sensitivity is well-documented in other low-frequency species including many phocid seals (see Wartzok and Ketten, 1999) and some terrestrial mammals, notably the Indian elephant (Heffner and Heffner, 1982).

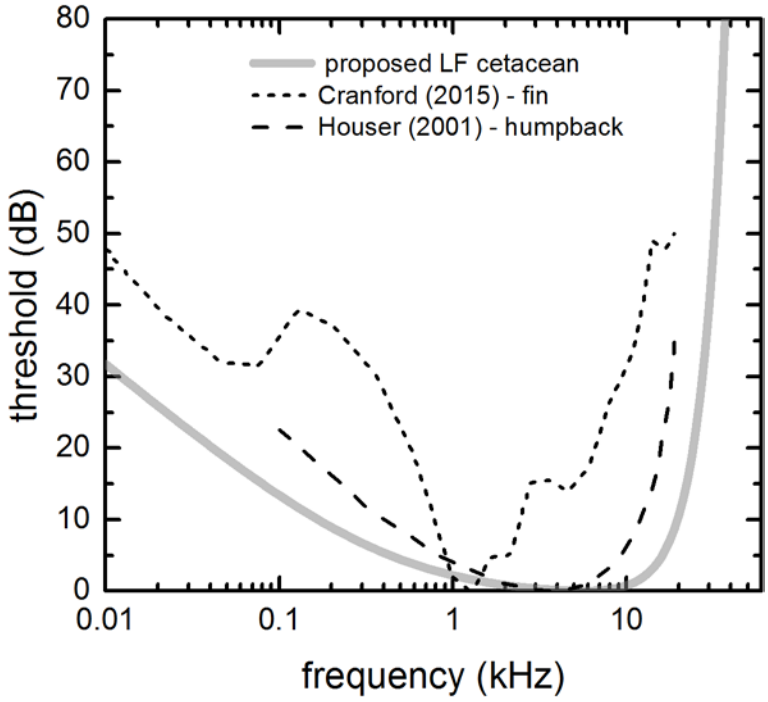


FIGURE A1.2. Comparison of proposed LF cetacean thresholds to those predicted by anatomical and finite-element models.

XIII. REFERENCES

American National Standards Institute (ANSI) (**2001**). "Design Response of Weighting Networks for Acoustical Measurements," ANSI S1.42-2001 (Acoustical Society of America). 14 pp.

Awbrey, F.T., Thomas, J.A., and Kastelein, R.A. (**1988**). "Low-frequency underwater hearing sensitivity in belugas, *Delphinapterus leucas*," J. Acoust. Soc. Am. 84, 2273-2275.

Babushina, E.S., Zaslavsky, G.L., and Yurkevich, L.I. (**1991**). "Air and underwater hearing of the northern fur seal - audiograms and auditory frequency discrimination," Biofizika 36, 904-907.

Brill, R.L., Moore, P.W.B., and Dankiewicz, L.A. (**2001**). "Assessment of dolphin (*Tursiops truncatus*) auditory sensitivity and hearing loss using jawphones," J. Acoust. Soc. Am. 109, 1717-1722.

Cranford, T.W. and Krysl, P. (**2015**). "Fin whale sound reception mechanisms: Skull vibration enables low-frequency hearing," PLoS ONE 10, 1-17.

Dow Piniak, W.E., Eckert, S.A., Harms, C.A., and Stringer, E.M. (**2012**). "Underwater hearing sensitivity of the leatherback sea turtle (Dermochelys coriacea): Assessing the potential effect of anthropogenic noise."

Finneran, J.J. (**2010**). "Auditory weighting functions and frequency-dependent effects of sound in bottlenose dolphins (*Tursiops truncatus*)," (Office of Naval Research (ONR), Washington, DC).

Finneran, J.J. (**2015**). "Noise-induced hearing loss in marine mammals: A review of temporary threshold shift studies from 1996 to 2015," J. Acoust. Soc. Am. 138, 1702-1726.

Finneran, J.J. and Schlundt, C.E. (**2010**). "Frequency-dependent and longitudinal changes in noise-induced hearing loss in a bottlenose dolphin (*Tursiops truncatus*)," J. Acoust. Soc. Am. 128, 567-570.

Finneran, J.J. and Schlundt, C.E. (**2011**). "Subjective loudness level measurements and equal loudness contours in a bottlenose dolphin (*Tursiops truncatus*)," J. Acoust. Soc. Am. 130, 3124-3136.

Finneran, J.J. and Jenkins, A.K. (**2012**). "Criteria and Thresholds for U.S. Navy Acoustic and Explosive Effects Analysis," (SSC Pacific, San Diego, CA).

Finneran, J.J. and Schlundt, C.E. (**2013**). "Effects of fatiguing tone frequency on temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*)," J. Acoust. Soc. Am. 133, 1819-1826.

Finneran, J.J., Dear, R., Carder, D.A., and Ridgway, S.H. (**2003**). "Auditory and behavioral responses of California sea lions (*Zalophus californianus*) to single underwater impulses from an arc-gap transducer," J. Acoust. Soc. Am. 114, 1667-1677.

Finneran, J.J., Carder, D.A., Schlundt, C.E., and Ridgway, S.H. (**2005a**). "Temporary threshold shift (TTS) in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones," J. Acoust. Soc. Am. 118, 2696-2705.

Finneran, J.J., Schlundt, C.E., Branstetter, B., and Dear, R.L. (**2007**). "Assessing temporary threshold shift in a bottlenose dolphin (*Tursiops truncatus*) using multiple simultaneous auditory evoked potentials," J. Acoust. Soc. Am. 122, 1249–1264.

Finneran, J.J., Carder, D.A., Schlundt, C.E., and Dear, R.L. (**2010a**). "Temporary threshold shift in a bottlenose dolphin (*Tursiops truncatus*) exposed to intermittent tones," J. Acoust. Soc. Am. 127, 3267-3272.

Finneran, J.J., Carder, D.A., Schlundt, C.E., and Dear, R.L. (**2010b**). "Growth and recovery of temporary threshold shift (TTS) at 3 kHz in bottlenose dolphins (*Tursiops truncatus*)," J. Acoust. Soc. Am. 127, 3256-3266.

Finneran, J.J., Schlundt, C.E., Dear, R., Carder, D.A., and Ridgway, S.H. (**2002**). "Temporary shift in masked hearing thresholds (MTTS) in odontocetes after exposure to single underwater impulses from a seismic watergun," J. Acoust. Soc. Am. 111, 2929-2940.

Finneran, J.J., Schlundt, C.E., Branstetter, B.K., Trickey, J., Bowman, V., and Jenkins, K. (**2015**). "Effects of multiple impulses from a seismic air gun on bottlenose dolphin hearing and behavior," J. Acoust. Soc. Am. 137, 1634-1646.

Finneran, J.J., Schlundt, C.E., Carder, D.A., Clark, J.A., Young, J.A., Gaspin, J.B., and Ridgway, S.H. (**2000**). "Auditory and behavioral responses of bottlenose dolphins (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*) to impulsive sounds resembling distant signatures of underwater explosions," J. Acoust. Soc. Am. 108, 417-431.

Finneran, J.J., Carder, D.A., Dear, R., Belting, T., McBain, J., Dalton, L., and Ridgway, S.H. (**2005b**). "Pure tone audiograms and possible aminoglycoside-induced hearing loss in belugas (*Delphinapterus leucas*)," J. Acoust. Soc. Am. 117, 3936-3943.

Gaspard, J.C., III, Bauer, G.B., Reep, R.L., Dziuk, K., Cardwell, A., Read, L., and Mann, D.A. (**2012**). "Audiogram and auditory critical ratios of two Florida manatees (*Trichechus manatus latirostris*)," J. Exp. Biol. 215, 1442-1447.

Gerstein, E.R., Gerstein, L., Forsythe, S.E., and Blue, J.E. (**1999**). "The underwater audiogram of the West Indian manatee (*Trichechus manatus*)," J. Acoust. Soc. Am. 105, 3575-3583.

Ghoul, A. and Reichmuth, C. (**2014**). "Hearing in the sea otter (Enhydra lutris): auditory profiles for an amphibious marine carnivore," Journal of comparative physiology. A, Neuroethology, sensory, neural, and behavioral physiology 200, 967-981.

Heffner, R.S. and Heffner, H.E. (**1982**). "Hearing in the elephant (*Elephas maximus*): Absolute sensitivity, frequency discrimination, and sound localization," Journal of Comparative and Physiological Psychology 96, 926-944.

Houser, D.S., Helweg, D.A., and Moore, P.W.B. (**2001**). "A bandpass filter-bank model of auditory sensitivity in the humpback whale," Aquatic Mammal. 27, 82-91.

Jacobs, D.W. and Hall, J.D. (**1972**). "Auditory thresholds of a fresh water dolphin, *Inia geoffrensis Blainville*," J. Acoust. Soc. Am. 51, 530-533.

Johnson, C.S. (**1967**). "Sound detection thresholds in marine mammals," in *Marine Bioacoustics*, edited by W.N. Tavolga (Pergamon Press, Oxford), pp. 247-260.

Johnson, C.S., McManus, M.W., and Skaar, D. (**1989**). "Masked tonal hearing thresholds in the beluga whale," J. Acoust. Soc. Am. 85, 2651-2654.

Kastak, D. and Schusterman, R.J. (**1999**). "In-air and underwater hearing sensitivity of a northern elephant seal (*Mirounga angustirostris*)," Canadian Journal of Zoology 77, 1751-1758.

Kastak, D., Southall, B.L., Schusterman, R.J., and Kastak, C.R. (**2005**). "Underwater temporary threshold shift in pinnipeds: effects of noise level and duration," J. Acoust. Soc. Am. 118, 3154-3163.

Kastak, D., Mulsow, J., Ghoul, A., and Reichmuth, C. (**2008**). "Noise-induced permanent threshold shift in a harbor seal," J. Acoust. Soc. Am. 123, 2986(A).

Kastak, D., Reichmuth, C., Holt, M.M., Mulsow, J., Southall, B.L., and Schusterman, R.J. (**2007**). "Onset, growth, and recovery of in-air temporary threshold shift in a California sea lion (*Zalophus californianus*)," J. Acoust. Soc. Am. 122, 2916–2924.

Kastelein, R., Gransier, R., van Mierlo, R., Hoek, L., and de Jong, C. (**2011**). "Temporary hearing threshold shifts and recovery in a harbor porpoise (*Phocoena phocoena*) and harbor seals (*Phoca vitulina*) exposed to white noise in a 1/1 octave band around 4 kHz," J. Acoust. Soc. Am. 129, 2432 (A).

Kastelein, R.A., Gransier, R., and Hoek, L. (**2013a**). "Comparative temporary threshold shifts in a harbor porpoise and harbor seal, and severe shift in a seal," J. Acoust. Soc. Am. 134, 13-16.

Kastelein, R.A., Hagedoorn, M., Au, W.W.L., and de Haan, D. (**2003**). "Audiogram of a striped dolphin (*Stenella coeruleoalba*)," J. Acoust. Soc. Am. 113, 1130-1137.

Kastelein, R.A., van Schie, R., Verboom, W.C., and de Haan, D. (**2005**). "Underwater hearing sensitivity of a male and a female Steller sea lion (*Eumetopias jubatus*)," J. Acoust. Soc. Am. 118, 1820-1829.

Kastelein, R.A., Wensveen, P., Hoek, L., and Terhune, J.M. (**2009**). "Underwater hearing sensitivity of harbor seals (*Phoca vitulina*) for narrow noise bands between 0.2 and 80 kHz," J. Acoust. Soc. Am. 126, 476–483.

Kastelein, R.A., Hoek, L., de Jong, C.A.F., and Wensveen, P.J. (**2010**). "The effect of signal duration on the underwater detection thresholds of a harbor porpoise (*Phocoena phocoena*) for single frequency-modulated tonal signals between 0.25 and 160 kHz," J. Acoust. Soc. Am. 128, 3211-3222.

Kastelein, R.A., Gransier, R., Hoek, L., and Olthuis, J. (**2012a**). "Temporary threshold shifts and recovery in a harbor porpoise (*Phocoena phocoena*) after octave-band noise at 4 kHz," J. Acoust. Soc. Am. 132, 3525-3537.

Kastelein, R.A., Gransier, R., Hoek, L., and Rambags, M. (**2013b**). "Hearing frequency thresholds of a harbor porpoise (*Phocoena phocoena*) temporarily affected by a continuous 1.5 kHz tone," J. Acoust. Soc. Am. 134, 2286-2292.

Kastelein, R.A., Schop, J., Gransier, R., and Hoek, L. (**2014a**). "Frequency of greatest temporary hearing threshold shift in harbor porpoises (*Phocoena phocoena*) depends on the noise level," J. Acoust. Soc. Am. 136, 1410-1418.

Kastelein, R.A., Schop, J., Hoek, L., and Covi, J. (**2015a**). "Hearing thresholds of a harbor porpoise (*Phocoena phocoena*) for narrow-band sweeps," J. Acoust. Soc. Am. 138, 2508-2512.

Kastelein, R.A., Gransier, R., Schop, J., and Hoek, L. (**2015b**). "Effects of exposure to intermittent and continuous 6–7 kHz sonar sweeps on harbor porpoise (*Phocoena phocoena*) hearing," J. Acoust. Soc. Am. 137, 1623-1633.

Kastelein, R.A., Gransier, R., Marijt, M.A.T., and Hoek, L. (**2015c**). "Hearing frequency thresholds of harbor porpoises (*Phocoena phocoena*) temporarily affected by played back offshore pile driving sounds," J. Acoust. Soc. Am. 137, 556-564.

Kastelein, R.A., Bunskoek, P., Hagedoorn, M., Au, W.W.L., and de Haan, D. (**2002a**). "Audiogram of a harbor porpoise (*Phocoena phocoena*) measured with narrow-band frequency-modulated signals," J. Acoust. Soc. Am. 112, 334-344.

Kastelein, R.A., Mosterd, P., van Santen, B., Hagedoorn, M., and de Haan, D. (**2002b**). "Underwater audiogram of a Pacific walrus (*Odobenus rosmarus divergens*) measured with narrow-band frequency-modulated signals," J. Acoust. Soc. Am. 112, 2173-2182.

Kastelein, R.A., Gransier, R., Hoek, L., Macleod, A., and Terhune, J.M. (**2012b**). "Hearing threshold shifts and recovery in harbor seals (*Phoca vitulin*a) after octave-band noise exposure at 4 kHz," J. Acoust. Soc. Am. 132, 2745-2761.

Kastelein, R.A., Hoek, L., Gransier, R., Rambags, M., and Claeys, N. (**2014b**). "Effect of level, duration, and inter-pulse interval of 1-2 kHz sonar signal exposures on harbor porpoise hearing," J. Acoust. Soc. Am. 136, 412-422.

Ketten, D.R. (**1994**). "Functional analyses of whale ears: adaptations for underwater hearing," in *IEEE Proceedings in Underwater Acoustics*, pp. 264-270.

Ketten, D.R. (**2000**). "Cetacean ears," in *Hearing by Whales and Dolphins*, edited by W. Au, A.N. Popper, and R.R. Fay (Springer-Verlag, New York), pp. 43-108.

Ketten, D.R. and Mountain, D. (**2009**). "Final report: modeling minke whale hearing," (submitted to E&P Sound and Marine Life Programme).

Kryter, K.D., Ward, W.D., Miller, J.D., and Eldredge, D.H. (**1966**). "Hazardous exposure to intermittent and steady-state noise," J. Acoust. Soc. Am. 39, 451-464.

Lemonds, D.W. (**1999**). "Auditory filter shapes in an Atlantic bottlenose dolphin (*Tursiops truncatus*)," University of Hawaii (PhD). 74 pp.

Ljungblad, D.K., Scroggins, P.D., and Gilmartin, W.G. (**1982**). "Auditory thresholds of a captive Eastern Pacific bottle-nosed dolphin, *Tursiops* spp.," J. Acoust. Soc. Am. 72, 1726-1729.

Lucke, K., Siebert, U., Lepper, P.A., and Blanchet, M.-A. (**2009**). "Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli," J. Acoust. Soc. Am. 125, 4060–4070.

Martin, K.J., Alessi, S.C., Gaspard, J.C., Tucker, A.D., Bauer, G.B., and Mann, D.A. (**2012**). "Underwater hearing in the loggerhead turtle (*Caretta caretta*): a comparison of behavioral and auditory evoked potential audiograms," J. Exp. Biol. 215, 3001-3009.

Maslen, K.R. (**1981**). "Towards a better understanding of temporary threshold shift of hearing," Applied Acoustics 14, 281-318.

Miller, J.D., Watson, C.S., and Covell, W.P. (**1963**). "Deafening effects of noise on the cat," Acta Oto-Laryngologica Supplement 176, 1-88.

Mooney, T.A., Nachtigall, P.E., Breese, M., Vlachos, S., and Au, W.W.L. (**2009**). "Predicting temporary threshold shifts in a bottlenose dolphin (*Tursiops truncatus*): The effects of noise level and duration," J. Acoust. Soc. Am. 125, 1816-1826.

Moore, P.W.B. and Schusterman, R.J. (**1987**). "Audiometric assessment of northern fur seals, *Callorhinus ursinus*," Mar. Mammal Sci. 3, 31-53.

Mulsow, J., Houser, D.S., and Finneran, J.J. (**2012**). "Underwater psychophysical audiogram of a young male California sea lion (*Zalophus californianus*)," J. Acoust. Soc. Am. 131, 4182-4187.

Mulsow, J., Schlundt, C.E., Brandt, L., and Finneran, J.J. (**2015**). "Equal latency contours for bottlenose dolphins (*Tursiops truncatus*) and California sea lions (*Zalophus californianus*)," J. Acoust. Soc. Am. 138, 2678-2691.

Nachtigall, P.E., Lemonds, D.W., and Roitblat, H.L. (**2000**). "Psychoacoustic studies of dolphin and whale hearing," in *Hearing by Whales and Dolphins*, edited by W.W.L. Au, A.N. Popper, and R.R. Fay (Springer, New York, NY), pp. 330-363.

Nachtigall, P.E., Au, W.W.L., Pawloski, J., and Moore, P.W.B. (**1995**). "Risso's dolphin (*Grampus griseus*) hearing thresholds in Kaneohe Bay, Hawaii," in *Sensory Systems of Aquatic Mammals*, edited by R.A. Kastelein, J.A. Thomas, and P.E. Nachtigall (DeSpil, Woerden, The Netherlands), pp. 49-53.

National Research Council (NRC) (**2003**). *Ocean Noise and Marine Mammals* (National Academies Press, Washington, DC). 219 pp.

Parks, S.E., Ketten, D.R., O'Malley, J.T., and Arruda, J. (**2007**). "Anatomical predictions of hearing in the North Atlantic right whale," The Anatomical Record 290, 734–744.

Pfingst, B.E., Hienz, R., Kimm, J., and Miller, J. (**1975**). "Reaction-time procedure for measurement of hearing. I. Suprathreshold functions," J. Acoust. Soc. Am. 57, 421-430.

Popov, V.V., Supin, A.Y., Rozhnov, V.V., Nechaev, D.I., and Sysueva, E.V. (**2014**). "The limits of applicability of the sound exposure level (SEL) metric to temporal threshold shifts (TTS) in beluga whales, *Delphinapterus leucas*," J. Exp. Biol. 217, 1804-1810.

Popov, V.V., Nechaev, D.I., Sysueva, E.V., Rozhnov, V.V., and Supin, A.Y. (**2015**). "Spectrum pattern resolution after noise exposure in a beluga whale, *Delphinapterus leucas*: Evoked potential study," J. Acoust. Soc. Am. 138, 377-388.

Popov, V.V., Supin, A.Y., Wang, D., Wang, K., Dong, L., and Wang, S. (**2011a**). "Noise-induced temporary threshold shift and recovery in Yangtze finless porpoises *Neophocaena phocaenoides asiaeorientalis*," J. Acoust. Soc. Am. 130, 574-584.

Popov, V.V., Supin, A.Y., Pletenko, M.G., Tarakanov, M.B., Klishin, V.O., Bulgakova, T.N., and Rosanova, E.I. (**2007**). "Audiogram variability in normal bottlenose dolphins (*Tursiops truncatus*)," Aquatic Mammal. 33, 24-33.

Popov, V.V., Klishin, V.O., Nechaev, D.I., Pletenko, M.G., Rozhnov, V.V., Supin, A.Y., Sysueva, E.V., and Tarakanov, M.B. (**2011b**). "Influence of acoustic noises on the white whale hearing thresholds," Doklady Biological Sciences 440, 332-334.

Popov, V.V., Supin, A.Y., Rozhnov, V.V., Nechaev, D.I., Sysuyeva, E.V., Klishin, V.O., Pletenko, M.G., and Tarakanov, M.B. (**2013**). "Hearing threshold shifts and recovery after noise exposure in beluga whales *Delphinapterus leucas*," J. Exp. Biol. 216, 1587-1596.

Reichmuth, C. (**2013**). "Equal loudness contours and possible weighting functions for pinnipeds," J. Acoust. Soc. Am. 134, 4210 (A).

Reichmuth, C. and Southall, B.L. (**2012**). "Underwater hearing in California sea lions (*Zalophus californianus*): Expansion and interpretation of existing data," Mar. Mammal Sci. 28, 358-363.

Reichmuth, C., Holt, M.M., Mulsow, J., Sills, J.M., and Southall, B.L. (**2013**). "Comparative assessment of amphibious hearing in pinnipeds," Journal of Comparative and Physiology A 199, 491-507.

Reichmuth, C., Ghoul, A., Rouse, A., Sills, J., and Southall, B. (**2016**). "Temporary threshold shift not measured in spotted or ringed seals exposed to single airgun impulses," J. Acoust. Soc. Am. (in review).

Ridgway, S.H., Carder, D.A., Kamolnick, T., Smith, R.R., Schlundt, C.E., and Elsberry, W.R. (**2001**). "Hearing and whistling in the deep sea: depth influences whistle spectra but does not attenuate hearing by white whales (*Delphinapterus leucas*) (Odontoceti, Cetacea)," J. Exp. Biol. 204, 3829-3841.

Sauerland, M. and Dehnhardt, G. (**1998**). "Underwater audiogram of a tucuxi (*Sotalia fluviatilis guianensis*)," J. Acoust. Soc. Am. 103, 1199-1204.

Schlundt, C.E., Finneran, J.J., Branstetter, B.K., Dear, R.L., Houser, D.S., and Hernandez, E. (**2008**). "Evoked potential and behavioral hearing thresholds in nine bottlenose dolphins (*Tursiops truncatus*)," J. Acoust. Soc. Am. 123, 3506(A).

Sills, J.M., Southall, B.L., and Reichmuth, C. (**2014**). "Amphibious hearing in spotted seals (*Phoca largha*): underwater audiograms, aerial audiograms and critical ratio measurements," J. Exp. Biol. 217, 726-734.

Sills, J.M., Southall, B.L., and Reichmuth, C. (**2015**). "Amphibious hearing in ringed seals (Pusa hispida): underwater audiograms, aerial audiograms and critical ratio measurements," J Exp Biol 218, 2250-2259.

Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran, J.J., Gentry, R.L., Greene Jr., C.R., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L. (**2007**). "Marine mammal noise exposure criteria: initial scientific recommendations," Aquatic Mammal. 33, 411-521.

Stebbins, W.C. (**1966**). "Auditory reaction time and the derivation of equal loudness contours for the monkey," Journal of the Experimental Analysis of Behavior 9, 135-142.

Szymanski, M.D., Bain, D.E., Kiehl, K., Pennington, S., Wong, S., and Henry, K.R. (**1999**). "Killer whale (*Orcinus orca*) hearing: Auditory brainstem response and behavioral audiograms," J. Acoust. Soc. Am. 106, 1134-1141.

Terhune, J.M. (**1988**). "Detection thresholds of a harbour seal to repeated underwater high-frequency, short-duration sinusoidal pulses," Canadian Journal of Zoology 66, 1578-1582.

Thomas, J., Chun, N., Au, W., and Pugh, K. (**1988**). "Underwater audiogram of a false killer whale (*Pseudorca crassidens*)," J. Acoust. Soc. Am. 84, 936-940.

Tremel, D.P., Thomas, J.A., Ramierez, K.T., Dye, G.S., Bachman, W.A., Orban, A.N., and Grimm, K.K. (**1998**). "Underwater hearing sensitivity of a Pacific white-sided dolphin, *Lagenorhynchus obliquidens*," Aquatic Mammal. 24, 63-69.

Tubelli, A.A., Zosuls, A., Ketten, D.R., Yamato, M., and Mountain, D.C. (**2012**). "A prediction of the minke whale (*Balaenoptera acutorostrata*) middle-ear transfer function," J. Acoust. Soc. Am. 132, 3263-3272.

Tyack, P.L. and Clark, C.W. (**2000**). "Communication and acoustic behavior of dolphins and whales," in *Hearing by Whales and Dolphins*, edited by W.W.L. Au, A.N. Popper, and R.R. Fay (Springer, New York), pp. 156-224.

Ward, W.D. (**1960**). "Recovery from high values of temporary threshold shift," J. Acoust. Soc. Am. 32, 497-500.

Ward, W.D. (**1997**). "Effects of high-intensity sound," in *Encyclopedia of Acoustics*, edited by M.J. Crocker (Wiley, New York, NY), pp. 1497-1507.

Ward, W.D., Glorig, A., and Sklar, D.L. (**1958**). "Dependence of temporary threshold shift at 4 kc on intensity and time," J. Acoust. Soc. Am. 30, 944-954.

Ward, W.D., Glorig, A., and Sklar, D.L. (**1959**). "Temporary Threshold Shift from Octave-Band Noise: Applications to Damage-Risk Criteria," J. Acoust. Soc. Am. 31, 522-528.

Wartzok, D. and Ketten, D. (**1999**). "Marine mammal sensory systems," in *The Biology of Marine Mammals*, edited by J.E. Reynolds and S.A. Rommel (Smithsonian Institution Press, Washington, DC).

Wensveen, P.J., Huijser, L.A.E., Hoek, L., and Kastelein, R.A. (**2014**). "Equal latency contours and auditory weighting functions for the harbour porpoise (*Phocoena phocoena*)," J. Exp. Biol. 217, 359-369.

White, M.J., Norris, J., Ljungblad, D.K., Baron, K., and di Sciara, G.N. (**1978**). "Auditory thresholds of two beluga whales (*Delphinapterus leucas*)," (Hubbs Sea World Research Institute, San Diego).

APPENDIX B: RESEARCH RECOMMENDATIONS FOR IMPROVED ACOUSTIC THRESHOLDS

In compiling, interpreting, and synthesizing the scientific literature to produce updated acoustic thresholds for this Technical Guidance, it is evident that additional data would be useful for future iterations of this document, since many data gaps still exist (Table B1). The need for the Technical Guidance to identify critical data gaps was also recommended during the initial peer review and public comment period.

Table B1: Summary of currently available marine mammal data.

Hearing Group	Audiogram Data/Number of Species	TTS Data/Number of Species	Sound Sources for TTS Studies
LF Cetaceans	Predictive modeling/2 species	None/0 species	None
MF Cetaceans	Behavioral/8 species	Behavioral/2 species	Octave-band noise; Tones; Mid-frequency sonar; Explosion simulator; Watergun; Airgun
HF Cetaceans	Behavioral/2 species	Behavioral/1 species	Tones, Mid-frequency sonar; Impact pile driver; Airgun*
PW Pinnipeds	Behavioral/5 species	Behavioral/2 species	Octave-band noise; Impact pile driver
OW Pinnipeds	Behavioral/3 species	Behavioral/1 species	Octave-band noise; Arc-gap transducer

* Data collected using AEP methodology (directly incorporated in Technical Guidance, since only data set available).

Below is a list of research recommendations that NMFS believes would help address current data gaps. Some of these areas of recommended research have been previously identified in other publications/reports (e.g., NRC 1994; NRC 2000; Southall et al. 2007; Southall et al. 2009; Hawkins et al. 2014;[39] Houser and Moore 2014; Lucke et al. 2014; Popper et al. 2014;[40] Williams et al. 2014; Erbe et al. 2016; Lucke et al. 2016). Note: Just because there may not be

[39] Although, Hawkins et al. 2014 identifies research gaps for fishes and invertebrates, many of the research recommendations can also be considered for other species, like marine mammals.

[40] Although, Popper et al. 2014 identifies research gaps for fishes and sea turtles, many of the research recommendations can also be considered for other species, like marine mammals.

enough information to allow for quantifiable modifications to acoustic thresholds associated with many of these recommendations, does not mean these recommendations cannot be incorporated as qualitative considerations within the comprehensive effects analysis.

I. SUMMARY OF RESEARCH RECOMMENDATIONS

1.1 LOW-FREQUENCY CETACEAN HEARING

As previously stated, direct measurements of LF cetacean hearing are lacking. Therefore, hearing predictions for these species are based on other methods (e.g., anatomical studies, predictive models, vocalizations, taxonomy, and behavioral responses to sound). Thus, additional data[41] collected would be extremely valuable to furthering the understanding of hearing ability within this hearing group and validating other methods for approximating hearing ability. For example, data collected on either stranded or animals associated with subsistence hunts would be extremely useful in confirming current predictions of LF cetacean hearing ability and would allow for the development of more accurate auditory weighting functions (e.g., Do species that vocalize at ultra-low frequencies, like blue and fin whales, have dramatically different hearing abilities than other mysticete species?). Until direct measurements can be made, predictive models based on anatomical data will be the primary means of approximating hearing abilities, with validation remaining a critical component of any modeling exercise (e.g., Cranford and Krysl 2014).

1.2 HEARING DIVERSITY AMONG SPECIES AND AUDITORY PATHWAYS

A better understanding of hearing diversity among species within a hearing group is also needed (e.g., Mooney et al. 2014) to comprehend how representative certain species (e.g., bottlenose dolphins, harbor porpoise, harbor seals) are of their hearing group as a whole. For example, are there certain species more susceptible to hearing loss from sound (i.e., all members of HF cetaceans), or are there additional delineations needed among the current hearing groups (e.g., deep diving species, etc.)? Having more data from species within a hearing group would also help identify if additional hearing groups are needed. This is especially the case for HF cetaceans where data are only available from four individuals of two species and those individuals have a lower hearing threshold compared to all other hearing groups.

Additionally, having a more complete understanding of how sound enters the heads/bodies of marine mammals and its implication on hearing and impacts of noise among various species is another area of importance (e.g., bone conduction mechanism in mysticetes: Cranford and Krysl 2015; previously undescribed acoustic pathways in odontocetes: Cranford et al. 2008; Cranford et al. 2010; filtering/amplification of transmission pathway: Cranford and Krysl 2012; directional hearing: Renaud and Popper 1975; Au and Moore 1984; Kastelein et al. 2005b).

[41] Data should be collected under appropriate permits or authorizations.

1.3 REPRESENTATIVENESS OF CAPTIVE INDIVIDUALS

Data from Castellote et al. (2014), from free-ranging belugas in Alaska, indicate that of the seven healthy individuals tested (3 females/4 males; 1 subadult/6 adults), all had hearing abilities "similar to those of belugas measured in zoological settings." Thus, from this one study, it appears that for baseline hearing measurements, captive individuals may be appropriate surrogates for free-ranging animals. Additionally, Mulsow et al. (2011) measured aerial hearing abilities of seven stranded California sea lions and found a high degree of intersubject variability but that high-frequency hearing limits were consistent with previously tested captive individuals. However, these are currently the only studies of their kind,[42] and more research is needed to examine if this trend is applicable to other species (Lucke et al. 2016).

1.3.1 Impacts of Age on Hearing

Hearing loss can result from a variety of factors beyond anthropogenic noise, including exposure to ototoxic compounds (chemicals poisonous to auditory structures), disease and infection, and heredity, as well as a natural part of aging (Corso 1959; Kearns 1977; WGSUA 1988; Yost 2007). High-frequency hearing loss, presumably a normal process of aging that occurs in humans and other terrestrial mammals, has also been demonstrated in captive cetaceans (Ridgway and Carder 1997; Yuen et al. 2005; Finneran et al. 2005b; Houser and Finneran 2006; Finneran et al. 2007b; Schlundt et al. 2011) and in stranded individuals (Mann et al. 2010). Thus, the potential impacts of age on hearing can be a concern when extrapolating from older to younger individuals.

Few studies have examined this phenomenon in marine mammals, particularly in terms of the potential impact of aging on hearing ability and TSs:

- Houser and Finneran (2006) conducted a comprehensive study of the hearing sensitivity of the U.S. Navy bottlenose dolphin population (i.e., tested 42 individuals from age four to 47 years; 28 males/14 females). They found that high-frequency hearing loss typically began between the ages of 20 and 30 years. However, the frequencies where this species is most susceptible to noise-induced hearing loss (i.e., 10 to 30 kHz) are the frequencies where the lowest variability exists in mean acoustic thresholds between individuals of different ages.

- Houser et al. (2008) measured hearing abilities of 13 Pacific bottlenose dolphins, ranging in age from 1.5 to 18 years. The authors' reported that "Variability in the range of hearing and age-related reductions in hearing sensitivity and range of hearing were consistent with those observed in Atlantic bottlenose dolphins."

[42] NMFS is aware that additional baseline hearing measurements have been recorded for additional free-ranging belugas by Castellote et al. with the analysis still in process. Furthermore, NMFS is aware that audiogram (AEP) data are often obtained during marine mammal stranding events exists, but these have yet to be published.

- Mulsow et al. (2014) examined aerial hearing thresholds for 16 captive sea lions, from age one to 26 years, and found that only the two 26-year old individuals had hearing classified as "aberrant" compared to other individuals (i.e., high-frequency hearing loss), which were deemed to have similar hearing abilities to previously measured individuals.

- Additionally, for harbor seals, similar exposure levels associated with TTS onset were found in Kastelein et al. 2012a for individuals of four to five years of age compared to that used in Kastak et al. 2005, which was 14 years old and for belugas in Popov et al. 2014 for an individual of 2 years of age compared to those used in Schlundt et al. 2000, which were 20 to 22 years old or 29 to 31 years old.

From these limited data, it appears that age may not be a significant complicating factor, in terms of assessing TSs for animals of different ages. Nevertheless, additional data are needed to confirm if these data are representative for all species (Lucke et al. 2016).

1.4 ADDITIONAL TTS MEASUREMENTS WITH MORE SPECIES AND/OR INDIVIDUALS

Currently, TTS measurements only exist for four species of cetaceans (bottlenose dolphins, belugas, harbor porpoises, and Yangtze finless porpoise) and three species of pinnipeds (Northern elephant seal, harbor seal, and California sea lion). Additionally, the existing marine mammal TTS measurements are from a limited number of individuals within these species. Having more data from a broader range of species and individuals would be useful to confirm how representative current individuals are of their species and/or entire hearing groups (Lucke et al. 2016). For example, TTS onset acoustic thresholds for harbor porpoise (HF cetacean) are much lower compared to other odontocetes (MF cetaceans), and it would be useful to know if all HF cetaceans share these lower TTS onset acoustic thresholds or if harbor porpoises are the exception.

Recently measured underwater hearing of two captive spotted seals (Sills et al. 2014) and two captive ringed seals (Sills et al. 2015) found these species' hearing abilities are comparable to harbor seals. Thus, harbor seals, where TTS data are available, are an appropriate surrogate for ice seal species. As more data become available, this assumption will be re-evaluated.

Finally, cetaceans are often used as surrogates for pinnipeds when no direct data exist. Having more information on the appropriateness of using cetaceans as surrogates for pinnipeds would be useful (i.e., Is there another mammalian group more appropriate?).

1.5 SOUND EXPOSURE TO MORE REALISTIC SCENARIOS

Most marine mammal TTS measurements are for individuals exposed to a limited number of sound sources (i.e., mostly tones and octave-band noise[43]) in laboratory settings. Measurements from exposure to actual sound sources (opposed to tones or octave-band noise) under more realistic exposure conditions (e.g., more realistic exposure durations and/or scenarios, including multiple pulses/pile strikes and at frequencies below 1 kHz where most anthropogenic noise occurs) are needed.

1.5.1 Frequency and Duration of Exposure

In addition to received level, NMFS recognizes that other factors, such as frequency and duration of exposure, are also important to consider within the context of PTS onset acoustic thresholds (Table B2). However, there are not enough data to establish numerical acoustic thresholds based on these added factors (beyond what has already been included in this document, in terms of marine mammal weighting functions and SEL_{cum} thresholds). When more data become available, it may be possible to incorporate these factors into quantitative assessments.

Further, it has been demonstrated that exposure to lower-frequency broadband sounds has the potential to cause TSs at higher frequencies (e.g., Lucke et al. 2009; Kastelein et al. 2015a; Kastelein et al. 2016). The consideration of duty cycle (i.e., energy per unit time) is another important consideration in the context of exposure duration (e.g., Kastelein et al. 2015b). Having a better understanding of these phenomena would be helpful.

1.5.2 Multiple Sources

Further, a better understanding of the effects of multiple sources and multiple activities on TS, as well as impacts from long-term exposure is needed. Studies on terrestrial mammals indicate that exposure scenarios from complex exposures (i.e., those involving multiple types of sound sources) result in more complicated patterns of NIHL (e.g., Ahroon et al. 1993).

[43] More recent studies (e.g., Lucke et al. 2009; Mooney et al. 2009b; Kastelein et al. 2014a; Kastelein et al. 2014b; Kastelein et al. 2015a; Kastelein et al. 2015b; Finneran et al. 2015; Kastelein et al. 2016) have used exposures from more realistic sources, like airguns, impact pile drivers, or tactical sonar.

Table B2: Additional factors for consideration (frequency and duration of exposure) in association with PTS onset acoustic thresholds.

I. Frequency*: General Trend Identified: 1) Growth of TS: Growth rates of TS (dB of TTS/dB noise) are higher for frequencies where hearing is more sensitive (e.g., Finneran and Schlundt 2010; Finneran and Schlundt 2013; Kastelein et al. 2014a; Kastelein et al. 2015b)
II. Duration: General Trends Identified: 1) Violation of EEH: Non-impulsive, intermittent exposures require higher SEL_{cum} to induce a TS compared to continuous exposures of the same duration (e.g., Mooney et al. 2009a; Finneran et al. 2010b; Kastelein et al. 2014a) 2) Violation of EEH: Exposures of longer duration and lower levels induce a TTS at a lower level than those exposures of higher level (below the critical level) and shorter duration with the same SEL_{cum} (e.g., Kastak et al. 2005; Kastak et al. 2007; Mooney et al. 2009b; Finneran et al. 2010a; Kastelein et al. 2012a; Kastelein et al. 2012b) 3) Recovery from a TS: With the same SEL_{cum}, longer exposures require longer durations to recover (e.g., Mooney et al. 2009b; Finneran et al. 2010a) 4) Recovery from a TS: Intermittent exposures recover faster compared to continuous exposures of the same duration (e.g., Finneran et al. 2010b; Kastelein et al. 2014a; Kastelein et al. 2015b)
III. Cumulative Exposure+: General Trend Identified: 1) Animals may be exposed to multiple sound sources and stressors, beyond acoustics, during an activity, with the possibility of the possibility of additive or synergistic effects (e.g., Sih et al. 2004; Rohr et al. 2006; Chen et al. 2007; Lucke et al. 2016)
* Frequency-dependent hearing loss and overall hearing ability within a hearing group is taken into account, quantitatively, with auditory weighting functions. + Note: NMFS is currently supporting a National Academies project entitled "Assessment of the Cumulative Effects of Anthropogenic Stressors on Marine Mammals" to better address this issue (https://www8.nationalacademies.org/cp/projectview.aspx?key=49715). NOAA is also in the process of developing an agency Ocean Noise Strategy Roadmap, which includes examining the acute, chronic, and cumulative effects of noise. (http://cetsound.noaa.gov/ons).

1.5.3 Possible Protective Mechanisms

Nachtigall and Supin (2013) recently reported that a false killer whale was able to reduce its hearing sensitivity (i.e., conditioned dampening of hearing) when a loud sound was preceded

by a warning signal. Nachtigall and Supin (2014) reported a similar finding in a bottlenose dolphin and a beluga (Nachtigall et al. 2016a). Further studies showed that conditioning is associated with the frequency of the warning signal (Nachtigall and Supin 2015), as well as if an animal is able to anticipate when a loud sound is expected to occur after a warning signal (Nachtigall et al. 2016b).

Additionally, Finneran et al. (2015) observed two of the three dolphins in their study displayed "anticipatory" behavior (e.g., head movement) during an exposure sequence to multiple airgun shots. It is unknown if this behavior resulted in some mitigating effects of the exposure. Recently, Popov et al. (2016) investigated the impact of prolonged sound stimuli (i.e., 1500 s continuous pip successions vs. 500-ms pip trains) on the beluga auditory system and found that auditory adaptation occurred during exposure (i.e., decrease in amplitude of rate following response associated with evoked potentials) at levels below which TTS onset would likely be induced. The amount of amplitude reduction depended on stimulus duration, with higher reductions occurring during prolonged stimulation. The authors also caution that adaptation will vary with sound parameters.

In the wild, potential protective mechanisms have been observed, with synchronous surfacing associated with exposure to playbacks of tactical sonar recorded in long-finned pilot whales(Miller et al. 2012). However, it is unclear how effective this behavior is in reducing received levels (Wensveen et al. 2015).

Thus, marine mammals may have multiple means of reducing or ameliorating the effects noise exposure. However, at this point, directly incorporating them into a comprehensive effects analysis that anticipates the likelihood of exposure ahead of an activity is difficult. More information on these mechanisms, especially associated with real-world exposure scenarios, would be useful.

1.5.4 Long-Term Consequences of Exposure

Kujawa and Liberman (2009) found that with large, but recoverable noise-induced thresholds shifts (maximum 40 dB TS measured by auditory brainstem response (ABR)), sound could cause delayed cochlear nerve degeneration in mice. Further, Lin et al. (2011) reported a similar pattern of neural degeneration in mice after large but recoverable noise-induced TSs (maximum ~50 dB TS measured by ABR), which suggests a common phenomenon in all mammals. The long-term consequences of this degeneration remain unclear.

Another study reported impaired auditory cortex function (i.e., behavioral and neural discrimination of sound in the temporal domain (discriminate between pulse trains of various repetition rates)) after sound exposure in rats that displayed no impairment in hearing (Zhou and Merzenich 2012). Zheng (2012) found reorganization of the neural networks in the primary auditory cortex (i.e., tonotopic map) of adult rats exposed to low-level noise, which suggests an adaptation to living in a noisy environment (e.g., noise exposed rats performed tasks better in noisy environment compared to control rats). Heeringa and van Dijk (2014) reported firing rates in the inferior colliculus of guinea pigs

had a different recovery pattern compared to ABR thresholds. Thus, it is recommended that there be additional studies to look at these potential effects in marine mammals (Tougaard et al. 2015).

Finally, it is also important to understand how repeated exposures resulting in TTS could potentially lead to PTS (e.g., Kastak et al. 2008; Reichmuth 2009). For example, occupational noise standards, such as those from the Occupational Safety & Health Administration (OSHA), consider the impact of noise exposure over a life-time of exposure (e.g., 29 CFR Part 1926 over 40 years). Similar, longer-term considerations are needed for marine mammals.

1.6 IMPACTS OF NOISE-INDUCED THRESHOLD SHIFTS ON FITNESS

When considering noise-induced thresholds shifts, it is important to understand that hearing is more than merely the mechanical process of the ear and neural coding of sound (detection). It also involves higher processing and integration with other stimuli (perception) (Yost 2007; Alain and Berstein 2008). Currently, more is known about the aspects of neural coding of sounds compared to the higher-level processing that occurs on an individual level.

Typically, effects of noise exposure resulting in energetic (Williams et al. 2006; Barber et al. 2010) and fitness consequences (increased mortality or decreased reproductive success) are deemed to have the potential to affect a population/stock (NRC 2005; Southall et al. 2007; SMRU Marine 2014) or as put by Gill et al. 2001 "From a conservation perspective, human disturbance of wildlife is important only if it affects survival or fecundity and hence causes a population to decline." The number of individuals exposed and the location and duration of exposure are important factors, as well. To determine whether a TS will result in a fitness consequence requires one to consider several factors.

First, one has to consider the likelihood an individual would be exposed for a long enough duration or to a high enough level to induce a TS (e.g., realistic exposure scenarios). Richardson et al. (1995) hypothesized that "Disturbance effects are likely to cause most marine mammals to avoid any 'zone of discomfort or nonauditory effects' that may exist" and that "The greatest risk of immediate hearing damage might be if a powerful source were turned on suddenly at full power while a mammal was nearby." It is uncertain how frequently individuals in the wild are experiencing situations where TSs are likely from individual sources (Richardson et al.1995; Erbe and Farmer 2000; Erbe 2002; Holt 2008; Mooney et al. 2009b).

In determining the severity of a TS, it is important to consider the magnitude of the TS, time to recovery (seconds to minutes or hours to days), the frequency range of the exposure, the frequency range of hearing and vocalization for the particular species (i.e., how animal uses sound in the frequency range of anthropogenic noise exposure; e.g., Kastelein et al. 2014b), and their overlap (e.g., spatial, temporal, and spectral). Richardson et al. (1995) noted, "To evaluate the importance of this temporary impairment, it would be necessary to consider the ways in which marine mammals use sound, and the consequences if access to this

information were impaired." Thus, exposure to an anthropogenic sound source, may affect individuals and species differently (Sutherland 1996).

Finally, different degrees of hearing loss exist: ranging from slight/mild to moderate and from severe to profound (Clark 1981), with profound loss being synonymous with deafness (CDC 2004; WHO 2015). For hearing loss in humans, Miller (1974) summarized "any injury to the ear or any change in hearing threshold level that places it outside the normal range constitutes a hearing impairment. Whether a particular impairment constitutes a hearing handicap or a hearing disability can only be judged in relation to an individual's life pattern or occupation." This statement can translate to considering effects of hearing loss in marine mammals, as well (i.e., substituting "occupation" for "fitness").

Simply because a hearing impairment may be possible does not necessarily mean an individual will experience a disability in terms of overall fitness consequence. However, there needs to be a better understanding of the impacts of repeated exposures. As Kight and Swaddle (2011) indicate "Perhaps the most important unanswered question in anthropogenic noise research – and in anthropogenic disturbance research, in general – is how repeated exposure over a lifetime cumulatively impacts an individual, both over the short- (e.g. condition, survival) and long- (e.g., reproductive success) term." Thus, more research is needed to understand the true consequences of noise-induced TSs (acute and chronic) to overall fitness.

1.7 BEHAVIOR OF MARINE MAMMALS UNDER EXPOSURE CONDITIONS WITH THE POTENTIAL TO CAUSE HEARING IMPACTS

Although assessing the behavioral response of marine mammals to sound is outside the scope of this document, understanding these reactions, especially in terms of exposure conditions having the potential to cause NIHL is critical to be able to predict exposure better. Understanding marine mammal responses to anthropogenic sound exposure presents a set of unique challenges, which arise from the inherent complexity of behavioral reactions. Responses can depend on numerous factors, including intrinsic, natural extrinsic (e.g., ice cover, prey distribution), or anthropogenic , as well as the interplay among factors (Archer et al. 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, hearing sensitivity, sex, age, reproductive status, geographic location, season, health, social behavior, or context.

Severity of behavioral responses can also vary depending on characteristics associated with the sound source (e.g., whether it is moving or stationary, number of sound sources, distance from the source) or the potential for the source and individuals to co-occur temporally and spatially (e.g., persistence or recurrence of the sound in specific areas; how close to shore, region where animals may be unable to avoid exposure, propagation characteristics that are either enhancing or reducing exposure) (Richardson et al. 1995; NRC 2003; Wartzok et al. 2004; NRC 2005; Southall et al. 2007; Bejder et al. 2009).

Further, not all species or individuals react identically to anthropogenic sound exposure. There may be certain species-specific behaviors (e.g., fight or flight responses; particularly

behaviorally sensitive species) that make a species or individuals of that species more or less likely to react to anthropogenic sound. Having this information would be useful in improving the recommended accumulations period (i.e., 24 h) and understanding situations where individuals are more likely to be exposed to noise over longer durations and are more at risk for NIHL, either temporary or permanent.

1.8 CHARACTERISTICS OF SOUND ASSOCIATED WITH NIHL AND IMPACTS OF PROPAGATION

It is known as sound propagates through the environment various physical characteristics change (e.g., frequency content with lower frequencies typically propagating further than higher frequencies; pulse length due to reverberation or multipath propagation in shallow and deep water). Having a better understanding of the characteristics of a sound that makes it injurious (e.g., peak pressure amplitude, rise time, pulse duration, etc.; Henderson and Hamernik 1986; NIOSH 1998) and how those characteristics change under various propagation conditions would be extremely helpful in the application of appropriate thresholds and be useful in supporting a better understanding as to how sounds could possess less injurious characteristics further from the source (e.g., transition range).

Further, validation and/or comparison of various propagation and exposure models for a variety of sources would be useful to regulators, who with more complex acoustic thresholds will be faced with evaluating the results from a multitude of models. This would also allow for a more complete comparison to the methodologies provided in this Technical Guidance. This would allow for a determination of how precautionary these methodologies are under various scenarios and allow for potential refinement.

1.9 NOISE-INDUCED THRESHOLD SHIFT GROWTH RATES AND RECOVERY

TS growth rate data for marine mammals are limited, with higher growth rates for frequencies where hearing is more sensitive (Finneran and Schlundt 2010; Finneran and Schlundt 2013; Kastelein et al. 2015b). Understanding how these trends vary with exposure to more complex sound sources (e.g., broadband impulsive sources) and among various species would be valuable.

Understanding recovery after sound exposure is also an important consideration. Currently, there is a lack of recovery data for marine mammals, especially for exposure to durations and levels expected under real-world scenarios. Thus, additional marine mammal noise-induced recovery data would be useful. A better understanding of likely exposure scenarios, including the potential for recovery, including how long after noise exposure recovery is likely to occur, could also improve the recommended baseline accumulation period.

1.10 METRICS AND TERMINOLOGY

Sound can be described using a variety of metrics, with some being more appropriate for certain sound types or effects compared with others (e.g., Coles et al. 1968; Hamernik et al. 2003; Madsen 2005; Davis et al. 2009; Zhu et al. 2009). A better understanding of the most appropriate metrics for establishing acoustic thresholds and predicting impacts to hearing would be useful in confirming the value of providing dual metric thresholds using the PK and SEL_{cum} metrics for impulsive sources. As science advances, additional or more appropriate metrics may be identified and further incorporated by NMFS. However, caution is recommended when comparing sound descriptions in different metrics (i.e., they are not directly comparable). Additionally, the practicality of measuring and applying metrics is another important consideration.

Further, the Technical Guidance's acoustic thresholds are based on the EEH, which is known to be inaccurate in some situations. Recently, Popov et al. 2014 suggested that RMS SPL multiplied by log duration better described their data than the EEH. Thus, better means of describing the interaction between SPL and duration of exposure would be valuable.

Finally, in trying to define metrics and certain terms (e.g., impulsive and non-impulsive) within the context of the Technical Guidance, NMFS often found difficulties due to lack of universally accepted standards and common terminology. Within the Technical Guidance, NMFS has tried to adopt terminology, definitions, symbols, and abbreviations that reflect those of the American National Standards Institute (ANSI). However, none of these standards are specific for underwater sound.[44] Thus, NMFS encourages the further development of appropriate standards for marine application.

1.11 EFFECTIVE QUIET

"Effective quiet" is defined as the maximum sound pressure level that will fail to produce any significant TS in hearing despite duration of exposure and amount of accumulation (Ward et al. 1976; Ward 1991). Effective quiet can essentially be thought of as a "safe exposure level" (i.e., risks for TS are extremely low or nonexistent) in terms of hearing loss[45] (Mills 1982; NRC 1993) and is frequency dependent (Ward et al. 1976; Mills 1982). Effective quiet is an important consideration for the onset TTS and PTS acoustic thresholds expressed by the SEL_{cum} metric because if not taken into consideration unrealistically low levels of exposure with long enough exposure durations could accumulate to exceed current SEL_{cum} acoustic thresholds, when the likelihood of an actual TS is extremely low (e.g., humans exposed to continuous levels of normal speech levels throughout the day are not typically subjected to TTS from this type of exposure).

---

[44] NMFS is aware of a draft international standard addressing underwater acoustic terminology (ISO/DIS 18405) and will further examine this standard, once it becomes final.

[45] Note: "Effective quiet" only applies to hearing loss and not to behavioral response (i.e., levels below "effective quiet" could result in behavioral responses). It also is separate consideration from defining "quiet" areas (NMFS 2009).

Currently, defining effective quiet for marine mammals is not possible due to lack of data. However, a recent study by Popov et al. 2014 on belugas exposed to half-octave noise centered at 22.5 kHz indicates that effective quiet for this exposure scenario and species might be around 154 dB. In Finneran's (2015) recent review of NIHL in marine mammals, effective quiet is predicted to vary by species (e.g., below 150 to 160 dB for bottlenose dolphins and belugas; below 140 dB for Yangtze finless porpoise; 124 dB for harbor porpoise; and 174 dB for California sea lions).

As more data become available, they would be useful in contributing to the better understanding of appropriate accumulations periods for the SEL_{cum} metric and NIHL, as well as the potential of low-level (e.g., Coping et al. 2014; Schuster et al. 2015), continuously operating sources (e.g., alternative energy tidal, wave, or wind turbines) to induce noise-induced hearing loss.

1.12 TRANSLATING BIOLOGICAL COMPLEXITY INTO PRACTICAL APPLICATION

Although, not a specific research recommendation, practical application of science is an important consideration. As more is learned about the potential effects of sound on marine mammals, the more complex future acoustic thresholds are likely to become. For example, before this Technical Guidance, NMFS primarily relied on two generic thresholds for assessing auditory impacts, with one for cetaceans (SPL RMS 180 dB) and one for pinnipeds (SPL RMS 190 dB). In this document, these two simple thresholds have now been replaced by ten PTS onset thresholds (with dual metrics for impulsive sounds), including the addition of auditory weighting functions. Although, these updated acoustic thresholds better represent the current state of knowledge, they have created additional challenges for implementation. Practical application always needs to be weighed against making acoustic thresholds overly complicated (cost vs. benefit considerations). The creation of tools to help ensure complex thresholds are applied correctly by action proponents, as well as managers, is a critical need.

Additionally, there is always a need for basic, practical acoustic training opportunities for action proponents and managers (most acoustic classes available are for students within an academic setting and not necessarily those who deal with acoustics in a more applied manner). Having the background tools and knowledge to be able to implement the Technical Guidance is critical to this document being a useful and effective tool in assessing the effects of noise on marine mammal hearing.

APPENDIX C: PEER REVIEW PROCESS AND PUBLIC COMMENT PERIOD

I. PEER REVIEW PROCESS

The President's Office Management and Budget (OMB 2005) states, "Peer review is one of the important procedures used to ensure that the quality of published information meets the standards of the scientific and technical community. It is a form of deliberation involving an exchange of judgments about the appropriateness of methods and the strength of the author's inferences. Peer review involves the review of a draft product for quality by specialists in the field who were not involved in producing the draft."

The peer review of this document was conducted in accordance with NOAA's Information Quality Guidelines[46] (IQG), which were designed for "ensuring and maximizing the quality, objectivity, utility, and integrity of information disseminated by the agency" (with each of these terms defined within the IQG). Further, the IQG stipulate that "To the degree that the agency action is based on science, NOAA will use (a) the best available science and supporting studies (including peer-reviewed science and supporting studies when available), conducted in accordance with sound and objective scientific practices, and (b) data collected by accepted methods or best available methods." Under the IQG and in consistent with OMB's Final Information Quality Bulletin for Peer Review (OMB Peer Review Bulletin (OMB 2005), the Technical Guidance was considered a Highly Influential Scientific Assessments (HISA),[47] and peer review was required before it could be disseminated by the Federal Government. OMB (2005) notes "Peer review should not be confused with public comment and other stakeholder processes. The selection of participants in a peer review is based on expertise, with due consideration of independence and conflict of interest."

The peer review of the Technical Guidance consisted of three independent reviews covering various aspects of the document: 1) There was an initial peer review of the entire draft Guidance in 2013, 2) a second peer review in March/April 2015 that focused on newly available science from the Finneran Technical Report (Finneran 2016; See Appendix A), and 3) a third peer review in April 2015 in response to public comments received during the initial public comment period, which focused on a particular technical section relating to the proposed application of impulsive and non-impulsive PTS acoustic thresholds based on physical characteristics at the source and how those characteristics change with range.[48]

---

[46] http://www.cio.noaa.gov/services_programs/IQ_Guidelines_011812.html

[47] "its dissemination could have a potential impact of more than $500 million in any one year on either the public or private sector; or that the dissemination is novel, controversial, or precedent-setting; or that it has significant interagency interest" (OMB 2005).

[48] Note: Upon evaluation of public comment received during the Technical Guidance's second public comment period (July 2015), NMFS decided to postpone implementing this methodology until more data were available to support its use.

Upon completion of the three peer reviews, NMFS was required to post and respond to all peer reviewer comments received via three separate Peer Review Reports.

1.1 INITIAL PEER REVIEW (ASSOCIATED WITH 2013 DRAFT GUIDANCE)

For the initial peer review of this document (July to September 2013), potential qualified peer reviewers were nominated by a steering committee put together by the Marine Mammal Commission (MMC). The steering committee consisted of MMC Commissioners and members of the Committee of Scientific Advisors (Dr. Daryl Boness, Dr. Douglas Wartzok, and Dr. Sue Moore).

Nominated peer reviewers were those with expertise marine mammalogy, acoustics/bioacoustics, and/or acoustics in the marine environment. Of the ten nominated reviewers, four volunteered, had no conflicts of interest, had the appropriate area of expertise,[49] and were available to complete an individual review (Table C1). The focus of the peer review was on the scientific/technical studies that have been applied and the manner that they have been applied in this document.

Table C1: Initial peer review panel.

Name	Affiliation
Dr. Paul Nachtigall	University of Hawaii
Dr. Doug Nowacek	Duke University
Dr. Klaus Lucke*	Wageningen University and Research (The Netherlands)
Dr. Aaron Thode	Scripps Institution of Oceanography
* Present affiliation: Curtin University (Australia)	

Peer reviewers' comments and NMFS' responses to the comments, from this initial peer review, can be found at: http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

1.2 SECOND PEER REVIEW (REVIEW OF THE FINNERAN TECHNICAL REPORT)

For their Phase 3 Acoustic Effects Analysis, the U.S. Navy provided NMFS with a technical report, by Dr. James Finneran, describing their proposed methodology for updating auditory weighting functions and subsequent numeric thresholds for predicting auditory effects (TTS/PTS thresholds) on marine animals exposed to active sonars, other (non-impulsive) active acoustic sources, explosives, pile driving, and air guns utilized during Navy training and testing activities.

[49] Reviewer credentials are posted at: http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

Upon evaluation, NMFS preliminarily determined that the proposed methodology, within the Finneran Technical Report (Finneran 2016), reflected the scientific literature and decided to incorporate it into the Technical Guidance. Before doing so, we commissioned an independent peer review of the Finneran Technical Report (i.e. second peer review). Note: Reviewers were not asked to review the entire Technical Guidance document.

For the second peer review (March to April 2015), NMFS again requested the assistance of the MMC to nominate peer reviewers. As with the initial peer review, potential qualified peer reviewers were nominated by a steering committee put together by the MMC, which consisted of MMC Commissioners and members of the Committee of Scientific Advisors (Dr. Daryl Boness, Dr. Douglas Wartzok, and Dr. Sue Moore).

Nominated peer reviewers were those with expertise[50] specifically in marine mammal hearing (i.e., behavior and/or AEP) and/or noise-induced hearing loss. Of the twelve nominated reviewers, four volunteered, had not conflicts of interest, had the appropriate area of expertise, and were available to complete an individual review of the Finneran Technical Report (Table C2).

Table C2: Second peer review panel.

Name	Affiliation
Dr. Whitlow Au	University of Hawaii
Dr. Colleen Le Prell	University of Florida*
Dr. Klaus Lucke	Curtin University (Australia)
Dr. Jack Terhune	University of New Brunswick (Canada)
* Affiliation during initial review (Affiliation during follow-up peer review: The University of Texas at Dallas)	

Peer reviewers' comments and NMFS' responses to the comments, from the second peer review, can be found at: http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

1.2.1 Follow-Up to Second Peer Review

Concurrent with the Technical Guidance's third public comment period (see Section 2.3 of this appendix), a follow-up peer review was conducted. The focus of this peer review was whether the 2016 Proposed Changes to the Technical Guidance, associated with the third public comment period, would substantially change any of the peer reviewers' comments provided during their original review (i.e., peer reviewers were not asked to re-review the Finneran Technical Report). Additionally, peer reviewers were not asked to comment on any potential policy or legal implications of the application of the Technical Guidance, or on the

[50] Reviewer credentials are posted at: http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

amount of uncertainty that is acceptable or the amount of precaution that should be embedded in any regulatory analysis of impacts.

All four previous peer reviewers were available to perform the follow-up peer review. Peer reviewers' comments and NMFS' responses to the comments, from this follow-up peer review, can be found at: http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

1.3 THIRD PEER REVIEW (REVIEW OF TRANSITION RANGE METHODOLOGY)

During the Technical Guidance's initial public comment period, NMFS received numerous comments relating to how the Technical Guidance classifies acoustic sources based on characteristics at the source (i.e., non-impulsive vs. impulsive). Many expressed concern that as sound propagates through the environment and eventually reaches a receiver (i.e., marine mammal) that physical characteristics of the sound may change and that NMFS' categorization may not be fully reflective of real-world scenarios. Thus, NMFS re-evaluated its methodology for categorizing sound sources to reflect these concerns. Thus, a third peer review focused on particular technical section relating to the Technical Guidance's proposed application of impulsive and non-impulsive PTS acoustic thresholds based on physical characteristics at the source and how those characteristics change with range (i.e., transition range). Note: Reviewers were not asked to review the entire Technical Guidance document.

Since the focus of the third peer review was focused on the physical changes a sound experiences as it propagates through the environment, the Acoustical Society of America's Underwater Technical Council was asked to nominate peer reviewers with expertise in underwater sound propagation and physical characteristics of impulsive sources, especially high explosives, seismic airguns, and/or impact pile drivers. Of the six nominated reviewers, two volunteered, were available, had no conflicts of interest, and had the appropriate area of expertise[51] to complete an individual review of the technical section (Table C3).

Additionally, NMFS wanted peer reviewers with expertise in marine and terrestrial mammal noise-induced hearing loss to review this technical section and ensure the proposed methodology was ground-truthed in current biological knowledge. Thus, NMFS re-evaluated peer reviewer nominees previously made by the MMC for the first and second peer reviews. From this list, two reviewers volunteered, were available, had no conflicts of interest, and had the appropriate area of expertise to serve as peer reviewers (Table C3).

[51] Reviewer credentials are posted at: http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

Table C3: Third peer review panel.

Name	Affiliation
Dr. Robert Burkard	University at Buffalo
Dr. Peter Dahl*	University of Washington
Dr. Colleen Reichmuth+	University of California Santa Cruz
Dr. Kevin Williams*	University of Washington

* Peer reviewers with expertise in underwater acoustic propagation

\+ Dr. Reichmuth was an alternate on the MMC original peer reviewer nomination list

Peer reviewers' comments and NMFS' responses to the comments, from the third peer review, can be found at: http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

Note: In response to public comments made during the second public comment period, NMFS decided to withdraw its proposed transition range methodology until more data can be collected to better support this concept (i.e., see Appendix B: Research Recommendations).

1.4 CONFLICT OF INTEREST DISCLOSURE

Each peer reviewer (i.e., initial, second, and third peer review) completed a conflict of interest disclosure form. It is essential that peer reviewers of NMFS influential scientific information (ISI) or HISA not be compromised by any significant conflict of interest. For this purpose, the term "conflict of interest" means any financial or other interest which conflicts with the service of the individual because it (1) could significantly impair the individual's objectivity or (2) could create an unfair competitive advantage for any person or organization. No individual can be appointed to review information subject to the OMB Peer Review Bulletin if the individual has a conflict of interest that is relevant to the functions to be performed.

The following website contains information on the peer review process including: the charge to peer reviewers, peer reviewers' names, peer reviewers' individual reports, and NMFS' response to peer reviewer reports:
http://www.cio.noaa.gov/services_programs/prplans/ID43.html.

II. PUBLIC COMMENT PERIODS

In addition to the peer review process, NMFS recognizes the importance of feedback from action proponents/stakeholders and other members of the public. The focus of the public comment process was on both the technical aspects of the document, as well as the implementation of the science in NMFS' policy decisions under the various applicable

statutes. The first two public comment periods were held after the peer review to ensure the public received the most scientifically sound product for review and comment. A third public focused comment period was held after incorporation of recommendations made by NMFS and Navy scientists (SSC-PAC) during further evaluation of the Finneran Technical Report after the second public comment period. During this third public comment period, there was a concurrent follow-up peer review. See section 1.2.1 above.

2.1 INITIAL PUBLIC COMMENT PERIOD (ASSOCIATED WITH 2013 DRAFT TECHNICAL GUIDANCE)

A public meeting/webinar was held to inform interested parties and solicit comments on the first publicly available version of the Draft Technical Guidance. The meeting/webinar was held on January 14, 2014, in the NOAA Science Center in Silver Spring, Maryland. The presentation and transcript from this meeting is available electronically (http://www.nmfs.noaa.gov/pr/acoustics/publicmeeting_transcript.pdf).

This public comment period was advertised via the Federal Register and originally lasted 30 days, opening on December 27, 2013 (NMFS 2013). During this 30-day period, multiple groups requested that the public comment period be extended beyond 30 days. Thus, the public comment period was extended an additional 45 days and closed on March 13, 2014 (NMFS 2014).

2.1.1 Summary of Public Comments Received

A total of 129[52] comments were received from individuals, groups, organizations, and affiliations. Twenty-eight of these were in the form of a letter, spreadsheet, or individual comment submitted by representatives of a group/organization/affiliation (some submitted on behalf of an organization and/or as an individual). Those commenting included: 11 members of Congress; eight state/federal/international government agencies; two Alaskan native groups; seven industry groups; five individual subject matter experts; a scientific professional organization; 12 non-governmental organizations; an environmental consulting firm; and a regulatory watchdog group. Each provided substantive comments addressing technical aspects or issues relating to the implementation of updated acoustic thresholds, which were addressed in the Final Technical Guidance or related Federal Register Notice.[53]

Of those not mentioned above, an additional 101 comments were submitted in the form of a letter or individual comment. Twelve of these comments specifically requested an extension of the original 30-day public comment period (a 45-day extension to original public

[52] Of this number, one comment was directed to the Federal Communications Commission (i.e., not meant for the Technical Guidance) and one commenter submitted their comments twice. In addition, one comment was not included in this total, nor posted because it contained threatening language.

[53] With the updates made to the Technical Guidance as a result of the second and third peer reviews, some of the comments made during the initial public comment period were no longer relevant and as such were not addressed.

comment period was granted). The remaining 89 comments were not directly applicable to the Technical Guidance (e.g., general concern over impacts of noise on marine mammals from various industry or military activities) and were not further addressed. Specific comments can be viewed on Regulations.gov: http://www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2013-0177.

NMFS' responses to substantive comments made during the initial public comment period were published in the Federal Register located on the following web site in conjunction with the Final Technical Guidance: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

2.2 SECOND PUBLIC COMMENT PERIOD (ASSOCIATED WITH 2015 DRAFT TECHNICAL GUIDANCE)

Because of the significant changes made to the Draft Technical Guidance from the two additional peer reviews, NMFS proposed a second 45-day public comment, which occurred in the summer of 2015. Notice of this public comment period was published in the Federal Register on July 31, 2015, and closed September 14, 2015 (NMFS 2015).

2.2.1 Summary of Public Comments Received

A total of 20 comments were received from individuals, groups, organizations, and affiliations in the form of a letter or individual comment submitted by representatives of a group/organization/affiliation (some submitted on behalf of an organization and/or as an individual). Those commenting included: two federal agencies; four industry groups; seven subject matter experts; a scientific professional organization; seven non-governmental organizations; two Alaskan native groups; an environmental consulting firm; and a regulatory watchdog group. Each provided substantive comments addressing technical aspects and/or issues relating to the implementation of updated acoustic thresholds, which were addressed in the Final Technical Guidance or related Federal Register Notice.

Of those not mentioned above, an additional four comments were submitted in the form of a letter or individual comment. One of these comments specifically requested an extension of the 45-day public comment period, while the remaining three comments were not directly applicable to the Technical Guidance (e.g., general concern over impacts of noise on marine mammals from various industry or military activities) and were not further addressed. Specific comments can be viewed on Regulations.gov: http://www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2013-0177.

NMFS responses to substantive comments made during the second public comment period were published in the Federal Register located on the following web site in conjunction with the Final Technical Guidance: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

2.3 THIRD PUBLIC COMMENT PERIOD (ASSOCIATED WITH 2016 PROPOSED CHANGES FROM DRAFT TECHNICAL GUIDANCE)[54]

While NMFS was working to address public comments and finalize the Technical Guidance, after the second public comment period, the Finneran Technical Report was further evaluated internally by NMFS, as well as externally by Navy scientists (SSC-PAC). As a result, several recommendations/modifications were suggested.

The recommendations included:

- Modification of methodology to establish predicted the composite audiogram and weighting/exposure functions for LF cetaceans
- Modification of the methodology used to establish auditory acoustic thresholds for LF cetaceans
- Movement of the white-beaked dolphin (*Lagenorhynchus albirostris*) from MF to HF cetaceans[55]
- Inclusion of a newly published harbor porpoise audiogram (HF cetacean) from Kastelein et al. 2015c
- The exclusion of multiple data sets, based on expert evaluation, from the phocid pinniped weighting function
- Removal of PK acoustic thresholds for non-impulsive sounds
- Use of dynamic range to predict PK acoustic thresholds for hearing groups where impulsive data did not exist.

After consideration of these recommendations, NMFS proposed to update the Draft Technical Guidance to reflect these suggested changes and solicited public comment on the revised sections of the document via a focused 14-day public comment period. This public comment period was advertised via the Federal Register and opened on March 16, 2016, and closed March 30, 2016 (NMFS 2016).

[54] Concurrent with this third public comment period, NMFS requested that the peer reviewers of the Finneran Technical Report review the Draft Technical Guidance's proposed changes and indicate if the revisions would significantly alter any of the comments made during their original review (i.e., follow-up to second peer review).

[55] Upon re-evaluation and considering comments made during the third public comment period, it was decided this move was not fully supported (i.e., move not supported to the level of that of the other two species in this family). Thus, this species remains a MF cetacean.

2.3.1 Summary of Public Comments Received

A total of 20[56] comments were received from individuals, groups, organizations, and affiliations in the form of a letter or individual comment submitted by representatives of a group/organization/affiliation (some submitted on behalf of an organization and/or as an individual). Those commenting included: two federal agencies; seven industry groups; three subject matter experts; a scientific professional organization; and nine non-governmental organizations. Each provided substantive comments addressing technical aspects and/or issues relating to the implementation of updated acoustic thresholds, which were addressed in the Final Technical Guidance or related Federal Register Notice.

Of those not mentioned above, an additional comment was submitted from a member of the public in the form of an individual comment. Three of these comments specifically requested an extension[57] of the 14-day public comment period. Specific comments can be viewed on Regulations.gov: http://www.regulations.gov/#!docketDetail;D=NOAA-NMFS-2013-0177.

NMFS responses to substantive comments made during the third public comment period were published in the Federal Register located on the following web site in conjunction with the Final Technical Guidance: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

2.4 CHANGES TO TECHNICAL GUIDANCE AS A RESULT OF PUBLIC COMMENTS

Public comment provided NMFS with valuable input during the development of the Technical Guidance. As a result of public comments, numerous changes were incorporated in the Final Technical Guidance, with the most significant being:

- Re-examination and consideration of LF weighting function and thresholds throughout the public comment process
- Updated methodology (dynamic range) for approximating PK acoustic thresholds for species where TTS data from impulsive sources were not available
- Removal of PK acoustic thresholds for non-impulsive sources
- Addition of an appendix providing research recommendations
- Adoption of a consistent accumulation period (24-h)

[56] One group of commenters experienced difficulty in submitting their public comments via regulations.gov. As a result, their duplicate comments were submitted three times and were counted toward this total of 20 public comments.

[57] The majority of the 20 comments received requested an extension of the public comment period. Three comments were from industry groups that only requested an extension and never provided additional comments (i.e., others in additional to requesting an extension provided substantive comments).

- More consistent means of defining generalized hearing range for each marine mammal hearing group based on ~65 dB threshold from the normalized composite audiogram.

- Modification to reflect ANSI standard symbols and abbreviations.

- Withdraw of the proposed transition range methodology (July 2015 Draft) until more data can be collected to better support this concept. Instead, this concept has been moved to the Research Recommendations (Appendix B).

- Replacement of alternative acoustic thresholds with weighting factor adjustments (WFAs) that more accurately allow those incapable of fully implementing the auditory weighting functions to implement this concept (Technical Guidance; Appendix D).

APPENDIX D: ALTERNATIVE METHODOLOGY

I. INTRODUCTION

This Appendix is provided to assist action proponents in the application of the updated acoustic thresholds presented in this Technical Guidance. Since the adoption of NMFS' original thresholds for assessing auditory impacts, the understanding of the effects of noise on marine mammal hearing has greatly advanced (e.g., Southall et al. 2007; Finneran 2015; Finneran 2016) making it necessary to re-examine the current state of science and our acoustic thresholds. However, NMFS recognizes in updating our acoustic thresholds to reflect the scientific literature, they have become more complex.

This Appendix provides a set of alternative tools, examples, and weighting factor adjustments (WFAs) to allow action proponents with different levels of exposure modeling capabilities to be able to accurately apply NMFS' updated acoustic thresholds for the onset of PTS for all sound sources.

Note: The alternative methods, within this Appendix, include multiple conservative assumptions and therefore would be expected to typically result in higher estimates of instances of hearing impairment. The larger the scale of the activity, the more these conservative overestimates would be compounded if the alternative methodologies were used.

II. WEIGHTING FACTOR ADJUSTMENT ASSOCIATED WITH SEL_{CUM} ACOUSTIC THRESHOLDS

Numerical criteria presented in the Technical Guidance consist of both an acoustic threshold and auditory weighting function associated with the SEL_{cum} metric. NMFS recognizes that the implementation of marine mammal weighting functions represents a new factor for consideration, which may extend beyond the capabilities of some action proponents. Thus, NMFS has developed simple weighting factor adjustments (WFA) for those who cannot fully apply auditory weighting functions associated with the SEL_{cum} metric.

WFAs consider marine mammal auditory weighting functions by focusing on a single frequency. This will typically result in similar, if not identical, predicted exposures for narrowband sounds or higher predicted exposures for broadband sounds, since only one frequency is being considered, compared to exposures associated with the ability to fully incorporate the Technical Guidance's weighting functions.

WFAs use the same acoustic thresholds contained in the Technical Guidance and allow for adjustments to be made for each hearing group based on source-specific information.

NMFS has provided a companion User Spreadsheet to help action proponents incorporate WFAs to determine isopleths for PTS onset associated with their activity: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm.

2.1 APPLICATION FOR NARROWBAND SOUNDS

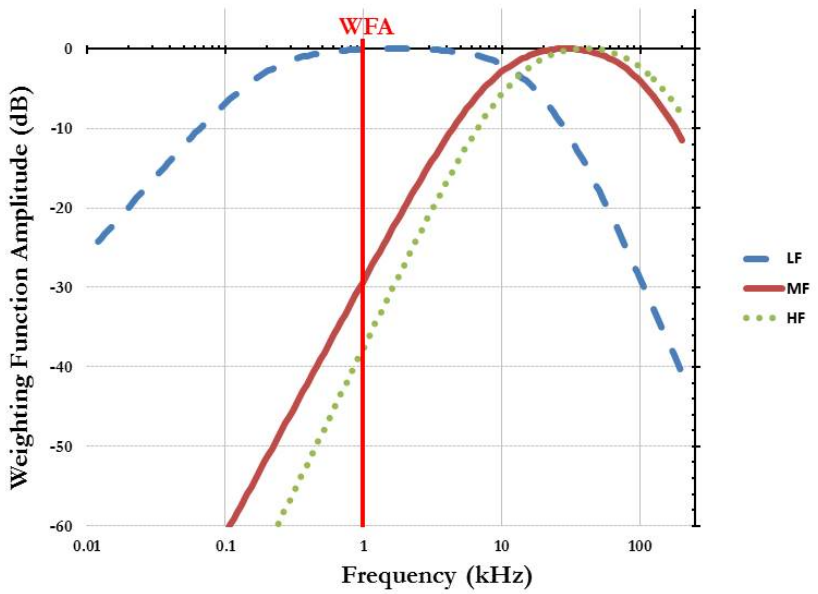
For narrowband sources, the selection of the appropriate frequency for consideration associated with WFAs is fairly straightforward. WFAs for a narrowband sound would take the weighting function amplitude, for each hearing group, associated with the particular frequency of interest and use it to make an adjustment to better reflect the hearing's group susceptibility to that narrowband sound.

As an example, a 1 kHz narrowband sound would result in the following WFAs:

- LF cetaceans: -0.06 dB
- MF cetaceans: -29.11 dB
- HF cetaceans: -37.55 dB
- Phocid pinnipeds: -5.90 dB
- Otariid pinnipeds: -4.87 dB

As this example illustrates, WFAs always result in zero or a negative dB amplitude. Additionally, the more a sound's frequency is outside a hearing group's most susceptible range (most susceptible range is where the weighting function amplitude equal zero), the more negative WFA that results (i.e., in example above 1 kHz is outside the most susceptible range for MF and HF cetaceans but in the most susceptible range for LF cetaceans; Figure D1). Further, the more negative WFA that results will lead to a smaller effect distance (isopleth) compared to a less negative or zero WFA. In other words, considering an identical SEL_{cum} acoustic threshold, a more negative WFA (i.e., source outside most susceptible frequency range) will result in a smaller effect distance (isopleth) compared to one that is less negative or closer to zero (i.e., source inside most susceptible frequency range; Figure D2).

Note: Action proponents should be aware and consider that sources may not always adhere to manufacturer specifications and only produce sound within the specified frequency (i.e., often sources are capable of producing sounds, like harmonics and subharmonics, outside their specified bands; Deng et al. 2014; Hastie et al. 2014). If it is unclear whether a source is narrowband or not, please consult with NMFS.



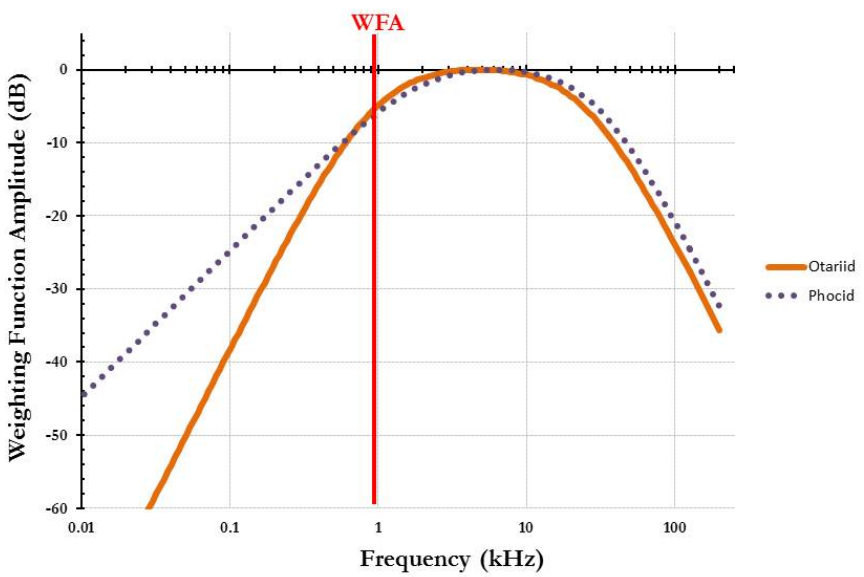


Figure D1: Example illustrating concept of weighting factor adjustment at 1 kHz (red line) with cetacean (top) and pinniped (bottom) auditory weighting functions.

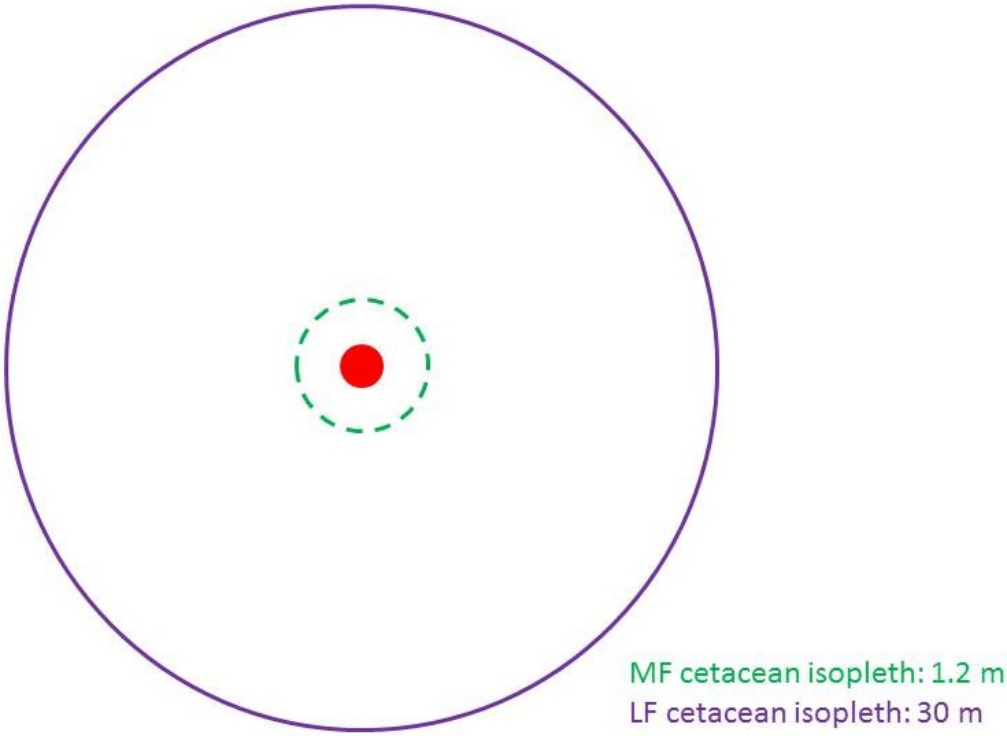


Figure D2: Simple example illustrating concept of weighting factor adjustment on isopleths for LF and MF cetaceans using hypothetical 1 kHz narrowband, intermittent source represented by the red dot (RMS source level of 200 dB; 1-second ping every 2 minutes). For a non-impulsive source, the PTS onset SEL_{cum} threshold for LF cetaceans is 199 dB, while for MF cetaceans is 198 dB. Despite LF cetaceans having a higher PTS onset threshold than MF cetaceans, the isopleth associated with LF cetaceans (30 m solid purple circle) is larger than that for MF cetaceans (1.2 m dashed green circle) based on 1 kHz being within LF cetacean's most susceptible frequency range vs. outside the most susceptible frequency range for MF cetaceans (isopleths not to scale).

2.2 APPLICATION FOR BROADBAND SOUNDS

For broadband sources, the selection of the appropriate frequency for consideration associated with WFAs is more complicated. The selection of WFAs associated with broadband sources is similar to the concept used for to determine the 90% total cumulative energy window (5 to 95%) for consideration of duration associated with the RMS metric and impulsive sounds (Madsen 2005) but considered in the frequency domain, rather than the time domain. This is typically referred to as the 95% frequency contour percentile (Upper frequency below which 95% of total cumulative energy is contained; Charif et al. 2010).

NMFS recognizes the consideration of WFAs may be new for action proponents and have provided representative "default" values for various broadband sources (see associated User Spreadsheet).

2.2.1 Special Considerations for Broadband Source

Since the intent of WFAs is to broadly account for auditory weighting functions below the 95% frequency contour percentile, it is important that only frequencies on the "left side" of the weighting function be used to make adjustments (i.e., frequencies below those where the weighting function amplitude is zero[58] or below where the function is essentially flat; resulting in every frequency below the WFA always having a more negative amplitude than the chosen WFA) (Figure D3). It is inappropriate to use WFAs for frequencies on the "right side" of the weighting function (i.e., frequencies above those where the weighting function amplitude is zero). For a frequency on the "right side" of the weighting function (Table D1), any adjustment is inappropriate and WFAs cannot be used (i.e., an action proponent would be advised to not use weighting functions and evaluate its source as essentially unweighted; see "Use" frequencies in Table D1, which will result in a weighting function amplitude of 0 dB).

Table D1: Applicability of weighting factor adjustments for frequencies associated with broadband sounds

Hearing Group	Applicable Frequencies	Non-Applicable Frequencies*
Low-Frequency Cetaceans (LF)	4.8 kHz and lower	Above 4.8 kHz (Use: 1.7 kHz)
Mid-Frequency Cetaceans (MF)	43 kHz and lower	Above 43 kHz (Use: 28 kHz)
High-Frequency Cetaceans (HF)	59 kHz and lower	Above 59 kHz (Use: 42 kHz)
Phocid Pinnipeds (PW)	11 kHz and lower	Above 11 kHz (Use: 6.2 kHz)
Otariid Pinnipeds (OW)	8.5 kHz and lower	Above 8.5 kHz (Use: 4.9 kHz)

* With non-applicable frequencies, user should input the "use" frequency in the User Spreadsheet, which will result in a weighting function amplitude of 0 dB (i.e., unweighted).

[58] A criteria of a -0.4 dB weighting function amplitude from the Technical Guidance's auditory weighting function was used to determine the demarcation between appropriate and inappropriate frequencies to use the WFAs.

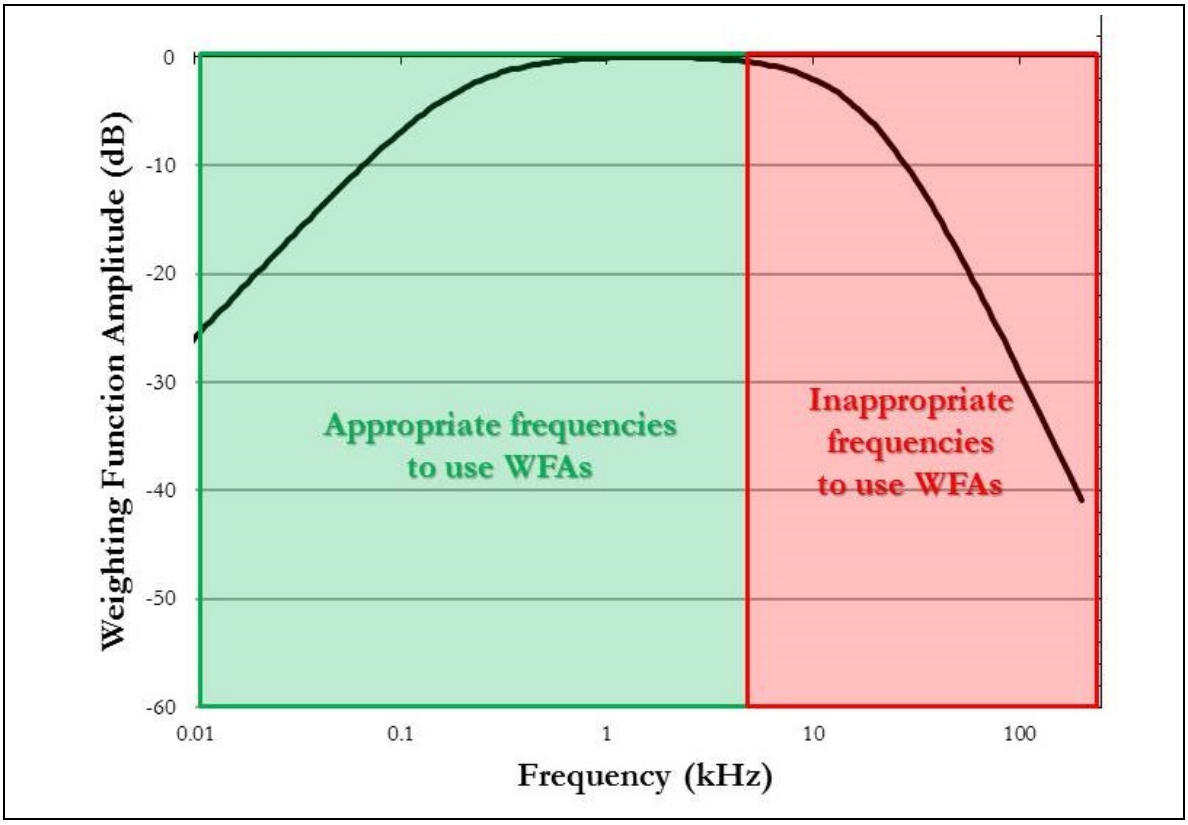


Figure D3: Example weighting function illustrating where the use of weighting function adjustments are (Green: "left side") and are not (Red: "right side") appropriate for broadband sources.

III. MODELING CUMULATIVE SOUND EXPOSURE LEVELS

To apply the PTS onset auditory acoustic thresholds expressed as the SEL_{cum} metric, accumulation time must be specified. Generally, it is predicted that most receivers will minimize their time in the closest ranges to a sound source/activity and that exposures at the closest point of approach are the primary exposures contributing to a receiver's accumulated level (Gedamke et al. 2011). Additionally, several important factors determine the likelihood and duration of time a receiver is expected to be in close proximity to a sound source (i.e., overlap in space and time between the source and receiver). For example, accumulation time for fast moving (relative to the receiver), mobile source, is driven primarily by the characteristics of source (i.e., transit speed, duty cycle). Conversely, for stationary sources, accumulation time is driven primarily by the characteristics of the receiver (i.e., swim speed and whether species is transient or resident to the area where the activity is occurring). For all sources, NMFS recommends a baseline accumulation period of 24-h, but acknowledges that there may be specific exposure situations where this accumulation period

requires an adjustment (e.g., if activity lasts less than 24 hours or for situations where receivers are predicted to experience unusually long exposure durations[59]).

Previous NMFS acoustic thresholds only accounted for the proximity of the sound source to the receiver, but acoustic thresholds in the Technical Guidance (i.e., expressed as SEL_{cum}) now take into account the duration of exposure. NMFS recognizes that accounting for duration of exposure, although supported by the science literature, adds a new factor, as far as the application of this metric to real-world activities and that all action proponents may not have the ability to easily incorporate this additional component. NMFS does not provide specifications necessary to perform exposure modeling and relies on the action proponent to determine the model that best represents their activity.

3.1 MORE SOPHISTICATED MODELS

Because of the time component associated with the SEL_{cum} metric, the use of different types of models to predict sound exposure may necessitate different approaches in evaluating likely effects in the context of the PTS onset acoustic thresholds. All marine mammals and some sources move in space and time, however, not all models are able to simulate relative source and receiver movement. Additionally, some models are able to predict the received level of sound at each modeled animal (often called animats) and accumulate sound at these receivers while incorporating the changing model environment.

Models that are more sophisticated may allow for the inclusion of added details to achieve more realistic results based on the accumulation of sound (e.g. information on residence time of individuals, swim speeds for transient species, or specific times when activity temporarily ceases). Alternatively, there may be case-specific circumstances where the accumulation time should be modified to account for situations where animals are expected to be in closer proximity to the source over a significantly longer amount of time, based on activity, site, and species-specific information (e.g., where a resident population could be found in a small and/or confined area (Ferguson et al. 2015) and a long-duration activity with a large sound source, or a continuous stationery activity nearby a pinniped pupping beach).

3.2 LESS SOPHISTICATED MODELS

For action proponents unable to incorporate animal and/or source movement, it may not be realistic to assume that animals will remain at a constant distance from the source accumulating acoustic energy for 24 hours. Thus, alternative methods are needed, which can provide a distance from the source where exposure exceeding a threshold is expected to occur and can be used in the same manner as distance has been used to calculate exposures

[59] For example, where a resident population could be found in a small and/or confined area (Ferguson et al. 2015) and/or exposed to a long-duration activity with a large sound source, or there could be a continuous stationery activity nearby an area where marine mammals congregate, like a pinniped pupping beach.

above previous NMFS thresholds. NMFS proposes two alternative methods: one for mobile sources and one for stationary sources.

3.2.1 Mobile Sources[60]

3.2.1.1 Linear Equivalents Used in Appendix

In underwater acoustics, equations/derivations are typically expressed in terms of logarithmic terms (i.e., levels). These equations can be further simplified by introducing linear equivalents of the levels (i.e., factors) related by multiplication instead of by addition. For example, source level[61] (SL) is replaced by the "source factor" $10^{\mathrm{SL}/(10\ \mathrm{dB})}$ (Ainslie 2010). In this appendix, the following linear equivalents are used:

- Sound exposure (E) = $10^{\mathrm{SEL}/(10\ \mathrm{dB})}$ μPa²s
- Mean-square sound pressure ($\overline{p^2}$) = $10^{\mathrm{SPL}/(10\ \mathrm{dB})}$ μPa²
- Source factor (S) = $10^{\mathrm{SL}/(10\ \mathrm{dB})}$ μPa²m²
- Energy source factor[62] (S_E) = $10^{\mathrm{SL}_E/(10\ \mathrm{dB})}$μPa² m²s

Both source level and energy source level (and their corresponding factors) are evaluated and reported in the direction producing the maximum SL.

3.2.1.2 "Safe Distance" Methodology

Cumulative sound exposure can be computed using a simple equation, assuming a constant received sound pressure level (SPL) that does not change over space and time[63] (Equation E1.; e.g., Urick 1983; ANSI 1986; Madsen 2005):

---

[60] The methodology for mobile sources presented in this Appendix underwent peer review via the publication process (Sivle et al. 2014) but did not undergo a separate peer review. It is an optional tool for the application of the acoustic thresholds presented in the Technical Guidance.

[61] For definition of SL, see Ainslie 2010. SL ≡ $10\log_{10}[p(s)^2 s^2/(1\ \mu\mathrm{Pa}^2\ \mathrm{m}^2)]$ dB (Ainslie writes this as SL ≡ $10\log_{10} p^2 s^2$ dB re 1 μPa²s m².) For a point source, s is a small distance from the source, where distortions due to absorption, refraction, reflection, or diffraction are negligible and $p(s)$ is the RMS sound pressure at that distance. For a large (i.e., finite) source, p is the hypothetical sound pressure that would exist at distance s from a point source with the same far-field radiant intensity as the true source. For further clarification see ISO 18405 Underwater Acoustics - Terminology, entry 2.3.2.1 "source level."

[62] For definition of $\mathrm{SL_E}$, see Ainslie 2010. $\mathrm{SL_E} \equiv 10\log_{10}[E(s)s^2/(1\ \mu\mathrm{Pa}^2\ \mathrm{m}^2\ \mathrm{s})]$ dB (Ainslie writes this as $\mathrm{SL_E} \equiv 10\log_{10} E(s)s^2$ dB 1 μPa² m²s). For a point source, s is a small distance from the source, where distortions due to absorption, refraction, reflection, or diffraction are negligible and $E(s)$ is the unweighted sound exposure at that distance. For a large (i.e., finite) source, E is the hypothetical sound exposure that would exist at distance s from a point source with the same duration and far-field radiant intensity as the true source. For further clarification see ISO 18405 Underwater Acoustics - Terminology, entry 2.3.2.2 "energy source level."

[63] Equation D1 assumes a constant source-receiver separation distance.

$$SEL_{cum} = SPL + 10 \log_{10} (\text{duration of exposure, expressed in seconds}) \text{ dB}$$

Equation D1

However, if one assumes a stationary receiver and a source moving at a constant speed in a constant direction, then exposure changes over space and time (i.e., greatest rate of accumulation at closest point of approach).

An alternative approach for modeling moving sources is the concept of a "safe distance" (R_0), which is defined by Sivle et al. (2014) as "the distance from the source beyond which a threshold[64] for that metric (SPL_0 or SEL_0) is not exceeded." This concept allows one to determine at what distance from a source a receiver would have to remain in order not to exceed a predetermined exposure threshold (i.e., E_0 which equals the weighted SEL_{cum} PTS onset threshold in this Technical Guidance) and is further illustrated in Figure D4.

[64] The threshold considered by Sivle et al. 2014 was associated with behavioral reactions.

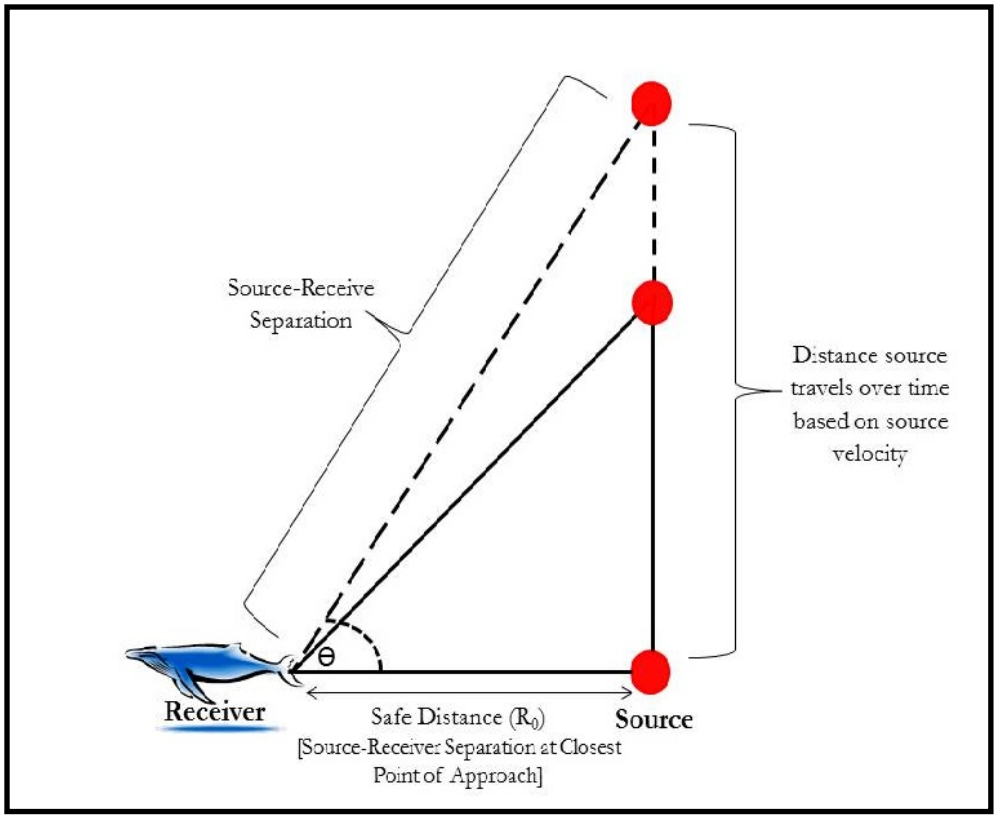


Figure D4: Illustration of the concept for mobile sources, with each red dot representing the source traveling over time. As the source travels further from the receiver, the source-receiver separation increases (i.e., hypotenuse gets longer).

This methodology accounts for several factors, including source level, duty cycle, and transit speed of the source and is independent of exposure duration (Equations D2a[65],b).

[65] This equation matches Equation 3 from Sivle et al. (2014), but is written in a simpler manner.

a

$$R_0 = \frac{\pi}{E_0 v} SD$$

OR **Equations D2a,b**

For impulsive sources, SD is replaced with S_E/τ:

b

$$R_0 = \frac{\pi}{E_0 v} \frac{S_E}{\tau}$$

where:

S = source factor ($10^{SL/(10\ dB)}$ μPa^2 m^2)
D =duty cycle (pulse duration x repetition rate)
v= transit speed
E_0 =exposure threshold ($10^{SEL_0/(10\ dB))}$ μPa^2 s)
S_E = energy source factor ($10^{SL_E/(10\ dB)}$ μPa^2 m^2 s)
τ = 1/repetition rate

R_0 represents the exposure isopleth calculated using NMFS' acoustic thresholds. Thus, area calculations and exposure calculations would be performed in the same manner[66] action proponents have previously used (e.g., determine area covered over a 24-h period multiplied by the density of a marine mammal species).

This approach considers four factors:

1. Source level (direct relationship: as source level increases, so does R_0; higher source level results is a greater accumulation of energy).

2. Duty cycle (direct relationship: as duty cycle increases, so does R_0; higher duty cycle results in more energy within a unit of time and leads a greater accumulation of energy).

3. Source transit speed (inverse relationship: as transit speed decreases, R_0 increases or vice versa; a faster transit speed results in less energy within a unit of time and leads to a lower accumulation of energy, while a slower transit speed will result in a greater accumulation of energy).

[66] Note: "Take" calculations are typically based on speed expressed in kilometers per hour, duration of an exposure expressed in hours (i.e., 24 hours), isopleths expressed in kilometers, and animal density expresses as animals per square kilometers. Thus, units would need to be converted to use Equations D2a,b.

4. Exposure threshold (inverse relationship: as the exposure threshold decreases, R_0 increases or vice versa; a higher exposure threshold result in needing more energy to exceed it compared to a lower threshold).

The action proponent is responsible for providing information on factors one through three above, while factor four is the updated PTS onset acoustic threshold (expressed as SEL_{cum} metric) provided within the Technical Guidance.

For this approach to be applicable to a broad range of activities, the following assumptions[67] must be made:

- Action proponents that are unable to apply full auditory weighting functions will rely on WFAs. This will create larger isopleths, for broadband sources, compared to action proponents capable of fully applying auditory weighting functions.

- The movement of the source is simple (i.e., source moves at a constant speed and in a constant direction). Caution should be applied if the source has the potential to move in a manner where the same group of receivers could be exposed to multiple passes from the source.

- Minimal assumptions are made about the receivers. They are considered stationary and assumed to not move up or down within the water column. There is no avoidance and the receiver accumulates sound via one pass of the source (i.e., receiver is not exposed to multiple passes from the source). Because this methodology only examines one pass of the source relative to receiver, this method is essentially time-independent (i.e., action proponent does not need to specify how long an activity occurs within a 24-h period).

    - These assumptions are appropriate for sources that are expected to move much faster than the receiver does. Further, assuming receivers do not avoid the source or change position vertically or horizontally in the water column will result in more exposures exceeding the acoustic thresholds compared to those receivers that would avoid or naturally change positions in the water column over time. Caution should be applied if the receiver has the potential to follow or move with the sound source.

- Distance (i.e., velocity x change over time) between "pulses" for intermittent sources is small compared with R_0, and the distance between "pulses" for intermittent sources is consistent. This assumption is appropriate for intermittent sources with a

[67] If any of these assumptions are violated and there is concern that the isopleth produced is potentially underestimated, action proponents should contact NMFS to see if any there are any appropriate adjustments that can be made (e.g., addition of a buffer, etc.). If not, the action proponent is advised to pursue other methodology capable of more accurately modeling exposure.

predictable duty cycle. If the duty cycle decreases, R_0 will become larger, while if the duty cycle increases, it will become smaller. Further, for intermittent sources, it is assumed there is no recovery in hearing threshold between pulses.

- Sound propagation is simple (i.e., approach uses spherical spreading[68]: 20 log R, with no absorption). NMFS recognizes that this might not be appropriate for all activities, especially those occurring in shallow water (i.e., sound could propagate further than predicted by this model)[69]. Thus, modifications to the R_0 predicted may be necessary in these situations.

Despite these assumptions, this approach offers a better approximation of the source-receiver distance over space and time for various mobile sources than choosing a set accumulation period for all sources, which assumes a fixed source-receiver distance over that time.

Ainslie and Von Benda-Beckmann (2013) investigated the effect various factors had on the derivation of R_0 and found exposures were highest for stationary receivers in the path of a source, compared to mobile receivers swimming away from the source. However, the authors did acknowledge, if the receivers actively swam toward the source, cumulative exposure would increase. Uncertainty associated with R_0 was found to be primarily driven by the exposure threshold (i.e., Technical Guidance's acoustic thresholds). Increasing duty cycle of the source or reducing speed (either source or receiver) will result in an increased R_0 (Sivle et al. 2014)

NMFS has provided a companion User Spreadsheet to help action proponents use this methodology to determine isopleths for PTS onset associated with their activity (http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm).

Note: NMFS' alternative methods apply only to acoustic thresholds in the SEL_{cum} metric. NMFS assumes action proponents will be able to perform exposure modeling using acoustic thresholds expressed using the PK metric (i.e., methodology is similar to that used with NMFS previous thresholds but with a different metric), and reminds action proponents since the Technical Guidance presents dual thresholds for impulsive sounds, they must evaluate thresholds using both metrics.

---

[68] Assuming spherical spreading allows for Equations D2a,b to remain simplified (i.e., assuming another spreading model results in more complicated equations that are no longer user-friendly nor as easy to implement).

[69] Note: Many moving sources, like seismic airguns or sonar, can be highly-directional (i.e., most of time sound source is directed to the ocean floor, with less sound propagating horizontally, compared to the vertical direction), which is not accounted for with this methodology. Additionally, many higher-frequency sounds, like sonar, are also attenuated by absorption, which is also taken into account in this model. These, among other factors, should be considered when evaluating whether spherical spreading is potentially resulting in an underestimation of exposure.

3.2.2 Stationary Sources

If there is enough information to accurately predict the travel speed of a receiver past a stationary sound source (including the assumption that the receiver swims on a straight trajectory past the source), then the mobile source approach can be modified for stationary sources (i.e., transit speed of the source is replaced by speed of the receiver). However, NMFS acknowledges that characteristics of the receiver are less predictable compared to those of the source (i.e., velocity and travel path), which is why the mobile source approach may not be appropriate for stationary sources and an alternate method is provided below.

An alternative approach is to calculate the accumulated isopleth associated with a stationary sound source within a 24-h period. For example, if vibratory pile driving was expected to occur over ten hours within a 24-h period, then the isopleth would be calculated by adding area with each second the source is producing sound. This is a highly conservative means of calculating an isopleth because it assumes that animals on the edge of the isopleth (in order to exceed a threshold) will remain there for the entire time of the activity.

For stationary, impulsive sources with high source levels (i.e., impulsive pile driving associated with large piles, stationary airguns associated with vertical seismic profiling (VSPs), and large explosives) accumulating over a 24-h period, depending on how many strikes or shots occur, could lead to unrealistically large isopleths associated with PTS onset. For these situations, action proponents should contact NMFS for possible applicable alternative methods.

NMFS has provided a companion User Spreadsheet to help action proponents wanting to use this methodology to determine isopleths for PTS onset associated with their activity (http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm).

Note: NMFS' alternative methods apply only to acoustic thresholds in the SEL_{cum} metric. NMFS assumes action proponents will be able to perform exposure modeling using acoustic thresholds expressed using the PK metric (i.e., methodology is similar to that used with NMFS previous thresholds but with a different metric) and reminds action proponents since the Technical Guidance presents dual thresholds for impulsive sounds, they must evaluate thresholds using both metrics.

APPENDIX E: GLOSSARY

95% Frequency contour percentile: Upper frequency below which 95% of total cumulative energy is contained (Charif et al. 2010).

Accumulation period: The amount of time a sound accumulates for the SEL_{cum} metric.

Acoustic threshold: An acoustic threshold in this document identifies the level of sound, after which exceeded, NMFS anticipates a change in auditory sensitivity (temporary or permanent threshold shift).

Ambient noise: All-encompassing sound at a given place, usually a composite of sound from many sources near and far (ANSI 1994).

Animat: A simulated marine mammal.

Anthropogenic: Originating (caused or produced by) from human activity.

Audible: Heard or capable of being heard. Audibility of sounds depends on level, frequency content, and can be reduced in the presence of other sounds (Morfey 2001)

Audiogram: A graph depicting hearing threshold as a function of frequency (ANSI 1995; Yost 2007) (Figure E1).

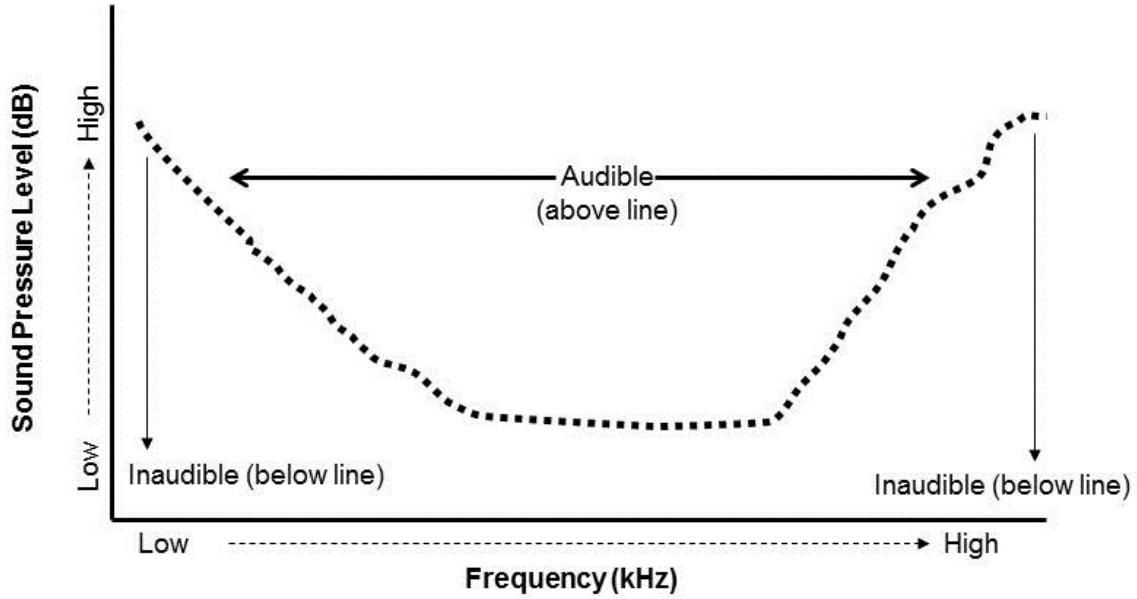


Figure E1. Example audiogram.

Auditory adaptation: Temporary decrease in hearing sensitivity occurring during the presentation of an acoustic stimulus (opposed to auditory fatigue which occurs post-stimulation) (ANSI 1995).

Auditory bulla: The ear bone in odontocetes that houses the middle ear structure (Perrin et al. 2009).

Auditory weighting function: Auditory weighting functions take into account what is known about marine mammal hearing sensitivity and susceptibility to noise-induced hearing loss and can be applied to a sound-level measurement to account for frequency-dependent hearing (i.e.,. an expression of relative loudness as perceived by the ear)(Southall et al. 2007; Finneran 2016). Similar to OSHA (2013), marine mammal auditory weighting functions in this document are used to reflect the risk of noise exposure on hearing and not necessarily capture the most sensitive hearing range of every member of the hearing group.

Background noise: Total of all sources of interference in a system used for the production, detection, measurement, or recording of a signal, independent of the presence of the signal (ANSI 2013).

Band-pass filter: A filter that passes frequencies within a defined range without reducing amplitude and attenuates frequencies outside that defined range (Yost 2007).

Bandwidth: Bandwidth (Hz or kHz) is the range of frequencies over which a sound occurs or upper and lower limits of frequency band(ANSI 2005). Broadband refers to a source that produces sound over a broad range of frequencies (for example, seismic airguns), while narrowband or tonal sources produce sounds over a more narrow frequency range, typically with a spectrum having a localized a peak in amplitude (for example, sonar) (ANSI 1986; ANSI 2005).

Bone conduction: Transmission of sound to the inner ear primarily by means of mechanical vibration of the cranial bones (ANSI 1995).

Broadband: See "bandwidth".

Cetacean: Any number of the order Cetacea of aquatic, mostly marine mammals that includes whales, dolphins, porpoises, and related forms; among other attributes they have a long tail that ends in two transverse flukes (Perrin et al. 2009).

Cochlea: Spirally coiled, tapered cavity within the temporal bone, which contains the receptor organs essential to hearing (ANSI 1995). For cetaceans, based on cochlear measurements two cochlea types have been described for echolocating odontocetes (type I and II) and one cochlea type for mysticetes (type M). Cochlea type I is found in species like the harbor porpoise and Amazon river dolphin, which produce high-frequency echolocation signals. Cochlea type II is found in species producing lower frequency echolocation signals (Ketten 1992).

Continuous sound: A sound whose sound pressure level remains above ambient sound during the observation period (ANSI 2005).

Critical level: The level at which damage switches from being primarily metabolic to more mechanical; e.g., short duration of impulse can be less than the ear's integration time, leading for the potential to damage beyond level the ear can perceive (Akay 1978).

Cumulative sound exposure level (SEL_{cum}; re: 1μPa^2s): Level of acoustic energy accumulated over a given period of time or event (EPA 1982) or specifically, ten times the logarithm to the base ten of the ratio of a given time integral of squared instantaneous frequency-weighted sound pressure over a stated time interval or event to the reference sound exposure (ANSI 1995; ANSI 2013).

Deafness: A condition caused by a hearing loss that results in the inability to use auditory information effectively for communication or other daily activities (ANSI 1995).

Decibel (dB): One-tenth of a bel. Unit of level when the base of the logarithm is the tenth root of ten, and the quantities concerned are proportional to power (ANSI 2013).

dB/decade: This unit is typically used to describe roll-off, where a decade is a 10-times increase in frequency (roll-off can also be described as decibels per octave, where an octave is 2-times increase in frequency)

Duty cycle: On/off cycle time or proportion of time signal is active (calculated by: pulse length x repetition rate). A continuous sound has a duty cycle of 1 or 100%.

Dynamic range of auditory system: Reflects the range of the auditory system from the ability to detect a sound to the amount of sound tolerated before damage occurs (i.e., the threshold of pain minus the threshold of audibility) (Yost 2007). For the purposes of this document, the intent is relating the threshold of audibility and TTS onset levels, not the threshold of pain.

Effective quiet: The maximum sound pressure level that will fail to produce any significant threshold shift in hearing despite duration of exposure and amount of accumulation (Ward et al. 1976; Ward 1991).

Endangered Species Act (ESA): The Endangered Species Act of 1973 (16. U.S.C 1531 et. seq.) provides for the conservation of species that are endangered or threatened throughout all or a significant portion of their range, and the conservation of the ecosystems on which they depend.

NOAA's National Marine Fisheries Service and the U.S. Fish and Wildlife Service (USFWS) share responsibility for implementing the ESA.

Energy Source Level (SL_E): The time-integrated squared signal sound pressure level measured in a given radian direction, corrected for absorption, and scaled to a reference distance (1 m) (adapted from Morfey 2001).

Equal Energy Hypothesis (EEH): Assumption that sounds of equal energy produce the equal risk for hearing loss (i.e., if the cumulative energy of two sources are similar, a sound from a lower level source with a longer exposure duration may have similar risks to a shorter duration exposure from a higher level source) (Henderson et al. 1991).

Equal latency: A curve that describe the frequency-dependent relationships between sound pressure level and reaction time and are similar in shape to equal loudness contours in humans (loudness perception can be studied under the assumption that sounds of equal loudness elicit equal reaction times; e.g., Liebold and Werner 2002).

Equal-loudness contour: A curve or curves that show, as a function of frequency, the sound pressure level required to cause a given loudness for a listener having normal hearing, listening to a specified kind of sound in a specified manner (ANSI 2013).

Far-field: The acoustic field sufficiently distant from a distributed source that the sound pressure decreases linearly with increasing distance (neglecting reflections, refraction, and absorption) (ANSI 2013).

Fitness: Survival and lifetime reproductive success of an individual.

Frequency: The number of periods occurring over a unit of time (unless otherwise stated, cycles per second or hertz) (Yost 2007).

Functional hearing range: There is no standard definition of functional hearing arrange currently available. "Functional" refers to the range of frequencies a group hears without incorporating non-acoustic mechanisms (Wartzok and Ketten 1999). Southall et al. 2007 defined upper and lower limits of the functional hearing range as ~60-70 dB above the hearing threshold at greatest hearing sensitivity (based on human and mammalian definition of 60 dB[70]).

Fundamental frequency: Frequency of the sinusoid that has the same period as the periodic quantity (Yost 2007; ANSI 2013). First harmonic of a periodic signal (Morfey 2001).

Harmonic: A sinusoidal quantity that has a frequency which is an integral multiple of the fundamental frequency of the periodic quantity to which it is related (Yost 2007; ANSI 2013).

Hearing loss growth rates: The rate of threshold shift increase (or growth) as decibel level or exposure duration increase (expressed in dB of temporary threshold shift/dB of noise).Growth rates of threshold shifts are higher for frequencies where hearing is more sensitive (Finneran and Schlundt 2010). Typically in terrestrial mammals, the magnitude of a threshold shift increases with increasing duration or level of exposure, until it becomes asymptotic (growth rate begins to level or the upper limit of TTS; Mills et al. 1979; Clark et al. 1987; Laroche et al. 1989; Yost 2007).

[70] In humans, functional hearing is typically defined as frequencies at a threshold of 60 to 70 dB and below (Masterson et al. 1969; Wartzok and Ketten 1999), with normal hearing in the most sensitive hearing range considered 0 dB (i.e., 60 to 70 dB above best hearing sensitivity).

Hertz (Hz): Unit of frequency corresponding to the number of cycles per second. One hertz corresponds to one cycle per second.

Impulsive sound: Sound sources that produce sounds that are typically transient, brief (less than 1 second), broadband, and consist of high peak sound pressure with rapid rise time and rapid decay (ANSI 1986; NIOSH 1998; ANSI 2005). They can occur in repetition or as a single event. Examples of impulsive sound sources include: explosives, seismic airguns, and impact pile drivers.

Information Quality Guidelines (IQG): Section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001 (Public Law 106-554), directs the Office of Management and Budget (OMB) to issue government-wide guidelines that "provide policy and procedural guidance to federal agencies for ensuring and maximizing the quality, objectivity, utility, and integrity of information (including statistical information) disseminated by federal agencies." OMB issued guidelines directing each federal agency to issue its own guidelines.

NOAA's Information Quality Guidelines can be viewed at:
http://www.cio.noaa.gov/services_programs/IQ_Guidelines_011812.html

Integration time (of the ear): For a signal to be detected by the ear, it must have some critical amount of energy. The process of summing the power to generate the required energy is completed over a particular integration time. If the duration of a signal is less than the integration time required for detection, the power of the signal must be increased for it to be detected by the ear (Yost 2007).

Intermittent sound: Interrupted levels of low or no sound (NIOSH 1998) or bursts of sounds separated by silent periods (Richardson and Malme 1993). Typically, intermittent sounds have a more regular (predictable) pattern of bursts of sounds and silent periods (i.e., duty cycle).

Isopleth: A line drawn through all points having the same numerical value. In the case of sound, the line has equal sound pressure or exposure levels.

Kurtosis: Statistical quantity that represents the impulsiveness ("peakedness") of the event; specifically the ratio of fourth- order central moment to the squared second-order central moment (Hamernik et al. 2003; Davis et al. 2009).

Linear interpolation: A method of constructing new data points within the range of a discrete set of known data points, with linear interpolation being a straight line between two points.

Marine Mammal Protection Act (MMPA): The Marine Mammal Protection Act (16. U.S.C. 1361 et. seq.)was enacted on October 21, 1972 and MMPA prohibits, with certain exceptions, the "take" of marine mammals in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the United States. NOAA's National Marine Fisheries Service and the U.S. Fish and Wildlife Service

(USFWS) share responsibility for implementing the MMPA.

Masking: Obscuring of sounds of interest by interfering sounds, generally of the similar frequencies (Richardson et al. 1995).

Mean-squared error (MSE): In statistics, this measures the average of the squares of the "errors," that is, the difference between the estimator and what is estimated.

Multipath propagation: This phenomenon occurs whenever there is more than one propagation path between the source and receiver (i.e., direct path and paths from reflections off the surface and bottom or reflections within a surface or deep-ocean duct; Urick 1983).

Mysticete: The toothless or baleen (whalebone) whales, including the rorquals, gray whale, and right whale; the suborder of whales that includes those that bulk feed and cannot echolocate (Perrin et al. 2009).

Narrowband: See "bandwidth".

National Marine Sanctuaries Act (NMSA): The National Marine Sanctuaries Act (16 U.S.C. 1431 et. seq.) authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or esthetic qualities as national marine sanctuaries. Day-to-day management of national marine sanctuaries has been delegated by the Secretary of Commerce to NOAA's Office of National Marine Sanctuaries.

National Standard 2 (NS2): The Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1801 et. seq.) is the principal law governing marine fisheries in the U.S. and includes ten National Standards to guide fishery conservation and management. One of these standards, referred to as National Standard 2 (NS2), guides scientific integrity and states that "(fishery) conservation and management measures shall be based upon the best scientific information available.

Non-impulsive sound: Sound sources that produce sounds that can be broadband, narrowband or tonal, brief or prolonged, continuous or intermittent) and typically do not have a high peak sound pressure with rapid rise time that impulsive sounds do. Examples of non-impulsive sound sources include: marine vessels, machinery operations/construction (e.g., drilling), certain active sonar (e.g. tactical), and vibratory pile drivers.

Octave: The interval between two sounds having a basic frequency ratio of two (Yost 2007). For example, one octave above 400 Hz is 800 Hz. One octave below 400 Hz is 200 Hz.

Odontocete: The toothed whales, including sperm and killer whales, belugas, narwhals, dolphins and porpoises; the suborder of whales including those able to echolocate (Perrin et al. 2009).

Omnidirectional: Receiving or transmitting signals in all directions (i.e., variation with direction is designed to be as small as possible).

Otariid: The eared seals (sea lions and fur seals), which use their foreflippers for propulsion (Perrin et al. 2009).

Peak sound pressure level (PK; re: 1 µPa): The greatest absolute instantaneous sound pressure within a specified time interval and frequency band (ANSI 1986; ANSI 2013).

Perception: Perception is the translation of environmental signals to neuronal representations (Dukas 2004).

Permanent threshold shift (PTS): A permanent, irreversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level. The amount of permanent threshold shift is customarily expressed in decibels (ANSI 1995; Yost 2007). Available data from humans and other terrestrial mammals indicate that a 40 dB threshold shift approximates PTS onset (see Ward et al. 1958, 1959; Ward 1960; Kryter et al. 1966; Miller 1974; Ahroon et al. 1996; Henderson et al. 2008).

Phocid: A family group within the pinnipeds that includes all of the "true" seals (i.e. the "earless" species). Generally used to refer to all recent pinnipeds that are more closely related to *Phoca* than to otariids or the walrus (Perrin et al. 2009).

Pinniped: Seals, sea lions and fur seals (Perrin et al. 2009).

Pulse duration: For impulsive sources, window that makes up 90% of total cumulative energy (5%-95%) (Madsen 2005)

Propagation loss: Reduction in magnitude of some characteristic of a signal between two stated points in a transmission system (for example the reduction in the magnitude of a signal between a source and a receiver) (ANSI 2013).

Received level: The level of sound measured at the receiver.

Reference pressure: See sound pressure level.

Repetition rate: Number of pulses of a repeating signal in a specific time unit, normally measured in pulses per second.

Rise time: The time interval a signal takes to rise from 10% to 90% of its highest peak (ANSI 1986; ANSI 2013).

Roll-off: Change in weighting function amplitude (-dB) with changing frequency.

Root-mean-square sound pressure level (RMS SPL; re: 1 µPa): The square root of the average of the square of the pressure of the sound signal over a given duration (ANSI 2005).

Sensation level (dB): The pressure level of a sound above the hearing threshold for an individual or group of individuals (ANSI 1995; Yost 2007).

Sound Exposure Level (SEL_{cum}; re: 1μPa^{2}s): A measure of sound level that takes into account the duration of the signal. Ten times the logarithm to the base 10 of the ration of a given time integral of squared instantaneous frequency-weighted sound pressure over a stated time interval or event to the product of the squared reference sound pressure and reference duration of one second (ANSI 2013).

Sound Pressure Level (SPL): A measure of sound level that represents only the pressure component of sound. Ten times the logarithm to the base 10 of the ratio of time-mean-square pressure of a sound in a stated frequency band to the square of the reference pressure (1 μPa in water)(ANSI 2013).

Source Level (SL): Sound pressure level measured in a given radian direction, corrected for absorption, and scaled to a reference distance (Morfey 2001). For underwater sources, the sound pressure level of is measured in the far-field and scaled to a standard reference distance[71] (1 meter) away from the source (Richardson et al. 1995; ANSI 2013).

Spatial: Of or relating to space or area.

Spectral/spectrum: Of or relating to frequency component(s) of sound. The spectrum of a function of time is a description of its resolution into components (frequency, amplitude, etc.). The spectrum level of a signal at a particular frequency is the level of that part of the signal contained within a band of unit width and centered at a particular frequency (Yost 2007).

Spectral density levels: Level of the limit, as the width of the frequency band approaches zero, of the quotient of a specified power-like quantity distributed within a frequency band, by the width of the band (ANSI 2013).

Subharmonic: Sinusoidal quantity having a frequency that is an integral submultiple of the fundamental frequency of a periodic quantity to which it is related (ANSI 2013).

Temporal: Of or relating to time.

Temporary threshold shift (TTS): A temporary, reversible increase in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level. The amount of temporary threshold shift is customarily expressed in decibels (ANSI 1995, Yost 2007). Based on data from cetacean TTS measurements (see Southall et al. 2007 for a review), a TTS of 6 dB is considered the minimum threshold shift clearly larger than any day-to-day or session-to-session variation in a subject's normal hearing ability (Schlundt et al. 2000; Finneran et al. 2000; Finneran et al. 2002).

[71] Standards for scaling to a reference distance will be provided in the forthcoming ISO/DIS 18405 standard.

Threshold (of audibility): The threshold of audibility (auditory threshold) for a specified signal is the minimum effective sound pressure level of the signal that is capable of evoking an auditory sensation in a specified fraction of trials (either physiological or behavioral) (Yost 2007). It recommended that this threshold be defined as the lowest sound pressure level at which responses occur in at least 50% of ascending trials. (ANSI 2009).

Threshold shift: A change, usually an increase, in the threshold of audibility at a specified frequency or portion of an individual's hearing range above a previously established reference level. The amount of threshold shift is customarily expressed in decibels (ANSI 1995, Yost 2007).

Tone: A sound wave capable of exciting an auditory sensation having pitch. A pure tone is a sound sensation characterized by a single pitch (one frequency). A complex tone is a sound sensation characterized by more than one pitch (more than one frequency) (ANSI 2013).

Uncertainty: Lack of knowledge about a parameter's true value (Bogen and Spears 1987; Cohen et al. 1996).

Variability: Differences between members of the populations that affects the magnitude of risk to an individual (Bogen and Spears 1987; Cohen et al. 1996; Gedamke et al. 2011).

LITERATURE CITED

Ahroon, W.A., R.P. Hamerik, and R.I. Davis. 1993. Complex noise exposures: An energy analysis. Journal of the Acoustical Society of America 93:997-1006.

Ahroon, W.A., R.P. Hamernik, and S.-F., Lei. 1996. The effects of reverberant blast waves on the auditory system. Journal of the Acoustical Society of America 100:2247-2257.

Ainslie, M.A. 2010. Principles of Sonar Performance Modeling. New York: Springer.

Ainslie, M. A., and A.M. Von Benda-Beckmann. 2013. Optimal soft start and shutdown procedures or stationary or moving sound sources. Proceedings of Meetings on Acoustics, 17: 070077.

Akay, A. 1978.A review of impact noise. Journal of the Acoustical Society of America 64:977-987.

Alain, C., and L.J. Berstein. 2008. From sound to meaning: The role of attention during auditory scene analysis. Current Opinion in Otolaryngology & Head and Neck Surgery 16:485-489.

Andersen, S. 1970. Auditory sensitivity of the harbour porpoise *Phocoena phocoena*. Investigations on Cetacea 2:255-259.

ANSI (American National Standards Institute). 1986. Methods of Measurement for Impulse Noise (ANSI S12.7-1986). New York: Acoustical Society of America.

ANSI (American National Standards Institute). 1995. Bioacoustical Terminology (ANSI S3.20-1995).New York: Acoustical Society of America.

ANSI (American National Standards Institute). 2005. Measurement of Sound Pressure Levels in Air (ANSI S1.13-2005). New York: Acoustical Society of America.

ANSI (American National Standards Institute). 2009. Methods for Manual Pure-Tone Threshold Audiometry (ANSI 3.21-2009). New York: Acoustical Society of America.

ANSI (American National Standards Institute). 2011. Design Response of Weighting Networks for Acoustical Measurements (ANSI S1.42-2011). New York: Acoustical Society of America.

ANSI (American National Standards Institute). 2013. Acoustic Terminology (ANSI S1.1-2013). New York: Acoustical Society of America.

Archer, F.I., S.L. Mesnick, and A.C. Allen. 2010. Variation and predictors of vessel-response behavior in a tropical dolphin community. NOAA Technical Memorandum NOAA-TM-NMFS-SWFSC-457. La Jolla, California: NMFS Southwest Fisheries Science Center.

Au, W.W.L., and P.W.B. Moore.1984. Receiving beam patterns and directivity indices of the Atlantic bottlenose dolphin *Tursiops truncatus*. Journal of the Acoustical Society of America 75:255-262.

Au, W.W.L., and M.C. Hastings. 2008. Principles of Marine Bioacoustics. New York: Springer.

Awbrey, F.T., J.A Thomas, and R.A. Kastelein. 1988. Low-frequency underwater hearing sensitivity in belugas, *Delphinapterus leucas*. Journal of the Acoustical Society of America. 84:2273-2275.

Babushina, E.S. 1997. Audiograms of the Caspian seal under water and in air. Sensory Systems 11:67-71.

Babushina, E.S., G.L. Zaslavsky, and L.I. Yurkevich. 1991. Air and underwater hearing of the northern fur seal : Audiograms, frequency and differential thresholds. Biofizika 36:909-913.

Barber, J.R., K.R. Crooks, and K.M. Fristrup. 2010. The costs of chronic noise exposure for terrestrial organisms. Trends in Ecology and Evolution 25:180-189.

Bejder, L., A. Samuels, H. Whitehead, H Finn, and S. Allen. 2009. Impact assessment research: use and misuse of habituation, sensitisation and tolerance in describing wildlife responses to anthropogenic stimuli. Marine Ecology Progress Series 395:177-185.

Bogen, K.T., and R.C. Spear. 1987. Integrating uncertainty and interindividual variability in environmental risk assessment. Risk Analysis 7:427-436.

Brill, R.L., P.W.B. Moore, and L.A. Dankiewicz. 2001. Assessment of dolphin (*Tursiops truncatus*) auditory sensitivity and hearing loss using jawphones. Journal of the Acoustical Society of America. 109:1717-1722.

Buck, K., A. Dancer, and R. Franke. 1984. Effect of the temporal pattern of a given noise dose on TTS in guinea pigs. Journal of the Acoustical Society of America 76:1090-1097.

Castellote, M. T.A. Mooney, L. Quakenbush, R. Hobbs, C. Goertz, and E. Gaglione. 2014. Baseline hearing abilities and variability in wild beluga whales (*Delphinapterus leucas*). The Journal of Experimental Biology 217:1682-1691.

CDC (Centers for Disease Control and Prevention). 2004. Hearing Loss. Atlanta, Georgia: Department of Health and Human Services.

Chen, C.J., Y.T. Dai, Y.M. Sun, Y.C. Lin, and Y.J. Juang. 2007. Evaluation of auditory fatigue in combined noise, heat, and workload exposure. Industrial Health 45:527-534.

Charif, R.A., A.M. Waack, and L.M. Strickman. 2010. Raven Pro 1.4 User's Manual. Ithaca, New York: Cornell Lab of Ornithology.

Clark, J.G 1981. Uses and abuses of hearing loss classification. ASHA 23:493-500.

Clark, C.W., and W.T. Ellison. 2004. Potential use of low-frequency sound by baleen whales for probing the environment: Evidence from models and empirical measurements. Pages 564-581 in J.A. Thomas, C.F. Moss, and M. Vater, eds. Echolocation in Bats and Dolphins. Chicago: University of Chicago Press.

Clark, W.W., B.A. Bohne, and F.A. Boettcher. 1987. Effect of periodic rest on hearing loss and cochlear damage following exposure to noise. Journal of the Acoustical Society of America 82:1253-1264.

Clifford, R.E., and R.A. Rogers. 2009. Impulse noise: Theoretical solutions to the quandary of cochlear protection. Annals of Otology, Rhinology & Laryngology 118:417-427.

Cohen, J.T., M.A. Lampson, and T.S. Bowers. 1996. The use of two-stage Monte Carlo simulation techniques to characterize variability and uncertainty in risk analysis. Human and Ecological Assessment 2:939-971.

Coles, R.R.A., G.R. Garinther, D.C. Hodge, and C.G. Rice.1968. Hazardous exposure to impulse noise. Journal of the Acoustical Society of America 43:336-343.

Coping, A., H. Battey, J. Brown-Saracino, M. Massaua, and C. Smith. 2014. An international assessment of the environmental effects of marine energy development. Ocean & Coastal Management 99:3-13.

Corso, J.F. 1959. Age and sex differences in pure-tone thresholds. Journal of the Acoustical Society of America 31:498-507.

Cranford, T.W., and P. Krysl. 2012. Acoustic function in the peripheral auditory system of Cuvier's beaked whale (*Ziphius cavirostris*). Pages 69-72 in A.N. Popper and A. Hawkins, eds. The Effects of Noise on Aquatic Life. New York: Springer.

Cranford, T.W. and P. Krysl. 2015. Fin whale sound reception mechanisms: Skull vibration enables low frequency hearing. PLOS ONE 10:1-17.

Cranford, T.W., P. Krysl, and J.A. Hildebrand. 2008. Acoustic pathways revealed: Simulated sound transmission and reception in Cuvier's beaked whale(*Ziphius cavirostris*). Bioinspiration & Biomimetics 3:1-10.

Cranford, T.W., P. Krysl, and M. Amundin. 2010. A new acoustic portal into the odontocete ear and vibrational analysis of the tympanoperiotic complex. PLOS ONE 5:e1 1927.

Cranford, T.W.,V. Trijoulet, C.R. Smith, and P. Krysl. 2014. Validation of a vibroacoustic finite element model using bottlenose dolphin simulations: the dolphin biosonar beam is focused in stages. Bioacoustics 23:161-194.

Dahlheim, M.E., and D.K. Ljungblad. 1990. Preliminary hearing study on gray whales (*Eschrichtius robustus*) in the field. Pages 335-346 in J. Thomas and R. Kastelein, eds. Sensory Abilities of Cetaceans. New York: Plenum Press.

Danielson, R., D. Henderson, M.A. Gratton, L. Bianchai, and R. Salvi. 1991. The importance of "temporal pattern" in traumatic impulse noise exposures Journal of the Acoustical Society of America 90:209-218.

Davis, R.I., W. Qiu, and R.P. Hamernik. 2009. Role of the kurtosis statistic in evaluating complex noise exposures for the protection of hearing. Ear & Hearing 30:628-634.

Deng, Z.D., B.L. Southall, T.J. Carlson, J. Xu, J.J. Martinez, M.A. Weiland, J. M. Ingraham. 2014. 200 kHz commercial sonar systems generate lower frequency side lobes audible to some marine mammals. PLOS ONE 9:e95315.

DOD (Department of Defense). 2004. Department of Defense Instruction: DOD Hearing Conservation Program (HCP). Washington, D.C.: Department of Defense.

Dukas, R. 2004. Causes and consequences of limited attention. Brain, Behavior and Evolution 63:197-210.

Dunn, D.E., R.R. Davis, C.J. Merry, and J.R. Franks. 1991. Hearing loss in the chinchilla from impact and continuous noise exposure. Journal of the Acoustical Society of America 90:1979-1985.

EPA (Environmental Protection Agency). 1982. Guidelines for Noise Impact Analysis (EPA Report Number 550/9-82-105).Washington, D.C.: Office of Noise Abatement and Control.

Erbe, C. 2002. Underwater noise of whale-watching boats and potential effects on killer whales (*Orcinus orca*), based on an acoustic impact model. Marine Mammal Science 18:394-418.

Erbe, C., and D.M. Farmer. 2000. Zones of impact around icebreakers affecting beluga whales in the Beaufort Sea. Journal of the Acoustical Society of America 108:1332-1340.

Erbe, C., C. Reichmuth, K. Cunningham, K. Lucke, and R. Dooling. 2016. Communication masking in marine mammals: A review and research strategy. Marine Pollution Bulletin 103:15-38.

Ferguson, M.C., C. Curtice, J. Harrison, and S.M. Van Parijs. 2015. Biologically Important Areas for cetaceans within U.S. waters – Overview and rationale. Aquatic Mammals 41:2-16.

Finneran, J.J. 2015. Noise-induced hearing loss in marine mammals: A review of temporary threshold shift studies from 1996 to 2015. Journal of the Acoustical Society of America 138:1702-1726.

Finneran, J.J. 2016. Auditory weighting functions and TTS/PTS exposure functions for cetaceans and marine carnivores. May 2016. San Diego, California: SPAWAR Systems Center Pacific.

Finneran, J.J. and A.K. Jenkins. 2012. Criteria and thresholds for U.S. Navy acoustic and explosive effects analysis. San Diego, California: SPAWAR Systems Center Pacific. http://www.dtic.mil/dtic/tr/fulltext/u2/a561707.pdf

Finneran, J.J., and C.E. Schlundt. 2010. Frequency-dependent and longitudinal changes in noise-induced hearing loss in a bottlenose dolphin (*Tursiops truncatus*). Journal of the Acoustical Society of America 128:567-570.

Finneran, J.J., and C.E. Schlundt. 2013. Effects of fatiguing tone frequency on temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*). Journal of the Acoustical Society of America 133:1819-1826.

Finneran, J.J., C.E. Schlundt, D.A. Carder, J.A. Clark, J.A. Young, J.B. Gaspin, and S.H. Ridgway. 2000. Auditory and behavioral responses of bottlenose dolphins (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*) to impulsive sounds resembling distant signatures of underwater explosions. Journal of the Acoustical Society of America 108:417-431.

Finneran, J.J., C.E. Schlundt, R. Dear, D.A. Carder, and S.H. Ridgway. 2002. Temporary shift in masked hearing thresholds in odontocetes after exposure to single underwater impulses from a seismic watergun. Journal of the Acoustical Society of America 111:2929-2940.

Finneran, J. J., R. Dear, D.A. Carder, and S.H. Ridgway. 2003. Auditory and behavioral responses of California sea lions (*Zalophus californianus*) to single underwater impulses from an arc-gap transducer. Journal of the Acoustical Society of America 114:1667-1677.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and S.H. Ridgway. 2005a. Temporary threshold shift in bottlenose dolphins (*Tursiops truncatus*) exposed to mid-frequency tones. Journal of the Acoustical Society of America 118:2696-2705.

Finneran, J.J., D.A. Carder, R. Dear, T. Belting, J. McBain, L. Dalton, and S.H. Ridgway. 2005b. Pure tone audiograms and possible aminoglycoside-induced hearing loss in belugas (*Delphinapterus leucas*). Journal of the Acoustical Society of America 117:3936–3943.

Finneran, J.J., C.E. Schlundt, B. Branstetter, and R.L. Dear. 2007a. Assessing temporary threshold shift in a bottlenose dolphin (*Tursiops truncatus*) using multiple simultaneous auditory evoked potentials. Journal of the Acoustical Society of America 122:1249–1264.

Finneran, J.J., H.R. London, and D.S. Houser. 2007b. Modulation rate transfer functions in bottlenose dolphins (*Tursiops truncatus*) with normal hearing and high-frequency hearing loss. Journal of Comparative Physiology, Part A 193:835–843.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and R.L. Dear. 2010a. Growth and recovery of temporary threshold shift at 3 kHz in bottlenose dolphins: Experimental data and mathematical models. Journal of the Acoustical Society of America 127:3256-3266.

Finneran, J.J., D.A. Carder, C.E. Schlundt, and R.L. Dear. 2010b. Temporary threshold shift in a bottlenose dolphin (*Tursiops truncatus*) exposed to intermittent tones. Journal of the Acoustical Society of America 127:3267-3272.

Finneran, J.J., C.E. Schlundt, B.K. Branstetter, J.S. Trickey, V. Bowman, and K. Jenkins. 2015. Effects of multiple impulses from as seismic airgun on bottlenose dolphin hearing and behavior. Journal of the Acoustical Society of America 137:1634-1646.

Francis, R.I.C.C., and R. Shotton. 1997. "Risk" in fisheries management: A review. Canadian Journal of Fisheries and Aquatic Science 54:1699–1715.

Galindo-Romero, M., T. Lippert, and A.N. Gavrilov. 2015. Empirical estimation of peak pressure levels in anthropogenic impulsive noise. Part I: Airgun arrays signals. Journal of the Acoustical Society of America 138:EL540-EL544.

Gedamke, J., N. Gales, and S. Frydman. 2011. Assessing risk of baleen whale hearing loss from seismic surveys: The effect of uncertainty and individual variation. Journal of the Acoustical Society 129:496-506.

Gerstein, E.R., L. Gerstein, S.E. Forsythe, J.E Blue. 1999. The underwater audiogram of the West Indian manatee (*Trichechus manatus*). Journal of the Acoustical Society of America 105: 3575-3583.

Ghoul, A., and C. Reichmuth. 2014. Hearing in the sea otter (*Enhydra lutris*): auditory profiles for an amphibious marine carnivore. Journal of Comparative Physiology A. 200:967-981.

Gill, J.A., K. Norris, and W.J. Sutherland. 2001. Why behavioural responses may not reflect the population consequences of human disturbance. Biological Conservation 97:265-268.

Hall, J.D., and C.S. Johnson. 1972. Auditory Thresholds of a Killer Whale *Orcinus orca* Linnaeus. Journal of the Acoustical Society of America 51:515-517.

Hamernik, R.P., and K.D. Hsueh. 1991. Impulse noise: Some definitions, physical acoustics and other considerations. Journal of the Acoustical Society of America 90:189-196.

Hamernik, R.P., W.A. Ahroon, and K.D. Hseuh. 1991. The energy spectrum of an impulse: Its relation to hearing loss. Journal of the Acoustical Society of America 90:197-204.

Hamernik, R.P., W.A. Ahroon, K.D. Hsueh, S.F. Lei, and R.I. Davis. 1993. Audiometric and histological differences between the effects of continuous and impulsive noise exposures. Journal of the Acoustical Society of America 93:2088-2095.

Hamernik, R.P., W. Qiu, and B. Davis. 2003. The effects of the amplitude distribution of equal energy exposures on noise-induced hearing loss: The kurtosis metric. Journal of the Acoustical Society of America 114:386-395.

Harris, C.M., 1998. Handbook of Acoustical Measurements and Noise Control. Woodbury, N.Y.: Acoustical Society of America.

Harwood, J., and K. Stokes. 2003. Coping with uncertainty in ecological advice: lessons from fisheries. Trends in Ecology and Evolution 18:617-622.

Hastie, G.D., C. Donovan, T. Götz, and V.M. Janik. 2014. Behavioral responses by grey seals (*Halichoerus grypus*) to high frequency sonar. Marine Pollution Bulletin 79:205-210.

Hawkins, A.D., A.E. Pembroke, and A.N. Popper. 2014. Information gaps in understanding the effects of noise on fishes and invertebrates. Reviews in Fish Biology and Fisheries. Published online: 12 September.

Heeringa, A.N., and P. van Dijk. 2014. The dissimilar time course of temporary threshold shifts and reduction of inhibition in the inferior colliculus following intense sound exposure. Hearing Research 312:38-47.

Heffner, H.E., and R.S. Heffner. 2003. Audition. Pages 413-440 in Davis, S., ed. Handbook of Research Methods in Experimental Psychology. New York: Blackwell.

Hemilä, S., S. Nummela, A. Berta, and T. Reuter. 2006. High-frequency hearing in phocid and otariid pinnipeds: An interpretation based on inertial and cochlear constraints (L). Journal of the Acoustical Society of America 120:3463-3466.

Henderson, D., and R.P. Hamernik.1982. Asymptotic threshold shift from impulse noise. Pages 265-298 in Hamernik, R.P., D. Henderson, and R. Salvi, eds. New Perspectives on Noise-Induced Hearing Loss. New York: Raven Press.

Henderson, D., and R.P. Hamernik. 1986. Impulse noise: Critical review. Journal of the Acoustical Society of America 80:569-584.

Henderson, D., B. Hu, and E. Bielefeld. 2008. Patterns and mechanisms of noise-induced cochlear pathology. Pages 195-217 in Schacht, J., A.N. Popper, and R.R Fay, eds. Auditory Trauma, Protection, and Repair. New York: Springer.

Henderson, D., M. Subramaniam, M.A. Grattona, and S.S. Saunders. 1991. Impact noise: The importance of level, duration, and repetition rate. Journal of the Acoustical Society of America 89:1350-1357.

HESS (High Energy Seismic Survey). 1999. High energy seismic survey review process and interim operational guidelines for marine surveys offshore Southern California. Prepared for The California State Lands Commission and The United States Minerals Management Service Pacific Outer Continental Shelf Region. Camarillo, California: High Energy Seismic Survey Team.

Holt, M.M. 2008. Sound exposure and Southern Resident killer whales (*Orcinus orca*)*:* A review of current knowledge and data gaps. NOAA Technical Memo.NMFS-NWFSC-89. U.S. Seattle, Washington: Department of Commerce.

Houser, D.S., and J.J. Finneran. 2006. Variation in the hearing sensitivity of a dolphin population determined through the use of evoked potential audiometry. Journal of the Acoustical Society of America 120:4090–4099.

Houser, D.S. and P.W. Moore. 2014. Report on the current status and future of underwater hearing research. San Diego, California: National Marine Mammal Foundation.

Houser, D.S., D.A. Helweg, and P.W.B. Moore. 2001. A bandpass filter-bank model of auditory sensitivity in the humpback whale. Aquatic Mammals 27:82-91.

Houser, D.S., A. Gomez-Rubio, and J.J. Finneran. 2008. Evoked potential audiometry of 13 Pacific bottlenose dolphins (*Tursiops truncatus gilli*). Marine Mammal Science 24:28-41.

Jacobs, D.W. J.D. and Hall. 1972. Auditory thresholds of a fresh water dolphin, *Inia geoffrensis Blainville*. Journal of the Acoustical Society of America. 51:530-533.

Jewett, D.L., and J.S. Williston. 1971. Auditory-evoked far fields averaged from the scalps of humans. Brain 94: 681-696.

Johnson, C.S. 1967. Sound detection thresholds in marine mammals. Pages 247-260 in Marine Bioacoustics, edited by W.N. Tavolga. Oxford: Pergamon Press.

Johnson, C.S., M.W. McManus, and D. Skaar. 1989. Masked tonal hearing thresholds in the beluga whale. Journal of the Acoustical Society of America. 85:2651-2654.

Kastak, D., and R.J. Schusterman. 1998. Low-frequency amphibious hearing in pinnipeds: Methods, measurements, noise, and ecology. Journal of the Acoustical Society of America 103:2216-2228.

Kastak, D., and R.J. Schusterman. 1999. In-air and underwater hearing sensitivity of a northern elephant seal (*Mirounga angustirostris*). Canadian Journal of Zoology 77:1751-1758.

Kastak, D., R.J. Schusterman, B.L. Southall, and C.J. Reichmuth. 1999. Underwater temporary threshold shift induced by octave-band noise in three species of pinniped. Journal of the Acoustical Society of America 106:1142-1148.

Kastak, D., and R.J. Schusterman. 2002. Changes in auditory sensitivity with depth in a free-diving California sea lion (*Zalophus californianus*). Journal of the Acoustical Society of America 112:329-333.

Kastak, D., B.L. Southall, R.J. Schusterman, and C. Reichmuth Kastak. 2005. Underwater temporary threshold shift in pinnipeds: Effects of noise level and duration. Journal of the Acoustical Society of America 118:3154-3163.

Kastak, D., J. Mulsow, A. Ghoul, and C. Reichmuth. 2008. Noise-induced permanent threshold shift in a harbor seal. Journal of the Acoustical Society of America 123:2986.

Kastak, D., C. Reichmuth, M.M. Holt, J. Mulsow, B.L. Southall, and R.J. Schusterman. 2007. Onset, growth, and recovery of in-air temporary threshold shift in a California sea lion (*Zalophus californianus*). Journal of the Acoustical Society of America, 122:2916-2924.

Kastelein, R.A., P. Mosterd, B. van Santen, M. Hagedoorn, and D. de Haan. 2002. Underwater audiogram of a Pacific walrus (*Odobenus rosmarus divergens*) measured with narrow-band frequency-modulated signals. Journal of the Acoustical Society of America 112:2173-2182.

Kastelein, R.A., M. Hagedoorn, W.W.L. Au, and D. de Haan, D. 2003. Audiogram of a striped dolphin (*Stenella coeruleoalba*). Journal of the Acoustical Society of America 113:1130-1137.

Kastelein, R.A., R. van Schie, W.C. Verboom, and D. de Haan. 2005a.Underwater hearing sensitivity of a male and a female Steller sea lion (*Eumetopias jubatus*). Journal of the Acoustical Society of America 118:1820-1829.

Kastelein, R.A., M. Janssen, W.C. Verboom, and D. de Haan. 2005b. Receiving beam patterns in the horizontal plane of a harbor porpoise (*Phocoena phocoena*)Journal of the Acoustical Society of America 118:1172-1179.

Kastelein, R.A., W.C. Verboom, and J.M. Terhune. 2009a. Underwater detection of tonal signals between 0.125 and 100 kHz by harbor seals (*Phoca vitulina*). Journal of the Acoustical Society of America, 125:1222-1229.

Kastelein, R.A., P. Wensveen, L. Hoek, and J.M. Terhune. 2009b. Underwater hearing sensitivity of harbor seals (*Phoca vitulina*) for narrow noise bands between 0.2 and 80 kHz. Journal of the Acoustical Society of America 126:476–483.

Kastelein, R.A., L. Hoek, C.A.F. de Jong, and P.J. Wensveen. 2010. The effect of signal duration on the underwater detection thresholds of a harbor porpoise (*Phocoena phocoena*) for single frequency-modulated tonal signals between 0.25 and 160 kHz. Journal of the Acoustical Society of America 128:3211-3222.

Kastelein, R.A., R. Gransier, L. Hoek, A. Macleod, and J.M. Terhune. 2012a. Hearing threshold shifts and recovery in harbor seals (*Phoca vitulina*) after octave-band noise exposure at 4 kHz. Journal of the Acoustical Society of America 132:2745-2761.

Kastelein, R.A., R. Gransier, L. Hoek, and J. Olthuis. 2012b. Temporary hearing threshold shifts and recovery in a harbor porpoise (*Phocoena phocoena*) after octave-band noise at 4 kHz. Journal of the Acoustical Society of America 132:3525-3537.

Kastelein, R.A., R. Gransier, and L. Hoek. 2013a. Comparative temporary threshold shifts in a harbor porpoise and harbor seal, and severe shift in a seal (L). Journal of the Acoustical Society of America 134:13-16.

Kastelein, R.A. R. Gransier, L. Hoek, and M. Rambags. 2013b. Hearing frequency thresholds of harbor porpoise (*Phocoena phocoena*) temporarily affected by a continuous 1.5 kHz tone. Journal of the Acoustical Society of America 134:2286-2292.

Kastelein, R.A., L. Hoek, R. Gransier, M. Rambags, and N. Claeys. 2014a. Effects of level, duration, and inter-pulse interval of 1-2 kHz sonar signal exposures on harbor porpoise hearing. Journal of the Acoustical Society of America 136:412-422.

Kastelein, R.A., J. Schop, R. Gransier, and L. Hoek. 2014b. Frequency of greatest temporary hearing threshold shift in harbor porpoise (*Phocoena phocoena*) depends on the noise level. Journal of the Acoustical Society of America 136:1410-1418.

Kastelein, R.A., R. Gransier, M.A.T. Marijt, and L. Hoek. 2015a. Hearing frequency thresholds of harbor porpoises (*Phocoena phocoena*) temporarily affected by play back offshore pile driving sounds. Journal of the Acoustical Society of America 137:556-564.

Kastelein, R.A., R. Gransier, J. Schop, and L. Hoek. 2015b. Effects of exposure to intermittent and continuous 6-7 kHz sonar sweeps on harbor porpoise (*Phocoena phocoena*) hearing. Journal of the Acoustical Society of America 137:1623-1633.

Kastelein, R.A., J. Schop, L. Hoek, and J. Covi. 2015c. Hearing thresholds of a harbor porpoise (*Phocoena phocoena*)for narrow-band sweeps. Journal of the Acoustical Society of America 138: 2508–2512.

Kastelein, R.A., L. Helder-Hoek, J. Covi, and R. Gransier. 2016. Pile driving playback sound and temporary threshold shift in harbor porpoises (*Phocoena phocoena*): Effect of exposure duration. Journal of the Acoustical Society of America 139:2842-2851.

Kastelein, R.A., R. Gransier, L. Hoek, and A. Macleod, and J.M. Terhune. Unpublished. Auditory and behavioral responses of two harbor seals (*Phoca vitulina*) to playbacks of offshore pile driving sounds, phase1: Behavioral response in one seal, but no TTS.

Kearns, J.R. 1977. Presbycusis. Canadian Family Physician 23:96-100.

Ketten, D. 2000. Cetacean ears. Pages 43-108 In: W.W.L Au, A.N. Popper, and R.R. Fay, eds. Hearing by Whales and Dolphins. New York: Springer.

Kight, C.R., and J.P. Swaddle. 2011. How and why environmental noise impacts animals: An integrative, mechanistic review. Ecology Letters 14:1052-1061.

Kryter, K.D., W.D. Ward, J.D. Miller, and D.H. Eldredge. 1966. Hazardous Exposure to Intermittent and Steady-State Noise. Journal of the Acoustical Society of America 39:451-464.

Kujawa, S.G., and M.C. Liberman. 2009. Adding insult to injury: Cochlear nerve degeneration after "temporary" noise-induced hearing loss. The Journal of Neuroscience 29:14077-14085.

Kyhn, L.A., J. Tougaard, F. Jensen, M. Wahlberg, K. Beedholm, and P.T. Madsen. 2009. Feeding at a high pitch: Source parameters of narrow band high-frequency clicks from echolocating off-shore hourglass dolphins and coastal Hector's dolphins. Journal of the Acoustical Society of America 125:1783-1791.

Kyhn, L.A., F.H. Jensen, K. Beedholm, J. Tougaard, M. Hansen, and P.T. Madsen. 2010. Echolocation in sympatric Peale's dolphins (*Lagenorhynchus australis*) and Commerson's dolphins (*Cephalorhynchus commersonii*) producing narrow-band high-frequency clicks. The Journal of Experimental Biology 213:1940-1949.

Laroche, C., R. Hétu, and S. Poireir. 1989. The growth of and recovery from TTS in human subjects exposed to impact noise. Journal of the Acoustical Society of America 85:1681-1690.

Lataye, R., and P. Campo. 1996. Applicability of the L_{eq} as a damage-risk criterion: An animal experiment. Journal of the Acoustical Society of America 99:1621-1632.

Leibold, L. J., and Werner, L. A. 2002. Relationship between intensity and reaction time in normal-hearing infants and adults. Ear & Hearing. 23:92-97.

Lemonds, D.W. 1999. Auditory filter shapes in an Atlantic bottlenose dolphin (*Tursiops truncatus*). Ph.D. Dissertation, University of Hawaii. 74 pp.

Levine, S., P. Hofstetter, X.Y. Zheng, and D. Henderson. 1998. Duration and peak level as co-factors in hearing loss from exposure to impact noise. Scandinavian Audiology Supplementum 48:27-36.

Lin, H.W., A.C. Furman, S.G. Kujawa, and M.C. Liberman. 2011. Primary neural degeneration in the guinea pig cochlea after reversible noise-induced threshold shift. Journal of the Association for Research in Otolaryngology 12:605-616.

Lippert, T., M. Galindo-Romero, A.N. Gavrilov, and O. von Estorff. 2015. Empirical estimation of peak pressure level from sound exposure level. Part II: Offshore impact pile driving noise. Journal of the Acoustical Society of America 138:EL287-EL292.

Ljungblad, D.K., P.D. Scroggins, and W.G. Gilmartin. 1982. Auditory thresholds of a captive Eastern Pacific bottle-nosed dolphin, *Tursiops* spp. Journal of the Acoustical Society of America. 72:1726-1729.

Lucke, K., U. Siebert, P.A. Lepper, and M-A.Blanchet. 2009. Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli. Journal of the Acoustical Society of America 125:4060-4070.

Lucke, K., E. Winter, F.-P. Lam, G. Scowcroft, A. Hawkins, and A.N. Popper. 2014. Report of the Workshop on International Harmonisation of Approaches to Define Underwater Noise Exposure Criteria (Budapest, Hungary 17th August 2013). Wageningen, The Netherlands: IMARES - Institute for Marine Resources & Ecosystem Studies.

Lucke, K., A.N. Popper, A.D. Hawkins, T. Akamatsu, M. André, B.K. Branstetter, M. Lammers, C.A. Radford, A.L. Stansbury, and T.A. Mooney. 2016. Auditory sensitivity in aquatic animals. Journal of the Acoustical Society of America 139:3097-3101.

Ludwig, D., R. Hilborn, and C. Waters. 1993. Uncertainty, resource exploitation, and conservation: Lessons from history. Science 260:17-36.

Luther, D.A., and R.H. Wiley. 2009. Production and perception of communicatory signals in a noisy environment. Biology Letters 5:183-187.

Madsen, P.T. 2005. Marine mammals and noise: Problems with root mean square sound pressure levels for transients. Journal of the Acoustical Society of America 117:3952–3957.

Mann, D., G. Bauer, R. Reep, J. Gaspard, K. Dziuk, and L. Read. 2009. Auditory and tactile detection by the West Indian manatee. St. Petersburg, Florida: Fish and Wildlife Research Institute.

Mann, D., M. Hill-Cook, C. Manire, D. Greenhow, E. Montie, J. Powell, R. Wells, G. Bauer, P. Cunningham-Smith, R. Lingenfelser, R. DiGiovanni, A. Stone, M. Brodsky, R. Stevens, G. Kieffer, and P. Hoetjes. 2010. Hearing loss in stranded odontocete dolphins and whales. PLOS ONE 5:13824.

Maslen, K. R. 1981. Towards a better understanding of temporary threshold shift of hearing. Applied Acoustics 14: 281–318.

Masterson, B., H. Heffner, and R. Ravizza. 1969. The evolution of human hearing. Journal of the Acoustical Society of America 45:966-985.

May-Collado, L., and I. Agnarsson. 2006. Cytochrome *b* and Bayesian inference of whale phylogeny. Molecular Phylogenetics and Evolution 38:344-354.

Miller, J.D. 1974. Effects of noise on people. Journal of the Acoustical Society of America 56:729 764.

Miller, P.J.O., P.H. Kvadsheim, F.-P. Lam, P.J. Wensveen, R. Antunes, A.C. Alves, F. Visser, L. Kleivane, P.L. Tyack, and L.D. Sivle. 2012. The severity of behavioral changes observed during experimental exposures of killer (*Orcinus orca*), long-finned pilot (*Globicephala melas*), and sperm (P*hyseter macrocephalus*) whales to naval sonar. Aquatic Mammals 38:362-401.

Mills, J.H. 1982. Effects of noise on auditory sensitivity, psychophysical tuning curves, and suppression. Pages 249-263 in R.P. Hamernik, D. Henderson, and R. Salvi, eds. New Perspectives on Noise-Induced Hearing Loss. New York: Raven Press.

Mills, J.H., R.M. Gilbert, and W.Y. Adkins. 1979. Temporary threshold shifts in humans exposed to octave bands of noise for 16 to 24 hours. Journal of the Acoustical Society of America 65:1238-1248.

Møhl, B. 1968. Auditory sensitivity of the common seal in air and water. Journal of Auditory Research 8:27-38.

Mooney, T.A., P.E. Nachtigall, and S. Vlachos.2009a. Sonar-induced temporary hearing loss in dolphins. Biology Letters5:565-567.

Mooney, T.A., P.E. Nachtigall, M. Breese, S. Vlachos, and W.W.L. Au. 2009b. Predicting temporary threshold shifts in a bottlenose dolphin (*Tursiops truncatus*): The effects of noise level and duration. Journal of the Acoustical Society of America 125:1816-1826.

Mooney, T.A., S. Li, D.R. Ketten, K. Wang, and D. Wang. 2014. Hearing pathways in the Yangtze finless porpoise, *Neophocaena asiaeorientalis asiaeorientalis*. The Journal of Experimental Biology 217:444-452.

Moore, P.W.B., and R.J. Schusterman. 1987. Audiometric assessment of northern fur seals, *Callorhinus ursinus*. Marine Mammal Science 3:31-53.

Morfey, C.L. 2001. Dictionary of Acoustics. New York: Academic Press.

Mulsow, J., C. Reichmuth, F. Gulland, D.A.S. Rosen, and J.J. Finneran. 2011. Aerial audiograms of several California sea lions (*Zalophus californianus*) and Steller sea lions (*Eumetopias jubatus*) measured using single and multiple simultaneous auditory steady-state response methods. The Journal of Experimental Biology 214:1138-1147.

Mulsow, J., D.S. Houser, and J.J. Finneran. 2012. Underwater psychophysical audiogram of a young male California sea lion (*Zalophus californianus*). Journal of the Acoustical Society of America. 131:4182-4187.

Mulsow, J., D. Houser, and J.J. Finneran. 2014. Aerial hearing thresholds and detection of hearing loss in male California sea lions (*Zalophus californianus*) using auditory evoked potentials. Marine Mammal Science 30:1383-1400.

Mulsow, J., C.E. Schlundt, L. Brandt, and J.J. Finneran. 2015. Equal latency contours for bottlenose dolphins (*Tursiops truncatus*) and California sea lions (*Zalophus californianus*). Journal of the Acoustical Society of America 138: 2678–2691.

Nachtigall, P.E., and A.Y. Supin. 2013. A false killer whale reduces its hearing sensitivity when a loud sound is preceded by a warning. The Journal of Experimental Biology 216:3062-3070.

Nachtigall, P.E., and A.Y. Supin. 2014. Conditioned hearing sensitivity in a bottlenose dolphin (*Tursiops truncatus*). The Journal of Experimental Biology 217:2806-2813.

Nachtigall, P.E., and A.Y. Supin. 2015. Conditioned frequency-dependent hearing sensitivity reduction in a bottlenose dolphin (*Tursiops truncatus*). The Journal of Experimental Biology 218:999-1005.

Nachtigall, P.E., W.W.L. Au, J. Pawloski, and P.W.B. Moore. 1995. Risso's dolphin (*Grampus griseus*) hearing thresholds in Kaneohe Bay, Hawaii. Pages 49-53 in Sensory Systems of Aquatic Mammals, edited by R.A. Kastelein, J.A. Thomas, and P.E. Nachtigall. The Netherlands: DeSpil, Woerden.

Nachtigall, P.E., J.L. Pawloski, and W.W. L. Au. 2003. Temporary threshold shifts and recovery following noise exposure in the Atlantic bottlenose dolphin (*Tursiops truncatus*). Journal of the Acoustical Society of America 113:3425-3429.

Nachtigall, P.E., A. Ya. Supin, J.L. Pawloski, and W.W.L. Au. 2004. Temporary threshold shifts after noise exposure in the bottlenose dolphin (*Tursiops truncatus*) measured using auditory evoked potentials. Marine Mammal Science 20:673-687.

Nachtigall, P.E., T.A. Mooney, K.A. Taylor, L.A. Miller, M.H. Rasmussen, T. Akamatsu, J. Teilmann, M. Linnenschmidt, and G.A. Vikingsson. 2008. Shipboard measurements of the hearing of the white-beaked dolphin *Lagenorhynchus albirostris*. The Journal of Experimental Biology 211:642-647.

Nachtigall, P.E., A. Ya Supin, J.-A. Estaban, and A.F. Pacini. 2016a. Learning and extinction of conditioned hearing sensation change in the beluga whale (*Delphinapterus leucas*). Journal of Comparative Physiology, Part A 202: 105-113.

Nachtigall, P.E., A.Ya. Supin, A.B. Smith, and A.F. Pacini. 2016b. Expectancy and conditioned hearing levels in the bottlenose dolphin (*Tursiops truncatus*). Journal of Experimental Biology 219:844-850.

NIOSH (National Institute for Occupational Safety and Health). 1998. Criteria for a recommended standard: Occupational noise exposure. Cincinnati, Ohio: United States Department of Health and Human Services.

NMFS (National Marine Fisheries Service). 2009. Endangered and Threatened Species: Designation of Critical Habitat for Cook Inlet Beluga Whale. Federal Register 74(230):63080-63095.

NMFS (National Marine Fisheries Service). 2013. Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals—Acoustic thresholds for Onset of Permanent and Temporary Threshold Shifts. Federal Register 78(249):78,822-78,823.

NMFS (National Marine Fisheries Service). 2014. Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals—Acoustic thresholds for Onset of Permanent and Temporary Threshold Shifts. Federal Register 79(19):4672-4673.

NMFS (National Marine Fisheries Service). 2015. Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals—Acoustic thresholds for Onset of Permanent and Temporary Threshold Shifts. Federal Register 80(147):45642-45643.

NMFS (National Marine Fisheries Service). 2016. Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals—Acoustic thresholds for Onset of Permanent and Temporary Threshold Shifts. Federal Register 81(51):14095-14096.

NOAA (National Oceanic and Atmospheric Administration).1998. Incidental taking of marine mammals; Acoustic harassment. Federal Register 63(143):40103.

NOAA (National Oceanic and Atmospheric Administration). 2013. Magnuson-Stevens Act Provisions, National Standard 2-Scientific Information. Federal Register 78(139):43066-43090.

NOAA (National Oceanic and Atmospheric Administration). 2014. Taking and Importing Marine Mammals; Precision Strike Weapon and Air-to-Surface Gunnery Training and Testing Operations at Eglin Air Force Base, FL. Federal Register 79(47):13568-13591.

NRC (National Research Council). 1993. Hazardous Exposure to Steady-State and Intermittent Noise. Washington, D.C.: National Academy Press.

NRC (National Research Council). 1994. Low-Frequency Sound and Marine Mammals: Current Knowledge and Research Needs. Washington, D.C.: National Academy Press.

NRC (National Research Council). 2000. Low-Frequency Sound and Marine Mammals: Progress Since 1994. Washington, D.C.: National Academy Press.

NRC (National Research Council). 2003. Ocean Noise and Marine Mammals. Washington, D.C.: National Academies Press.

NRC (National Research Council). 2004. Improving the Use of the "Best Scientific Information Available" Standard in Fisheries Management. Washington, D.C.: National Academy Press.

NRC (National Research Council). 2005. Marine Mammal Populations and Ocean Noise. Washington, D.C.: National Academies Press.

OMB (Office of Management and Budget). 2005. Final information quality bulletin for peer review. Federal Register 70(10):2664-2677.

OSHA (Occupational Safety & Health Administration). 2013. OSHA Technical Manual. Washington, D.C.: United States Department of Labor.

Parks, S., D.R. Ketten, J.T. O'Malley, and J. Arruda.2007. Anatomical Predictions of Hearing in the North Atlantic Right Whale. The Anatomical Record 290:734-744.

Perrin, W.F., B. Würsig, and J.G.M. Thewissen (Eds). 2008. Encyclopedia of Marine Mammals (Second Edition).San Diego, California: Elsevier.

Popper, A.N., A.D. Hawkins, R.R. Fay, D.A. Mann, S. Bartol, T.J. Carlson, S. Coombs, W.T. Ellison, R.L. Gentry, M.B. Halvorsen, S. Løkkeborg, P.H. Rogers, B.L. Southall, D.G. Zeddies, and W.N. Tavolga. 2014. Sound Exposure Guidelines for Fishes and Sea Turtles: A Technical Report prepared by ANSI-Accredited Standards Committee S3/SC1. New York: Springer.

Popov, V.V., A.Y. Supin, D. Wang, K. Wang, L. Dong, and S. Wang. 2011a. Noise-induced temporary threshold shift and recovery in Yangtze finless porpoises *Neophocaena phocaenoides asiaeorientalis*. Journal of the Acoustical Society of America 130:574-584.

Popov, V.V., V.O. Klishin, D.I. Nechaev, M.G. Pletenko, V.V. Rozhnov, A.Y. Supin, E.V. Sysueva, and M.B. Tarakanov. 2011b. Influence of acoustic noises on the white whale hearing thresholds. Doklady Biological Sciences 440:332-334.

Popov, V.V., A. Ya Supin, V. V Rozhnov, D.I. Nechaev, E.V. Sysuyeva, V.O. Klishin, M.G. Pletenko, and M.B. Tarakanov. 2013. Hearing threshold shifts and recovery after noise exposure in beluga whales, *Delphinapterus leucas*. The Journal of Experimental Biology 216:1587-1596.

Popov, V.V., A.Ya Supin, V.V. Rozhnov, D.I. Nechaev, and E.V. Sysueva. 2014. The limits of applicability of the sound exposure level (SEL) metric to temporal threshold shifts (TTS) in beluga whales, *Delphinapterus leucas*. The Journal of Experimental Biology 217:1804-1810.

Popov, V.V., D.I. Nechaev, E.V. Sysueva, V.V. Rozhnov, and A.Ya. Supin. 2015. Spectrum pattern resolution after noise exposure in a beluga whale, *Delphinapterus leucas*: Evoked potential study. Journal of the Acoustical Society of America 138:377-388.

Popov, V.V., E.V. Sysueva, D.I. Nechaev, V.V. Rozhnov, and A.Ya. Supin. 2016. Auditory evoked potentials in the auditory system of a beluga whale *Delphinapterus leucas* to prolonged sound stimuli. Journal of the Acoustical Society of America 139:1101-1109.

Price, G.R., and S. Wansack.1989. Hazard from intense midrange impulses. Journal of the Acoustical Society of America 86:2185-2191.

Punt, A.E., and G.P. Donovan. 2007. Developing management procedures that are robust to uncertainty: lessons from the International Whaling Commission. International Council for the Exploration of the Sea Journal of Marine Science 64:603-612.

Reichmuth, C. 2007. Assessing the hearing capabilities of mysticete whales. A proposed research strategy for the Joint Industry Programme on Sound and Marine Life on 12 September.http://www.soundandmarinelife.org/Site/Products/MysticeteHearingWhitePaper-Reichmuth.pdf.

Reichmuth, C. 2013. Equal loudness contours and possible weighting functions for pinnipeds. Journal of the Acoustical Society of America 134: 4210.

Reichmuth, C., and B.L. Southall**.** 2012. Underwater hearing in California sea lions (*Zalophus californianus*): Expansion and interpretation of existing data. Marine Mammal Science 28: 358-363.

Reichmuth, C., M.M. Holt, J. Mulsow, J.M. Sills, and B.L. Southall.2013. Comparative assessment of amphibious hearing in pinnipeds. Journal of Comparative Physiology A 199:491-507.

Renaud, D.L., and A.N. Popper. 1975. Sound localization by the bottlenose porpoise (*Tursiops truncatus*). Journal of Experimental Biology 63:569-585.

Richardson, W.J., and C.I. Malme. 1993. Man-made noise and behavioral responses. Pages 631-700. In Burns, J.J., J.J. Montague, and C.J. Cowles, eds. The Bowhead Whale. The Society for Marine Mammalogy, Special Publication Number 2.

Richardson, W.J., C.R. Greene, Jr., C.I. Malme, and D.H. Thomson. 1995. Marine mammals and noise. New York: Academic Press.

Ridgway, S.H., and P.L. Joyce. 1975. Studies on seal brain by radiotelemetry. Rapports et Proces-Verbaux des Reunions Conseil International pour L'Exploration de la Mer 169:81-91.

Ridgway, S.H., and D.A. Carder. 1997. Hearing deficits measured in some *Tursiops truncatus*, and discovery of a deaf/mute dolphin. Journal of the Acoustical Society of America 101:590-594.

Ridgway, S. and D.A. Carder. 2001. Assessing hearing and sound production in cetacean species not available for behavioral audiograms: experiences with sperm, pygmy sperm, and gray whales. Aquatic Mammals 27:267-276.

Ridgway, S.H., D.A. Carder, T. Kamolnick, R.R. Smith, R.R., C.E. Schlundt, and W.R. Elsberry. 2001. Hearing and whistling in the deep sea: depth influences whistle spectra but does not attenuate hearing by white whales (*Delphinapterus leucas*) (Odontoceti, Cetacea). J. Exp. Biol. 204:3829-3841.

Rohr, J.R., J.L. Kerby, and A. Sih. 2006. Community ecology as a framework for predicting contaminant effects. Trends in Ecology and Evolution 21:606-613.

Sauerland, M., and G. Dehnhard. 1998. Underwater audiogram of a tucuxi (*Sotalia fluviatilis guianensis*). Journal of the Acoustical Society of America. 103:1199-1204.

Saunders, J.C., S.P. Dear, and M.E. Schneider. 1985. The anatomical consequences of acoustic injury: A review and tutorial. Journal of the Acoustical Society of America 78:833-860.

Schlundt, C.E., J.J. Finneran, D.A. Carder, and S.H. Ridgway. 2000. Temporary shift in masked hearing thresholds of bottlenose dolphins, *Tursiops truncatus*, and white whales, *Delphinapterus leucas*, after exposure to intense tones. Journal of the Acoustical Society of America 107:3496-3508.

Schlundt, C.E., J.J. Finneran, B.K. Branstetter, R.L. Dear, D.S. Houser, and E. Hernandez. 2008. Evoked potential and behavioral hearing thresholds in nine bottlenose dolphins (*Tursiops truncatus*). Journal of the Acoustical Society of America. 123:3506.

Schlundt, C.E., R.L. Dear, D.S. Houser, A.E. Bowles, T. Reidarson, and J.J. Finneran. 2011. Auditory evoked potentials in two short-finned pilot whales (*Globicephala macrorhynchus*). Journal of the Acoustical Society of America 129:1111-1116.

Schuster, E., L. Bulling, and J. Köppel. 2015. Consolidating the state of knowledge: A synoptical review of wind energy's wildlife effects. Environmental Management 56:300-331.

Schusterman, R.J., and P.W. Moore. 1978. The upper limit of underwater auditory frequency discrimination in the California sea lion. Journal of the Acoustical Society of America 63:1591-1595.

Schusterman, R.J., R.F. Balliet, and J. Nixon. 1972. Underwater audiogram of the California sea lion by the conditioned vocalization technique. Journal of the Experimental Analysis of Behavior 17:339-350.

SEAMARCO. 2011. Temporary hearing threshold shifts and recovery in a harbor porpoise and two harbor seals after exposure to continuous noise and playbacks of pile driving sounds. SEAMARCO Ref: 2011/01. Harderwijk, The Netherlands: SEAMARCO (Sea Mammal Research Company).

Sertlek, H.O., H. Slabbekoorn, C.J. Ten Cate, and M.A. Ainslie. 2014. Insights into the calculation of metrics for transient sources in shallow water. Proceedings of Meetings on Acoustics 17:070076.

Sih, A., A.M. Bell, and J.L. Kerby. 2004. Two stressors are far deadlier than one. Trends in Ecology and Evolution 19:274-276.

Sills, J.M., B.L. Southall, and C. Reichmuth. 2014. Amphibious hearing in spotted seals (*Phoca largha*): Underwater audiograms, aerial audiograms and critical ratio measurements. The Journal of Experimental Biology 217:726-734.

Sills, J.M., B.L. Southall, and C. Reichmuth. 2015. Amphibious hearing in ringed seals (*Pusa hispida*): Underwater audiogram, aerial audiograms and critical ratio measurements. The Journal of Experimental Biology 218:2250-2259.

Sisneros, J.A., A.N. Popper, A.D. Hawkins, and R.R. Fay. 2016. Auditory evoked potential audiograms compared with behavioral audiograms in aquatic animals. Pages 1049-1056. In A.N. Popper and A. Hawkins (eds.) The Effects of Noise on Aquatic Life II. New York: Springer.

Sivle, L.D., P.H. Kvadsheim, and M.A. Ainslie. 2014. Potential for population-level disturbance by active sonar in herring. ICES Journal of Marine Science 72: 558-567.

SMRU Marine. 2014. The Interim Population Consequences of Disturbance (PCOD) framework. http://www.smru.co.uk//pcod.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33:411-521.

Southall, B., J. Berkson, D. Bowen, R. Brake, J. Eckman, J. Field, R. Gisiner, S. Gregerson, W. Lang, J. Lewandowski, J. Wilson, and R. Winokur. 2009. Addressing the Effects of Human-Generated Sound on Marine Life: An Integrated Research Plan for U.S. federal agencies. Washington, D.C.: Interagency Task Force on Anthropogenic Sound and the Marine Environment of the Joint Subcommittee on Ocean Science and Technology.

Starck, J., E. Toppila, and I. Pyykkö. 2003. Impulse noise and risk criteria. Noise & Health 5:63-73.

Sutherland, W.J. 1996. From Individual Behaviour to Population Ecology. New York: Oxford University Press.

Szymanski, M.D., D.E. Bain, K. Kiehl, S. Pennington, S. Wong, and K.R. Henry, K.R. 1999. Killer whale (*Orcinus orca*) hearing: Auditory brainstem response and behavioral audiograms. Journal of the Acoustical Society of America 106:1134-1141.

Terhune, J.M. 1988. Detection thresholds of a harbour seal to repeated underwater high-frequency, short-duration sinusoidal pulses. Canadian Journal of Zoology 66:1578-1582.

Terhune, J.M., and K. Ronald. 1972. The harp seal, *Pagophilus groenlandicus* (Erxleban, 1777). III. The underwater audiogram. Canadian Journal of Zoology 50:565-569.

Terhune, J.M., and K. Ronald.1975. Underwater hearing sensitivity of two ringed seals (*Pusa hispida*). Canadian Journal of Zoology 53:227-231.

Thomas, J., N. Chun, W. Au, and K. Pugh. 1988. Underwater audiogram of a false killer whale (*Pseudorca crassidens*). Journal of the Acoustical Society of America. 84:936-940.

Thomas, J., P. Moore, R. Withrow, and M. Stoermer. 1990. Underwater audiogram of a Hawaiian monk seal (*Monachus schauinslandi*). Journal of the Acoustical Society of America 87:417-420.

TNO (Netherlands Organisation for Applied Scientific Research). 2011. Standard for measurement and monitoring of underwater noise, Part I: physical quantities and their units. TNO-DV 2011 C235. M.A. Ainslie (ed.). The Hague, The Netherlands: TNO.

Tougaard, J., and L.A. Kyhn. 2010. Echolocation sounds of hourglass dolphins (*Lagenorhynchus cruciger*) are similar to narrow band high-frequency echolocation sounds of the dolphin genus *Cephalorhynchus*. Marine Mammal Science 26:239-245.

Tougaard, J., A.J. Wright, and P.T. Madsen. 2015. Cetacean noise criteria revisited in the light of proposed exposure limits for harbour porpoise. Marine Pollution Bulletin 90: 196-208.

Tremel, D.P., J.A. Thomas, K.T. Ramirez, G.S. Dye, W.A. Bachman, A.N. Orban, and K.K. Grimm. 1998. Underwater hearing sensitivity of a Pacific white-sided dolphin, *Lagenorhynchus obliquidens*. Aquatic Mammals 24:63-69.

Tubelli, A., A. Zosuls, D. Ketten, M. Yamato, and D.C. Mountain. 2012. A prediction of the minke whale (*Balaenoptera acutorostrata*) middle-ear transfer function. Journal of the Acoustical Society of America 132: 3263-3272.

Urick, R.J. 1983. Principles of Underwater Sound. New York, New York: McGraw-Hill Book Company.

Wang, D., K. Wang, Y. Xiao, and G. Sheng. 1992. Auditory sensitivity of a Chinese river dolphin *Lipotes vexillifer*. Pages 213-221 In J.A. Thomas, R.A. Kastelein, and A.Y. Supin (eds.) Marine Mammal Sensory Systems. New York: Plenum Press.

Ward, W.D. 1960. Recovery from high values of temporary threshold shift. Journal of the Acoustical Society of America 32:497-500.

Ward, W.D. 1962. Damage-risk criteria for line spectra. Journal of the Acoustical Society of America 341610-1619.

Ward, W.D. 1991. The role of intermittence in PTS. Journal of the Acoustical Society of America 90:164-169.

Ward, W.D. 1997. Effects of high-intensity sound. Pages 1497-1507 In M.J. Crocker (ed.) Encyclopedia of Acoustics, Volume III. New York: John Wiley & Sons.

Ward, W.D., A. Glorig, and D.L. Sklar. 1958. Dependence of temporary threshold shift at 4 kc on intensity and time. Journal of the Acoustical Society of America 30:944-954.

Ward, W.D., A. Glorig, and D.L. Sklar. 1959. Temporary threshold shift from octave-band noise: Application to damage-risk criteria. Journal of the Acoustical Society of America 31:522-528.

Ward, W.D., E.M. Cushing, and E.M. Burns. 1976. Effective quiet and moderate TTS: Implications for noise exposure standards. Journal of the Acoustical Society of America 59:160-165.

Wartzok, D., and D.R. Ketten. 1999. Marine mammal sensory systems. Pages 117-175 in J.E. Reynolds III and S.A. Rommel, eds. Biology of Marine Mammals. Washington, D.C.: Smithsonian Institution Press.

Wartzok, D., A.N. Popper, J. Gordon, and J. Merrill. 2004. Factors affecting the responses of marine mammals to acoustic disturbance. Marine Technology Society Journal 37:4-13.

Wensveen, P.J., L.A.E. Huijser, L. Hoek, and R.A. Kastelein. 2014. Equal latency contours and auditory weighting functions for the harbour porpoise (*Phocoena phocoena*). The Journal of Experimental Biology 217:359-369.

Wensveen, P.J., A.M. von Benda-Beckmann, M.A. Ainslie, F.-P. Lam, P.H. Kvadsheim, P.L. Tyack, and P.J.O. Miller. 2015. How effectively do horizontal and vertical response strategies of long-finned pilot whales reduce sound exposure from naval sonar? Marine Environmental Research 106:68-81.

WGSUA (Working Group on Speech Understanding and Aging). 1988. Speech understanding and aging. Journal of the Acoustical Society of America 83:859-895.

White, M.J., J. Norris, D.K. Ljungblad, K. Baron, and G.N. di Sciara. 1978. Auditory thresholds of two beluga whales (*Delphinapterus leucas*). San Diego: Hubbs Sea World Research Institute.

WHO (World Health Organization). 2015. Deafness and hearing impairment. Fact Sheet N°300. March. Geneva, Switzerland: World Health Organization. http://www.who.int/mediacentre/factsheets/fs300/en/.

Williams, R., D. Lusseau, and P.S. Hammond. 2006. Estimating relative energetic costs of human disturbance to killer whales (*Orcinus orca*). Biological Conservation 133:301-311.

Williams, R., E. Ashe, L. Blight, M. Jasny, and L. Nowlan. 2014. Marine mammals and ocean noise: Future directions and information needs with respect to science, policy and law in Canada. Marine Pollution Bulletin 86:29-38.

Wright, A.J. 2015. Sound science: Maintaining numerical and statistical standards in the pursuit of noise exposure criteria for marine mammals. Frontiers in Marine Science 2:Article 99.

Yost, W.A. 2007. Fundamentals of Hearing: An Introduction. New York: Academic Press.

Yuen, M.M.L., P.E. Nachtigall, M. Breese, and A.Y. Supin. 2005. Behavioral and auditory evoked potential audiograms of a false killer whale (*Pseudorca crassidens*). Journal of the Acoustical Society of America 118:2688–2695.

Zheng, W. 2012. Auditory map reorganization and pitch discrimination in adult rats chronically exposed to low-level ambient noise. Frontiers in Systems Neuroscience 6:Article 65.

Zhou, X., and M.M. Merzenich. 2012. Environmental noise exposure degrades normal listening processes. Nature Communications 3:843.

Zhu, X., J.H. Kim, W.J. Song, W.J. Murphy, and S. Song 2009. Development of a noise metric for assessment of exposure risk to complex noises. Journal of the Acoustical Society of America 126:703-712.

APPENDIX C

Final Scoping Report for Environmental Impact Statement on Effects of Oil & Gas Activities (Seismic and Exploratory Drilling) in the Arctic Oceans dated June 2010 by Office of Protected Resources, NOAA Fisheries (National Marine Fisheries Service)

FINAL

Scoping Report

for

Environmental Impact Statement on Effects of Oil & Gas Activities (Seismic and Exploratory Drilling) in the Arctic Ocean

June 2010

Office of Protected Resources

NOAA Fisheries

National Marine Fisheries Service

This page intentionally left blank.

TABLE OF CONTENTS

1.0 INTRODUCTION 1

1.1 Scoping Overview 1
1.2 Project Background and Overview 2
1.3 Purpose of the Project 4

2.0 SCOPING METHODS 5

2.1. Scoping Announcements and Newsletters 5
2.2 Public Scoping Meetings 6

3.0 SUMMARY OF COMMENTS RECEIVED 7

3.1 Issues Identified During Scoping 7
3.2 Public Comments 9

4.0 NEXT STEPS IN THE PLANNING PROCESS 11

4.1 Develop Alternatives 11
4.2 Describe the Affected Environment 11
4.3 Assess Environmental Consequences of Alternatives 11
4.4 Issue the Draft EIS 11
4.5 Issue the Final EIS and Record of Decision 11

5.0 CONTACTS 13

APPENDICES

Appendix A Scoping Outreach Materials

Appendix B Public Scoping Meeting Materials

Appendix C Comment Analysis Report

LIST OF TABLES

Table 1. Scoping Meetings, Locations & Dates 1

Table 2. Issue Category Codes 8

Table 3. Summary of Statements of Concern 9

LIST OF FIGURES

Figure 1. Comments by Issue 7

This page intentionally left blank.

ACRONYMS AND ABBREVIATIONS

2D	Two-dimensional
3D	Three-dimensional
BOE	Bureau of Ocean Energy Management
CAR	Comment Analysis Report
CASy	Comment Analysis System
Comment ID	Automated Tracking Number
DPEIS	Draft Programmatic Environmental Impact Statement
EIS	Environmental Impact Statement
ITA	Incidental Take Authorizations
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
OCS	Outer Continental Shelf
PEA	Programmatic Environmental Assessment
PSA	Public Service Announcement
ROD	Record of Decision
SOCs	Statements of Concern
U.S.	United States

This page intentionally left blank.

1.0 INTRODUCTION

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) to analyze the environmental impacts of issuing Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act (MMPA). These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the United States (U.S.) Beaufort and Chukchi Seas off Alaska. NMFS is serving as the lead agency for this EIS and is responsible for the development of the EIS in collaboration with the cooperating agencies. The U.S. Bureau of Ocean Energy Management (BOE) (formerly the U.S. Minerals Management Service [MMS]) is a cooperating agency. As a result of the scoping process, the North Slope Borough and the Environmental Protection Agency (EPA) were invited to become cooperating agencies; their decisions were pending at the time of release of this document.

The Notice of Intent (NOI) to prepare an EIS was published in the *Federal Register* on February 8, 2010 (75 FR 6175). The scoping period, during which issues and concerns are identified, was also initiated February 8, 2010. Scoping comments were received through April 9, 2010 as specified in the NOI.

1.1 Scoping Overview

NMFS hosted public scoping meetings for the Effects of Oil and Gas Activities in the Arctic Ocean EIS to disseminate information about the proposed project and to identify issues and concerns that should be addressed in the EIS (Table 1). The meetings consisted of an open house, a brief presentation, and then a public comment opportunity. Native language translation was provided upon request in Point Hope and Kaktovik. Transcripts of each public scoping meeting are available on the project website (http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm).

TABLE 1. SCOPING MEETINGS, LOCATIONS & DATES

Meeting	Date	Location
Kotzebue Public Scoping Meeting	February 18, 2010 6:00- 8 p.m.	Northwest Arctic Borough Assembly Chambers, Kotzebue, AK
Point Hope Public Scoping Meeting	February 19, 2010 5:00-7:00 p.m.	Point Hope Community Center, Point Hope, AK
Point Lay Public Scoping Meeting	February 22, 2010 7:00-9:00 p.m.	Point Lay Community Center, Point Lay, AK
Wainwright Public Scoping Meeting	March 9, 2010 7:00-9:00 p.m.	Wainwright Community Center, Wainwright, AK
Barrow Public Scoping Meeting	March 10, 2010 7:00-9:30 p.m.	Inupiat Heritage Center, Barrow, AK
Nuiqsut Public Scoping Meeting	March 11, 2010 7:00-9:00 p.m.	Nuiqsut Community Center, Nuiqsut, AK

Meeting	Date	Location
Kaktovik Public Scoping Meeting	March 12, 2010 6:30-8:30 p.m.	Kaktovik Community Center, Kaktovik, AK
Anchorage Public Scoping Meeting	March 23, 2010 7:00-9:00 p.m.	Egan Center, 555 West 5th Avenue, Anchorage, AK

In a separate, but parallel process for government to government consultation, Tribal governments in each community, with the exception of Anchorage, were notified of the EIS process and invited to participate. The first contact was via letter, dated January 29, 2010; follow-up calls were made with the potentially affected Tribal governments, and each was visited during the scoping process. The Comment Analysis Report (CAR) includes comments received in the scoping period during government to government consultation between NMFS, BOE, and the Tribal governments. Comments submitted in writing by Tribal governments during the scoping period are also included in the CAR.

This document is a public record of the scoping activities conducted for the Effects of Oil and Gas Activities on the Arctic Ocean EIS from the issuing of the NOI through the close of the scoping period. Comments received prior to April 9, 2010 are summarized and presented in this document. Comments received after the close of scoping will be considered during the development of the EIS but are not part of this report.

The organization of this report begins with an overview of the outreach to notify the public and convene the scoping meetings. The body of this report then provides a brief summary of comments offered during the scoping period. The concluding section describes the next steps in the planning process.

A series of appendices compile the supporting materials for the summaries provided in this report. Materials regarding public notice and outreach, meeting materials, and the comment analysis report are provided in the appendices.

1.2 Project Background and Overview

In 2006, the BOE prepared a Programmatic Environmental Assessment (PEA) for Arctic Outer Continental Shelf (OCS) Seismic Surveys. NMFS was a cooperating agency in the preparation of the PEA. Afterwards, in accord with NOAA Administrative Order 216-6 (Environmental Review Procedures for Implementing the National Environmental Policy Act, 1999), NMFS adopted the PEA and issued one-year Incidental Harassment Authorizations to oil and gas companies for the taking of marine mammals during seismic surveys.

In 2007, the BOE began a Draft Programmatic EIS (DPEIS); NMFS agreed to be a cooperating agency and adopt the document as its own NEPA analysis. This project assessed the impacts of BOE's issuance of permits and authorizations under the OCS Lands Act for seismic surveys in the U.S. Beaufort and Chukchi Seas and NMFS' authorizations to take marine mammals incidental to conducting those surveys. The intent of the DPEIS was to try to address the potential effects of concurrent offshore seismic survey activities and the potential for an increase in such activities.

The DPEIS was halted because new information became available, such as scientific study results and changes in projections of levels of proposed offshore activity. This new information altered the scope of the study, range of possible alternatives, and analyses. This led to the need for a new NEPA process, and the start of the Effects of Oil and Gas Activities in the Arctic Ocean EIS. This EIS will analyze the

impacts of issuing marine mammal ITAs under the MMPA related to oil and gas industry exploration activities (including both seismic surveys and exploration drilling), and the issuance of permits for seismic surveys in the Beaufort and Chukchi Sea by BOE under the OCS Lands Act .

NMFS issues these authorizations to the oil and gas industry during offshore exploration activities (primarily seismic surveys and exploratory drilling). In order to issue authorizations, NMFS must determine that the taking:

- will have a negligible impact on the species or stock(s); and
- will not have an unmitigable adverse impact on the availability of such species or stock(s) for taking for subsistence uses (where relevant)

  Additionally, the authorization shall prescribe the permissible methods of taking, other means of affecting the least practicable adverse impact on such species or stock(s), and requirements pertaining to the mitigation, monitoring, and reporting of such takings.

The term "take," under the MMPA, means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal." Except with respect to 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]."*

This EIS will consider seismic and drilling activities in Federal and state waters of the U.S. Beaufort and Chukchi Seas. The EIS will identify potential impacts that seismic surveys (including two dimensional [2D] and three-dimensional [3D] streamer and ocean bottom cable surveys, and shallow hazard seismic surveys) and exploratory drilling in the Beaufort and Chukchi Seas could have on the physical, biological, and social environments. Methods to mitigate impacts will also be considered. In addition, the EIS will contain an analysis of secondary and cumulative effects of the alternatives.

The effects of 2D and 3D streamer and ocean bottom cable surveys (also referred to as seismic surveys) and shallow hazard and site clearance surveys will be analyzed in this EIS. 2D and 3D seismic surveys are conducted to obtain data on geological formations from the sediment near-surface to several thousand meters deep (below the sediment surface). This information enables the industry to accurately assess potential hydrocarbon reservoirs and helps to optimally locate exploration and development wells that can maximize the extraction and production from a reservoir. High resolution seismic surveys are also used to locate shallow geological hazards. Such information allows BOE to fulfill its statutory responsibilities to ensure safe operations, support environmental impact analyses, protect benthic resources through avoidance measures, and perform other statutory responsibilities.

The EIS will also analyze effects of offshore exploratory drilling operations during the open water season so that oil companies can drill exploration targets on their OCS leases in the Beaufort and Chukchi Seas. NMFS would also analyze the effects of obtaining geotechnical data for pre-feasibility analyses of shallow sub-sea sediments as part of its proposed exploratory drilling operations by drilling a series of boreholes, each up to 400 feet (122 m) in depth.

1.3 Purpose of the Project

The Effects of Oil and Gas Activities in the Arctic Ocean EIS will analyze the potential effects of geophysical surveys and exploratory drilling activities and the issuance of ITAs under the MMPA for the taking of marine mammals incidental to these activities, conduct a cumulative effects analysis, consider a reasonable range of alternatives consistent with NMFS' statutory mandates, reanalyze the range of practicable mitigation and monitoring measures for marine mammals, and evaluate the availability of marine mammals for subsistence uses.

In order to comply with NEPA and to achieve increased administrative efficiency on the ITA program, NMFS has determined that this EIS will analyze a range of oil and gas exploratory actions and that will also satisfy the Council on Environmental Quality's NEPA regulations and the NOAA NEPA Administrative Order 216-6. This EIS would cover known and reasonably foreseeable projects requiring ITAs in the U.S. Arctic regions for future years, until at which time a revision to the document becomes necessary. NMFS has determined that an EIS would serve a more beneficial use in terms of agency decision making and would allow greater public participation in future decisions related to ITAs for the oil and gas industry.

2.0 SCOPING METHODS

Scoping is designed to be an open, public process for identifying the scope of physical, biological, and social environmental issues related to the proposed project that should be addressed through NEPA. The scoping process provides people potentially affected by the project an opportunity to express their views and offer any suggestions they may have regarding the project. Scoping is typically accomplished through written correspondence, public scoping meetings, use of electronic media, and formal and informal consultation with agency officials, interested individuals, and groups.

The scoping process is the first phase of an ongoing public participation program, which keeps relevant agencies and the interested public engaged in the project's progress and informed of opportunities to participate in preparation of the EIS. In the scoping phase, individuals, Tribes, agencies, non-governmental organizations, and the resource development industry have an opportunity to bring local issues and concerns within the project area to light and make comments and suggestions that will help develop a reasonable range of alternatives to be evaluated within the EIS.

The scoping process utilized a number of techniques to ensure that agencies, officials, and members of the public were informed of the project, including:

- Development of a project mailing list
- Distribution of an initial newsletter with project information and a public comment form to parties on the mailing list
- Agency scoping consultation and coordination letters
- Government to government consultation and coordination letters
- Newspaper and online notices of scoping meetings
- Public service announcements of scoping meetings
- *Federal Register* notices announcing scoping meetings
- Public scoping meetings in Kotzebue, Point Hope, Point Lay, Wainwright, Barrow, Nuiqsut, Kaktovik, and Anchorage.
- Project email address for comments (arcticeis.comments@noaa.gov).
- Project website for project information and electronic comment forms (http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm).

2.1. Scoping Announcements and Newsletters

The Effects of Oil and Gas Activities in the Arctic Ocean EIS process began with publication of the NOI in the *Federal Register* on February 8, 2010. A copy of the NOI is included in Appendix A.

A newsletter with project information, public scoping meeting announcements, and public comment forms was mailed on February 12, 2010 to agencies, organizations, and individuals identified on the mailing list. NMFS sent letters on January 29, 2010 initiating government to government consultation in the communities of Kotzebue, Point Hope, Point Lay, Wainwright, Barrow, Nuiqsut, and Kaktovik.

Newspaper announcements for the scoping meetings were advertised in the *Arctic Sounder* on February 11 and March 4, 2010; the *Nome Nugget* on February 11, February 18 and March 4, 2010; and the *Anchorage Daily News* on March 7 and March 21, 2010. Public service announcements (PSAs) were faxed on February 10, 2010 to KICY 805 AM, KBRW, K268 AA, K201 AV, KNOM 780 AM and KOTZ radio stations. PSAs were also faxed on March 3 and March 5, 2010 to KSKA, KBFX, KMXS, KBRJ, KBRW, K201AG and K201AH radio stations. Press releases were sent to the

Arctic Sounder and *Nome Nugget* on March 4, 2010. A press release was sent to the *Anchorage Daily News* on March 5, 2010. This information is included in Appendix A. Online advertisements of the public scoping meetings were also submitted to the What's Up list serve.

2.2 Public Scoping Meetings

Eight public scoping meetings were conducted in February and March 2010, with the dates and locations detailed in Table 1. The scoping meeting format and the information presented was the same at each public meeting. During the open house session, attendees had the opportunity to view presentation boards and maps that displayed project information and were able to ask questions of the project team. A project overview, including an introduction to the NEPA process, was then presented. The public question and comment period followed with a court reporter recording public testimony.

Comment forms were made available at the meetings so that attendees could submit written comments during the meeting or mail them in at a later date. Supporting information for the public scoping meetings, including display boards and the formal presentation, is included in Appendix B.

The Effects of Oil and Gas Activities in the Arctic Ocean EIS scoping meetings were generally well attended, with many public comments in some locations. Those attending the meetings were typically aware of on-going discussions regarding proposed activities in the Chukchi and Beaufort Seas.

3.0 SUMMARY OF COMMENTS RECEIVED

Public scoping comments were received in several ways:

- Oral discussion or testimony from the public meeting transcripts;
- Written comments received by mail or by fax; and
- Written comments submitted electronically by e-mail or through the project website.

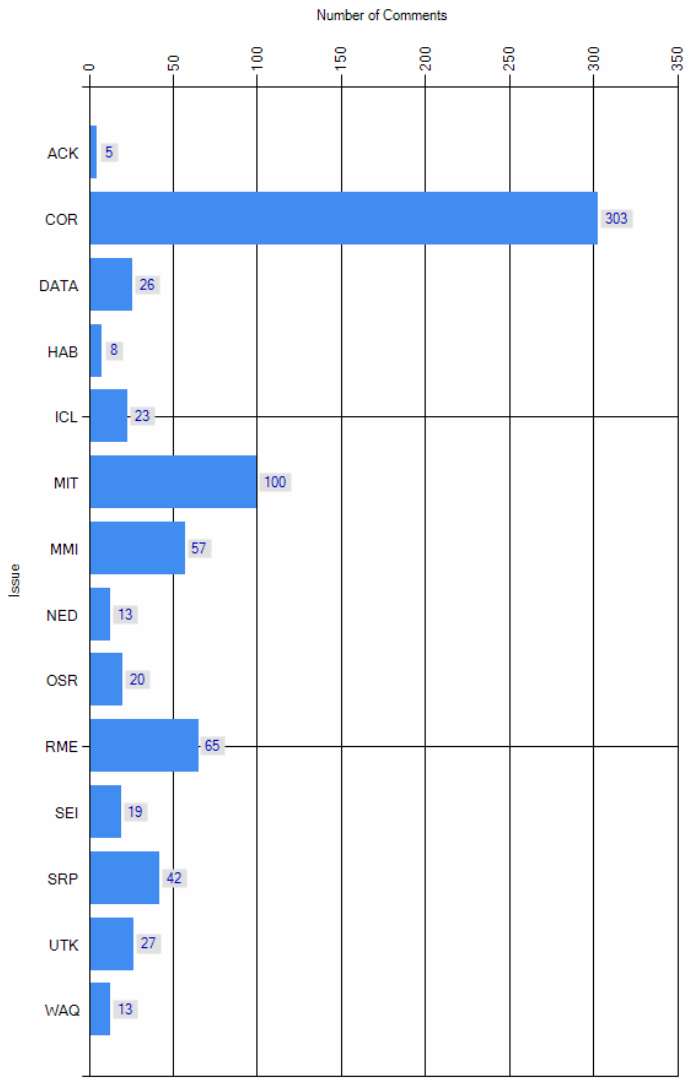
There were a total of 73 submissions during the scoping period, including all formats described above. Comments were assigned subject category codes to describe the content of the comment. The issue categories and codes are listed in Table 2. The issues were grouped by general topics, including effects, available information, regulatory compliance, Inupiat culture, and general. The relative distribution of comments by issue is shown in Figure 1.

Group affiliations of those that submitted comments include: Federal agencies, Tribal governments, state agencies, local governments, businesses, special interest groups/non-governmental organizations, and individuals. The complete text of public comments received is included in the Administrative Record for the EIS.

All unique submissions were read and analyzed for substantive comments. Substantive comments were assigned a single ***Issue Code*** in the Comment Analysis System database (CASy). Each comment coded also received an automatic tracking number ***(Comment ID)*** by CASy.

The public comment submissions generated 721 coded comments, which were then grouped into ***Statements of Concern*** (SOCs). SOCs are summary statements intended to capture the different themes identified in the substantive comments. Every substantive comment was assigned to an SOC; 178 SOCs were developed. Each SOC is represented by an issue category code followed by a number: NMFS will use the SOCs to develop alternatives and mitigation measures in the EIS, as appropriate.

FIGURE 1. COMMENTS BY ISSUE



3.1 Issues Identified During Scoping

The comments received during the scoping period were coded into 14 issue categories, described as follows:

TABLE 2. ISSUE CATEGORY CODES

GROUP	Issue Category	Code	Summary
Effects	Habitat	HAB	Comments associated with habitat requirements, or potential habitat impacts from seismic activities and exploratory drilling. Comment focus is habitat, not animals.
	Marine Mammal and other Wildlife Impacts	MMI	General comments related to potential impacts to marine mammals or wildlife, unrelated to subsistence resource concepts.
	National Energy Demand and Supply	NED	Comments related to meeting national energy demands, supply of energy.
	Oil Spill Risks	OSR	Concerns about potential for oil spill, ability to clean up spills in various conditions, potential impacts to resources or environment from spills.
	Socioeconomic Impacts	SEI	Comments on economic impacts to local communities, regional economy, and national economy, can include changes in the social or economic environments (MONEY, JOBS).
	Subsistence Resource Protection	SRP	Comments on need to protect subsistence resources and potential impacts to these resources. Can include ocean resources as our garden, contamination (SUBSISTENCE ANIMALS, HABITAT).
	Water and Air Quality	WAQ	Comments regarding water and air quality, including potential to impact or degrade these resources.
Available Information	Data	DATA	Comments referencing scientific studies that should be considered.
	Research, Monitoring, Evaluation Needs	RME	Comments on baseline research, monitoring, and evaluation needs
Regulatory Compliance (Process: NEPA, Permits, this EIS)	Coordination and Compatibility	COR	Comments on compliance with other statutes, laws or regulations that should be considered; coordinating with Federal, state, local agencies or organizations; permitting requirements.
	Mitigation Measures	MIT	Comments related to suggestions for or implementation of mitigation measures.
Inupiat Culture	Inupiat Culture and Way of Life	ICL	Comments related to potential cultural impacts or desire to maintain traditional practices (PEOPLE).
	Use of Traditional Knowledge	UTK	Comments regarding how traditional knowledge (TK) is used in the document or decision making process, need to incorporate TK, or processes for documenting TK.
General	Comment Acknowledged	ACK	Entire submission determined not to be substantive and warranted only a "comment acknowledged" response.

3.2 Public Comments

All comments received at public scoping meetings were assigned to issue categories, as previously discussed, based on the content of the comment. The summarized comments, grouped by issue, can be seen in the Comment Analysis Report in Appendix C. Below is a very brief summary of issues; it is recommended to review the CAR to understand the range of issues identified during scoping. The most frequently coded topics were related to regulatory compliance, including the issue categories of coordination and compatibility and mitigation measures. However, as illustrated in the CAR, a broad set of issues was identified during scoping, including concerns regarding potential impacts to the Inupiat culture and way of life, use of traditional knowledge, and potential environmental effects. There were also many comments regarding available data and mitigation measures. Several individual submissions included extremely detailed information.

TABLE 3. SUMMARY OF STATEMENTS OF CONCERN

GROUP	Issue Category	Summary of Statements of Concern
Effects	Habitat	Three SOCs were developed for HAB. Several focus on the concepts that habitat may be affected by climate change/loss of sea ice and potential increases in human activities. Another SOC reflects that there is important habitat in the Beaufort Sea for bowhead whales.
	Marine Mammal and other Wildlife Impacts	The 16 SOCs for MMI are divergent. Some indicate that oil and gas activities negatively impact marine species; even low levels of sound can be disruptive. Acidification, increased vessel traffic, and the cumulative effects of projects also pose threats to marine mammals. Other SOCs indicate that offshore exploration and production activities have not had adverse effects on marine mammal stocks, and research indicates that the health or reproductive fitness of populations has not been impacted.
	National Energy Demand and Supply	Three SOCs were identified for NED. Concerns include the need for stable domestic energy supplies, the potential for undiscovered resource potential in the outer continental shelf, and the disproportionate impact to Inupiat people due to national energy demands.
	Oil Spill Risks	The 11 SOCs identified for OSR are divergent. Some highlight the risks of oil spills, need for spill plans, difficulty of cleaning up oil spills in Arctic waters, and the lack of resources in the Arctic for response to a spill. Other SOCs indicate that technology and industry standards have prevented spills and that most spills have resulted from tankers, not pipelines.
	Socioeconomic Impacts	Three SOCs were developed for SEI. Concerns focus on benefits to the state and nation from oil and gas development, the benefits to the oil and gas industry from predictability in permitting processes, and increases in the cost of whaling activities due to oil and gas activities.
	Subsistence Resource Protection	The 11 SOCs developed for SRP are divergent. One statement indicates that industrial activities should not impact subsistence in the Chukchi Sea, as proposed activities are far offshore. The other concerns are related to potential impacts to subsistence resources due to aircraft disturbance, increased vessel traffic, ice breaking, noise

GROUP	Issue Category	Summary of Statements of Concern
		and cumulative impacts. There are also concerns about contamination from drilling muds and potential contamination from spills. Risks to hunters include increased travel time due to deflected animals from industry activities.
	Water and Air Quality	The 6 SOCs developed for WAC focus on sources and levels of pollutants, potential for bioaccumulation, and lack of technology to eliminate contamination threats.
Available Information	Data	Ten SOCs developed for DATA highlight numerous reports, studies, and sources of information recommended for review by NMFS.
	Research, Monitoring, Evaluation Needs	The 14 SOCs developed for RME are divergent. Some indicate the need for additional research and monitoring, while others state that sufficient data exists to support proposed activities. Concerns are expressed that the environmental baseline is changing and that industry authorizations should be delayed until additional research is conducted.
Regulatory Compliance (Process: NEPA, Permits, this EIS)	Coordination and Compatibility	There were 58 SOCs generated for COR, or approximately one-third of all SOCs produced during the scoping period. Statements focus on compliance with laws, statutes, and regulations; agency processes and interagency coordination, the scope of this EIS, and permitting requirements.
	Mitigation Measures	The 27 SOCs identified for MIT suggest a diversity of mitigation measures, including use of technology, activity restrictions/caps, area restrictions, ballast/hull cleaning requirements, designation of shipping lanes, speed restrictions, activity restrictions during periods of low visibility/inclement weather that inhibits marine mammal observations, and others. Suggestions include monitoring the effectiveness of existing mitigation measures, and the use of local residents for monitoring activities. Other statements indicate that existing measures are sufficient to mitigate impacts from proposed oil and gas activities, and that arbitrary restrictions could impair industry's ability for exploration of leases.
Inupiat Culture	Inupiat Culture and Way of Life	The 6 SOCs developed for ICL are divergent. One statement indicates that a benefit from industrial noise could be to cause whales to move closer to shore for easier subsistence access. The other statements indicate concern for potential impacts to subsistence communities and activities, including human health impacts and potential for impacts to subsistence foods. Other concerns are that communities are not compensated for impacts related to oil and gas activities, and a compromise is needed between protection of subsistence resources and providing local jobs.
	Use of Traditional Knowledge	The 10 SOCs developed for UTK highlight the importance of incorporating Traditional Knowledge in the planning process and encouraged use of Traditional Knowledge provided during prior projects. There is also concern that information provided by communities is not incorporated or considered valid.
General	Comment Acknowledged	Entire submission determined not to be substantive; no SOCs were developed.

4.0 NEXT STEPS IN THE PLANNING PROCESS

4.1 Develop Alternatives

A reasonable range of alternatives that meet the purpose and need of the project will be identified and examined in the EIS. Pertinent input from the scoping process will be incorporated into the range of potential alternatives. This ensures that the full spectrum of positions expressed by participants in the scoping process has been considered. Alternatives that were eliminated from further consideration and not brought forward for formal analysis in the EIS will be identified, along with justifications for elimination. Each viable alternative will be developed with conceptual plans by utilizing available information or by identifying additional information to be obtained in order to evaluate all of the alternatives on an equal basis. This step is underway, beginning after the scoping comments were analyzed.

4.2 Describe the Affected Environment

Available environmental information associated with the identified issue categories will be reviewed and summarized. The summary will include the most recent scientific research available and all pertinent studies and surveys required for areas that would be potentially impacted by all viable alternatives. This information will be presented in the *Affected Environment* chapter of the EIS. This step is scheduled to begin in June 2010.

4.3 Assess Environmental Consequences of Alternatives

The potential environmental consequences of alternatives carried forward for analysis will be evaluated, including direct, indirect, and cumulative effects. NEPA compliance associated with Federal, state, and local agency permits will be identified and incorporated into the analysis of potential effects. This step will be conducted concurrently with the Affected Environment summary and is scheduled to begin in July 2010.

4.4 Issue the Draft EIS

A Draft EIS will be prepared and made available for review by the public, government to government, local, state, and Federal agencies. The Draft EIS will be available for a 60-day review after the Notice of Availability has been published in the *Federal Register*. The public hearings will offer another opportunity for public comment on the Draft EIS. Currently, the public comment period is estimated to begin in December 2010 and run through February 2011. Public Hearings for the Draft EIS are estimated to occur in January 2011.

4.5 Issue the Final EIS and Record of Decision

After analyzing public comments received on the Draft EIS, the document will be revised to prepare a Final EIS. The Final EIS will include the comments submitted on the Draft EIS, including changes made to the EIS in response to comments. This step will include public notice of document availability, the distribution of the document, and a 30-day comment/waiting period on the final document. This step is projected to occur between May and June 2011.

NMFS and BOE are expected to each issue a separate Record of Decision (ROD) which will then conclude the EIS process in July 2011. The selected alternative will be identified in each ROD, as well as the agency's rationale for their conclusions regarding the environmental effects and appropriate mitigation measures for the proposed project.

This page intentionally left blank.

5.0 CONTACTS

Lead Agency
National Marine Fisheries Service
Mr. Michael Payne
Chief – Permits, Conservation & Education Division
Office of Protected Resources
1315 East-West Highway
Silver Spring, MD 20190
Phone: (301) 713-2289 ext. 110
Fax: (301) 713-0376

Cooperating Agency
Bureau of Ocean Energy Management
Mr. Jeffery Loman
Acting Regional Director
Alaska OCS Region
3801 Centerpoint Drive, Suite 500
Anchorage, Alaska 99503-5823
Phone: (907) 334-5205

Project Website: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm

Project Email: arcticeis.comments@noaa.gov

This page intentionally left blank.

APPENDIX A
Scoping Outreach Materials

Notice of Intent

Notice of Public Scoping Meetings

Project Mailing List

Newsletter #1 and Comment Form

Newspaper Advertisements

Press Release

Online Advertisements

Radio Public Service Announcements

Notice of Intent

DC 20230 (or via the Internet at *dhynek@doc.gov*).

Written comments and recommendations for the proposed information collection should be sent within 30 days of publication of this notice to Brian Harris-Kojetin, OMB Desk Officer either by fax (202–395–7245) or e-mail *(bharrisk@omb.eop.gov).*

Dated: February 2, 2010.

Glenna Mickelson,

Management Analyst, Office of the Chief Information Officer.

[FR Doc. 2010–2658 Filed 2–5–10; 8:45 am]

BILLING CODE 3510–07–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XU06

Notice of Intent to Prepare an Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean

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

ACTION: Notice of Intent to prepare an Environmental Impact Statement; request for comments.

SUMMARY: The National Marine Fisheries Service (NMFS) announces its intent to prepare an Environmental Impact Statement (EIS) to analyze the environmental impacts of issuing Incidental Take Authorizations (ITAs) pursuant to the Marine Mammal Protection Act (MMPA) to the oil and gas industry for the taking of marine mammals incidental to offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas off Alaska.

DATES: All comments, written statements, and questions regarding the scoping process and preparation of the EIS must be received no later than April 9, 2010.

ADDRESSES: Written comments and statements should be addressed to Mr. P. Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20190–3225. The mailbox address for providing e-mail comments is *arcticeis.comments@noaa.gov*. Comments sent via e-mail, including all attachments, must not exceed a 10–megabyte file size. Comments and statements may also be submitted via fax to (301) 713–0376. Information on this project can also be found on the Protected Resources webpage at: *http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm*.

FOR FURTHER INFORMATION CONTACT: Michael Payne, Office of Protected Resources, NMFS, (301) 713–2289 ext. 110.

SUPPLEMENTARY INFORMATION:

Background

Sections 101 (a)(5)(A) and (D) of the MMPA (16 USC 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 proposed authorization is provided to the public for review. The term "take" under the MMPA means "to harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." 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]."

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."

Summary of Previous National Environmental Policy Act (NEPA) Documents

In 2006, the U.S. Minerals Management Service (MMS) prepared a Programmatic Environmental Assessment (PEA) for the 2006 Arctic Outer Continental Shelf (OCS) seismic surveys. NMFS was a cooperating agency and adopted the Final PEA on June 28, 2006. Under this PEA, NMFS issued Incidental Harassment Authorizations under Section 101(a)(5)(D) of the MMPA to oil and gas companies for the taking of marine mammals incidental to seismic surveys in 2006. This PEA analyzed the effects of four concurrent seismic surveys in the Beaufort Sea and four concurrent seismic surveys in the Chukchi Sea. At that time, NMFS indicated that increased activity and new available science would result in a need to prepare an EIS for future authorizations.

On April 6, 2007, NMFS and MMS published a Notice of Availability for a Draft Programmatic EIS (DPEIS) and a schedule of public hearings (72 FR 17117) to assess the impacts of MMS' issuance of permits and authorizations under the Outer Continental Shelf Lands Act (OCSLA) for the conduct of seismic surveys in the Chukchi and Beaufort Seas off Alaska and NMFS' authorizations under the MMPA to incidentally harass marine mammals while conducting those surveys. The proposed scope and effects of the seismic survey activities analyzed in the DPEIS were based on the best available information at the time. Since then, new information (e.g., scientific study results, changes in projections of level of activity) has become available that alters the scope, range of possible alternatives, and analyses in the DPEIS. Therefore, MMS and NMFS filed a Notice of Withdrawal of the DPEIS on October 28, 2009 (74 FR 55539) and announced our decision to begin a new NEPA process.

Objectives of the EIS

This NOI announces NMFS' intent, as lead agency, to prepare a new EIS to analyze the potential effects of both geophysical surveys and exploratory drilling, address cumulative effects over a longer time frame, consider a more reasonable range of alternatives consistent with our statutory mandates, and reanalyze the range of practicable mitigation and monitoring measures for protecting marine mammals and availability of marine mammals for subsistence uses. MMS will be a cooperating agency on this EIS.

Specifically, this EIS would:

(1) Assess the environmental impacts to the physical, biological, cultural, economic, and social resources from deep-penetration, two-dimensional (2D) and three-dimensional (3D) streamer and ocean bottom cable surveys (hereafter referred to as seismic surveys)

and shallow hazard and site clearance surveys;

(2) Assess the environmental impacts to the physical, biological, cultural, economic, and social resources from open water offshore exploratory drilling operations during the open water season in order for the industry to drill priority exploration drill sites on MMS OCS leases in the Chukchi and Beaufort Seas. Also, as part of this EIS, NMFS will analyze the effects of obtaining geotechnical data for pre-feasibility analyses of shallow sub-sea sediments as part of its proposed exploratory drilling operations; and

(3) Assess whether alternatives developed would allow for the implementation of a long-term planning process pursuant to section 101(a)(5)(A) of the MMPA through the development and implementation of regulations that would be in place for 5 year time periods.

For the purposes of complying with NEPA and to achieve greater administrative efficiency in its ITA program, NMFS has determined the need to prepare an EIS that will analyze a range of oil and gas exploratory actions and that will satisfy the requirements of the Council on Environmental Quality's NEPA regulations and the NOAA NEPA administrative order 216–6. The proposed EIS would cover known and reasonably foreseeable projects requiring ITAs in the U.S. Arctic regions for future years, until such time that a revision of the document is necessary. NMFS has determined, based on the following factors, that an EIS would serve a more beneficial use in terms of agency decisionmaking and would allow greater public participation in future decisions related to ITAs for the oil and gas industry:

- NMFS and MMS have received preliminary information from industry that suggests an additional increase in seismic survey applications beyond recent levels;
- NMFS has received applications for exploratory drilling and expects more in the future, the effects of which were not analyzed in the withdrawn DPEIS;
- Understanding that both drilling and seismic activities could be expected to continue in the immediate years, both agencies determined that a longer timeframe needed to be analyzed in order to most effectively and fully evaluate the potential for cumulative impacts; and
- NMFS prepares environmental analyses under NEPA to support the issuance of ITAs under sections 101(a)(5)(A) and (D) of the MMPA. Therefore, this EIS will also be used to support future MMPA authorizations issued by NMFS for seismic and exploratory drilling activities in state and Federal waters in the U.S. Arctic Ocean in the Beaufort and Chukchi Seas.

Finally, the environmental analysis will assist NMFS and MMS in carrying out other statutory responsibilities relating to the agencies' role in authorizing seismic survey and exploratory drilling activities or incidental take of marine mammals (e.g., assessing environmental impacts on listed species under the Endangered Species Act [Section 7 consultation] and effects of the proposed action on essential fish habitat [EFH] under the Magnuson-Stevens Fishery Conservation and Management Act [EFH consultation]).

Overview of Proposed Activities

Seismic Activities

This EIS would analyze effects of seismic activities during the open water season in the Beaufort and Chukchi Seas. Seismic surveys are conducted to obtain data on geological formations from the sediment near-surface to several thousand meters deep (below the sediment surface). This information enables industry to accurately assess potential hydrocarbon reservoirs, helps to optimally locate exploration and development wells, maximizing extraction and production from a reservoir, and to locate shallow geologic hazards. It also allows MMS to fulfill its statutory responsibilities to ensure safe operations, support environmental impact analyses, protect benthic resources through avoidance measures, and perform other statutory responsibilities.

Seismic surveys are most often characterized by the type of data being collected. Seismic surveys may be described in very general terms by when the surveys occur (pre-lease, post-lease) because the timing can indicate the type of data likely to be collected. Surveys may be described by the acoustic sound source (air gun, water gun, sparker, pinger, etc.) or by the purpose for which the data is being collected (speculative shoot, exclusive shoot, site clearance).

Each seismic vessel may be accompanied by other support vessels for provision re-supply and crew change. In addition, fixed-wing aircraft may be used for marine mammal surveillance over-flights.

Drilling Activities

This EIS would also analyze effects of offshore exploratory drilling operations during the open water season in order that oil companies can drill exploration targets on their OCS leases in the Beaufort and Chukchi Seas. Also, as part of this EIS, NMFS would analyze the effects of obtaining geotechnical data for pre-feasibility analyses of shallow sub-sea sediments as part of its proposed exploratory drilling operations by drilling a series of boreholes, each up to 400 feet (122 m) in depth.

Each drilling vessel is typically accompanied by up to two Arctic class ice management vessels which also serve duty as anchor tenders and other drill ship support tasks, as well as additional support vessels, oil spill response vessels, and aircraft. Additional support vessels will be used for provision re-supply and crew change. In addition, fixed-wing aircraft may be used for marine mammal surveillance over-flights, as well as for activities such as crew change and provision re-supply.

Scoping

Publication of this notice begins the official scoping period that will help clarify previously identified issues of concern and determine the range and structure of alternatives to be considered in the EIS. NMFS invites comments and input from the public, organizations and interest groups, local governments, and Federal and state agencies on issues surrounding the proposal. The scoping period will end on April 9, 2010; for consideration in the development of the EIS, all written statements and questions must be received by this date, via contact means identified above (see **ADDRESSES**).

NMFS will consider all comments received during the scoping period. All hardcopy submissions must be unbound and suitable for copying and electronic scanning. Comments sent via e-mail, including all attachments, must not exceed a 10–megabyte file size. NMFS requests that you include in your comments:

(1) Your name and address;

(2) Whether or not you would like a copy of the Draft EIS; and

(3) Any background documents to support your comments as you feel necessary.

Instructions: All comments received are a part of the public record. All Personal Identifying Information (for example, name, address, etc.) voluntarily submitted by the commenter may be publicly accessible. Do not submit Confidential Business Information or otherwise sensitive or protected information.

This notice requests public participation in the scoping process, provides information on how to

participate, and identifies a set of preliminary alternatives to serve as a starting point for discussions. The public will have additional opportunities to comment on the Draft EIS and any applications received under the MMPA as part of this action. In particular, NMFS is soliciting information on:

(1) Effects of oil and gas exploration on marine mammal behavior and use of habitat;

(2) Effects of oil and gas exploration on availability of species for subsistence uses;

(3) Available new science on the Arctic ecosystem; and

(4) Available new technology for monitoring or obtaining seismic/drilling data.

The scoping comments will help inform NMFS' formulation of a range of reasonable alternatives considered in the EIS. The scope and structure of the alternatives evaluated will reflect the combined input from the public, industry, stakeholders, affected state and Federal agencies, and NMFS administrative and research offices. The range of reasonable alternatives that are analyzed in this EIS will be determined based on information gathered during scoping and will be consistent with the purpose and need of NMFS' and MMS' actions and with applicable law.

Issues and concerns associated with oil and gas related activities in the Arctic marine environment have been documented by the scientific community, government publications, at scientific symposia, through the scoping and public hearings/comments, and other NEPA analyses. In addition, public testimony and traditional knowledge from Alaskan Natives have provided valuable information about the potential impacts to marine mammals and on subsistence hunting of such species from seismic surveying and drilling operations. Based on information from these sources, the following prominent issues and concerns on which NMFS is seeking public comments have been identified and will be included in an alternatives framework and analysis of effects:

- Protection of subsistence resources and Inupiat culture and way of life
- Disturbance to bowhead whale migration patterns
- Impacts of seismic operations on marine fish reproduction, growth, and development
- Harassment and potential harm of wildlife, including marine mammals and marine birds, by vessel operations, movements, and noise
- Impacts on water quality
- Changes in the socioeconomic environment
- Impacts to threatened and endangered species
- Impacts to marine mammals, including disturbance and changes in behavior
- Incorporation of traditional knowledge in the decision-making process
- Effectiveness and feasibility of marine mammal monitoring and other mitigation and monitoring measures

To provide a framework for public comments, the range of reasonable alternatives will include the Proposed Action and several other action alternatives, as well as a No Action alternative. The action alternatives analyzed will represent a range of levels of activities from unrestricted to no seismic or exploratory drilling and could address the following, although this list is not exhaustive:

Levels of Activity

- Number, scale/size, location, and duration of seismic activities
- Number, scale/size, location, and duration of drilling activities
- Number, scale/size, location, and duration of shallow hazard/site clearance activities
- Number, scale/size, location, and duration of associated support activities (vessel, aircraft, shore)
- The degree to which those activities can overlap in space and time

Mitigation

- Exclusion zones based on received levels of sounds;
- Exclusion zones based on presence of specific biological factors in combination with received levels of sound;
- Exclusion zones based on presence and timing of subsistence activities;
- Time/area closures for biological and subsistence reasons; and
- Limitations on certain combinations of activities in specific temporal/spatial circumstances.

The EIS will assess the direct and indirect effects of the alternative approaches to authorizing oil and gas seismic surveys under the OCSLA and the taking of marine mammals incidental to seismic surveys and exploratory drilling activities under the MMPA. The EIS will assess the effects on the marine mammal species and availability of those species for subsistence uses, as well as other components of the marine ecosystem and human environment. The EIS will assess the contribution of these activities to the cumulative effects on these resources, including effects from past, present, and reasonably foreseeable future events and activities in the U.S. Arctic. Anyone having relevant information they believe NMFS should consider in its analysis should provide a description of that information along with complete citations for supporting documents.

For additional information on the withdrawn MMS and NMFS 2007 DPEIS, please visit the MMS website at: *http://www.mms.gov/alaska/ref/EIS%20EA/draft_arctic_peis/draft_peis.htm.*

Scoping Meetings Agenda

Public scoping meetings will be held at the following locations in February and March, 2010: Anchorage, Barrow, Kaktovik, Kotzebue, Nuiqsut, Point Hope, Point Lay, and Wainwright. Public scoping meetings will be held at the following dates, times, and locations:

(1) February 18, 2010, 6 – 8 p.m., Northwest Arctic Borough Assembly Chambers, Kotzebue, Alaska;

(2) February 19, 2010, 5 – 7 p.m., Point Hope Community Center, Point Hope, Alaska; and

(3) February 22, 2010, 7 – 9 p.m., Point Lay Community Center, Point Lay, Alaska.

The final dates, times, and locations are not yet finalized for the public scoping meetings in Anchorage, Barrow, Kaktovik, Nuiqsut, and Wainwright; a supplement to this NOI will be published with the final meeting dates, times, and locations. Comments will be accepted at all public scoping meetings, as well as during the scoping period and can be submitted via the methods described earlier in this document (see **ADDRESSES**).

Special Accommodations

These meetings are accessible to people with disabilities. Requests for sign language interpretation or auxiliary aids should be directed to Sheyna Wisdom by telephone at (907) 261–6705 or by email at *Sheyna_Wisdom@URSCorp.com* at least 7 days before the scheduled meeting date.

Dated: February 2, 2010.

James H. Lecky,

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

[FR Doc. 2010–2681 Filed 2–5–10; 8:45 am]

BILLING CODE 3510–22–S

Notice of Public Scoping Meetings

Dated: February 18, 2010.

Tammy C. Adams,

Acting Chief, Permits, Conservation and Education Division, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 2010–3742 Filed 2–23–10; 8:45 am]

BILLING CODE 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XS88

Schedules for Atlantic Shark Identification Workshops and Protected Species Safe Handling, Release, and Identification Workshops; Correction

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

ACTION: Notice of public workshops; correction.

SUMMARY: Due to an unanticipated temporary closure of the Princess Bayside Hotel in Ocean City, MD, NMFS is changing the location of its March 24, 2010, Protected Species Safe Handling, Release, and Identification Workshop that was announced in the **Federal Register** on December 8, 2009. The locations of the remaining workshops in February and March 2010 remain unchanged. The Protected Species Safe Handling, Release, and Identification Workshops are mandatory for vessel owners and operators who use bottom longline, pelagic longline, or gillnet gear, and have also been issued shark or swordfish limited access permits. Additional free workshops will be held in 2010 and announced in the **Federal Register**.

DATES: The dates and times for the remaining Protected Species Safe Handling, Release and Identification Workshops in February and March 2010 have not been changed and will be held February 24, March 10, and March 24, 2010. See **SUPPLEMENTARY INFORMATION** for further details.

ADDRESSES: The remaining Protected Species Safe Handling, Release, and Identification workshops will be held in Boston, MA; Galveston, TX; and Ocean City, MD. See **SUPPLEMENTARY INFORMATION** for the corrected Ocean City, MD, workshop location.

FOR FURTHER INFORMATION CONTACT: Richard A. Pearson by phone:(727) 824–5399, or by fax: (727) 824–5398.

SUPPLEMENTARY INFORMATION:

Correction

In the **Federal Register** of December 8, 2009, in FR Doc. E9–29258, on page 64665, in the third column, correct the location of the sixth workshop listed under the heading "Workshop Dates, Times, and Locations" to read:

Workshop Dates, Times, and Locations

6. March 24, 2010, from 9 a.m. - 5 p.m., Princess Royal Hotel, 9100 Coastal Highway, Ocean City, MD 21842.

Atlantic Shark Identification Workshop

Since January 1, 2007, shark limited access and swordfish limited access permit holders who fish with longline or gillnet gear have been required to submit a copy of their Protected Species Safe Handling, Release, and Identification Workshop certificate in order to renew either permit (71 FR 58057; October 2, 2006). These certificate(s) are valid for three years. As such, vessel owners who have not already attended a workshop and received a NMFS certificate, or vessel owners whose certificate(s) will expire prior to the next permit renewal, must attend a workshop to fish with, or renew, their swordfish and shark limited access permits. Additionally, new shark and swordfish limited access permit applicants who intend to fish with longline or gillnet gear must attend a Protected Species Safe Handling, Release, and Identification Workshop and submit a copy of their workshop certificate before either of the permits will be issued. Approximately 78 free Protected Species Safe Handling, Release, and Identification Workshops have been conducted since 2006.

At least one operator on vessels using longline or gillnet gear must be issued, and possess on board, a valid Protected Species Safe Handling, Release, and Identification Workshop certificate issued to that operator, in addition to having on board a valid workshop certificate issued to the vessel owner. Both vessel owner and operator certificates are valid for three years. As such, vessel operators who have not already attended a workshop and received a NMFS certificate, or vessel operators whose certificate(s) will expire prior to their next fishing trip, must attend a workshop to operate a vessel with swordfish and shark limited access permits.

Registration

To register for a scheduled Protected Species Safe Handling, Release, and Identification Workshop, please contact Angler Conservation Education at (386) 852–9137.

Registration Materials

To ensure that workshop certificates are linked to the correct permits, participants will need to bring the following items with them to the workshop:

Individual vessel owners must bring a copy of the appropriate swordfish and/or shark permit(s), a copy of the vessel registration or documentation, and proof of identification.

Representatives of a business owned or co-owned vessel must bring proof that the individual is an agent of the business (such as articles of incorporation), a copy of the applicable swordfish and/or shark permit(s), and proof of identification.

Vessel operators must bring proof of identification. Workshop Objectives

The protected species safe handling, release, and identification workshops are designed to teach longline and gillnet fishermen the required techniques for the safe handling and release of entangled and/or hooked protected species, such as sea turtles, marine mammals, and smalltooth sawfish. The proper identification of protected species will also be taught at these workshops in an effort to improve reporting. Additionally, individuals attending these workshops will gain a better understanding of the requirements for participating in these fisheries. The overall goal of these workshops is to provide participants with the skills needed to reduce the mortality of protected species, which may prevent additional regulations on these fisheries in the future.

Dated: February 18, 2010.

Emily Menashes,

Acting Director, Office of Sustainable Fisheries, National Marine Fisheries Service.

[FR Doc. 2010–3733 Filed 3–23–10; 8:45 am]

BILLING CODE 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XU53

Notice of Public Scoping Meetings for the Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean

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

ACTION: Notice of public scoping meetings.

SUMMARY: NMFS will hold five public scoping meetings in March 2010 to

receive public comments on NMFS' intent to prepare an environmental impact statement (EIS) on the effects of oil and gas activities (e.g., seismic surveys and exploratory drilling) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas).

DATES: The comment period for the scoping process is from February 8, 2010, through April 9, 2010. See SUPPLEMENTARY INFORMATION under the "Meeting Dates, Times, and Locations" heading for the dates and locations of the public scoping meetings.

ADDRESSES: The public has the opportunity to submit comments and statements regarding NMFS' intent to prepare this EIS using the following methods:

- Mail: P. Michael Payne, Chief, Permits, Conservation and Education Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910;
- Facsimile (fax) to: (301) 713–0376;
- E-mail to: *arcticeis.comments@noaa.gov*; or
- Public hearings: submit oral or written comments at public scoping meetings.

Comments sent via e-mail, including all attachments, must not exceed a 10–megabyte file size. Information on this project can also be found on the Protected Resources webpage at: *http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm*.

FOR FURTHER INFORMATION CONTACT: Michael Payne, Office of Protected Resources, NMFS, (301) 713–2289 ext. 110.

SUPPLEMENTARY INFORMATION:

Background

On February 8, 2010 (75 FR 6175), NMFS announced its intent to prepare an EIS on the effects of oil and gas activities in the U.S. Chukchi and Beaufort Seas. In that notice, NMFS announced that it would hold a total of eight public scoping meetings in February and March 2010. However, the February 8, 2010 (75 FR 6175), notice only provided dates, times, and locations for the first three meetings.

NMFS has scheduled additional public scoping meetings to be held in Wainwright, Barrow, Nuiqsut, Kaktovik, and Anchorage. The purposes of these meetings are to provide an opportunity for the public to learn about the proposed action, identify issues to be addressed in the EIS process, and to submit oral or written comments on this proposal.

Meeting Dates, Times, and Locations

The dates, times, and locations of the public scoping meetings are as follows:

(1) March 9, 2010, 7 - 9 p.m., Wainwright Community Center, Wainwright, Alaska;

(2) March 10, 2010, 7:30 - 9:30 p.m., Inupiat Heritage Center, Barrow, Alaska;

(3) March 11, 2010, 7 - 9 p.m., Nuiqsut Community Center, Nuiqsut, Alaska;

(4) March 12, 2010, 6:30 - 8:30 p.m., Kaktovik Community Center, Kaktovik, Alaska; and

(5) March 23, 2010, 7 - 9 p.m., Egan Center, 555 West Fifth Avenue, Anchorage, Alaska 99501.

Special Accommodations

These meetings are accessible to people with disabilities. Requests for sign language interpretation or auxiliary aids should be directed to Sheyna Wisdom by telephone at (907) 261–6705 or by e-mail at *Sheyna_Wisdom@URSCorp.com* at least 7 days before the scheduled meeting date.

Dated: February 18, 2010.

Wanda L. Cain,

Acting Deputy Director, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 2010–3750 Filed 2–23–10; 8:45 am]

BILLING CODE 3510–22–S

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0648–XU10

Taking of Threatened or Endangered Marine Mammals Incidental to Commercial Fishing Operations; Proposed Permit

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

ACTION: Notice; request for comments.

SUMMARY: NMFS proposes to issue a permit for a period of three years to authorize the incidental, but not intentional, taking of individuals from the Central North Pacific (CNP) stock of endangered humpback whales (*Megaptera novaeangliae*) by the Hawaii-based longline fisheries (deep-set and shallow-set). In accordance with the Marine Mammal Protection Act (MMPA), NMFS has made a preliminary determination that incidental taking from commercial fishing will have a negligible impact on CNP humpback whales; a recovery plan was completed in 1991; and vessels have been registered, a monitoring plan is in place, and a NMFS has insufficient funds to develop a Take Reduction Plan (TRP) at this time to address taking in these fisheries. Accordingly, NMFS proposes to issue the required permits to the Hawaii-based longline fisheries. NMFS solicits public comments on the negligible impact determination and on the proposal to issue this permit.

DATES: Comments must be received by March 26, 2010.

ADDRESSES: A draft of the negligible impact determination is available on the Internet at the following address: *http://fpir.noaa.gov/*. Written copies of the determination may be requested from, and comments on the determination and proposed permit should be sent to: Lisa Van Atta, Assistant Regional Administrator, Protected Resources Division, NMFS Pacific Islands Region, 1601 Kapiolani Boulevard, Suite 1110, Honolulu, HI 96814. Comments may also be sent by e-mail to: *MMPA.permit-PIR@noaa.gov* or by fax to (301) 427–2533. Comments received after the 30–day comment period may not be considered or made part of the record.

The recovery plan for humpback whales is available on the Internet at the following address: *http://www.nmfs.noaa.gov/pr/recovery/plans.htm#mammals*.

FOR FURTHER INFORMATION CONTACT: Lisa Van Atta, Assistant Regional Administrator, Protected Resources Division, Pacific Islands Region, (808) 944–2257 or Tom Eagle, Office of Protected Resources, (301) 713–2322, ext. 105.

SUPPLEMENTARY INFORMATION: NMFS is now considering the issuance of a permit under MMPA section 101(a)(5)(E) to vessels registered in the Hawaii-based longline fisheries (deep-set and shallow-set) to incidentally take individuals from the CNP stock of humpback whales (*Megaptera novaeangliae*), which are listed as endangered under the Endangered Species Act (ESA).

The Hawaii-based longline fisheries do not take other species or stocks of threatened or endangered marine mammals; therefore, no other species or stocks are considered for this proposed permit. The information available from the Hawaii-based deep-set longline fishery since 1994 indicates that there has never been incidental mortality or serious injury of CNP humpback whales; therefore, none is anticipated in the 3–year duration of the permit. Since 1994, there has been only one serious injury of a CNP humpback whale in the Hawaii-based shallow-set longline

SCOPING MEETING – OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN

Date: February 18, 2010
Time: 6:00-8:00 pm
Location: Northwest Arctic Borough Assembly Chambers

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

The meeting will have an informal open house, followed by a presentation, and an opportunity to offer comments.

Please join us!

SCOPING MEETING – OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN

Date: February 19, 2010
Time: 5:00-7:00 pm
Location: Point Hope
Community Center

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

The meeting will have an informal open house, followed by a presentation, and an opportunity to offer comments.

Please join us!

SCOPING MEETING – OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN

Date: February 22, 2010
Time: 7:00-9:00 pm
Location: Point Lay
Community Center

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

The meeting will have an informal open house, followed by a presentation, and an opportunity to offer comments.

Please join us!

SCOPING MEETING – OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN

Date: March 9, 2010
Time: 7:00-9:00 pm
Location: Wainwright Community Center

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

The meeting will have an informal open house, followed by a presentation, and an opportunity to offer comments.

Please join us!

SCOPING MEETING – OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN

Date: March 10, 2010
Time: 7:30-9:30 pm
Location: Barrow Inupiat Heritage Center

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

The meeting will have an informal open house, followed by a presentation, and an opportunity to offer comments.

Please join us!

SCOPING MEETING – OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN

Date: March 11, 2010
Time: 7:00-9:00 pm
Location: Nuiqsut Community Center

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

The meeting will have an informal open house, followed by a presentation, and an opportunity to offer comments.

Please join us!

SCOPING MEETING – OIL AND GAS ACTIVITIES IN THE ARCTIC OCEAN

Date: March 12, 2010
Time: 6:30-8:30 pm
Location: Kaktovik Community Center

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

The meeting will have an informal open house, followed by a presentation, and an opportunity to offer comments.

Please join us!

Project Mailing List

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	CHRIS	TOMPSETT	NEPA NATURAL RESOURCES	NAVY		1176 HOWELL STREET CODE 551 BLDG	11 NUWCDIVNPT	NEWPORT	RI	02841		
			DEPUTY UNDERSECRETARY	DEPARTMENT OF DEFENSE	INSTALLATIONS AND ENVIRONMENT	3400 DEFENSE PENTAGON	Room 3B856A	WASHINGTON	DC	20301	3400	
MR	JOHN W	KATZ	ALASKA'S WASHINGTON REPRESENTATIVE			444 N CAPITOL ST NW STE 518	Washington, DC 20301-3400	WASHINGTON	DC	20001		
MS	CINDY	SHOGAN	EXECUTIVE DIRECTOR	ALASKA WILDERNESS LEAGUE		122 C STREET NW STE 240		WASHINGTON	DC	20001		
			UPSTREAM GENERAL MANAGER	AMERICAN PETROLEUM INSTITUTE	EXPLORATION AFFAIRS DEPT	1220 L STREET NW		WASHINGTON	DC	20005		
			LIBRARIAN	AMERICAN PETROLEUM INSTITUTE	LIBRARY	1220 L STREET NW		WASHINGTON	DC	20005		
MR	MATT	CROMWELL		TERRIS, PRAVIK AND MILLIAN		1121 12TH STREET		WASHINGTON	DC	20005		
MS	NICOLETTE	NYE	DIRECTOR	NATIONAL OCEAN INDUSTRIES ASSOCIATION	GOVERNMENT AFFAIRS	1120 G STREET NW SUITE 900		WASHINGTON	DC	20005		
			DIRECTOR	US FISH AND WILDLIFE SERVICE	FEDERAL ACTIVITES BRANCH	1849 C ST, NW		WASHINGTON	DC	20240		
			LIBRARIAN	US DEPARTMENT OF ENERGY	TECHNICAL INFORMATION CENTER	1000 INDEPENDENCE AVE SW		WASHINGTON	DC	20858		
				OCEAN CONSERVANCY	WASHINGTON DC OFFICE	1300 19TH ST, NW	8TH FLOOR	WASHINGTON	DC	20036		
MR	BILL	MEADOWS	PRESIDENT	WILDERNESS SOCIETY		1615 M STREET, NW		WASHINGTON	DC	20036		
			DIRECTOR	NATIONAL PARKS AND CONSERVATION ASSOCIATION		1300 19TH STREET NW, SUITE 300		WASHINGTON	DC	20036		
MS	RENEE	ORR	CHIEF, LEASING DIVISION	MINERALS MANAGEMENT SERVICE		MS-4010	381 ELDEN STREET	HERNDON	VA	20170	4817	
				NATIONAL PARK SERVICE	DIVISION OF ENVIRONMENTAL QUALITY	1849 C STREET NW		WASHINGTON	DC	20240		
MR	HENRI	BISSON	SENIOR ADVISOR TO THE SECRETARY	FOR ALASKAN AFFAIRS	DEPT OF THE INTERIOR	1849 C STREET NW		WASHINGTON	DC	20240		
			DIRECTOR	US ENVIRONMENTAL PROTECTION AGENCY	OFFICE OF FEDERAL ACTIVITIES	1200 PENNSYLVANIA, NW		WASHINGTON	DC	20460	1	
MS	ANGELA	MAZZULLO	BUDGET ANALYST	MINERALS MANAGEMENT SERVICE		MS-2320	1849 C STREET NW	WASHINGTON	DC	20240		
			DIRECTOR	US DEPARTMENT OF TRANSPORTATION	OFFICE OF PIPELINE SAFETY	1200 NEW JERSEY AVE, SE	EAST BLDG, 12 FLOOR	WASHINGTON	DC	20590		
HONORABLE	MARK	BEGICH	SENATOR	US CONGRESS	UNITED STATES SENATE			WASHINGTON	DC	20510	0204	
HONORABLE	LISA	MURKOWSKI	SENATOR	US CONGRESS	UNITED STATES SENATE			WASHINGTON	DC	20510		
HONORABLE	DON	YOUNG	CONGRESSMAN	US CONGRESS	US HOUSE OF REPRESENTATIVES			WASHINGTON	DC	20515		
				LYNX, INC		33 BEDFORD ST		LEXINGTON	MA	2420		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
			SCIENTIFIC PROGRAM DIRECTOR	MARINE MAMMAL COMMISSION		4340 EAST WEST HWY STE 700		BETHESDA	MD	20814	4498	
MS	CANIESHA	WASHINGTON	CONTENT AND LICENSING SPECIALIST	LEXISNEXIS ACADEMIC AND LIBRARY SOLUTIONS	EXECUTIVE SOURCES	7500 OLD GEORGETOWN RD STE 1300		BETHESDA	MD	20814	6198	
MR	STEVE	KOKKINAKIS	NEPA COORDINATION & COMPLIANCE	NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION		1325 EAST WEST HWY	SSMC3 ROOM 15723	SILVER SPRING	MD	20910	3283	
				NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION	PLANNING AND INTEGRATION	1325 EAST WEST HWY		SILVER SPRING	MD	20910		
				US ARCTIC RESEARCH COMMISSION	WASHINGTON DC OFFICE	4350 N FAIRFAX DRIVE, SUITE 510		ARLINGTON	VA	22203		
MS	SARAH	JENSEN		LAW OFFICE OF JESSICA LAFEVRE		429 N SAINT ASAPH STR		ALEXANDRIA	VA	22314		
MS	JESSICA S	LEFEVRE	ATTORNEY AT LAW			429 N SAINT ASAPH STR		ALEXANDRIA	VA	22314		
			DIRECTOR	NATURAL RESOURCES DEFENSE COUNCIL		40 WEST 20TH STREET		NEW YORK	NY	10011		
MS	BRENDA	MORGAN	[redacted]									
MS	DENISE	STEPHENSON HAWK	CHAIRMAN	THE STEPHENSON GROUP		1201 PEACHTREE STR	400 COLONY SQUARE STE 200	ATLANTA	GA	30361		
				I.H.S. ENERGY		321 INVERNESS DR, SOUTH		ENGLEWOOD	CO	80112		
				ENCANA OIL AND GAS (USA) INC		370 17TH STREET, SUITE 1700		DENVER	CO	80202		
				FOREST OIL CORPORATION		707 17TH STREET, SUITE 3600		DENVER	CO	80202		
MS	KRISTEN	METZGER	CONTINENTAL SHELF ASSOCIATES			8502 SW KANSAS AVE		STUART	FL	34997	7120	
MR	STEVE	VIADA	CONTINENTAL SHELF ASSOCIATES INTERNATIONAL			8502 SW KANSAS AVE		STUART	FL	34997	7120	
MS	STEPHANIE	HAZLETT	[redacted]									
	MANIKA	SCHULTZ										
MS	MARY	HAAN										
MR	WALLACE	TAYLOR										
PROFESSOR	PAUL	FRIESEMA		NORTHWESTERN UNIVERSITY	INSTITUTE FOR POLICY RESEARCH	601 UNIVERSITY PLACE	340 SCOTT HALL	EVANSTON	IL	60208	1006	
MR	KEITH	COUVILLION		CHEVRONTEXACO CORP		935 GRAVIER STR		NEW ORLEANS	LA	70112		
			REGIONAL DIRECTOR	MINERALS MANAGEMENT SERVICE	GULF OF MEXICO REGION	1201 ELMWOOD PARK BLVD		NEW ORLEANS	LA	70123		
DR	BOB	GRAMLING		UNIVERSITY OF LOUISIANA LAFAYETTE	DEPT OF SOCIOLOGY AND ANTHROPOLOGY	PO BOX 40198		LAFAYETTE	LA	70504	0198	

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MS	ERIN	KOZAKIEWICZ	LAND ASSISTANT	DEVON ENERGY PRODUCTION COMPANY LP	WESTERN DIVISION	20 NORTH BROADWAY STE 1500		OKLAHOMA CITY	OK	73102	8260	
MR	W P	MCALISTER		DEVON ENERGY PRODUCTION COMPANY		20 NORTH BROADWAY		OKLAHOMA CITY	OK	73102	8260	
				OIL AND GAS JOURNAL		PO BOX 2002		TULSA	OK	74101		
MR	JAMES	SHERRARD	[redacted]									
MR	G S	NADY	SENIOR STAFF LAND REPRESENTATIVE	SHELL OFFSHORE INC		PO BOX 576		HOUSTON	TX	77001	0576	
MR	J Y	CHRISTOPHER	VICE PRESIDENT	HESS CORPORATION		500 DALLAS STREET		HOUSTON	TX	77002		
MR	JOHN L	DAVIS	LAND CONSULTANT	TOTAL E&P USA INC		PO BOX 4397		HOUSTON	TX	77002	4397	
MR	RANDALL D	JONES	MANAGER LAND & NEGOTIATIONS	AURORA GAS LLC		2500 CITY WEST BLVD STE 2500		HOUSTON	TX	77002		
MS	LORI	PRICE	LAND COORDINATOR	ENI PETROLEUM EXPLORATION CO INC		1201 LOUISIANA STE 3500		HOUSTON	TX	77002		
MR	PAUL G	YALE		EXXONMOBIL PRODUCTION COMPANY		800 BELL STREET	CORP-EMB-3061J	HOUSTON	TX	77002		
MR	WILLIAM	RISSER, MD	[redacted]									
MS	CHERYL	SAHA		PETROBRAS AMERICA INC		10350 RICHMOND AVE STE 1400		HOUSTON	TX	77042		
				WESTERN GEOPHYSICAL COMPANY		3900 ESSEX LANE, SUITE 1200		HOUSTON	TX	77027		
MR	SCOTT	CORNWELL		BHP BILLITON PETROLEUM (AMERICAS)		1360 POST OAK BLVD STE 150		HOUSTON	TX	77056	3020	
			LIBRARIAN	AMOCO PRODUCTION COMPANY	LIBRARY	501 WESTLAKE PARK BLVD		HOUSTON	TX	77079	2604	
MR	JAMES	MIKESCH	EXPLORATION MANAGER	BURLINGTON RESOURCES	NEW VENTURES	600 N DAIRY ASHFORD STR		HOUSTON	TX	77079	1100	
MR	BOB	GAGE	SENIOR STAFF LANDSMAN	MURPHY EXPLORATION & PRODUCTION COMPANY	INTERNATIONAL	16290 KATY FREEWAY STE 600		HOUSTON	TX	77094		
MR	TODD	KRATZ	SENIOR LAND REP	CHEVRON USA INC	EXPLORATION AND PRODUCTION	PO BOX 36366		HOUSTON	TX	77236		
MR	TODD L	LIEBL	MANAGER, US ONSHORE LAND	ANADARKO PETROLEUM CORPORATION	DELAWARE CORP	PO BOX 1330		HOUSTON	TX	77251	1330	
MR	JIM	CARLTON		CONOCOPHILLIPS ALASKA INC		PO BOX 2197	3 WL-STE 3052	HOUSTON	TX	77252	2197	
				TEXACO INC		4800 FOURNACE PLACE		HOUSTON	TX	77401		
MR	STUART	GUSTAFSON	VICE PRESIDENT	ARMSTRONG OIL AND GAS INC	OPERATIONS	1421 BLAKE STR		DENVER	CO	80202		
MR	ED	KERR	VP FOR LAND	ARMSTRONG OIL AND GAS INC		1421 BLAKE STR		DENVER	CO	80202		
MR	LANE	FRANKS	PRESIDENT	LIBERTY PETROLEUM CORP		10851 NORTH BLACK CANYON HIGHWAY STE 540		PHOENIX	AZ	85029		
MR	A LAURENCE	D'ANNA	NORTH AMERICAN CIVIL RECOVERIES	ARBITRAGE CORP		377 SOUTH NEVADA STR		CARSON CITY	NV	89703	4290	
MS	KAY R	MUNGER	PRESIDENT	MUNGER OIL INFORMATION SERVICES		PO BOX 45738		LOS ANGELES	CA	90045	0738	
MS	ELLEN	ARONSON	REGIONAL MANAGER	MINERALS MANAGEMENT SERVICE	PACIFIC OCS REGION	770 PASEO CAMARILLO (MS 7000)		CAMARILLO	CA	93010		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	RICHARD	CHARTER	MARINE CONSERVATION ADVOCATE	ENVIRONMENTAL DEFENSE		123 MISSION ST FL 28		SAN FRANCISCO	CA	94105	5142	
DR	EDGAR	WAYBURN MD	CHAIRMAN	SIERRA CLUB	ALASKA TASK FORCE	85 SECOND STREET 2ND FLOOR		SAN FRANCISCO	CA	94105	3441	
DR	W M	MARQUETTE		NATIONAL MARINE FISHERIES SERVICE	BOWHEAD WHALE PROJECT	18805 89TH AVENUE N		EDMONDS	WA	98020		
			LIBRARIAN	ENVIRONMENTAL PROTECTION AGENCY	REGION 10	1200 SIXTH AVE OMP-104		SEATTLE	WA	98101		
MR	ELBERT	MOORE	DIRECTOR, OFFICE OF ECOSYSTEMS AND COMMUNITIES	ENVIRONMENTAL PROTECTION AGENCY	REGION 10	1200 SIXTH AVE MS ECO-088		SEATTLE	WA	98101	1128	
MR	RUSSELL E	NELSON JR		ALASKA FISHERIES SCIENCE CENTER	RACE DIVISION	7600 SAND POINT WY NE BLDG 4		SEATTLE	WA	98115	0070	
MR	BRIAN	ROSS	LIBRARIAN	NOAA LIBRARY		7600 SAND POINT WY NE BLDG 3 E/OC43		SEATTLE	WA	98115	0070	
MR	STEVEN	BRAUND		STEVEN R. BRAUND AND ASSOCIATES		308 G STREET		ANCHORAGE	AK	99501		
			LEGAL DIRECTOR	TRUSTEES FOR ALASKA		1026 W 4TH AVENUE STE 201		ANCHORAGE	AK	99501		
				US FISH AND WILDLIFE SERVICE	ANCHORAGE ECOLOGICAL SERVICES	605 W 4TH AVE RM G-62		ANCHORAGE	AK	99501		
			REGIONAL DIRECTOR	NATIONAL PARKS AND CONSERVATION ASSOCIATION		750 WEST 2ND AVENUE STE 205		ANCHORAGE	AK	99501		
				INDIGENOUS PEOPLES COUNCIL FOR MARINE MAMMALS		1577 C STREET, SUITE 300		ANCHORAGE	AK	99501		
			DIRECTOR	ALASKA FEDERATION OF NATIVES		1577 C STREET, SUITE 300		ANCHORAGE	AK	99501		
			DIRECTOR	STATE OF ALASKA	AK OIL AND GAS CONSERVATION COMMISSION	333 W 7TH AVE, SUITE 100		ANCHORAGE	AK	99501		
				OCEAN CONSERVANCY	ALASKA OFFICE	1775 MORNINGTIDE CT		ANCHORAGE	AK	99501		
			EXECUTIVE DIRECTOR	ALASKA INTER-TRIBAL COUNCIL	ENVIRONMENTAL PROGRAM	445 EAST FIFTH AVE		ANCHORAGE	AK	99501		
			COMMANDER	US COAST GUARD SECTOR		510 L STREET SUITE 100		ANCHORAGE	AK	99501	1946	
			REGIONAL DIRECTOR	NATIONAL PARK SERVICE		240 WEST 5TH AVENUE #114		ANCHORAGE	AK	99501	2327	
			EXECUTIVE DIRECTOR	ALASKA CONSERVATION FOUNDATION		441 WEST 5TH AVE STE 402		ANCHORAGE	AK	99501	2340	
			SPECIAL ASSISTANT TO THE SECRETARY FOR ALASKA	US DEPARTMENT OF THE INTERIOR	OFFICE OF THE SECRETARY	1689 C STREET STE 100		ANCHORAGE	AK	99501	5151	
				OFFICE OF SENATOR LISA MURKOWSKI		510 L STREET STE 550		ANCHORAGE	AK	99501		
			DIRECTOR	NATIONAL WILDLIFE FEDERATION		750 WEST 2ND AVE STE 200		ANCHORAGE	AK	99501		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
			OFFICE DIRECTOR	US ARCTIC RESEARCH COMMISSION		420 L STREET STE 315		ANCHORAGE	AK	99501		
			EXECUTIVE DIRECTOR	EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL		441 WEST 5TH SUITE 500		ANCHORAGE	AK	99501		
				MARINE ADVISORY PROGRAM		1007 WEST 3RD AVE STE 100		ANCHORAGE	AK	99501		
				DEPT OF NATURAL RESOURCES	OFFICE OF PROJECT MANAGEMENT AND PERMITTING	550 WEST 7TH AVE STE 1600		ANCHORAGE	AK	99501	1000	
				WILDLIFE FEDERATION OF ALASKA	ALASKA OFFICE	750 WEST 2ND AVE, STE 200		ANCHORAGE	AK	99501		
MS	ELAINE	ABRAHAM	CHAIRPERSON	ALASKA NATIVE SCIENCE COMMISSION		429 L STREET		ANCHORAGE	AK	99501		
			DIRECTOR	DEPARTMENT OF NATURAL RESOURCES	DIVISION OF OIL & GAS	550 WEST 7TH AVENUE STE 800		ANCHORAGE	AK	99501	3560	
MR	JAMES D	ARLINGTON		PACIFIC ENERGY RESOURCES LTD	ALASKA BUSINESS UNIT	310 K STREET STE 700		ANCHORAGE	AK	99501		
MS	PAMELA	BERGMANN	REGIONAL ENVIRONMENTAL OFFICER	US DEPARTMENT OF THE INTERIOR	OFFICE OF ENVIRONMENTAL POLICY	1689 C STREET RM 119		ANCHORAGE	AK	99501	5126	
MR	KEITH	BOGGS	PROGRAM MANAGER	ALASKA NATURAL HERITAGE PROGRAM		707 A STREET STE 208		ANCHORAGE	AK	99501		
MR	BRIAN	BOYD	ATTORNEYS AT LAW	BOYD, CHANDLER & FALCONER LLP		911 W 8TH AVE STE 302		ANCHORAGE	AK	99501		
MR	STEPHEN R	BRAUND				3O8 G STREET STE 323		ANCHORAGE	AK	99501		
MR	JIM	COWAN		AK DEPT OF NATURAL RESOURCES	DIVISION OF OIL AND GAS	550 WEST 7TH AVE STE 800		ANCHORAGE	AK	99501	3560	
MS	MELANIE	DUCHIN	CLIMATE CAMPAIGNER	GREENPEACE	ALASKA OFFICE	125 CHRISTENSEN DRIVE STE 2		ANCHORAGE	AK	99501		
MR	J PATRICK	FOLEY		PIONEER NATURAL RESOURCES USA INC	LAND DEPT	700 G STR STE 600		ANCHORAGE	AK	99501		
MS	ELSIE M.	HENDRIX	PRESIDENT	CULLY CORPORATION		405 E. FIREWEED, SUITE 203		ANCHORAGE	AK	99503		
MS	ELEANOR	HUFFINES	REGIONAL DIRECTOR	THE WILDERNESS SOCIETY		705 CHRISTENSEN DRIVE		ANCHORAGE	AK	99501		
MR	PAUL	LAIRD	GENERAL MANAGER	ALASKA SUPPORT INDUSTRY ALLIANCE		646 W 4TH AVE STE 200		ANCHORAGE	AK	99501		
			DIRECTOR	MARINE ADVISORY PROGRAM		1007 WEST 3RD, SUITE 100		ANCHORAGE	AK	99501		
MR	BILL	LAMOREAUX	ANCHORAGE DISTRICT OFFICE	DEPARTMENT OF ENVIRONMENTAL CONSERVATI0N	STATE OF ALASKA	555 CORDOVA STREET		ANCHORAGE	AK	99501	2617	
MS	KAREN	MATTHIAS	CONSUL	CANADIAN CONSULATE		310 K STREET STE 220		ANCHORAGE	AK	99501		
MR	JOHN	NORMAN	CHAIR	ALASKA OIL AND GAS CONSERVATION COMMISSION		333 WEST 7TH AVENUE STE 100		ANCHORAGE	AK	99501		
MR	CHAD	PADGETT	SPECIAL ASSISTANT TO CONGRESSMAN YOUNG	OFFICE OF CONGRESSMAN DON YOUNG		510 L STREET STE 580		ANCHORAGE	AK	99501	1964	

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	JOSEPH J	PERKINS JR ESQ		GUESS & RUDD P C		510 L STREET STE 700		ANCHORAGE	AK	99501		
MS	TRISH	ROLFE	ALASKA REPRESENTATIVE	SIERRA CLUB ALASKA FIELD OFFICE		333 WEST 4TH AVE STE 307		ANCHORAGE	AK	99501	2341	
DR	STAN	SENNER		NATIONAL AUDUBON SOCIETY		441 WEST FIFTH AVE STE 300		ANCHORAGE	AK	99501		
MR	CLARENCE	SUMMERS		NATIONAL PARK SERVICE	SUBSISTENCE DIVISION	241 WEST 5TH AVENUE #114		ANCHORAGE	AK	99501	2327	
MR	PETER	VAN TUYN		TRUSTEES FOR ALASKA		1026 W 4TH AVE STE 201		ANCHORAGE	AK	99501		
			LIBRARIAN	ALASKA RESOURCES LIBRARY & INFORMATION SERVICES		3150 C STREET, SUITE 100		ANCHORAGE	AK	99503		
				PRINCE WILLIAM SOUND RCAC		3709 SPENARD RD STE 100		ANCHORAGE	AK	99503		
				US FISH AND WILDLIFE SERVICE	MIGRATORY BIRD MANAGEMENT	1011 EAST TUDOR ROAD		ANCHORAGE	AK	99503	6199	
			LIBRARIAN	US FISH AND WILDLIFE SERVICE	LIBRARY	1011 EAST TUDOR ROAD		ANCHORAGE	AK	99503		
			ASSISTANT REGIONAL DIRECTOR	US FISH AND WILDLIFE SERVICE	SUBSISTENCE AND FISHERIES	1011 EAST TUDOR ROAD		ANCHORAGE	AK	99503		
			LIBRARIAN	ANCHORAGE MUNICIPAL LIBRARIES	Z.J. LOUSSAC LIBRARY	3600 DENALI ST		ANCHORAGE	AK	99503		
				ANADARKO PETROLEUM CORP		3201 C STREET STE 603		ANCHORAGE	AK	99503		
			PROJECT MANAGER	PRINCE WILLIAM SOUND RCAC	REGIONAL CITIZEN'S ADVISORY COUNCIL	3709 SPENARD ROAD STE 100		ANCHORAGE	AK	99503		
MS	MARILYN	CROCKETT	EXECUTIVE DIRECTOR	ALASKA OIL AND GAS ASSOCIATION		121 WEST FIREWEED LANE STE 207		ANCHORAGE	AK	99503		
MR	JOHN R	DAVIS	SUPERVISOR	WESTERN GECO		2525 GAMBELL STR STE 400		ANCHORAGE	AK	99503	2838	
MR	RICH	FOX	LAND MANAGER ALASKA	SHELL FRONTIER OIL AND GAS INC		3601 C STREET SUITE 1334		ANCHORAGE	AK	99503		
MR	GEOFF	HASKETT	REGIONAL DIRECTOR	US FISH AND WILDLIFE SERVICE	REGION 7	1011 EAST TUDOR ROAD		ANCHORAGE	AK	99503	6199	
MR	STEVE	KROHN	PRODUCTION MANAGER	EXXONMOBIL CORPORATION		3301 C STR STE 400		ANCHORAGE	AK	99503		
MR	PAUL	RAMERT		ASRC ENERGY SERVICES		2700 GAMBELL STR STE 200		ANCHORAGE	AK	99503		
MS	TAMARA	SHEFFIELD		ALASKA OIL AND GAS ASSOCIATION		121 WEST FIREWEED LANE #207		ANCHORAGE	AK	99503		
MR	EUGENE	VIRBEN	SUPERINTENDENT OF ADMINISTRATION	BUREAU OF INDIAN AFFAIRS	WEST CENTRAL ALASKA FIELD OFFICE	3601 C STREET STE 1258		ANCHORAGE	AK	99503	5947	
MR	JOHN	ZAGER	MANAGER	CHEVRON USA INC		3800 CENTERPOINT DRIVE STE 100		ANCHORAGE	AK	99503		
MS	TERRY	CUMMINGS	[redacted]									
			LIBRARIAN	ELMENDORF AFB LIBRARY		10480 22ND ST		ELMENDORF AFB	AK	99506		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
			LIBRARIAN	US ARMY CORPS OF ENGINEERS	LIBRARY	PO BOX 898		ANCHORAGE	AK	99506		
				US ARMY CORPS OF ENGINEERS	REGULATORY BRANCH - ALASKA DISTRICT	PO BOX 898		ANCHORAGE	AK	99506	0898	
MR	TOM	LOHMAN	ENVIRONMENTAL RESOURCE SPECIALIST	DEPT OF WILDLIFE MGMT	NORTH SLOPE BOROUGH	4011 WINCHESTER LOOP		ANCHORAGE	AK	99507		
			EDITOR	ALASKA PUBLIC RADIO NETWORK	EDITORIAL DEPT	3877 UNIVERSITY DR		ANCHORAGE	AK	99508		
			DIRECTOR ALASKA SCIENCE CENTER	US GEOLOGICAL SURVEY		4210 UNIVERSITY DRIVE		ANCHORAGE	AK	99508	4664	
			CONSORTIUM LIBRARY	UNIVERSITY OF ALASKA ANCHORAGE	GOVERNMENT DOCUMENTS	3211 PROVIDENCE DRIVE		ANCHORAGE	AK	99508	8176	
MR	TONY	DEGANGE	BIOLOGICAL OFFICE CHIEF	US GEOLOGICAL SURVEY		4230 UNIVERSITY DRIVE STE 201		ANCHORAGE	AK	99508	4650	
DR	GUNNAR	KNAPP		UNIVERSITY OF ALASKA ANCHORAGE	INSTITUTE OF SOCIAL & ECONOMIC RESEARCH	3211 PROVIDENCE DRIVE		ANCHORAGE	AK	99508		
MR	MICHAEL	PELIKAN	DIRECTOR	ALASKA PACIFIC UNIVERSITY	ACADEMIC SUPPORT CENTER LIBRARY	4101 UNIVERSITY DRIVE RM 310		ANCHORAGE	AK	99508	4672	
MS	CELIA	ROZEN		ALASKA RESOURCES LIBRARY & INFORMATION SERVICES	ACQUISITIONS	3211 PROVIDENCE DRIVE STE 111	LIBRARY BLDG	ANCHORAGE	AK	99508	4614	
MS	PAULETTA	SAWYER	ACQUISITIONS	UNIVERSITY OF ALASKA ANCHORAGE	CONSORTIUM LIBRARY	3211 PROVIDENCE DRIVE		ANCHORAGE	AK	99508		
MS	SUZANNE	SHARP	RESEARCHER	UNIVERSITY OF ALASKA ANCHORAGE	INSTITUTE OF SOCIAL AND ECONOMIC RESEARCH	3211 PROVIDENCE DRIVE, 5TH FLOOR	DIPLOMACY BLDG	ANCHORAGE	AK	99508		
			DIRECTOR	CENTER FOR BIOLOGICAL DIVERSITY	ALASKA OFFICE	PO BOX 100599		ANCHORAGE	AK	99510		
MS	DOROTHY	CHILDERS	EXECUTIVE DIRECTOR	ALASKA MARINE CONSERVATION COUNCIL		PO BOX 101145		ANCHORAGE	AK	99510	1145	
MR	STEPHEN	CONN	EXECUTIVE DIRECTOR	ALASKA PUBLIC INTEREST RESEARCH GROUP		PO BOX 101093		ANCHORAGE	AK	99510		
MR	MICHAEL	GALGINAITIS		APPLIED SOCIOCULTURAL RESEARCH		PO BOX 101352		ANCHORAGE	AK	99510	1352	
MR	PAT	NOAH		CONOCOPHILLIPS ALASKA INC	LAND DEPT	PO BOX 100360		ANCHORAGE	AK	99510	0360	
MR	DAVID	W BROWN	LAND MANAGER	CONOCOPHILLIPS ALASKA INC	LAND DEPARTMENT	PO BOX 100360 ATO 1470		ANCHORAGE	AK	99510	0360	
MS	MARCIA	COMBES	DIRECTOR	ENVIRONMENTAL PROTECTION AGENCY	ALASKA OPERATIONS OFFICE	222 W 7TH AVENUE BOX 19		ANCHORAGE	AK	99513	7588	
MS	JENNIFER	CURTIS		ENVIRONMENTAL PROTECTION AGENCY		222 WEST 7TH AVE #19		ANCHORAGE	AK	99513		
MS	JEANNE	HANSON		NATIONAL MARINE FISHERIES SERVICE		222 WEST 7TH AVENUE BOX 43		ANCHORAGE	AK	99513	7577	
MR	THOMAS	LONNIE	STATE DIRECTOR	BUREAU OF LAND MANAGEMENT		222 WEST 7TH AVE STE 13		ANCHORAGE	AK	99513		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	REX	ROCK	PRESIDENT	TIGARA CORPORATION		2121 ABBOTT ROAD		ANCHORAGE	AK	99507		
MR	THEODORE L	ROCKWELL		ENVIRONMENTAL PROTECTION AGENCY	ALASKA OPERATIONS OFFICE	222 WEST 7TH AVENUE BOX 14		ANCHORAGE	AK	99513	7588	
			DIRECTOR	NATIONAL MARINE FISHERIES SERVICE	ALASKA REGIONAL OFFICE, ANCHORAGE	222 WEST 7TH AVE BOX 43		ANCHORAGE	AK	99513		
MR	BRAD	SMITH	MARINE MAMMAL BIOLOGIST	NATIONAL MARINE FISHERIES SERVICE		222 WEST 7TH AVE BOX 43		ANCHORAGE	AK	99513	7577	
			ENERGY REPORTER	ANCHORAGE DAILY NEWS		PO BOX 149001		ANCHORAGE	AK	99514	9001	
MS	MEDA	SNYDER		ALASKA NANUUQ COMMISSION		1951 JARVIS		ANCHORAGE	AK	99515		
			STATE PIPELINE COORDINATOR	JOINT PIPELINE OFFICE		411 WEST 4TH AVE		ANCHORAGE	AK	99517		
				ALASKA NEWSPAPERS INC		301 CALISTA CT STE B		ANCHORAGE	AK	99518		
			REGION II, H&R CHIEF	STATE OF ALASKA	DEPT OF FISH & GAME	333 RASPBERRY ROAD		ANCHORAGE	AK	99518	1599	
				ARCTIC SOUNDER		301 CALISTA COURT SUITE B		ANCHORAGE	AK	99518	3000	
				ALASKA JOURNAL OF COMMERCE		301 ARCTIC SLOPE SUITE 350		ANCHORAGE	AK	99518		
MR	JIM	FALL	PROGRAM MANAGER SUBSISTENCE DIVISION	STATE OF ALASKA	DEPT OF FISH AND GAME	333 RASPBERRY ROAD		ANCHORAGE	AK	99518	1599	
MS	BETH	HALEY		LGL ALASKA RESEARCH ASSOCIATES INC		1101 EAST 76TH AVENUE SUITE B		ANCHORAGE	AK	99518		
			LAND MANAGER ALASKA	BP EXPLORATION (ALASKA) INC		PO BOX 196612		ANCHORAGE	AK	99519	6612	
MS	JUDY	BUONO	LAND & TITLE CORDINATOR	BP EXPLORATION (ALASKA) INC		PO BOX 196612		ANCHORAGE	AK	99519	6612	
MR	KEVIN A	TABLER		UNION OIL COMPANY OF CALIFORNIA		PO BOX 196247		ANCHORAGE	AK	99519	6247	
MR	CHARLES	UNDERWOOD JR	LANDSMAN	MARATHON OIL COMPANY	TEAM	PO BOX 196168		ANCHORAGE	AK	99519	6168	
				RURAL CAP	URAL RESOURCES	PO BOX 200908		ANCHORAGE	AK	99520		
MR	PAUL	DAVIS	[redacted]									
MS	PATRICIA LONGLEY	COCHRAN	EXECUTIVE DIRECTOR	ALASKA NATIVE SCIENCE COMMISSION		PO BOX 244305		ANCHORAGE	AK	99524		
MR	GABE	SCOTT		CASCADIA WILDLANDS PROJECT		PO BOX 853		CORDOVA	AK	99574		
MS	FRANCES ANN	DEGNAN	SECRETARY/TREASURER	RESOURCES SERVICE AREA		PO BOX 33		UNALAKLEET	AK	99684		
				US FISH AND WILDLIFE SERVICE	NORTHERN ALASKA ECOLOGICAL SVCS	101 12TH AVE BOX 19 RM 110		FAIRBANKS	AK	99701		
MR	DOUG	DASHER	NORTHERN ALASKA DISTRICT OFFICE	STATE OF ALASKA	DEPT OF ENVIRONMENTAL CONSERVATION	610 UNIVERSITY AVE		FAIRBANKS	AK	99701	4980	
				FAIRBANKS DAILY NEWS MINER		PO BOX 710		FAIRBANKS	AK	99707		
			DIRECTOR	ALASKA NATIVE KNOWLEDGE NETWORK		PO BOX 756730		FAIRBANKS	AK	99775		
			DIRECTOR	ARCTIC CONNECTIONS				FAIRBANKS	AK			

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	JOHN J	BURNS	MMS/SCI COMM MEMBER	LIVING RESOURCES INC		PO BOX 83570		FAIRBANKS	AK	99708		
MS	PAMELA A	MILLER	NORTHERN ALASKA ENVIRONMENTAL	NORTHERN ALASKA ENVIRONMENTAL CENTER		830 COLLEGE ROAD		FAIRBANKS	AK	99708		
			LIBRARIAN	NORTHERN ALASKA ENVIRONMENTAL CENTER		830 COLLEGE ROAD		FAIRBANKS	AK	99708		
MR	BOB	KARLEN		BUREAU OF LAND MANAGEMENT	NORTHERN FIELD OFFICE	1150 UNIVERSITY AVENUE		FAIRBANKS	AK	99709		
MR	JACK	KERIN	DIVISION OF WATER	STATE OF ALASKA	DEPT OF NATURAL RESOURCES	3700 AIRPORT WAY		FAIRBANKS	AK	99709		
MR	STANLEY	LEAPHART		CITIZENS' ADVISORY COMMISSION ON FEDERAL AREAS	DEPT OF NATURAL RESOURCES	3700 AIRPORT WAY		FAIRBANKS	AK	99709	4699	
			LIBRARIAN	TUZZY CONSORTIUM LIBRARY		114 ILLINIOIS AVE		ANAKTUVUK PASS	AK	99721		
			VILLAGE COORDINATOR	NORTH SLOPE BOROUGH		PO BOX 21010		ANAKTUVUK PASS	AK	99721		
			DIRECTOR	NUNAMIUT CORPORATION		PO BOX 21009		ANAKTUVUK PASS	AK	99721		
MR	GEORGE	PANEAK	MAYOR	CITY OF ANAKTUVUK PASS		PO BOX 21030		ANAKTUVUK PASS	AK	99721		
MR	THOMAS	RULLAND	PRESIDENT	NAGSRAGMUIT TRIBAL COUNCIL		PO BOX 21065		ANAKTUVUK PASS	AK	99721		
			ENVIRONMENTAL PROGRAM MANAGER	NATIVE VILLAGE OF BARROW		PO BOX 215		BARROW	AK	99723		
			PRESIDENT	BARROW WHALING CAPTAINS ASSOCIATION		PO BOX 492		BARROW	AK	99723		
			MAYOR	CITY OF BARROW		PO BOX 629		BARROW	AK	99723		
				TUZZY CONSORTIUM LIBRARY		PO BOX 749		BARROW	AK	99723		
			PRESIDENT	ILISAGVIK COLLEGE		PO BOX 749		BARROW	AK	99723		
			INUPIAT HERITAGE CENTER			PO BOX 69		BARROW	AK	99723		
			NEWS DIRECTOR	KBRW NEWS		PO BOX 109		BARROW	AK	99723		
			NEWS DIRECTOR	BARROW CABLE TV		PO BOX 489		BARROW	AK	99723		
			NATURAL RESOURCES DIRECTOR	INUPIAT COMMUNITY OF THE ARCTIC SLOPE		PO BOX 934		BARROW	AK	99723		
				NORTH SLOPE BOROUGH	PLANNING DEPARTMENT	PO BOX 69		BARROW	AK	99723		
MR	JOHNNY	ADAMS	[redacted]									
MS	MARIE	ADAMS CARROLL		NORTH SLOPE BOROUGH	PUBLIC INFORMATION OFFICE	PO BOX 69		BARROW	AK	99723		
MS	MAGGIE	AHMAOGAK	EXECUTIVE DIRECTOR	ALASKA ESKIMO WHALING COMMISION		PO BOX 570		BARROW	AK	99723		
MS	KATHY	AHGEAK	LIAISON OFFICER IHLC	NORTH SLOPE BOROUGH	PLANNING DEPT	PO BOX 69		BARROW	AK	99723		
			DIRECTOR	ARCTIC DEVELOPMENT COUNCIL		PO BOX 1353		BARROW	AK	99723		
MR	JOSEPH K	AKPIK	[redacted]									
MR	CHARLES	BROWER	CHAIRMAN	UKPEAGVIK INUPIAT CORPORATION		PO BOX 623		BARROW	AK	99723	0890	
MS	CHARLOTTE	BROWER	[redacted]									
Mr.	EUGENE	BROWER	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX 1084		BARROW	AK	99723		
MR	GORDON	BROWER	[redacted]									

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	ARNOLD	BROWER JR		BARROW WHALING CAPTAINS ASSOCIATION		BOX 402		BARROW	AK	99723		
MR	HARRY	BROWER JR	CHAIRMAN	ALASKA ESKIMO WHALING COMMISSION		PO BOX 712		BARROW	AK	99723		
MR	HARRY	BROWER JR	CHAIRMAN	ALASKA ESKIMO WHALING COMMISSION		PO BOX 570		BARROW	AK	99723		
MR	GEORGE	EDWARDSON	PRESIDENT	INUPIAT COMMUNITY OF THE ARCTIC SLOPE		PO BOX 934		BARROW	AK	99723		
MR	ANTHONY	EWARDSEN	PRESIDENT	UKPEAGVIK INUPIAT CORPORATION		PO BOX 890		BARROW	AK	99723		
MR	TONY	EWARDSEN		ALASKA ESKIMO WHALING COMMISSION		PO BOX 596		BARROW	AK	99723		
MR	CRAIG	GEORGE		NORTH SLOPE BOROUGH	DEPT OF WILDLIFE MANAGEMENT	PO BOX 69		BARROW	AK	99723		
MR	RICHARD	GLENN	VICE PRESIDENT LAND	ARCTIC SLOPE REGIONAL CORPORATION		PO BOX 129		BARROW	AK	99723		
MS	RAYNITA "TAQULIK"	HEPA	DIRECTOR	DEPT OF WILDLIFE MANAGEMENT	NORTH SLOPE BOROUGH	PO BOX 69		BARROW	AK	99723		
MR	BOB	HARCHAREK	MAYOR	CITY OF BARROW		PO BOX 629		BARROW	AK	99723		
MR	EDWARD	HOPSON										
MR	CHARLES	HOPSON	CHAIRMAN	ALASKA ESKIMO WHALING COMMISSION		PO BOX 172		BARROW	AK	99723		
MS	MARTHA	HOPSON										
MR	EDWARD	ITTA SR	MAYOR	NORTH SLOPE BOROUGH		PO BOX 69		BARROW	AK	99723		
MR	HERMAN	KIGNAK SR	CHAIRMAN	ARCTIC SLOPE NATIVE ASSOCIATION		PO BOX 1232		BARROW	AK	99723		
MS	DOREEN	LAMPE	PRESIDENT	INUPIAT COMMUNITY OF THE ARCTIC SLOPE		PO BOX 934		BARROW	AK	99723		
MR	PRICE	LEAVITT	EXECUTIVE DIRECTOR	INUPIAT COMMUNITY OF THE ARCTIC SLOPE		PO BOX 934		BARROW	AK	99723	0934	
MS	JANICE	MEADOWS	EXECUTIVE DIRECTOR	ALASKA ESKIMO WHALING COMMISSION		PO BOX 570		BARROW	AK	99723		
MR	PERCY	NUSUNGINYA	TRIBAL COUNCIL PRESIDENT	NATIVE VILLAGE OF BARROW		PO BOX 1130		BARROW	AK	99723	1130	
MR	THOMAS	OLEMAUN	PRESIDENT	NATIVE VILLAGE OF BARROW	INUPIAT TRADITIONAL GOVERNMENT	PO BOX 1130		BARROW	AK	99723		
MR	JOE	SAGE		NATIVE VILLAGE OF BARROW	WILDLIFE DIRECTOR	PO BOX 1130		BARROW	AK	99723		
MR	JAMES	PATKOTAK										
MS	ROSABELLE	REXFORD										
MS	ROBERTA	QUINTAVELL	PRESIDENT, CEO, DIRECTOR	ARCTIC SLOPE REGIONAL CORPORATION		PO BOX 129		BARROW	AK	99723		
MR	JOSEPH	UPICKSON										
			LIBRARIAN	NORTH SLOPE BOROUGH	LIBRARY/MEDIA SCHOOL DISTRICT	PO BOX 169		BARROW	AK	99723		
	WASKU	WILLIAMS										
			MANAGER, PLANNING AND DEVELOPMENT	ALASKA CLEAN SEAS		POUCH 340022		PRUDHOE BAY	AK	99734	0022	

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	REGINAL	ANINGAYOU SR		ALASKA ESKIMO WHALING COMMISSION		PO BOX 23		GAMBELL	AK	99742		
MR	LEONARD	APANGALOOK		ALASKA ESKIMO WHALING COMMISSION		PO BOX 93		GAMBELL	AK	99742		
MR	MICHAEL	APATIKI	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX		GAMBELL	AK	99742		
MR	MERLIN	KOONOOKA	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 67		GAMBELL	AK	99742		
			LIBRARIAN	KAVEOLOOK SCHOOL LIBRARY		PO BOX 10		KAKTOVIK	AK	99747		
HONORABLE	ANNIE	TIKLUK	MAYOR	CITY OF KAKTOVIK	CITY OFFICE	PO BOX 27		KAKTOVIK	AK	99747		
			PRESIDENT	KAKTOVIK INUPIAT CORPORATION		PO BOX 73		KAKTOVIK	AK	99747		
MR	THOMAS	AGIAK		ALASKA ESKIMO WHALING COMMISSION		PO BOX 24		KAKTOVIK	AK	99747		
MR	FREDDIE	AISHANNA										
			LIBRARIAN	KAVEOLOOK SCHOOL LIBRARY		2001 BARTER AVE		KAKTOVIK	AK	99747		
	BERDELL	AKOOTCHOOK	VILLAGE COORDINATOR	NORTH SLOPE BOROUGH		PO BOX 102		KAKTOVIK	AK	99747		
MR	ISAAC	AKOOTCHOOK	PRESIDENT	NATIVE VILLAGE OF KAKTOVIK		PO BOX 130		KAKTOVIK	AK	99747		
MR	ISAAC	AKOOTCHOOK										
MS	IDA E	ANGASAN										
MR	WALT	AUDI										
MR	JOSEPH	KALEAK	PRESIDENT	KAKTOVIK WHALING CAPTAINS		PO BOX 83		KAKTOVIK	AK	99747		
MR	JOSEPH	KALEAK	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 83		KAKTOVIK	AK	99747		
MR	JAMES	LAMPE SR		ALASKA ESKIMO WHALING COMMISSION		PO BOX 7		KAKTOVIK	AK	99747		
MR	FENTON	REXFORD	PRESIDENT	KAKTOVIK INUPIAT CORPORATION		010 A STREET		KAKTOVIK	AK	99747		
MR	FENTON	REXFORD	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX 137		KAKTOVIK	AK	99747		
MR	NOLAN	SOLOMAN										
MR	LON	SONSALLA										
MR	GEORGE	TAGAROOK										
HONORABLE	ANNIE	TIKLUK	MAYOR	CITY OF KAKTOVIK		PO BOX 27		KAKTOVIK	AK	99747		
MS	MERYLIN	TRAYNOR										
MR	RAYMOND	HAWLEY	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 50075		KIVALINA	AK	99750		
MR	ORAN	KNOX SR		ALASKA ESKIMO WHALING COMMISSION		PO BOX 50045		KIVALINA	AK	99750		
MR	CALEB	WESLEY	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX		KIVALINA	AK	99750		
MR	LOWELL	SAGE JR	PRESIDENT	NATIVE VILLAGE OF KIVALINA		PO BOX 50051		KIVALINA	AK	99750		
MR	EUGENE	SMITH	MAYOR	CITY OF KOTZEBUE		PO BOX		KOTZEBUE	AK	99752		
			VICE PRESIDENT	NANA REGIONAL CORPORATION	LANDS DEPARTMENT	PO BOX 49		KOTZEBUE	AK	99752		
			LIBRARIAN	CHUKCHI CONSORTIUM LIBRARY		604 THIRD STREET		KOTZEBUE	AK	99752		
			CHAIRPERSON	NATIVE VILLAGE OF KOTZEBUE		PO BOX 296		KOTZEBUE	AK	99752		
	MARIE	GREENE	PRESIDENT	NANA REGIONAL CORPORATION		PO BOX 49		KOTZEBUE	AK	99752		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	WILLIE	GOODWIN	CHAIRMAN	ALASKA BELUGA WHALE COMMITTEE		PO BOX 334		KOTZEBUE	AK	99752		
MR	JEFF	HADLEY		CITY OF KOTZEBUE	PLANNING DIVISION	PO BOX 46		KOTZEBUE	AK	99752		
MR	GUY	ADAMS	EXECUTIVE DIRECTOR	NATIVE VILLAGE OF KOTZEBUE IRA		PO BOX 296		KOTZEBUE	AK	99752	0296	
MR	REGGIE	JOULE	REPRESENTATIVE	ALASKA STATE LEGISLATURE		PO BOX 673		KOTZEBUE	AK	99752		
MR	KRIS	LETHIN	PRESIDENT/CEO	KIKIKTAGRUK INUPIAT CORP		PO BOX 1050		KOTZEBUE	AK	99752		
	SIIKAURAQ	WHITING	MAYOR	NORTHWEST ARCTIC BOROUGH		PO BOX 1110		KOTZEBUE	AK	99752		
MR	LEO	FERREIRA III	VILLAGE COORDINATOR	NATIVE VILLAGE OF POINT LAY		PO BOX 59031		POINT LAY	AK	99759		
			LIBRARIAN	KALI COMMUNITY SCHOOL/COMMUNITY LIBRARY		1029 UGRUK AVE		POINT LAY	AK	99759		
MS	ANNE	MARTIN		NATIVE VILLAGE OF POINT LAY		PO BOX 101		POINT LAY	AK	99759		
MR	THOMAS	NUKAPIGAK		ALASKA ESKIMO WHALING COMMISSION		PO BOX 59101		POINT LAY	AK	99759		
MR	JULIUS	REXFORD	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 59016		POINT LAY	AK	99759		
MR	JULIUS	REXFORD	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX 59016		POINT LAY	AK	99759		
MR	JULIUS	REXFORD	PRESIDENT	NATIVE VILLAGE OF POINT LAY		PO BOX 59031		POINT LAY	AK	99759		
MS	FREDRICKA	STALKER	PRESIDENT	NATIVE VILLAGE OF POINT LAY		PO BOX 59031		POINT LAY	AK	99759		
MS	ALMA	UPICKSOUN	CHAIRMAN	CULLY CORPORATION		PO BOX 59089		POINT LAY	AK	99759		
			LIBRARIAN	KEGOYAH KOZGA PUBLIC LIBRARY		PO BOX 165		NOME	AK	99762		
MR	CHARLES	BROWER		ESKIMO WALRUS COMMISSION		PO BOX 948		NOME	AK	99762		
			CITY MANAGER	CITY OF NOME		PO BOX 281		NOME	AK	99762		
MR	ORVILLE	AHKINGA SR	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 7025		DIOMEDE	AK	99762		
MR	ORVILLE	AHKINGA JR	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX 7046		DIOMEDE	AK	99762		
MR	ORVILLE	AHKINGA JR	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 7046		DIOMEDE	AK	99762		
MR	RONALD	OZENNA		ALASKA ESKIMO WHALING COMMISSION		PO BOX 7023		DIOMEDE	AK	99762		
MR	CHARLES	MENADELOOK		ALASKA ESKIMO WHALING COMMISSION		PO BOX 7043		LITTLE DIOMEDE	AK	99762		
			LIBRARIAN	KEGOYAH KOZGA PUBLIC LIBRARY		223 FRONT STREET		NOME	AK	99762		
MR	CHARLES D.N.	BROWER	CHAIRMAN	ICE SEAL COMMITTEE		PO BOX 946		NOME	AK	99762		
MR	CHARLES	JOHNSON	EXECUTIVE DIRECTOR	ALASKA NANUUQ COMMISSION		PO BOX 946		NOME	AK	99762		
MS	VERA	METCALF	DIRECTOR	ESKIMO WALRUS COMMISSION		PO BOX 94		NOME	AK	99762		
MS	DENISE	MICHELS	MAYOR	CITY OF NOME		PO BOX 281		NOME	AK	99762		
MR	BENJAMIN P	NAGEAK	CHAIRMAN	ESKIMO WALRUS COMMISSION		PO BOX 948		NOME	AK	99762		
DR	RICHARD	STERN	GENERAL MANAGER	BERING AIR INC		PO BOX 1650		NOME	AK	99762		
MR	JIM	STIMPFLE										
MS	CAROLINE	CANNON	PRESIDENT	NATIVE VILLAGE OF POINT HOPE		PO BOX 266		POINT HOPE	AK	99766		
MS	LILY	TUZROYLUKE	PRESIDENT	NATIVE VILLAGE OF POINT HOPE		PO BOX 109		POINT HOPE	AK	99766		
			LIBRARIAN	TIKIGAQ LIBRARY		PO BOX 148		POINT HOPE	AK	99766		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
			VILLAGE COORDINATOR	NORTH SLOPE BOROUGH		PO BOX 108		POINT HOPE	AK	99766		
MR	ISAAC	KILLIGVUK, SR		ALASKA ESKIMO WHALING COMMISSION		PO BOX 710		POINT HOPE	AK	99766		
MR	JAKE	KOONUK										
MR	RAY	KOONUK SR	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 192		POINT HOPE	AK	99766		
MR	RAY	KOONUK SR	PRESIDENT	POINT HOPE WHALING CAPTAINS ASSOCIATION		PO BOX 350		POINT HOPE	AK	99766		
MR	GEORGE	KINGIK	MAYOR	CITY OF POINT HOPE		PO BOX 169		POINT HOPE	AK	99766		
MR	ELIJAH	ROCK SR	SECRETARY	ALASKA ESKIMO WHALING COMMISSION		PO BOX 68		POINT HOPE	AK	99766		
MR	REX	ROCK SR		ALASKA ESKIMO WHALING COMMISSION		PO BOX 107		POINT HOPE	AK	99766		
MR	JACK	SCHAEFER										
MR	SAYERS	TUZROYKUK SR	CHAIRMAN	TIKIGAQ CORP		PO BOX 9		POINT HOPE	AK	99766		
			LIBRARIAN	TIKIGAK SCHOOL/COMMUNITY LIBRARY		1837 TIKIGAK AVE		POINT HOPE	AK	99766		
MR	REX	TUZROYLUKE JR										
MR	ISAAC	KULOWIYI	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX		SAVOONGA	AK	99769		
MR	GEORGE	NOONGWOOK	VICE-CHAIRMAN	ALASKA ESKIMO WHALING COMMISSION		PO BOX 81		SAVOONGA	AK	99769		
MR	PERRY	PUNGOWIYI		ALASKA ESKIMO WHALING COMMISSION		PO BOX 77		SAVOONGA	AK	99769		
			PRESIDENT	NATIVE VILLAGE OF SHISHMAREF		PO BOX 72110		SHISHMAREF	AK	99772		
MS	KARLA	NAYUKPUK	PRESIDENT	NATIVE VILLAGE OF SHISHMAREF IRA		PO BOX 72110		SHISHMAREF	AK	99772		
MS	NELLIE	WEYIOUSANNA		ILISAGVIK LIBRARY		PO BOX 90		SHISHMAREF	AK	99772		
			LIBRARIAN	UNIVERSITY OF ALASKA FAIRBANKS	ELMER E RASMUSON LIBRARY	310 TANANA DR		FAIRBANKS	AK	99775		
			LIBRARIAN	UNIVERSITY OF ALASKA FAIRBANKS	INSTITUTE OF ARCTIC BIOLOGY	311 IRVING BLDG		FAIRBANKS	AK	99775		
			DIRECTOR	UNIVERSITY OF ALASKA FAIRBANKS	GEOPHYSICAL INSTITUTE	PO BOX 757320		FAIRBANKS	AK	99775	7320	
DR	VERA	ALEXANDER	DIRECTOR, COASTAL MARINE INSTITUTE	UNIVERSITY OF ALASKA FAIRBANKS	SCHOOL OF FISHERIES & OCEAN SCIENCES	245 O'NEILL BUILDING		FAIRBANKS	AK	99775	7220	
MR	RAY	BARNHARDT		ALASKA NATIVE KNOWLEDGE NETWORK	ALASKA RSI	PO BOX 756730		FAIRBANKS	AK	99775	6730	
			DIRECTOR	STATE OF ALASKA	DIVISION OF GEOLOGICAL AND GEOPHYSICAL SURVEYS	3354 COLLEGE ROAD		FAIRBANKS	AK	99709		
			DIRECTOR	ARCTIC CONNECTIONS		PO BOX 82803		FAIRBANKS	AK	99708		
MR	RICHARD	MILLER	ELMER E RASMUSON LIBRARY	UNIVERSITY OF ALASKA FAIRBANKS	GOVERNMENT DOCUMENTS/MAPS	PO BOX 756817		FAIRBANKS	AK	99775	6817	
			VILLAGE COORDINATOR	NORTH SLOPE BOROUGH		PO BOX 128		WAINWRIGHT	AK	99782		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	FREDRICK	AHMAOGAK										
MR	RANSOM	AGNASSAGGA		ALASKA ESKIMO WHALING COMMISSION		PO BOX 161		WAINWRIGHT	AK	99782		
MR	BARRY	BODFISH SR										
			LIBRARIAN	ALAK COMMUNITY/SCHOOL LIBRARY		567 MAIN ST		WAINWRIGHT	AK	99782		
MS	JUNE	CHILDRESS	PRESIDENT	OLGOONIK CORPORATION		PO BOX 29		WAINWRIGHT	AK	99782		
MS	JUNE	CHILDRESS	PRESIDENT	VILLAGE OF WAINWRIGHT		PO BOX 184		WAINWRIGHT	AK	99782		
MS	JUNE	CHILDRESS	PRESIDENT	WAINWRIGHT TRADITIONAL COUNCIL		PO BOX 143		WAINWRIGHT	AK	99782		
MR	WALTER	NAYAKIK	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX		WAINWRIGHT	AK	99782		
MR	ENOCH	OKTOLLIK	MAYOR	CITY OF WAINWRIGHT		PO BOX 9		WAINWRIGHT	AK	99782		
MR	JACK	PANIK		ALASKA ESKIMO WHALING COMMISSION		PO BOX 4		WAINWRIGHT	AK	99782		
MR	HOWARD	PATKOTAK	CHAIRMAN	OLGOONIK CORPORATION		PO BOX 29		WAINWRIGHT	AK	99782		
MR	ROSSMAN	PEETOOK	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 43		WAINWRIGHT	AK	99782		
MR	KENNETH	TAGAROOK										
MR	HARRY	TAZRUK										
MR	LUTHER	KOMONASEAK	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 54		WALES	AK	99783		
MR	RAYMOND	SEETOOK		ALASKA ESKIMO WHALING COMMISSION		PO BOX 553		WALES	AK	99783		
MR	JACOB	SOOLOOK		ALASKA ESKIMO WHALING COMMISSION		PO BOX 507		WALES	AK	99783		
MR	WINTON	WEYAPUK	PRESIDENT	WHALING CAPTAINS ASSOCIATION		PO BOX		WALES	AK	99783		
			VILLAGE COORDINATOR	NORTH SLOPE BOROUGH		PO BOX 329		NUIQSUT	AK	99789		
MR	ARCHIE	AHKIVIANA		ALASKA ESKIMO WHALING COMMISSION		PO BOX 22		NUIQSUT	AK	99789		
MS	MARJORIE	AHNUPKANA										
MS	ROSEMARY	AHTUANGARUAK										
MR	JIM T	ALLEN										
HONORABLE	CARL	BROWER	MAYOR	CITY OF NUIQSUT		PO BOX 89148		NUIQSUT	AK	99789		
MR	CARL	BROWER	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 89033		NUIQSUT	AK	99789		
MS	FLORES	ELFOEELOUK										
MS	EMMA	EUDILIAK										
MS	MAGGIE	HOPSON										
MR	HERBERT	IPALOOK	PRESIDENT	WHALING CAPTAINS ASSOCIATION		BOX 329		NUIQSUT	AK	99789		
MS	BERNICE	KAIGELAK	PRESIDENT	NATIVE VILLAGE OF NUIQSUT		PO BOX 89169		NUIQSUT	AK	99789		
MR	LYDIN	KISOADIK										
MS	MAGGIE	KORALDY										
MS	SARAH	KUNAKNONY										
MR	LEONARD	LAMPE SR	PRESIDENT	NATIVE VILLAGE OF NUIQSUT		PO BOX 89169		NUIQSUT	AK	99789		
MS	MARTHA	LAREPE										
MR	ROGER	LOCKWOOD	LIBRARIAN	TRAPPER SCHOOL COMMUNITY LIBRARY		3310 3RD AVE		NUIQSUT	AK	99789		

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
MR	FRANK	LONG	[redacted]									
MR	GORDAN	MATUMACK										
MR	ELI	NUKAPIGAK										
MR	ISAAC	NUKAPIGAK	PRESIDENT	KUUKPIK CORPORATION		PO BOX 89187		NUIQSUT	AK	99789		
MR	ISAAC	NUKAPIGAK	[redacted]									
MR	ISAAC	NUKAPIGAK	COMMISSIONER	ALASKA ESKIMO WHALING COMMISSION		PO BOX 84054		NUIQSUT	AK	99789		
MR	JOE	NUKAPIGAK	CHAIRMAN	KUUKPIK VILLAGE CORPORATION		PO BOX 89187		NUIQSUT	AK	99789		
MS	RUTH	NUKAPIGAK	[redacted]									
MS	EMILY	PANIGER										
MR	WILLIE	SIELAK JR										
	AUNUPTANA	SIMIKTUG										
MS	ALICE	TPALOOK										
MS	EMILLY	WILSON										
MR	JOEB	WOODSON										
				TUZZY CONSORTIUM LIBRARY	MEADE RIVER SCHOOL/COMMUNITY LIBRARY	4001 KIPPI ST		ATQASUK	AK	99791		
			VILLAGE COORDINATOR	NORTH SLOPE BOROUGH		PO BOX 99		ATQASUK	AK	99791		
			PRESIDENT	ATQASUK INUPIAT CORPORATION		PO BOX 91021		ATQASUK	AK	99791		
MS	CANDACE	ITTA	MAYOR	CITY OF ATQASUK		PO BOX 91119		ATQASUK	AK	99791		
MR	JIMMY	NAYUKOK	PRESIDENT	ATQASUK CORPORATION		TIKIGLYK & AKPIK ST		ATQASUK	AK	99791		
GOVERNOR	SEAN	PARNELL	GOVERNOR	STATE OF ALASKA	OFFICE OF THE GOVERNOR	PO BOX 11000		JUNEAU	AK	99811		
			DIRECTOR	STATE OF ALASKA	DIVISION OF GOVERNMENT COORDINATION	PO BOX 110030		JUNEAU	AK	99811		
			DIRECTOR	STATE OF ALASKA	DIVISION OF BUDGET AND MANAGEMENT	PO BOX 110020		JUNEAU	AK	99811		
			DOCUMENTS LIBRARIAN	JUNEAU PUBLIC LIBRARY		292 MARINE WAY		JUNEAU	AK	99801		
				UNIVERSITY OF ALASKA SOUTHEAST	LIBRARY - MAILSTOP BEI	11120 GLACIER HIGHWAY		JUNEAU	AK	99801	8676	
MS	KATTANYNA	BENNETT	[redacted]									
MS	LAYLA	HUGHES		WORLD WILDLIFE FUND		419 SIXTH STR STE 317		JUNEAU	AK	99801		
MR	TOM	IRWIN	COMMISSIONER	DEPT OF NATURAL RESOURCES	STATE OF ALASKA	400 WILLOUGHBY AVE 5TH FLOOR		JUNEAU	AK	99801	1724	
MR	ERIC	JORGENSEN	MANAGING ATTORNEY	EARTHJUSTICE		325 FOURTH STREET		JUNEAU	AK	99801		
MS	IRIS	KORHONEN-PENN		EARTHJUSTICE		325 4TH STREET		JUNEAU	AK	99801		
			REGIONAL ADMINISTRATOR	NATIONAL MARINE FISHERIES SERVICE	ALASKA REGIONAL OFFICE	PO BOX 21668		JUNEAU	AK	99802	1668	
			DIRECTOR	DEPARTMENT OF FISH AND GAME	HABITAT DIVISION	PO BOX 115526		JUNEAU	AK	99811	5526	
				ALASKA STATE LIBRARY	GOVERNMENT PUBLICATIONS	PO BOX 110571		JUNEAU	AK	99811	0571	

Master Mailing List Newsletter #1 with Blackout of Personal Addresses

Salutation	First	Last	Title	Organization	Department	Address1	Address2	City	State	Zip	Zip2	Country
			COMMISSIONER	DEPT OF COMMUNITY AND REGIONAL AFFAIRS		PO BOX 112100		JUNEAU	AK	99811	2100	
MR	RANDY	BATES	DIRECTOR	DIVISION OF COASTAL AND OCEAN MANAGEMENT	DEPARTMENT OF NATURAL RESOURCES	302 GOLD STREET STE 202		JUNEAU	AK	99811	1030	
MR	MICHAEL	CUSHING		STATE OF ALASKA	DEPT OF COMMUNITY & REGIONAL AFFAIRS	PO BOX 112100		JUNEAU	AK	99811	2100	
MR	RANDY	RUARO	DEPUTY CHIEF OF STAFF	STATE OF ALASKA	OFFICE OF THE GOVERNOR	PO BOX 110001		JUNEAU	AK	99811		
					LIBRARIAN	VALDEZ CONSORTIUM LIBRARY		VALDEZ	AK	99686		
MR	JOHN	WALSH		JM WALSH COMPANY INC		PO BOX 240952		DOUGLAS	AK	99824		
				CANADIAN WILDLIFE SERVICE	NATIONAL WILDLIFE RESEARCH CENTER	100 GAMELIN STREET		HULL	PQ	K1A 0H3		CANADA
DR	W JOHN	RICHARDSON	EXECUTIVE VICE PRESIDENT	LGL LIMITED	ENVIRONMENTAL RESEARCH ASSOCIATES	22 FISHER STREET PO BOX 280		KING CITY	ON	L7B 1A6		CANADA
			MANAGER, LAND NEGOTIATIONS	PETRO-CANADA (ALASKA) INC		150 - 6TH AVENUE SW		CALGARY	AB	T2P 3E3		CANADA
MR	JEFF	BEVER	TEAM LEADER	PETRO-CANADA (ALASKA) INC	NORTH AMERICAN FRONTIERS	PO BOX 2844		CALGARY	AB	T2P 3E3		CANADA
MR	NEAL	ALEXANDER		ENCANA OIL AND GAS (USA) INC		3900 421 7TH AVENUE, SW		CALGARY	AB	T2P 4K9		CANADA
MS	HELGA	GRAU	CANADIAN CIRCUMPOLAR LIBRARY - CAMERON	UNIVERSITY OF ALBERTA	SCIENCE AND TECHNOLOGY LIBRARY			EDMONTON	AB	T6G 2J8		CANADA
MR	ART	RAMIREZ		RADARSAT INTERNATIONAL		13800 COMMERCE PARKWAY	MCDONALD DETTWILER BLDG	RICHMOND	BC	V86V2J 3		CANADA
				INSTITUTE OF OCEAN SCIENCES	DEPT OF FISHERIES AND OCEANS	PO BOX 6000		SIDNEY	BC	V8L 4B2		CANADA
			LIBRARIAN	JOINT SECRETARIAT	LIBRARY	PO BOX 2120		INUVIK	NT	X0E 0T0		CANADA
			LIBRARIAN	CANADIAN CIRCUMPOLAR LIBRARY	LIBRARY			EDMONTON	AB	T8G2JB		CANADA
			LIBRARIAN	DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS		PO BOX 1500		YELLOWKNIFE	NT	X1A3RZ		CANADA
				DEPARTMENT OF INDIAN AND NORTHERN AFFAIRS	NATURAL RESOURCES AND ECONOMIC DEVELOPMENT	PO BOX 1500		YELLOWKNIFE	NT	X1A3RZ		CANADA

Newsletter #1 and Comment Form

Effects of Oil and Gas Activities in the Arctic Ocean
Environmental Impact Statement

February 2010 Newsletter #1

This is the first in a series of newsletters concerning the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement. It is being mailed to Federal, state, and local agencies; elected and appointed officials; Alaska Native groups; other interested organizations; and individual citizens to inform people about the EIS project and to solicit comments. This and subsequent newsletters can be found on the project website at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Scoping Notice

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS). The project will analyze the impacts of issuing marine mammal Incidental Take Authorizations, under the Marine Mammal Protection Act (MMPA).

The term "take" under the MMPA means "to harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." 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; 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."*

NMFS issues these authorizations to the oil and gas industry during offshore exploration activities (primarily seismic surveys and exploratory drilling). In order to issue authorizations, NMFS must determine that the taking:

- will have no more than a negligible impact on the species or stock(s)
- will not have an adverse impact that cannot be mitigated regarding the availability of the species or stock(s) for subsistence uses (where relevant)
- the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are identified.

This EIS will consider activities in Federal and state waters of the U.S. Beaufort and Chukchi Seas.

The scoping period for the Effects of Oil and Gas Activities in the Arctic Ocean EIS begins February 8, 2010 and ends April 9, 2010.

Scoping is a formal process that requires the lead agency to reach out to all interested parties early in the development of an EIS. The intent is to identify areas of concern associated with the proposed action that should be fully addressed in the EIS, including cumulative impacts, and ask for guidance on alternatives to the proposed action that should be considered. The scoping process provides opportunities for people potentially affected by the proposed action to express their views and concerns, and offer suggestions.

The purposes of this newsletter are to:

- Provide background information on the proposed action to issue incidental take authorizations.
- Provide an overview of the EIS process, and invite you to participate!

About the Environmental Impact Statement

NMFS is serving as the lead agency for this EIS. The U.S. Minerals Management Service (MMS) joins the effort as a cooperating agency. The EIS will analyze the environmental impacts to the physical, biological, and social resources from seismic activities and exploratory drilling in the Beaufort and Chukchi Seas.

Previous issues and concerns associated with oil and gas related activities in the Arctic marine environment have been documented by the scientific community, government publications, at scientific symposia, through the scoping and public hearings/comments, and other National Environmental Policy Act (NEPA) analyses. In addition, public testimony and traditional knowledge from Alaska Natives has provided valuable information about the potential impacts to marine mammals and on subsistence hunting of such species from seismic surveying and drilling operations. This EIS will build upon these efforts.

The EIS will address long-term cumulative effects, consider a reasonable range of alternatives consistent with NMFS' legal mandates, and analyze the range of practical mitigation and monitoring measures for protecting marine mammals and the availability of marine mammals for subsistence uses.

Project History

In 2006, the MMS prepared a Programmatic Environmental Assessment (PEA) for Arctic Outer Continental Shelf (OCS) seismic surveys. Afterwards, in accord with the MMPA, NMFS conducted its own Environmental Assessments and issued annual Incidental Harassment Authorizations to oil and gas companies for the taking of marine mammals during seismic surveys.

In 2007, the MMS began a Draft Programmatic EIS (DPEIS). This project assessed the impacts of MMS' issuance of permits and authorizations under the OCS Lands Act for seismic surveys in the Beaufort and Chukchi Seas near Alaska, and NMFS' authorizations to incidentally harass marine mammals while conducting those surveys. The intent of the DPEIS was to try to address the potential effects of concurrent offshore exploration activities and the potential for an increase in such activities.

The DPEIS was halted because new information became available, such as scientific study results and changes in projections of levels of offshore activity. This new information altered the scope of the study, range of possible alternatives, and analyses. This led to the need for a new NEPA process, and the start of the **Effects of Oil and Gas Activities in the Arctic Ocean EIS**.

Beluga whale pod (Source: National Marine Mammal Laboratory)

Preparing the Environmental Impact Statement

The EIS will identify potential impacts that seismic surveys and exploratory drilling in the Beaufort and Chukchi Seas could have on the physical, biological, and social environments. Methods to mitigate impacts will also be considered. In addition, the EIS will contain an analysis of secondary and cumulative effects of the alternatives.

As the lead agency, NMFS is responsible for the development of the EIS, in cooperation with the MMS.

The process for the Effects of Oil and Gas Activities in the Arctic Ocean EIS is summarized in ten broad steps:

Step	Steps in the NEPA Process
1	**Federal Notice of Intent (NOI) to Prepare an Environmental Impact Statement (EIS)** February 8, 2010
2	**Scoping** Scoping period: February 8 to April 9, 2010 Public Scoping Meetings: February 18 to March 23, 2010 Scoping Report: Estimated May 2010
3	**Analysis of Alternatives**
4	**NMFS Selects Preferred Alternative**
5	**Issue Draft EIS** Estimated release: mid-December 2010 Available for 45-day public review, through early February 2011
6	**Public Hearing on Draft EIS** Estimated: January 2011
7	**Public Comment Review and Synthesis** Comment Analysis Report Available, Estimated: March 2011
8	**Respond to Comments/Prepare Final EIS** Estimated: June 2011
9	**Issue Final EIS** Estimated: late June 2011 Available for minimum 30-day public review
10	**Record of Decision** Public statements of agency decisions Estimated: July 2011

Objectives of the Public Involvement Process

All interested parties are invited to participate in the EIS process. This includes members of the general public, Alaska Native organizations, local and regional interest groups, the oil and gas industry, and state and Federal agencies are encouraged to participate. Objectives of the public involvement process include:

- Share information about NEPA requirements
- Obtain and analyze comments and suggestions from interested parties that will help determine issues and concerns
- Use comments and suggestions to help define a reasonable range of alternatives to be evaluated in the EIS, and to develop suitable mitigation and monitoring measures
- Incorporate relevant issues in the analysis process
- Respond to public comments and incorporate public comments into the document

How Can YOU Participate in the EIS?

Your comments are very important to us, particularly at this early stage in the project. There are several ways to participate in the EIS process. In February and March, 2010 there will be public scoping meetings in several communities. Comments can be provided in-person at the meeting locations below:

Scoping Meetings

Date	Time	Location
February 18	6:00-8:00pm	Kotzebue – Northwest Arctic Borough Assembly Chambers
February 19	5:00-7:00pm	Point Hope Community Center
February 22	7:00-9:00pm	Point Lay Community Center
March 9	7:00-9:00pm	Wainwright Community Center
March 10	7:30-9:30pm	Barrow – Inupiat Heritage Center
March 11	7:00-9:00pm	Nuiqsut Community Center
March 12	6:30-8:30pm	Kaktovik Community Center
March 23	7:00-9:00pm	Anchorage – Egan Center

To request accommodation of a disability or special need at a public meeting (e.g., sign language interpreter), please contact Sheyna Wisdom, seven (7) days prior to the meeting, via:

Fax: (907) 562-1297
Telephone: (907) 562-3366 or (800) 909-6787
Email: sheyna_wisdom@urscorp.com

NMFS will make a reasonable effort to provide effective accommodations for all participants.

How to Submit Comments

In addition to attending scoping meetings and providing verbal comments, there are several ways to submit written comments:

- Bring them to a scoping meeting
- Use the comment form on the project website, http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm
- Email us at arcticeis.comments@noaa.gov
- Fax comments to: (301) 713-0376
- Mail comments to:
  Mr. P. Michael Payne
  Chief – Permits, Conservation & Education Division
  Office of Protected Resources, NMFS
  1315 E West Hwy Room 13705
  Silver Spring, MD 20910-6233

Let us know what aspects of this EIS process are important to you!

Written scoping comments can be submitted until April 9, 2010.

Comments received after this time will be considered, but will not be included in the scoping report. Comments will be reviewed and incorporated into the Draft EIS. A summary of scoping comments will be provided in the next newsletter.

Other Opportunities to Participate

Public involvement will continue throughout the EIS process. The goal is to receive public and agency comments, identify key issues of concern, and improve analysis. Additional newsletters will be distributed to provide updates.

Once the Draft EIS is complete, the document will be released to the public for an estimated review period of 45 days. During the review period, NMFS will conduct public hearings to accept comments on the Draft EIS. Public testimony, written comments, and electronic comments will be accepted during the review period. Future newsletters will provide information on how you can receive a copy of the Draft EIS, schedule public hearings, and opportunities for comment.

Visit the project website for on-going information updates: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm. We are all interested in ensuring that offshore development in the Arctic is conducted in a safe manner, and minimizes adverse impacts to stocks of marine mammals and their availability for subsistence harvest.

Mr. P. Michael Payne
Chief – Permits, Conservation & Education Division
Office of Protected Resources, NMFS
1315 E West Hwy Room 13705
Silver Spring, MD 20910-6233

Place a
First Class
Postage
Stamp Here

Your input is an important element in the scoping phase of this EIS. To help us consider your views and suggestions, please submit your comments to the EIS team. If you wish to send your comments by mail, write them down on this sheet and mail to our address, which is preprinted on the back of this page. Please write legibly (printing is appreciated) and you may attach additional sheets if necessary. You can also submit comments by email to arcticeis.comments@noaa.gov or through the comment section of the website at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Name (PLEASE PRINT): _____

Address: _____

City, State, Zip Code: _____

Telephone (Optional): _____

E-mail (Optional): _____

☐ **Please retain or add my name to the project mailing list. I wish to receive information in the mail.**

☐ **Please add my name and e-mail address to the list. I wish to receive information by electronic mail.**

COMMENTS:

Note: To mail, fold page in thirds so that the address on the back of this sheet shows.
Tape shut and affix a standard first class postage stamp. ***Thank you for your participation!***

PRSRT STD
US Postage
PAID
Permit # 845
Anch, AK

Newspaper Advertisements

ALASKA NEWSPAPERS, INC.
301 CALISTA COURT, SUITE B
ANCHORAGE, ALASKA 99518-3028
☎(907) 272-9830 * 🖷(907) 272-9512

URS Corporation
Attn: Michelle Harper
P.O. Box 203970
Austin, TX 78720

Date: May 5, 2010
CASE/PO/AIO:
INVOICE(S): 021000380086
PAPER: ARCTIC SOUNDER

AFFIDAVIT OF PUBLICATION

UNITED STATES OF AMERICA, STATE OF ALASKA, THIRD DIVISION

BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC THIS DAY PERSONALLY APPEARED **STACY N. DEACON** WHO, BEING FIRST DULY SWORN, ACCORDING TO LAW, SAYS THAT SHE IS THE ADMINISTRATIVE ASSISTANT OF **ALASKA NEWSPAPERS, INC. DBA THE ARCTIC SOUNDER** PUBLISHED AT ANCHORAGE IN SAID DIVISION THREE AND STATE OF ALASKA AND THAT THE ADVERTISEMENT, OF WHICH THE ANNEXED IS A TRUE COPY, WAS PUBLISHED IN SAID PUBLICATION ON **2/11/2010** AND THEREAFTER FOR A TOTAL OF **1** CONSECUTIVE ISSUE(S), THE LAST PUBLICATION APPEARING ON **2/11/2010**, AND THAT THE RATE CHARGED THEREON IS NOT IN EXCESS OF THE RATE CHARGED TO PRIVATE INDIVIDUALS.

STAMP

CHRISTINA RITTER
My Commission Expires
NOTARY PUBLIC
April 1, 2013
STATE OF ALASKA

STACY N. DEACON
ADMINISTRATIVE ASSISTANT, AK NEWSPAPERS INC.

SUBSCRIBED AND SWORN BEFORE ME ON
May 5, 2010

CHRISTINA RITTER
NOTARY PUBLIC FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES ON APRIL 1, 2013

ALASKA NEWSPAPERS, INC.

INVOICE

Alaska Newspapers, Inc.

301 Calista Ct,
Suite B
Anchorage,
Alaska 99518-3028
Phone: (907) 272-9830
Fax: (907) 272-9512

Bill To

URS CORPORATION
Attn : ACCOUNTS PAYABLE
P.O. Box 203970
Austin TX 78720

Invoice #	021000380086
Invoice Date	2/12/2010
Order #	Kimberly Wetzel
Terms	Net 30 Days
Old ID	2777
Sales Rep.	BAN

Insertion Details

Insertion Id	80219				
Advertiser Name	URS CORPORATION			PO Number	Kimberly Wetze
Publication	The Arctic Sounder			Issue Date	2/11/2010
Description	B&W , 2x6.5 , Display Ad.			Page Num	
Headline	Public Scoping AD			Tears	2
Column Inches	13.00	$ per Column Inch	$26.00	Affidavits	0

Ad Cost for this Insertion :	$338.00

Ad Cost for this Insertion :	$338.00
Total Surcharges for this Insertion :	$0.00
Total Discounts for this Insertion :	$0.00
Bill Cost for this Insertion :	$338.00
Amount Prepaid for this Insertion :	$0.00
Amount to pay for this Insertion :	$338.00

LEGISLATURE

Omnibus energy bills target lower expenses

Efficiency proposals extend from cities to villages

BOB TKACZ
For Alaska Newspapers

After a year of work, including unprecedented formal legislative hearings in a dozen rural communities including Ruby, Ouzinkie and Kotzebue among other Bush villages, committees of the Alaska House and Senate are grinding through the mundane work of passing a state energy policy and packages of bills to lower energy costs in the government and private sector.

Parts of eight Senate bills were rolled into SB 220 and elements of six House measures were repacked as HB 305. All had been introduced last year. The House Special Committee on Energy also introduced HB 306, declaring a state energy policy. No Senate policy bill was introduced but language like that in HB 306 was included in SB 220.

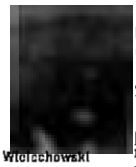
McGuire

"We have a bill we think will go a long way in moving the State of Alaska forward," said Sen. Lesil McGuire, R-Anchorage, head of the Energy Committee and co-chair with Sen. Bill Wielechowski, D-Anchorage, of the Senate Resources Committee.

The policy proposals call for a 15 percent per capita increase in state energy efficiency by 2020 and the use of renewable energy to supply 50 percent of its electrical needs by 2025.

Funding for the score of new and continuing programs in the omnibus bills will be considered in separate proposals, but the Senate co-chairs asked for $329 million to fund their plans. No estimate of House bill costs is yet available.

A $200 million deposit into the Railbelt Energy Fund, for improvements to the energy grid in the central corridor over the next 50 years, accounts for most of the money request. The fund now holds about $50 million but a study by consultants Black and Veatch identified $2 billion in near-term and out-year work needed to modernize the Railbelt grid.


Wielechowski

Other recommendations include $50 million for the popular home weatherization program and $25 million for the Renewable Energy Fund established in 2008. Gov. Sean Parnell said enough money is already "in the pipeline" and asked for only $25 million for alternative energy projects.

The Senate co-chairs also want $10 million for Southeast hydrogeneration and transmission lines; $8 million for village power system upgrades; $4 million for bulk fuel storage facilities in rural communities; $3 million for the Power Project Loan Fund, available to utilities, independent power producers and local governments; and $3 million to match $9 million in federal grants for public transportation projects.

The total request is $40 million more than the governor's budget proposal for the same items. The co-chairs also ask for unspecified "full funding" for the Power Cost Equalization Program and for support for a "regional integrated resource plan" for Southeast, which is also in the governor's budget.

Both bills require the Department of Transportation to prepare annual energy conservation targets for public buildings that their occupant agencies would work to achieve. The Senate bill requires DOT to improve the energy efficiency of the state's 1,800 public facilities and report its achievements annually to the Legislature.

Other language establishes a procurement preference for equipment or appliances bought by the state that qualified under the federal EPA's Energy Star Program.

Fuel-buying cooperative

A new initiative that could save millions of dollars for rural villages requires the Alaska Energy Authority to establish a state fuel-buying cooperative. It would be open to schools, municipalities and private businesses. The AEA would also be required to hire an economist who would evaluate every project receiving alternative energy grants and the bill amends grant program methodology.

The Alaska Housing Finance Corp. would be required to provide technical assistance to local governments that are adopting their own energy efficiency codes.

HB 305 would create a new Department of Energy. SB 220 doesn't include that proposal, and Parnell opposes it. The governor has said he wants existing agencies to share the work under the general direction of Gene Therriault, formerly a senator from Fairbanks who was hired as the governor's special assistant on energy issues last year.

Major elements from existing bills in the omnibus packages include:

- HB 196: Revival of the Alternative Energy Loan Fund, created in the 1980s for construction of small-scale alternative energy projects with interest rates between 5 and 8 percent.
- SB 31: Creation of a renewable energy production tax credit program that expires in 2025.
- SB 150: Establishment of an Emerging Energy Technology Fund to support energy research and development.
- SB 186: Requires projects funded by the Renewable Energy Fund include a "verifiable" financial benefit that exceeds their grant amounts.
- SB 71: Requires the state to consider the administration to consider alternative energy systems in all new public works projects.

Through Feb. 3 the Senate Resources Committee had held two hearings on SB 220 with a third set for Feb. 11. The House Energy Committee had one hearing on HB 305 on Jan. 26 and scheduled a second, also on Feb. 11.

NEWS IN BRIEF

School construction bill moves forward

The Alaska Senate Education Committee recently approved extending the current school construction debt reimbursement program for another three years from Nov. 30, 2010 to Nov. 30, 2013.

The school construction debt reimburse program has been in existence for more than 30 years with the objective to help provide high quality educational facilities for Alaska's students.

Co-chair Kevin Meyer, R-Anchorage, who is one of the sponsors of SB 237, announced "this program allows projects on the Department of Education and Early Development's approved list to be reimbursed for up to 70 percent of their costs by the state. This way, local governments share in the cost of school construction they might not otherwise be able to afford without assistance."

Additionally, the announcement outlined in a letter from the Senate Education Committee stated that "by extending the program for three years, the bill will allow future reauthorizations to occur within the opening days of a new Legislature rather than during the waning days of a Legislature's second session."

PUBLIC SCOPING MEETINGS
Effects of Oil and Gas Activities in the Arctic Ocean
Environmental Impact Statement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites the public to open house and scoping meetings. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations in the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas. Scoping comments must be received by April 9, 2010.

The public scoping meetings provide an opportunity to express your views and identify issues to address in the EIS process. The meetings will include background information on the proposed project as well as the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments. There will be additional scoping meetings in Anchorage, Barrow, Kaktovik, Nuiqsut, and Wainwright in March.

Please contact Michael Payne, NMFS Office of Protected Resources, (301) 713-2289 ext. 110 or visit the project website for more information: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Requests for sign language interpretation or auxiliary aids should be made at least 7 days before the scheduled meeting to Sheyna Wisdom at (907) 261-6705 or Sheyna_Wisdom@urscorp.com.

KOTZEBUE
Thursday, February 18, 2010
Northwest Arctic Borough Assembly Chambers
6:00-8:00pm

POINT HOPE
Friday, February 19, 2010
Community Center
5:00-7:00pm

POINT LAY
Monday, February 22, 2010
Community Center
7:00-9:00pm

The Nome Nugget
Nugget Publishing,Inc.
P.O. Box 610
Nome, Alaska 99762-0610

RECEIVED
FEB 25 2010

Invoice

DATE	INVOICE #
02/17/10	27073

BILL TO:
URS Corp 911 W 8th Ave. Suite 300 Anchorage, AK 99501

RECEIVED
FEB 23 2010
BY

P.O. NUMBER	TERMS	PROJECT

QUANTITY	DESCRIPTION	RATE	AMOUNT
36	Display advertising 3 col x6" x2 wk Scoping Meetings	18.00	648.00
		TOTAL	$648.00

vendor # 1638777
joy_wakefield-gonzalez
@ urscorp.com
26220558.05000

Notice this document is the best available for scanning. The original (copy) is not readable. Please contact either the source or provider of the document for assistance.

PUBLIC SCOPING MEETINGS

Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites the public to open house and scoping meetings. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas. **Scoping comments must be received by April 9, 2010.**

The public scoping meetings provide an opportunity to express your views and identify issues to address in the EIS process. The meetings will include background information on the proposed project as well as the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments. There will be additional scoping meetings in Anchorage, Barrow, Kaktovik, Nuiqsut, and Wainwright in March.

Please contact Michael Payne, NMFS Office of Protected Resources, ***(301) 713-2289 ext. 110*** or visit the project website for more information: ***http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.***
Requests for sign language interpretation or auxiliary aids should be made at least 7 days before the scheduled meeting to Sheyna Wisdom at ***(907) 261-6705*** or ***Sheyna_Wisdom@urscorp.com***

KOTZEBUE
Northwest Arctic Borough Assembly Chambers
Thursday, February 18
6 p.m. - 8 p.m.

POINT HOPE
Community Center
Friday, February 19
5 p.m. - 7 p.m.

POINT LAY
Community Center
Monday, February 19
7 p.m. - 9 p.m.

2/11-18

Publisher's Affidavit

UNITED STATES OF AMERICA,

State Of Alaska } SS:

Second Division

Mary Strauch, being first duly sworn on oath deposes and says:

That I am and was at all times herein this affidavit mentioned, Alaska Assel of THE NOME NUGGET, a newspaper of general circulation and published weekly at Nome, Second Division, State of Alaska, that the Scoping meetings

a printed copy of which is hereto annexed, was published in said paper once and every week for two successive and consecutive weeks in the issues of the following dates:

Feb 11 & 18, 2010

Mary Strauch

SUBSCRIBED and SWORN to before me this 18th day of Feb, 20 10

NOTARY PUBLIC in and for the State of Alaska.

My commission expires 02/07/12

Mary L Wolcure

ALASKA NEWSPAPERS, INC.
301 CALISTA COURT, SUITE B
ANCHORAGE, ALASKA 99518-3028
☎(907) 272-9830 * 🖷(907) 272-9512

URS Corporation
Attn: Michelle Harper
P.O. Box 203970
Austin, TX 78720

Date: May 5, 2010
CASE/PO/AIO:
INVOICE(S): 021000380087
PAPER: ARCTIC SOUNDER

AFFIDAVIT OF PUBLICATION

UNITED STATES OF AMERICA, STATE OF ALASKA, THIRD DIVISION

BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC THIS DAY PERSONALLY APPEARED **STACY N. DEACON** WHO, BEING FIRST DULY SWORN, ACCORDING TO LAW, SAYS THAT SHE IS THE ADMINISTRATIVE ASSISTANT OF **ALASKA NEWSPAPERS, INC. DBA THE ARCTIC SOUNDER** PUBLISHED AT ANCHORAGE IN SAID DIVISION THREE AND STATE OF ALASKA AND THAT THE ADVERTISEMENT, OF WHICH THE ANNEXED IS A TRUE COPY, WAS PUBLISHED IN SAID PUBLICATION ON **2/18/2010** AND THEREAFTER FOR A TOTAL OF **1** CONSECUTIVE ISSUE(S), THE LAST PUBLICATION APPEARING ON **2/18/2010**, AND THAT THE RATE CHARGED THEREON IS NOT IN EXCESS OF THE RATE CHARGED TO PRIVATE INDIVIDUALS.

STACY N. DEACON
ADMINISTRATIVE ASSISTANT, AK NEWSPAPERS INC.

STAMP

CHRISTINA RITTER
My Commission Expires
NOTARY PUBLIC
April 1, 2013
STATE OF ALASKA

SUBSCRIBED AND SWORN BEFORE ME ON
May 5, 2010

CHRISTINA RITTER
NOTARY PUBLIC FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES ON APRIL 1, 2013

INVOICE

Alaska Newspapers, Inc.

301 Calista Ct,
Suite B
Anchorage,
Alaska 99518-3028
Phone: (907) 272-9830
Fax: (907) 272-9512

Bill To

URS CORPORATION
Attn : ACCOUNTS PAYABLE
P.O. Box 203970
Austin TX 78720

Invoice #	021000380087
Invoice Date	2/18/2010
Order #	Kimberly Wetzel
Terms	Net 30 Days
Old ID	2777
Sales Rep.	BAN

Insertion Details:

Insertion Id	80220		
Advertiser Name	URS CORPORATION		
Publication	The Arctic Sounder		
Description	B&W , 2x6.5 , Display Ad.		
Headline	Public Scoping AD		
Column Inches	13.00	$ per Column Inch	$26.00

PO Number	Kimberly Wetze
Issue Date	2/18/2010
Page Num	
Tears	2
Affidavits	0

Ad Cost for this Insertion :	$338.00

Ad Cost for this Insertion :	$338.00
Total Surcharges for this Insertion :	$0.00
Total Discounts for this Insertion :	$0.00
Bill Cost for this Insertion :	$338.00
Amount Prepaid for this Insertion :	$0.00
Amount to pay for this Insertion :	$338.00

SPELLERS OF DISTINCTION

Left: Northwest Arctic School District spelling bee champion Jenny Westlake of Kiana is all smiles after her championship. Westlake will represent the district at the state spelling Bee on Feb. 26 in Anchorage.

Far left: Northwest Arctic School District spelling bee contestants (front row) Autumn Barr (Deering), Ember Eck (Kotzebue Middle School), Emily Hoke (June Nelson Elementary), Marlene Gray (Ambler), Billy Zibell (Noorvik) and (back row) Brock McDonald (Noatak), Jenny Westlake (Kiana). Not pictured but participating via audio conference: Sarah Washington (Buckland), Cheyenne Davis (Selawik).

JAKE STOOPS/COURTESY PHOTOS

HIGH SCHOOL BASKETBALL

Barrow boys win Valdez Elks Tournament

Whalers beat Nome 80-61 in Saturday's championship

VAN WILLIAMS
vwilliams@alasknewspapers.com

Eager to avenge a loss to arch rival Nome from seven days earlier, the Barrow boys basketball team didn't disappoint in the rematch.

This time around the Whalers controlled the action from the very beginning en route to a 70-61 victory in the championship game of last week's Valdez Elks Tournament.

Tournament MVP Tyler Adams pumped in 23 points, Albert Gerke added 18 points and Victor Unuina delivered a double-double with 14 points and 10 rebounds. The win improved Barrow's record to 16-2 on the year.

More importantly, though, it was the second victory over reigning state runner-up Nome in three games this season, a vast improvement from last season when the Whalers dropped three of four to the Nanooks.

"Confidence wise, it's good," Barrow coach Jeremy Arnhart said.

The Whalers beat Cordova, 4A Houston and Nome on their way to winning the Valdez Elks Tournament for the second straight year. Last year's championship propelled Barrow to the Class 3A state tournament, so maybe this year's title will do the same.

"We went down there expecting to win," Arnhart said. "To get the finals we had to defeat some good teams. It was like a state tournament atmosphere as afar as the caliber of teams there."

In the title tilt, Barrow extended its lead to 22-15 after Adams drilled a half-court shot at the first-quarter buzzer. The advantage was 36-26 at halftime, although the score was even in the second half.

Nome's player-of-the-year candidate Jeremy Head netted a game-high 35 points.

Still, though, Arnhart was happy with how his team limited what his teammates could do.

"The thing I think that helped us win is we defended well," the coach said. "If we want to be good and we can beat anybody, we have to defend well and we did that pretty much the whole tournament.

"We're not leveling off. We're getting better and better."

Arnhart was especially pleased with the aggressive mind-set Adams brought to the court, something he's been trying to get the 6-foot-1 junior guard to do more often.

"He was wanting the ball and taking the ball to the rim, not just becoming a 3-point shooter," the coach said. "He actually played a complete basketball game, especially against Cordova and Nome."

Against Cordova, Adams poured in a season-high 30 points, many of the late, to help Barrow rally from a double-digit deficit to win 63-55.

"He pretty much kept us in the game," Arnhart said.

In the semifinals, Barrow beat Houston 60-49 behind double-figure scorers Daniel Thomas (19) and Gerke (14).

Adams was quiet that game but he made lots of noise in the championship game against Nome, using his dribble penetration and cause breakdowns in the defense.

"If he's handling the ball a lot, that allows us to get Albert down low where he can rebound and where he is more effective," Arnhart said. "When he penetrates, his vision is very good and he creates opportunities for a lot of players, and I think we got away from that earlier.

"For us to be good, that's the kind of style we need to play in the half-court set."

Barrow girls finish 2-1

The Lady Whalers weren't going to let a disappointment of losing the first game in overtime of the Valdez Elks Tournament.

So they took out their frustrations on Nome and Hutchison.

The Barrow girls bounced back after a tough OT loss to eventual champion North Pole to win two straight games and place third in the eight-team event.

Kivvaq Nungasak and Jaleen Simmonds were both named to the all-tournament team. Nungasak also was the 3-point winner after making the most 3-pointers in three games.

The Lady Whalers walked away with the Sportsmanship Award as well.

In the opener, North Pole beat Barrow 45-43 despite 17 points from Simmonds.

Barrow beat up Nome 67-34 to secure the No. 1 seed at the upcoming Western Conference regional tournament. The Lady Whalers put the game away with a 24-1 advantage in the second quarter.

Nungasak sank seven 3-pointers en route to scoring a season-high 27 points.

In the third-place game, Barrow beat Hutchison 52-40.

"We had a couple girls getting sick and played pretty poorly, but we found ways to score when it mattered," Barrow coach Ryan Meyers said.

Van Williams can be reached at 907-348-2452 or 800-770-9830, ext. 452.

PUBLIC SCOPING MEETINGS
Effects of Oil and Gas Activities in the Arctic Ocean
Environmental Impact Statement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites the public to open house and scoping meetings. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas. Scoping comments must be received by April 9, 2010.

The public scoping meetings provide an opportunity to express your views and identify issues to address in the EIS process. The meetings will include background information on the proposed project as well as the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments. There will be additional scoping meetings in Anchorage, Barrow, Kaktovik, Nuiqsut, and Wainwright in March.

Please contact Michael Payne, NMFS Office of Protected Resources, (301) 713-2289 ext. 110 or visit the project website for more information: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Requests for sign language interpretation or auxiliary aids should be made at least 7 days before the scheduled meeting to Sheyna Wisdom at (907) 261-6705 or Sheyna_Wisdom@urscorp.com.

KOTZEBUE
Thursday, February 18, 2010
Northwest Arctic Borough Assembly Chambers
6:00-8:00pm

POINT HOPE
Friday, February 19, 2010
Community Center
5:00-7:00pm

POINT LAY
Monday, February 22, 2010
Community Center
7:00-9:00pm

Join your local volunteer fire department today!

Contact the Office of Rural Fire Protection for more information **1-877-355-5472**

Scheduled Project Code Red Training

- Recurrent Training in Nulato March 29-31, 2010
- Tooksook Bay - April 1-3, 2010
- St. Paul Island - April 5-7, 2010
- King Cove - April 19-21, 2010
- Shungnak - May 3-5, 2010
- Scammon Bay - June 8-10, 2010

This message brought to you by your Alaska Office of Rural Fire Protection and your local Fire Department.

www.burny.alaska.gov

The Nome Nugget
Nugget Publishing,Inc.
P.O. Box 610
Nome, Alaska 99762-0610

Invoice

AAC - MAILROOM
MAR 10 2010

DATE	INVOICE #
03/03/10	27168

BILL TO:
URS Corp P.O. Box 203970 Austin, TX 78720

P.O. NUMBER	TERMS	PROJECT

QUANTITY	DESCRIPTION	RATE	AMOUNT
	Display advertising 3 col xz6" x 1 wk 3.4 NOAA Scoping 1638777	18.00	18.00
		TOTAL	$18.00

Copy

PUBLIC SCOPING MEETINGS

Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites the public to open house and scoping meetings. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas. **Scoping comments must be received by April 9, 2010.**

The public scoping meetings provide an opportunity to express your views and identify issues to address in the EIS process. The meetings will include background information on the proposed project as well as the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments.

Please contact Michael Payne, NMFS Office of Protected Resources, ***(301) 713-2289 ext. 110*** or visit the project website for more information: ***http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.***

Requests for sign language interpretation or auxiliary aids should be made at least 7 days before the scheduled meeting to Sheyna Wisdom at ***(907) 261-6705*** or ***Sheyna_Wisdom@urscorp.com.***

WAINWRIGHT
Tue., March 9, 2010
Community Center
7 p.m. - 9 p.m.

BARROW
Wed., March 10, 2010
Inupiat Heritage Center
7:30 p.m. - 9:30 p.m.

NUIQSUT
Thur., March 11, 2010
Community Center
7 p.m. 9 p.m.

KAKTOVIK
Fri., March 12, 2010
Community Center
6:30 p.m. - 8:30 p.m.

3/4

Publisher's Affidavit

UNITED STATES OF AMERICA,

State Of Alaska } SS:

Second Division

Mary Straub, being first duly sworn on oath deposes and says:

That I am and was at all times herein this affidavit mentioned, admin assist of THE NOME NUGGET, a newspaper of general circulation and published weekly at Nome, Second Division, State of Alaska, that the Public Scoping Meetings Wainwright, Barrow, Nuiqsut, Kaktovik a printed copy of which is hereto annexed, was published in said paper once and every week for one successive and consecutive weeks in the issues of the following dates:

March 4, 2010

Mary Straub

SUBSCRIBED and SWORN to before me this 4th day of March, 2010

NOTARY PUBLIC in and for the State of Alaska.

My commission expires 02/07/12

Nancy L Wolcome

ALASKA NEWSPAPERS, INC.
301 CALISTA COURT, SUITE B
ANCHORAGE, ALASKA 99518-3028
☎(907) 272-9830 * 🖷(907) 272-9512

URS Corporation
Attn: Michelle Harper
P.O. Box 203970
Austin, TX 78720

Date: May 5, 2010
CASE/PO/AIO:
INVOICE(S): 031000381601
PAPER: ARCTIC SOUNDER

AFFIDAVIT OF PUBLICATION

UNITED STATES OF AMERICA, STATE OF ALASKA, THIRD DIVISION

BEFORE ME, THE UNDERSIGNED, A NOTARY PUBLIC THIS DAY PERSONALLY APPEARED **STACY N. DEACON** WHO, BEING FIRST DULY SWORN, ACCORDING TO LAW, SAYS THAT SHE IS THE ADMINISTRATIVE ASSISTANT OF **ALASKA NEWSPAPERS, INC. DBA THE ARCTIC SOUNDER** PUBLISHED AT ANCHORAGE IN SAID DIVISION THREE AND STATE OF ALASKA AND THAT THE ADVERTISEMENT, OF WHICH THE ANNEXED IS A TRUE COPY, WAS PUBLISHED IN SAID PUBLICATION ON **3/4/2010** AND THEREAFTER FOR A TOTAL OF **1** CONSECUTIVE ISSUE(S), THE LAST PUBLICATION APPEARING ON **3/4/2010**, AND THAT THE RATE CHARGED THEREON IS NOT IN EXCESS OF THE RATE CHARGED TO PRIVATE INDIVIDUALS.

STAMP

CHRISTINA RITTER
My Commission Expires
NOTARY PUBLIC
April 1, 2013
STATE OF ALASKA

STACY N. DEACON
ADMINISTRATIVE ASSISTANT, AK NEWSPAPERS INC.

SUBSCRIBED AND SWORN BEFORE ME ON
May 5, 2010

Christina Ritter
CHRISTINA RITTER
NOTARY PUBLIC FOR THE STATE OF ALASKA
MY COMMISSION EXPIRES ON APRIL 1, 2013

INVOICE

Alaska Newspapers, Inc.

301 Calista Ct,
Suite B
Anchorage,
Alaska 99518-3028
Phone: (907) 272-9830
Fax: (907) 272-9512

Bill To

URS CORPORATION
Attn : ACCOUNTS PAYABLE
P.O. Box 203970
Austin TX 78720

Invoice #	031000381601
Invoice Date	3/4/2010
Order #	Kimberly Wetzel
Terms	Net 30 Days
Old ID	2777
Sales Rep.	BAN

Insertion Details:

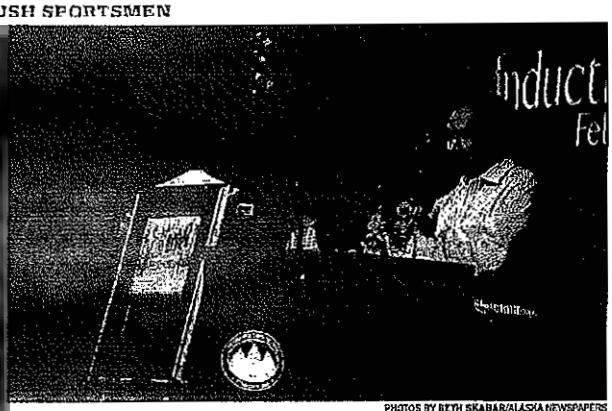
Insertion Id	81734			PO Number	Kimberly Wetze
Advertiser Name	URS CORPORATION				
Publication	The Arctic Sounder			Issue Date	3/4/2010
Description	B&W , 2x6.5 , Display Ad.			Page Num	
Headline	Public Scoping 4-9-10			Tears	2
Column Inches	13.00	$ per Column Inch	$26.00	Affidavits	0

Ad Cost for this Insertion :	$338.00

Ad Cost for this Insertion :	$338.00
Total Surcharges for this Insertion :	$0.00
Total Discounts for this Insertion :	$0.00
Bill Cost for this Insertion :	$338.00
Amount Prepaid for this Insertion :	$0.00
Amount to pay for this Insertion :	$338.00

CELEBRATING BUSH SPORTSMEN

Reggie Joule gives a speech during his induction to the Alaska Sports Hall of Fame during ceremonies in Anchorage on Feb. 25. Joule's athletic feats in Native olympic games led to his nomination for this year's class.



PHOTOS BY BETH SKABAR/ALASKA NEWSPAPERS

Elliott Sampson's family accepted the award for him for the moment of his victory at the 1981 state high school cross country championship. Sampson died in 2005.

Lawmakers reduce goals for polar bear conference

Cost of species listing, PR assessment on agenda

ASSOCIATED PRESS

The federal listing of polar bears as a threatened species so outraged Alaska lawmakers, they considered spending more than a million dollars for a public relations effort to reverse the decision.

A request for proposals from public relations firms now has more modest goals: a conference assessing what the Endangered Species Act will cost Alaska, and whether a public relations campaign would be useful.

A legislative request for proposals from public relations firms was modified three times since mid-December. Proposals have been in hand since Jan. 20.

For a fee of up to $1.5 million, lawmakers are looking for someone who can put on a conference in Anchorage, gather panelists to speak on the effects of the ESA and recommend whether Alaska should embrace a public relations effort to counter its negative economic effects.

"We're not going to reverse the listing," said John Bitney, an aide to Rep. John Harris, chairman of the Legislative Council, which will make a decision on proposals. "I don't think we expected that."

With recent success by environmental groups petitioning for Alaska species to be listed, and seeking to block offshore petroleum exploration with lawsuits demanding that federal agencies do proper environmental reviews, Alaska lawmakers worry that the state's primary source of revenue is threatened.

As much as 90 percent of Alaska's general fund revenue is generated by the petroleum industry. Lawmakers fear restrictions to protect polar bears, Cook Inlet beluga whales or other listed species could diminish prospects for oil that could be shipped south through the 800-mile trans-Alaska pipeline or for natural gas that could fill a proposed multibillion dollar pipeline.

Majority opinion

Majority lawmakers in the Alaska Legislature have been frank about their skepticism that polar bears are in danger from global warming, which they have characterized as a blip in the Earth's weather history. Both the House and Senate in 2007 passed resolutions urging the Bush administration to reject listing polar bears.

"The application for this listing is based on the unfounded, unproven scientific hypothesis that climate change is caused by human activity, in the form of increased release of carbon dioxide into the atmosphere," said Harris, who was House speaker at the time.

Lawmakers later appropriated money to back a lawsuit filed by former Gov. Sarah Palin to reverse the listing.

Harris, who recently pulled out of the race for the GOP gubernatorial nomination, declined to be interviewed about the public relations contract. Bitney said Harris is reticent to speak about proposals under review.

A conference to review the polar bear listing process and the science behind it has been criticized as a sham with preordained conclusions.

The state's largest newspaper, the Anchorage Daily News, called it a public relations campaign likely to have credibility problems from the start. Kassie Siegel, the Center for Biological Diversity attorney who drafted the petition to list polar bears, said lawmakers likely would tap into professional climate skeptics.

"It's been really well demonstrated that there's an orchestrated disinformation campaign to confuse people about climate change. There has been for years," she said.

The Legislature's first request called for a conference that would have drummed up ammo to be used by state attorneys in the polar bear lawsuit. Respondents were to outline how they would support the state's position, enlist the assistance of other states' wildlife agencies and help prepare testimony before Congress.

That may have strayed into the governor's jurisdiction, Bitney said, and the proposal request was modified.

The final version asks companies to evaluate whether a public relations campaign based on the conclusions reached by the conference panel could diminish negative economic effects of the Endangered Species Act.

The conference would still review how the federal government concluded polar bears are endangered. The state claims polar bears should not be listed because their numbers have not crashed.

Palin's view rejected

Palin raised the same issue. George W.

See Page 16, BEARS

PUBLIC SCOPING MEETINGS

Effects of Oil and Gas Activities in the Arctic Ocean

Environmental Impact Statement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites the public to open house and scoping meetings. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas. **Scoping comments must be received by April 9, 2010.**

The public scoping meetings provide an opportunity to express your views and identify issues to address in the EIS process. The meetings will include background information on the proposed project as well as the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments.

Please contact Michael Payne, NMFS Office of Protected Resources, (301) 713-2289 ext. 110 or visit the project website for more information: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Requests for sign language interpretation or auxiliary aids should be made at least 7 days before the scheduled meeting to Sheyna Wisdom at (907) 261-6705 or Sheyna_Wisdom@urscorp.com.

WAINWRIGHT
Tuesday, March 9, 2010
Community Center
7:00-9:00pm

NUIQSUT
Thursday, March 11, 2010
Community Center
7:00-9:00pm

BARROW
Wednesday, March 10, 2010
Inupiat Heritage Center
7:30-9:30pm

KAKTOVIK
Friday, March 12, 2010
Community Center
6:30-8:30pm

BIRTH

Jaiden Ruth Panik-Bordeaux

Sharinda Teryn Bordeaux and Sammy Panik, of Wainwright, announce the birth of their daughter, Jaiden Ruth Panik-Bordeaux, at 10:10 a.m. Feb. 12, 2010, at the Samuel Simmonds Memorial Hospital in Barrow. She weighed 8 pounds, 10.7 ounces and measured 21-1/2 inches. Her maternal great-grandmother is Elizabeth Hollingsworth, paternal great-grandparents are Sharron and Joe Kippi, maternal grandparents are Mary Ann Strickland and Arthur Bordeaux, and paternal grandparents are Ida and Jack Panik.

Anchorage Daily News
Affidavit of Publication

1001 Northway Drive, Anchorage, AK 99508

AD #	DATE	PO	ACCOUNT	PRICE PER DAY	OTHER CHARGES	OTHER CHARGES #2	OTHER CHARGES #3	GRAND TOTAL
745029	03/07/2010	26220558.	URSC0705	$149.40				
	03/21/2010	26220558.	URSC0705	$149.40				
				$298.80	$0.00	$0.00	$0.00	$298.80

STATE OF ALASKA
THIRD JUDICIAL DISTRICT

Shane Drew, being first duly sworn on oath deposes and says that he is an advertising representative of the Anchorage Daily News, a daily newspaper.

That said newspaper has been approved by the Third Judicial Court, Anchorage, Alaska, and it now and has been published in the English language continually as a daily newspaper in Anchorage, Alaska, and it is now and during all said time was printed in an office maintained at the aforesaid place of publication of said newspaper. That the annexed is a copy of an advertisement as it was published in regular issues (and not in supplemental form) of said newspaper on the above dates and that such newspaper was regularly distributed to its subscribers during all of said period. That the full amount of the fee charged for the foregoing publication is not in excess of the rate charged private individuals.

Signed Shane Drew

Subscribed and sworn to me before this date:

3/30/10

Notary Public in and for the State of Alaska.
Third Division. Anchorage, Alaska

MY COMMISSION EXPIRES: 12/17/13

Cynthia A Gro

CYNTHIA A. GROVE
NOTARY
PUBLIC
STATE OF ALASKA

PUBLIC SCOPING MEETING
Effects of Oil and Gas Activities in the Arctic Ocean
Environmental Impact Statement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites the public to an open house and scoping meeting to be held in Anchorage on Tuesday, March 23, 2010 at the Egan Center, 555 W. 5th Ave. from 7:00 to 9:00pm.

NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal incidental Take Authorizations to the oil and gas industry during offshore exploration activities (e.g., seismic surveys and exploratory drilling) in Federal and state waters of the U.S. Chukchi and Beaufort Seas. Scoping comments must be received by April 9, 2010.

The public scoping meeting provides an opportunity to express your views and identify issues to address in the EIS process. The meeting will include background information on the proposed project as well as the EIS process. There will be an informational open house, followed by a presentation, and an opportunity to offer comments. Please contact Michael Payne, NMFS Office of Protected Resources, (301) 713-2289 ext. 110 or visit the project website for more information: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Requests for sign language interpretation or auxiliary aids should be made at least 7 days before the scheduled meeting to Sheyna Wisdom at (907) 261-6705 or Sheyna.Wisdom@urscorp.com.

Published: March 7 & 21, 2010

Press Release

News Release – Arctic Sounder and Nome Nugget

Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement – Public Scoping Meetings

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is hosting several public scoping meetings focusing on a plan to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act (MMPA). These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Beaufort and Chukchi Seas. The first three scoping meetings will be held in Kotzebue on Thursday, February 18th, Point Hope on Friday, February 19th, and Point Lay on Monday, February 22nd. Additional scoping meetings in Wainwright, Barrow, Nuiqsut, Kaktovik and Anchorage will be held in March.

NMFS is serving as the lead agency for this Environmental Impact Statement (EIS). The U.S. Minerals Management Service (MMS) joins the effort as a cooperating agency. The EIS will analyze the environmental impacts to the physical, biological, and social resources from seismic activities and exploratory drilling. Methods to mitigate impacts will also be considered. In addition, the EIS will contain an analysis of secondary and cumulative effects of the alternatives.

NMFS issues ITAs to the oil and gas industry during offshore exploration activities (primarily seismic surveys and exploratory drilling). The term "take" under the MMPA means "to harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." In order to issue authorizations, NMFS must determine that the taking: 1) will have no more than a negligible impact on the species or stock(s), 2) will not have an adverse impact that cannot be mitigated regarding the availability of the species or stock(s) for subsistence uses (where relevant), and 3) the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are identified.

In 2007, MMS began a Draft Programmatic EIS to address the potential effects of concurrent offshore exploration activities and the potential for an increase in such activities. This EIS was alted because new information became available, such as scientific study results and changes in projections of levels of offshore activity. This led to the need for a new analysis, and the start of the Effects of Oil and Gas Activities in the Arctic Ocean EIS.

The scoping meetings provide an opportunity for the public to learn about the proposed action, express their views and concerns, and identify issues to be addressed in the EIS process.

KOTZEBUE	**POINT HOPE**	**POINT LAY**
February 18, 2010 Arctic Borough Assembly Chambers 6:00-8:00pm	February 19, 2010 Point Hope Community Center 5:00-7:00pm	February 22, 2010 Point Lay Community Center 7:00-9:00pm

Each meeting will have an informational open house, followed by a presentation, and an opportunity for the public to ask questions and offer comments.

News Release – Arctic Sounder and Nome Nugget

Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement – Public Scoping Meetings

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is hosting several public scoping meetings focusing on a plan to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act (MMPA). These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Beaufort and Chukchi Seas. Scoping meetings will be held in Wainwright on Tuesday, March 9th, Barrow on Wednesday, March 10th, Nuiqsut on Thursday, March 11th, and Kaktovik on Friday, March 12th. Three scoping meetings were held in February in Kotzebue, Point Hope, and Point Lay. A scoping meeting will also be held in Anchorage on March 23rd.

NMFS is serving as the lead agency for this Environmental Impact Statement (EIS). The U.S. Minerals Management Service (MMS) joins the effort as a cooperating agency. The EIS will analyze the environmental impacts to the physical, biological, and social resources from seismic activities and exploratory drilling. Methods to mitigate impacts will also be considered. In addition, the EIS will contain an analysis of secondary and cumulative effects of the alternatives.

NMFS issues ITAs to the oil and gas industry during offshore exploration activities (primarily seismic surveys and exploratory drilling). The term "take" under the MMPA means "to harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." In order to issue authorizations, NMFS must determine that the taking: 1) will have no more than a negligible impact on the species or stock(s), 2) will not have an adverse impact that cannot be mitigated regarding the availability of the species or stock(s) for subsistence uses (where relevant), and 3) the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are identified.

In 2007, MMS began a Draft Programmatic EIS to address the potential effects of concurrent offshore exploration activities and the potential for an increase in such activities. This EIS was alted because new information became available, such as scientific study results and changes in projections of levels of offshore activity. This led to the need for a new analysis, and the start of the Effects of Oil and Gas Activities in the Arctic Ocean EIS.

The scoping meetings provide an opportunity for the public to learn about the proposed action, express their views and concerns, and identify issues to be addressed in the EIS process. The Anchorage public scoping meeting will be held Tuesday March 23 2010 at the Egan Center, 555 W. 5TH Ave from 7:00 to 9:00pm.

Each meeting will have an informational open house, followed by a presentation, and an opportunity for the public to ask questions and offer comments.

News Release – Anchorage Daily News

Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement – Public Scoping Meetings

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) is hosting a public scoping meeting focusing on a plan to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act (MMPA). These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Beaufort and Chukchi Seas. **The Anchorage public scoping meeting will be held Tuesday March 23, 2010 at the Egan Center, 555 W. 5TH Ave from 7:00 to 9:00pm.** Three scoping meetings were held in February in Kotzebue, Point Hope, and Point Lay. Four additional scoping meetings were also held between March 9-12, 2010 in Wainwright, Barrow, Nuiqsut, and Kaktovik respectively.

NMFS is serving as the lead agency for this Environmental Impact Statement (EIS). The U.S. Minerals Management Service (MMS) joins the effort as a cooperating agency. The EIS will analyze the environmental impacts to the physical, biological, and social resources from seismic activities and exploratory drilling. Methods to mitigate impacts will also be considered. In addition, the EIS will contain an analysis of secondary and cumulative effects of the alternatives.

NMFS issues ITAs to the oil and gas industry during offshore exploration activities (primarily seismic surveys and exploratory drilling). The term "take" under the MMPA means "to harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect." In order to issue authorizations, NMFS must determine that the taking: 1) will have no more than a negligible impact on the species or stock(s), 2) will not have an adverse impact that cannot be mitigated regarding the availability of the species or stock(s) for subsistence uses (where relevant), and 3) the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are identified.

In 2007, MMS began a Draft Programmatic EIS to address the potential effects of concurrent offshore exploration activities and the potential for an increase in such activities. This EIS was halted because new information became available, such as scientific study results and changes in projections of levels of offshore activity. This led to the need for a new analysis, and the start of the Effects of Oil and Gas Activities in the Arctic Ocean EIS.

The scoping meetings provide an opportunity for the public to learn about the proposed action, express their views and concerns, and identify issues to be addressed in the EIS process. Each meeting has an informational open house, followed by a presentation, and an opportunity for the public to ask questions and offer comments.

Please contact Michael Payne, NMFS Office of Protected Resources, (301) 713-2289 ext. 110 or visit the project website for more information:
http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm .

Online Advertisements

Submit to Peg Tileston pegt@gci.net

February 18
KOTZEBUE - An Open House/Public Scoping Meeting will be held from 6:00 p.m. to 8:00 p.m. at the Northwest Arctic Borough Assembly Chambers. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

February 19
POINT HOPE – An Open House/Public Scoping Meeting will be held from 5:00 p.m. to 7:00 p.m. at the Point Hope Community Center. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

February 22
POINT LAY – An Open House/Public Scoping Meeting will be held from 7:00 p.m. to 9:00 p.m. at the Point Lay Community Center. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Submit to Peg Tileston pegt@gci.net

March 9
WAINWRIGHT - An Open House/Public Scoping Meeting will be held from 7:00 p.m. to 9:00 p.m. at the Wainwright Community Center. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

March 10
BARROW – An Open House/Public Scoping Meeting will be held from 7:30 p.m. to 9:30 p.m. at the Inupiat Heritage Center. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

March 11
NUIQSUT – An Open House/Public Scoping Meeting will be held from 7:00 p.m. to 9:00 p.m. at the Nuiqsut Community Center. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

March 12
KAKTOVIK – An Open House/Public Scoping Meeting will be held from 6:30 p.m. to 8:30 p.m. at the Kaktovik Community Center. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

March 23
ANCHORAGE – An Open House/Public Scoping Meeting will be held from 7:00 p.m. to 9:00 p.m. at the Egan Center. The National Marine Fisheries Service (NMFS) is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations (ITAs) under the Marine Mammal Protection Act. These

authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas. The meeting will present background information on the proposed action to issue ITAs and an overview of the EIS process. For more information, visit: http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm.

Radio Public Service Announcement

FAX TRANSMITTAL

URS

560 E. 34th Ave., Suite 100
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Director of Public Service Announcements	FROM: Amy Lewis
FIRM: KOTZ	DATE: February 10, 2010
FAX NO: (907) 442-2292	PAGE: 1 of 2

SUBJECT: Scoping Meeting Announcement for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

MEMO: **PSA ANNOUNCEMENT**

Hello,

This fax includes an announcement for a scoping meeting to be held for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement in Kotzebue on February 18th from 6:00 p.m. to 8:00 p.m.

If it is possible, please announce the location and time of the meeting on KOTZ, particularly on the day of the meeting. If there are any questions, please call me at 503-948-7223 or Joan Kluwe at 907-374-0303.

Thank you,

Amy Lewis
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

Public Service Announcement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites you to an open house and public scoping meeting. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

A Public scoping meeting will be held in **Kotzebue** on **Thursday, February 18th, 2010**.

The public scoping meetings provide an opportunity to learn about the project, express your views, and identify issues to be addressed in the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments.

- **The meeting in *Kotzebue* on *Thursday, February 18th* will be held at the Northwest Arctic Borough Assembly Chambers from *6:00-8:00pm.***

Please come join us!

FAX TRANSMITTAL

URS

560 E. 34th Ave., Suite 100
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Director of Public Service Announcements

FROM: Amy Lewis

FIRM: KBRW

DATE: February 10, 2010

FAX NO: (907) 852-2274

PAGE: 1 of 2

SUBJECT: Scoping Meeting Announcement for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

MEMO: **PSA ANNOUNCEMENT**

Hello,

This fax includes an announcement for scoping meetings to be held for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement in Point Hope on February 19th, and Point Lay on February 22nd. The meeting time in Point Hope from 5:00 p.m. to 7:00 p.m, and in Point Lay is from 7:00 p.m. to 9:00 p.m.

If it is possible, please announce the locations and times of the meetings on KBRW, K268AA and K201AV, particularly on the days of the meetings. If there are any questions, please call me at 503-948-7223 or Joan Kluwe at 907-374-0303.

Thank you,

Amy Lewis
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

FAX TRANSMITTAL

URS

560 E. 34th Ave., Suite 100
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Candace Weidler	FROM: Amy Lewis
FIRM: KICY 850 AM	DATE: February 10, 2010
FAX NO: (907) 443-2344	PAGE: 1 of 2

SUBJECT: Scoping Meeting Announcement for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

MEMO: **PSA ANNOUNCEMENT**

Hello,

This fax includes an announcement for scoping meetings to be held for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement in Point Hope on February 19th, and Point Lay on February 22nd. The meeting time in Point Hope from 5:00 p.m. to 7:00 p.m, and in Point Lay is from 7:00 p.m. to 9:00 p.m.

If it is possible, please announce the locations and times of the meetings on KICY, particularly on the days of the meetings. If there are any questions, please call me at 503-948-7223 or Joan Kluwe at 907-374-0303.

Thank you,

Amy Lewis
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

FAX TRANSMITTAL

URS

560 E. 34th Ave., Suite 100
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Laurell Kinneen	FROM: Amy Lewis
FIRM: KNOM 780 AM	DATE: February 10, 2010
FAX NO: (907) 443-5757	PAGE: 1 of 2

SUBJECT: Scoping Meeting Announcement for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

MEMO: **PSA ANNOUNCEMENT**

Hello,

This fax includes an announcement for scoping meetings to be held for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement in Point Hope on February 19th, and Point Lay on February 22nd. The meeting time in Point Hope from 5:00 p.m. to 7:00 p.m, and in Point Lay is from 7:00 p.m. to 9:00 p.m.

If it is possible, please announce the locations and times of the meetings on KNOM, particularly on the days of the meetings. If there are any questions, please call me at 503-948-7223 or Joan Kluwe at 907-374-0303.

Thank you,

Amy Lewis
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

Public Service Announcement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites you to open house and public scoping meetings. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

Public scoping meetings will be held in **Point Hope** on **Friday, February 19th,** and **Point Lay** on **Monday, February 22nd**.

The public scoping meetings provide an opportunity to learn about the project, express your views, and identify issues to be addressed in the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments.

- **The meeting in *Point Hope* on *Friday, February 19th* will be held at the Point Hope Community Center from *5:00-7:00pm*.**

- **The meeting in *Point Lay* on *Monday, February 22nd* will be held at the Point Lay Community Center from *7:00-9:00pm*.**

Please come join us!

FAX TRANSMITTAL

URS

560 E. 34th Ave., Suite 100
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Director of Public Service Announcements	FROM: Amy Lewis
FIRM: KBRW	DATE: March 3, 2010
FAX NO: (907) 852-2274	PAGE: 1 of 2

SUBJECT: Scoping Meeting Announcement for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

MEMO: **PSA ANNOUNCEMENT**

Hello,

This fax includes an announcement for scoping meetings to be held for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement. Meetings will be held in Wainwright, Barrow, Nuiqsut, and Kaktovik.

If it is possible, please announce the locations and times of the meetings on KBRW, K201AG and K201AH, particularly on the days of the meetings. If there are any questions, please call me at 503-948-7223 or Joan Kluwe at 907-374-0303.

Thank you,

Amy Lewis
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

Public Service Announcement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites you to open house and public scoping meetings. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

Public scoping meetings will be held in **Wainwright, Barrow, Nuiqsut, and Kaktovik.**

The public scoping meetings provide an opportunity to learn about the project, express your views, and identify issues to be addressed in the EIS process. Each meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments.

- **The meeting in *Wainwright* on *Tuesday, March 9th* will be held at the Wainwright Community Center from *7:00-9:00pm*.**

- **The meeting in *Barrow* on *Wednesday, March 10th* will be held at the Inupiat Heritage Center from *7:30-9:30pm*.**

- **The meeting in *Nuiqsut* on *Thursday, March 11th* will be held at the Nuiqsut Community Center from *7:00-9:00pm*.**

- **The meeting in *Kaktovik* on *Friday, March 12th* will be held at the Kaktovik Community Center from *6:30-8:30pm*.**

Please come join us!

FAX TRANSMITTAL

URS

560 E. 34th Ave., Suite 100
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Director of PSAs	FROM: Amy Lewis (503) 948-7223
FIRM: KBRJ and KMXS – Anchorage Media Group	DATE: March 5, 2010
FAX NO: (907) 275-2292	PAGE: 1 of 2

SUBJECT: Scoping Meeting Announcement for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

MEMO: **PSA ANNOUNCEMENT**

Hello,

This fax includes an announcement for a scoping meeting to be held for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement. The meeting will be held in Anchorage on Tuesday March 23 at the Eagan Center. The meeting time is from 7:00 p.m. to 9:00 p.m.

If it is possible, please announce the location and time of the meeting on KBRJ and KMXS, particularly on the day of the meeting. If there are any questions, please call me at 503-948-7223 or Joan Kluwe at 907-374-0303.

Thank you,

Amy Lewis
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

FAX TRANSMITTAL

URS

560 E. 34th Ave., Suite 100
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Director of PSAs	FROM: Amy Lewis (503) 948-7223
FIRM: KSKA	DATE: March 5, 2010
FAX NO: (907) 550-8403	PAGE: 1 of 2

SUBJECT: Scoping Meeting Announcement for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement

MEMO: **PSA ANNOUNCEMENT**

Hello,

This fax includes an announcement for a scoping meeting to be held for the Effects of Oil and Gas Activities in the Arctic Ocean Environmental Impact Statement. The meeting will be held in Anchorage on Tuesday March 23 at the Eagan Center. The meeting time is from 7:00 p.m. to 9:00 p.m.

If it is possible, please announce the location and time of the meeting on KSKA, particularly on the day of the meeting. If there are any questions, please call me at 503-948-7223 or Joan Kluwe at 907-374-0303.

Thank you,

Amy Lewis
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

Public Service Announcement

The National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) invites you to an open house and public scoping meeting. NMFS is preparing an Environmental Impact Statement (EIS) to analyze the impacts of issuing marine mammal Incidental Take Authorizations under the Marine Mammal Protection Act. These authorizations are issued to the oil and gas industry during offshore exploration activities, such as seismic surveys or exploratory drilling, that take place in Federal and state waters of the U.S. Chukchi and Beaufort Seas.

A public scoping meeting will be held in **Anchorage** on Tuesday, **March 23, 2010** at the Egan Center, 555 W. 5th Ave. from **7:00 to 9:00pm.**

The public scoping meeting provides an opportunity to learn about the project, express your views, and identify issues to be addressed in the EIS process. The meeting will have an informational open house, followed by a presentation, and an opportunity to offer comments.

Please come join us!

APPENDIX B
Public Scoping Meeting Materials

Presentation

Display Boards

Sign In Sheets

Presentation

Environmental Impact Statement on Effects of Oil & Gas Activities (Seismic and Exploratory Drilling) in the Arctic Ocean

Public Scoping Meeting
Anchorage, AK
March 23, 2010

Office of Protected Resources

NOAA Fisheries National Marine Fisheries Service

Welcome and Introductions

National Marine Fisheries Service

Jim Lecky
Michael Payne
Jolie Harrison
Candace Nachman
Shane Guan

Minerals Management Service

John Goll
Jeffery Loman
Kimberly Skrupky

URS

Jon Isaacs
Joan Kluwe
Sheyna Wisdom
Amy Lewis

Scoping Meeting Agenda

- Information on Scoping Process
- Review of Proposed Action
- NEPA Process
- Activities covered by EIS
- Issues and Concerns
- Next Steps
- Public Comment Period

Statement of Intent

- Analyze the environmental impacts of issuing Incidental Take Authorizations (ITAs) pursuant to sections 101(a)(5)(A) and (D) of the Marine Mammal Protection Act (MMPA)
- Issue ITAs to the oil and gas industry for the taking of marine mammals incidental to offshore exploration activities in Federal and state waters of the U.S. Chukchi and Beaufort Seas

MMPA Definitions

- *Take* = to harass, hunt, capture, kill or collect, or attempt to harass, hunt, capture, kill or collect
- *Harassment* = any act of pursuit, torment, or annoyance which:
  - has the potential to injure (Level A)
  - has the potential to disturb by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B)

Purpose of NEPA

The National Environmental Policy Act (NEPA) promotes efforts to:

- Minimize impacts to the environment, including the human environment
- Assess environmental impacts of proposed action and a reasonable range of alternatives
- Solicit public comments on issues and alternatives during scoping process

Proposed Action

- Authorize incidental takes allowing industry “the incidental, but not intentional, taking of small numbers of marine mammals” within the Chukchi and Beaufort Seas
- NMFS and MMS must understand consequences of this action on the environment before issuing authorizations
  - Effects on marine mammal species or stocks
  - Effects on communities and subsistence

Requirements of MMPA

Authorizations shall be granted if:

- taking will have a negligible impact on the species or stock(s)
- taking will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses
- the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth

Previous NEPA Documents

- June 28, 2006 – MMS Programmatic Environmental Assessment (PEA) for 2006 Arctic OCS seismic surveys
  - Analyzed effects of 8 concurrent surveys in Beaufort and Chukchi Seas (4 in each planning area)
  - NMFS indicated increased activity and new available science would warrant an EIS
- April 6, 2007 – NMFS and MMS published Draft Programmatic EIS (DPEIS)

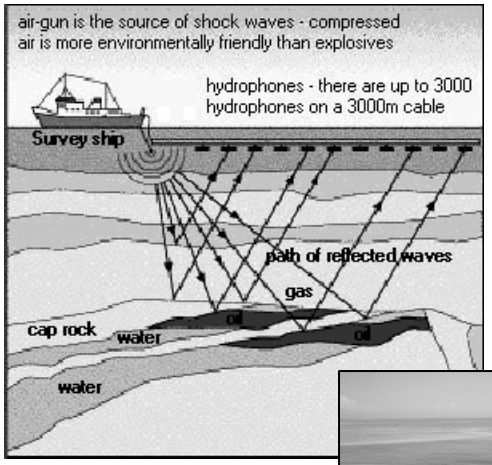
Why is new EIS needed?

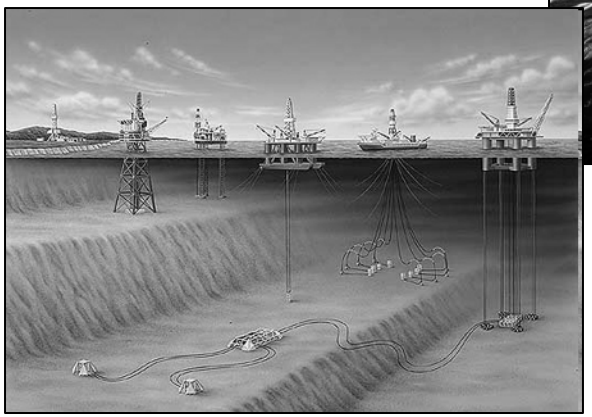
- New information that alters scope, alternatives, and analyses
- Industry suggests increased seismic activity
- Applications have been received for exploratory drilling
- Cumulative impact analysis to address a longer time frame
  - October 2009 – 2007 EIS withdrawn
  - February 2010 – NMFS announces notice of intent to prepare new EIS

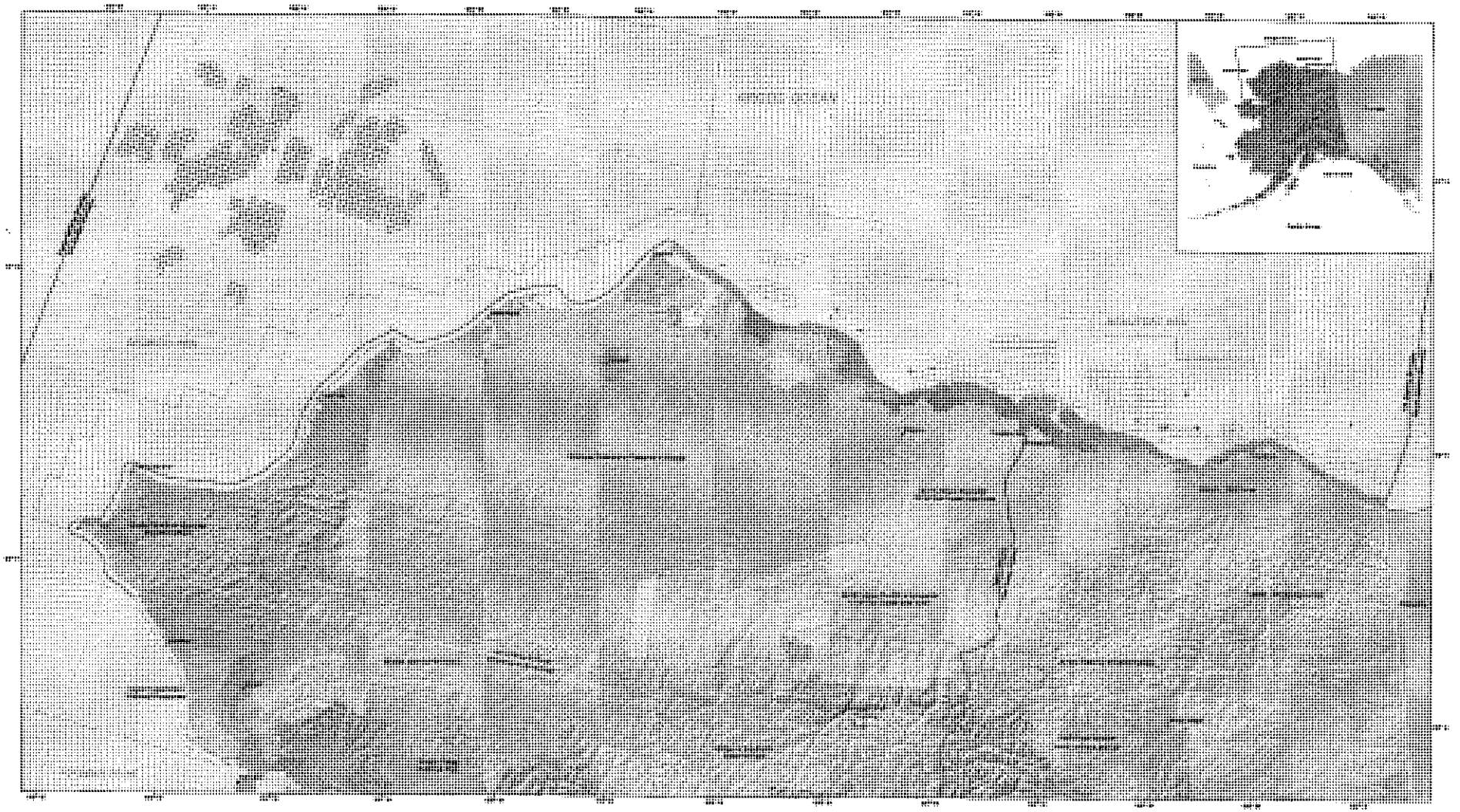
What will EIS include?

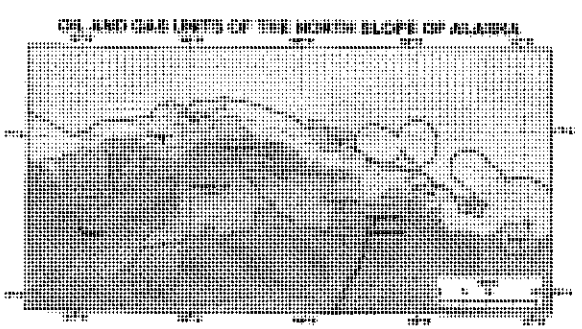
Exploratory activities

- Shallow hazard/site clearance surveys
- 2D/3D seismic surveys
- Exploratory drilling









FEDERAL AND STATE OFFSHORE OIL & GAS LEASES
BEAUFORT & CHUKCHI SEAS

N

Kilometers: 0 25 50 75 100 200

Miles: 0 25 50 75 100 200

Map Symbols

- Offshore Oil & Gas Wells
- Federal/State Maritime Boundary (3-Miles Offshore)
- Active State Leases (As of December 1, 2009)
- Beaufort Sea Available State Leases
- Beaufort Sea Lease Sale Boundary
- Active Federal Leases
- Pending Federal Leases
- Beaufort and Chukchi Federal Lease Sale Boundary
- Onshore Oil & Gas Lease Sale Areas
- Federal Administrative Areas

COORDINATE SYSTEM:
NAD 1983 UTM Zone 6N
Projection: Transverse Mercator
False Easting: 500000.000000
False Northing: 0.000000
Central Meridian: -147.000000
Scale Factor: 0.999600
Latitude of Origin: 0.000000
Linear Unit: Meter

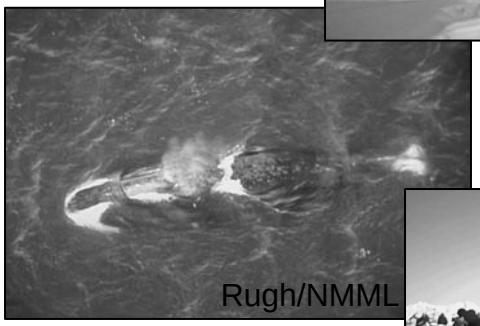
DATA SOURCES:
ADNR-DOG (2009): State Lease Boundaries & Tracts; Oil & Gas Well Locations; State & Federal Lands
MMS (2007): Offshore Lease Boundaries & Tracts; 3-Mile Offshore Boundary; Continental Shelf Boundary

M:\Projects\Federal\26220555 - NMFS TO 10 Arctic Seismic & Drilling Pt Stirling\Offshore O&G Lease Map.mxd

What will EIS include?

- Consider Impacts on Resources
  - Physical
  - Biological
  - Social
- Types of Impacts
  - Direct and Indirect
  - Short and Long-term
  - Cumulative

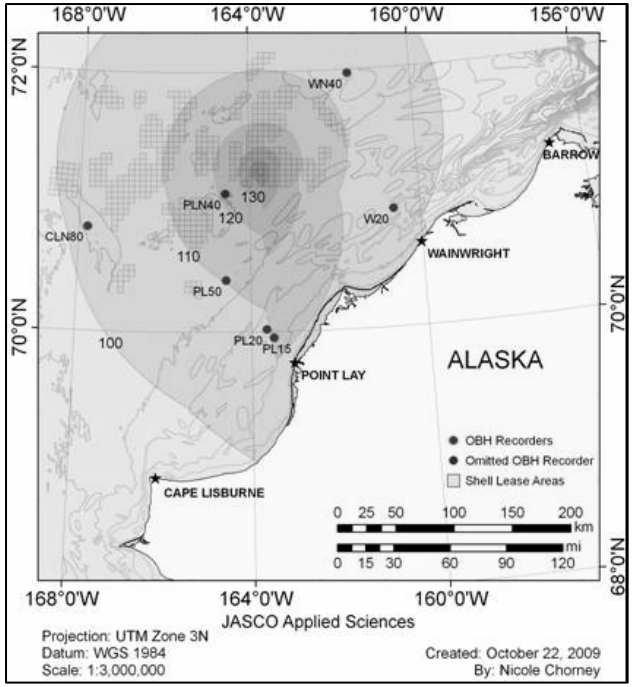
Kluwe/URS


Rugh/NMML

Kluwe/URS

Impacts on Physical

- Physical Oceanography
  - Sea Ice
  - Water Column/Water Quality
  - Sediments
- Climate
- Air Quality
- Acoustics



Impacts on Biological

- Marine mammals
- Seabirds
- Other marine species
  - Marine fish
  - Plankton
  - Benthic
- Threatened and Endangered

NMFS

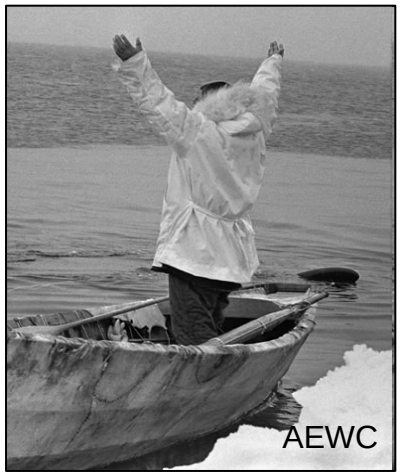
Wisdom/URS

Garlich-Miller/USFWS

Perham/USFWS

Impacts on Sociocultural

- Coastal communities
- Subsistence uses
- Historic and cultural sites
- Inupiat way of life
- Human health
- Land and water use
- Transportation
- Recreation and tourism
- Visual
- Environmental Justice



Development of Alternatives

- Input from scoping process
- Levels of Activity
  (Number, scale/size, location, and duration of):
  - seismic activities
  - exploratory drilling activities
  - shallow hazard/site clearance activities
  - anticipated support activities (vessel, aircraft, shore)

Development of Alternatives

- Mitigation
  - Exclusion zones based on received levels of sound
  - Exclusion zones based on presence of specific biological factors in combination with received levels of sound
  - Exclusion zones based on presence and timing of subsistence activities
  - Time/area closures for biological and subsistence reasons

Issues and Concerns

- Protection of subsistence resources and Inupiat culture and way of life
- Disturbance to marine mammal migration patterns (bowhead, beluga, etc.)
- Impacts on marine fish, reproduction, growth, and development
- Oil and gas activity impacts on marine mammals and seabirds, including noise, movement, operations

Issues and Concerns (cont.)

- Impacts to threatened & endangered species (including polar bear, walrus)
- Incorporation of Traditional Knowledge in the decision-making process
- Effectiveness and feasibility of marine mammal monitoring and other mitigation measures
- Provide adequate lead time for communities to understand activities and respond

Requesting Information

- Effects of oil and gas seismic and exploration on:
  - marine mammal behavior and use of habitat
  - availability of species for subsistence uses and success of subsistence harvesting
- New Arctic ecosystem science
- New technology for monitoring seismic/drilling activity
- Recommendations for monitoring and mitigation

Option for Rulemaking

- NMFS is considering a long-term planning process under MMPA for 5-year regulations
  - Rather than annual Incidental Harassment Authorization (IHA)
  - Industry will submit petition
  - Implementation goal is 2012
  - EIS would provide NEPA compliance with either annual or 5-year ITAs

Next Steps in EIS Process

- Review comments received during meetings and comment period
- Issue scoping report
- Develop alternatives based on comments
- Prepare Draft EIS
  - Describe environment affected by proposed action
  - Evaluate environmental consequences of proposed action
  - Release Draft EIS for public comment (*estimated* December 2010)
  - Public comment period (*estimated* through March 2011)
- Prepare Final EIS (June 2011)

Scoping Meeting Locations

- February 18 – Kotzebue
- February 19 – Point Hope
- February 22 – Point Lay
- March 9 – Wainwright
- March 10 – Barrow
- March 11 – Nuiqsut
- March 12 – Kaktovik
- March 23 – Anchorage

Scoping Meeting Procedures

- Oral Comments
  - Please sign in at the registration table
  - Please be concise
  - Transcripts of today's meeting are being captured by a court reporter

Scoping Meeting Procedures

- Written Comments
  - Comments due no later than April 9, 2010
  - May be turned in today, mailed, e-mailed, or faxed
  - Submit e-mail comments to: *arcticeis.comments@noaa.gov*
  - Submit written comments to:

Michael Payne
NOAA/NMFS
Office of Protected Resources
Permits and Conservation Division
1315 East-West Highway
Silver Spring, MD 20910
Fax: (301) 713-0376

Additional Information

- Available on NMFS web page:

http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm

- To receive a copy of the DEIS, please register and indicate your interest. The DEIS will also be posted on the website for electronic review.

Thank You for Participating

in the
Effects of Oil and Gas Activities
(Seismic Surveys and Exploratory Drilling)
in the Arctic Ocean
Scoping Process

Display Boards

WELCOME!

Environmental Impact Statement
on Effects of Oil & Gas Activities
(Seismic and Exploratory Drilling)
in the Arctic Ocean

Public Scoping Meeting

Office of Protected Resources

NOAA Fisheries

National Marine Fisheries Service

Arctic EIS Objectives

- What is purpose of Arctic EIS?
  - Analyze the environmental impacts of issuing Incidental Take Authorizations (ITAs) pursuant to sections 101(a)(5)(A) and (D) of the Marine Mammal Protection Act (MMPA)
  - Issue ITAs to the oil and gas industry for the taking of marine mammals incidental to offshore exploration activities in Federal and state waters of the U.S. Chukchi and Beaufort Seas

- Authorizations shall be granted if:
  - taking will have a negligible impact on the species or stock(s)
  - taking will not have an unmitigable adverse impact on the availability of the species or stock(s) for subsistence uses
  - the permissible methods of taking and requirements pertaining to the mitigation, monitoring, and reporting of such takings are set forth

Purpose of NEPA

The National Environmental Policy Act (NEPA) promotes efforts to:

- Prevent damage to environment, including the human environment
- Assess environmental impacts of proposed action and a reasonable range of alternatives
- Solicit public comments on issues and alternatives during scoping process

Proposed Action

- Authorize incidental takes allowing industry "the incidental, but not intentional, taking of small numbers of marine mammals" within the U.S. Chukchi and Beaufort Seas
- Understand consequences of this action on the environment before issuing authorizations
  - Effects on marine mammal species or stock(s)
  - Effects on communities and subsistence

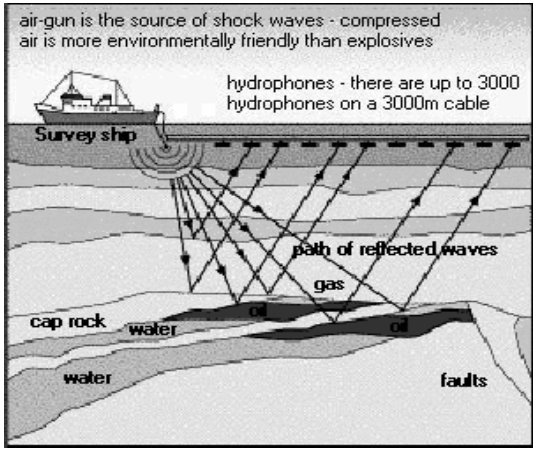
Development of Alternatives

- Levels of Activity
  (Number, scale/size, location, and duration of):
  - seismic activities
  - exploratory drilling activities
  - shallow hazard/site clearance activities
  - anticipated support activities (vessel, aircraft, shore)

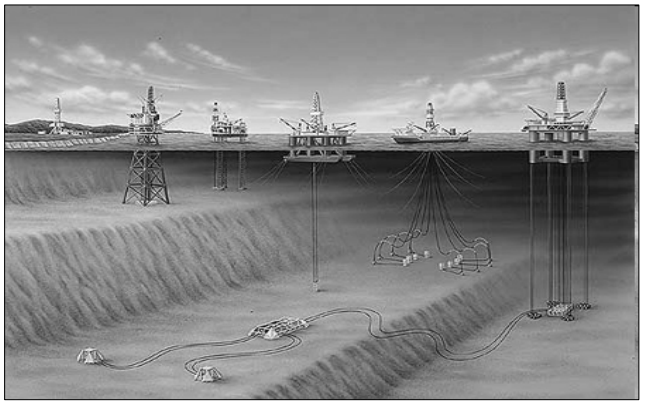
- Mitigation
  - Exclusion zones based on received levels of sound
  - Exclusion zones based on presence of specific biological factors in combination with received levels of sound
  - Exclusion zones based on presence and timing of subsistence activities
  - Time/area closures for biological and subsistence reasons

What will EIS include?

- Activities
  - Shallow hazard/site clearance surveys
  - 2D/3D seismic surveys
  - Exploratory drilling



- Types of Impacts
  - Direct and Indirect
  - Short and Long-term
  - Cumulative (past, present, reasonably foreseeable future)

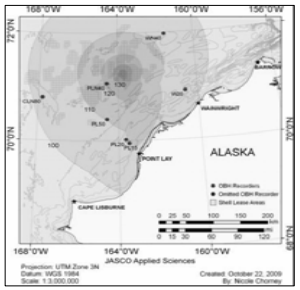


What will EIS include?

Impacts

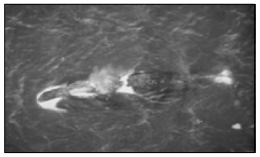
Physical Resources

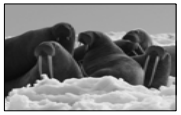
Physical Oceanography
Sea Ice
Water Column/Water Quality
Sediments
Climate
Air Quality
Acoustics



Biological Resources

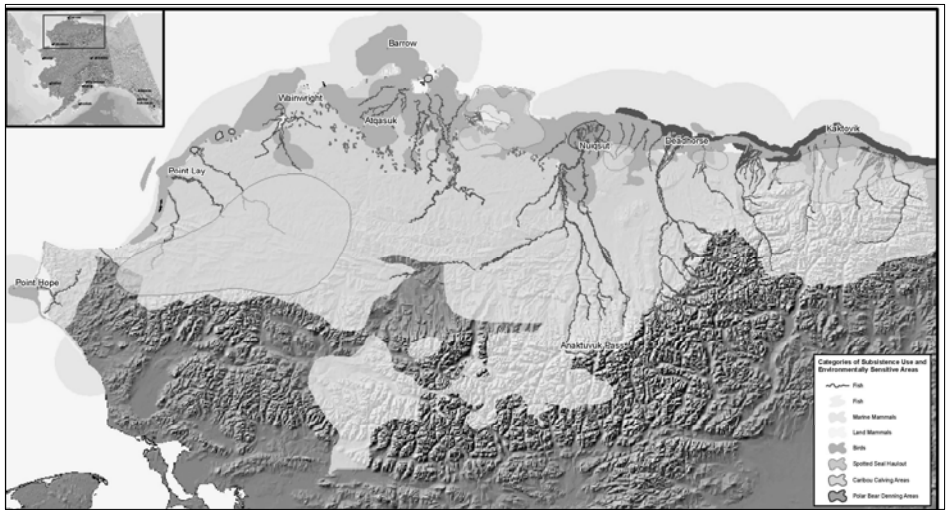
Marine Mammals
Seabirds
Marine Fish
Plankton
Benthic
Terrestrial Wildlife
Threatened & Endangered





Sociocultural Resources

Subsistence Uses
Coastal Communities
Historic Sites
Human Health
Transportation
Land Use
Visual
Recreation & Tourism
Environmental Justice



Steps in the NEPA Process

❶	**Federal Notice of Intent (NOI)** February 8, 2010
❷	**Scoping** Scoping period: February 8 to April 9, 2010 Public Scoping Meetings: February 18 to March 23, 2010 Scoping Report, Estimated: May 2010
❸	**Analysis of Alternatives**
❹	**NMFS Selects Preferred Alternative**
❺	**Issue Draft EIS** Estimated release: mid-December 2010 Available for 45-day public review, through early February 2011
❻	**Public Hearing on Draft EIS** Estimated: January 2011
❼	**Public Comment Review and Synthesis** Comment Analysis Report Available, Estimated: March 2011
❽	**Respond to Comments/Prepare Final EIS** Estimated: June 2011
❾	**Issue Final EIS** Estimated: late June 2011, Minimum 30-day public review
❿	**Record of Decision** Public statements of agency decisions Estimated: July 2011

Scoping Meeting Schedule

- February 18 – Kotzebue
- February 19 – Point Hope
- February 22 – Point Lay
- March 9 – Wainwright
- March 10 – Barrow
- March 11 – Nuiqsut
- March 12 – Kaktovik
- March 23 – Anchorage

How can you participate?

- **Oral Comments**
  - Please sign in at the registration table
  - Please keep comments to 4 minutes
  - Transcripts of today's meeting are being captured by a court reporter

- **Written Comments**
  - Comments due no later than April 9, 2010
  - May be turned in today, mailed, e-mailed, or faxed
  - Submit e-mail comments to: *arcticeis.comments@noaa.gov*
  - Submit written comments to:

Michael Payne
NOAA/NMFS
Office of Protected Resources
Permits, Conservation, and Education Division
1315 East-West Highway
Silver Spring, MD 20910
Fax: (301) 713-0376

Project web page:

http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm

Sign-in Sheets

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

(1)

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Mike LeVine	Oceana	[redacted]	[redacted]	yes
David Dickson	Alaska Wilderness League	[redacted]	[redacted]	YES
Eleanor Huffines	PEW	[redacted]	[redacted]	~~[illegible]~~
Marilyn Heiman	Pew	[redacted]	[redacted]	

(2)

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Chris Krenz	Oceana (Scientist)	[redacted]		yes
William G. Kelly Jr. 1850 Fall Line Dr. Driggs, ID 83422	Center for Regulatory Effectiveness			yes
JEFF CHILDS	—			Yes
Sarah Rider	NAVFAC Atlantic Biologist			no

③

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Jennifer Nist	NOAA GC	[redacted]	[redacted]	
Shane Guan	NMFS	[redacted]	[redacted]	
Stewart Seaberg	ASRC Energy Services	[redacted]	[redacted]	
Nicole Whittington Evans	The Wilderness Society	[redacted]	[redacted]	

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Anchorage
March 23,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Raychelle Daniel	Pew	[redacted]	[redacted]	
Andrew Hartsig	Ocean Conservancy	[redacted]	[redacted]	Yes
Duncan Eley	Pocaews	[redacted]	[redacted]	[illegible]
Michael Galginaitis	Applied Sociocultural Research	[redacted]	[redacted]	No

(5)

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Lucas Frances	Shell	[redacted]	[redacted]	N
Carl Portman	RDC	[redacted]	[redacted]	yes
Marilyn Crockett	AOGA	[redacted]	[redacted]	yes
Robert Snydan	NSB	[redacted]	[redacted]	yes

6

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Anchorage
March 23,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Jeff Johnson 900 E. Benson MAOG 9-2 Anchorage 99508	BP	[redacted]	[redacted]	
Emily Lindow	NOAA	[redacted]	[redacted]	
GAEL KINGIK	NUPITO Point Hope	[redacted]	[redacted]	
SARAH TSOFLIAS	IAGC geologist	[redacted]	[redacted]	

7

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Janet Clarke		[redacted]		
Dave Rugh	NMML, NMFS			
Lisa Baraff	URS			
KEN BOLD	STATE OF AK			NO

8

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Anchorage
March 23,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Jolie Harrison ~~NMFS~~	NMFS	[redacted]	[redacted]	N
Anne Southam	ERM	[redacted]	[redacted]	N
KARIN BERENTSEN	STATOIL	[redacted]	[redacted]	N
Charles Greene Greenridge Sciences 6160-C Wallace Berkeley Rd Santa Barbara CA 93117	Greenridge Sciences	[redacted]	[redacted]	N

(9)

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Brandon Southall 911 Center Street Suite B Santa Cruz CA 95060	SEA, Inc. marine Scientist	[redacted]	[redacted]	yes
MARTIN COHEN 2301B HAZARD STREET, HOUSTON, TX 77019.	STATOIL (EXPLORATION MGR.)	[redacted]	[redacted]	No.
Wayne Wooster 2700 Gambell St, Ste 200 Anchorage, AK 99503	ASRC Energy Services	[redacted]	[redacted]	NO
Gary N Rea 7041 Potter Heights Anchorage, AK 99516	"	[redacted]	[redacted]	N

(10)

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Anchorage
March 23,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
STEINAR ELDØY STATOIL, N-4035 Stavanger	Statoil	[redacted]		
Tom Boyd URS 504 34th AVE ANCH. AK	URS			
BRUCE ST. PIERRE CONOCOPHILLIPS, AK 700 G ST. ANCH. AK 99501	CONOCOPHILLIPS			YES.
Bill Koski	LGL Ltd			
Darren Ireland	LGL AK			

11

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Craig Reiser 1101 E 76th Ave Suite B Anchorage, AK 99518	LGL Biologist	[redacted]	[redacted]	
Craig George	NSB			
Eric Myers	Audubon Alaska			
John Hopson Jr	Wainwright			Yes
David Hannay	JASCO Acoustician			

(12)

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Anchorage

March 23,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Michael Link	LGL	[redacted]	[redacted]	N
Dale Funk	LGL	[redacted]	[redacted]	N

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Barrow

March 10,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
NEIL BOSH P.O. BOX 501 Bellingham, WA, 98227		[redacted]		
Brionne Elkins P.O. Box 1774 Barrow, AK 99723	NSB			
Jessica Doyle Box 1872 Barrow Alk	NSB Lensing			
Johnnie Kunaq Brower	Self			
Charles Okakok	Self Inupiaq Nation			

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Barrow

March 10,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Rachel Edwardson Box 694 Barrow, AK 99723	Uncivilized Films Director	[redacted]	[redacted]	
Shawna Larson 308 G Street, #202 Anch. AK 99501	Pacific Environment	[redacted]	[redacted]	
Emma Hopson Box 1677 Barrow, AK		[redacted]	[redacted]	
Adeline Hopson Box 172 Barrow, AK 99723	Self	[redacted]	[redacted]	

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Barrow
March 10,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT
Rick L Rice PO Box 1230 BRW 99723	self	[redacted]	[redacted]	NO?
Jason Herreman PO Box 69 Barrow, AK 99723	NSB Wildlife Dept.	[redacted]	[redacted]	
Edward Itta PO B 69 Brw, AK 99723	NSB Mayor	[redacted]	[redacted]	
Karla Kolash PO Box 69 Brw, 99723	NSB Mayor's Office	[redacted]	[redacted]	
Ben Albers 1115 N. Forest #4 Bellingham, WA 98225	Self	[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Barrow

March 10,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
DAVE ANDERSON PO BOX 1510 BARROW AK 99723		[redacted]		
Jim Salzwedel PO BX 1535 BARROW				
B. Ristroph PO BOX 69 BRW	NSB Law Dept			no
P. Leavitt, Sr Box 934 ~~ICAS~~ Brw, AK 99723	ICAS			yes
Todd Sformo POBox 1821 Barrow AK 99723	DWM			No.

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Barrow

March 10,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
HANS NEIDIG	Eni Petroleum	[redacted]	[redacted]	NO
Debby Edwardson	Ilisagvik College	[redacted]	[redacted]	
George Edwardson	ICAS	[redacted]	[redacted]	
BEN GREENE	NSB PLANNING	[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Barrow

March 10,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Geoff Carroll	ADFG	[redacted]	[redacted]	
Ryan Lee Oyagak Po Box 1178	Self	[redacted]	[redacted]	
Kelly McFarlin PO Box 266	University of Alaska PhD student	[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Kaktovik

March 12,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Nora Jane Burns PO Box 101 Kaktovik, Ak 99747		[redacted]		
Jennifer & Art Smith				N
LEE KAYOTUK				
Carla Sims Kayotuk 16 99747				✓

(*) send copy of presentation

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Kaktovik

March 12,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Pete Velsko		[redacted]	[redacted]	
Jim Gadamus		[redacted]	[redacted]	
Matthew Rexford	City of Kaktovik Board Member	[redacted]	[redacted]	
Edward Rexford	N.V.K.	[redacted]	[redacted]	
Harry Lord	Universal Ghetell	[redacted]	[redacted]	✓

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Kaktovik

March 12,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT
FENTON Rexford Box 130	NATIVE Village of Kaktovik	[redacted]	[redacted]	yes
GEORGE KALEAKSK	ASRC	[redacted]	[redacted]	
Leonard Akootchook		[redacted]	[redacted]	
Marie Rexford	Resident	[redacted]	[redacted]	
		[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Kotzebue

February 18, 2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Caleb Pungowiyi Box 637 Kotzebue, AK 99752	OCEANA	[redacted]	[redacted]	yes
Uklallayseak Tom Okleasik POB 1110 Kotzebue	NWAB	[redacted]	[redacted]	yes
Willie Goodwin	Beluga Whale Committee	[redacted]	[redacted]	yes
John Chase	NAB	[redacted]	[redacted]	No

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Kotzebue

February 18, 2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
TIM SMITH BOX 747 NOME, AK 99762	NOME FISHERMEN'S ASSOCIATION	[redacted]	[redacted]	NO
Grant Hildreth	NWAB	[redacted]	[redacted]	No
Bobby Wells Mayor	Norvik	[redacted]	[redacted]	NO
Frank Stein	Kotzebue	[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Nuiqsut

March 11,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Rosemary Ahtuangaruak	ICAS	[redacted]	[redacted]	Y
James Tagak P.O. Box 89264 Nuiqsut, AK. 99789	PNR Liaison			
Ed Nukapigak Box 89008 Nuiqsut AK 99789				Y/C
Thomas Nukapigak				
[illegible]	NWCA			

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Nuiqsut

March 11,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
George Siekak		[redacted]		
Jimmy A. Oyagak	City of NUI			?
Sarah Oyagak	City of NUI			
Billy Oyagak				

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Nuiqsut

March 11,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Dwayne Hopson	NVN	[redacted]	[redacted]	
Lucy Nukapigak		[redacted]	[redacted]	
Jimmy Nukapigak	SDS	[redacted]	[redacted]	
Carl Brower	Whaler	[redacted]	[redacted]	

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Nuiqsut
March 11,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Thomas Napageak Jr	city of Nui	[redacted]		
WILLIE SIELAK JR	NUI			
Archie Carolyn Akkiviana	Nui			
David Brower III	Nui			

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Nuiqsut
March 11,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Ig.'ak Nakaigak		[redacted]		
Larry A Kasak				
Bernia Kaigelel P.O. Box 82098 Nuiqsut AK 99789				Jea
Twkle ALASUK				
Dorcas Tukle				

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Nuiqsut

March 11,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Justin Long PO BOX. 300		[redacted]	[redacted]	
Eli Nukapigak		[redacted]	[redacted]	
Dora Leavitt		[redacted]	[redacted]	
Eric Leavitt		[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Point Hope

February 19,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT
Lillie Lampert		[redacted]		No
Esther Nashoolpuk				?
Kristi Frankson				
Elijah Rock Sr.				?
Dorcus Rock				?

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Point Hope

February 19,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Caroline P Cannon		[redacted]		
Jack Schaefer	ICAS			YES

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Point Lay

February 22,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Bill A. Tracey SR P.O. Box 59029 Point Lay, AK. 99759	Pt. Lay resident NSB Planning	[redacted]	[redacted]	
Thomas Nukapigak P.O. Bx 59101 Pt-Lay AK 99759	Native Village of Pt Lay Vice President	[redacted]	[redacted]	
NEIL PASKEWITZ POBOX 42 PT, LAY, AK	Police DEPT	[redacted]	[redacted]	
NATHAN HENRY		[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Point Lay

February 22,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Mario Tracey P.O. Box 59029 Point Lay, Alaska 99759	NSB Mayor's Village Liaison	[redacted]		
Lena Ferreira Box 59005 Point Lay AK 99759				

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Wainwright

March 9,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Geraldine Ningeok		[redacted]		NO
George Akootak				NO
Alice Nashoolpuk				NO

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Wainwright
March 9,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Dennis Avedzanna PO Box 82 Wainwright AK		[redacted]		
Bob Sheatz PO Box 162 Wainwright, AK 99782				
Michael Jagusak Box 163 Wainwright AK 99782				
Roy Ahmaogak 99782				
Terry Tagarook PO Box 96 Wainwright, AK 99782				

NMFS
EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS
PROJECT SCOPING MEETING
Wainwright
March 9,2010
SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Bonnie SPENCER 1026 Penn St Box 87 Wainwright, AK 99782		[redacted]		
Eleanor Bodfish PO Box 137 WAINWRIGHT, AK 99782				
Herbert Taggaroak Gal-Del Wain wright AK 99782				
Freddie Ekak PO Box 78 Wainwright AK 99782				

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Wainwright

March 9,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
John Hopson Jr	Olgoonik	[redacted]	[redacted]	Lets see
Edna Ahmaogak		[redacted]	[redacted]	
Marjorie Angashuk	NSB Fire Dept	[redacted]	[redacted]	
Cora Akpik		[redacted]	[redacted]	

NMFS

EFFECTS OF OIL AND GAS ACTIVITIES ON ARCTIC OCEAN EIS

PROJECT SCOPING MEETING

Wainwright

March 9,2010

SIGN-IN SHEET

URS

PLEASE PRINT NAME AND ADDRESS	AGENCY and DISCIPLINE	PHONE NUMBER	EMAIL ADDRESS	MAKE ORAL COMMENT ?
Lizzie Agurluk		[redacted]		

APPENDIX C
Comment Analysis Report

Comment Analysis Report

During the scoping period for the *Environmental Impact Statement (EIS) on the Effects of Oil and Gas Activities in the Arctic Ocean*, the National Marine Fisheries Service (NMFS) received a total of 73 submissions, containing 721 substantive comments. Submissions included email, letters, and transcripts of public testimony given at scoping meetings and the proceedings of government-to-government consultations.

The body of this document contains the 178 Statements of Concern (SOCs) developed to help summarize scoping comments. The SOCs are ordered according to the original grouping of issues categories, as outlined below.

Group Page

Effects *2*
- HAB Habitat
- MMI Marine Mammal and other Wildlife Impacts
- NED National Energy Demand and Supply
- OSR Oil Spill Risks
- SEI Socioeconomic Impacts
- SRP Subsistence Resource Protection
- WAQ Water and Air Quality

Available Information *9*
- DATA Data
- RME Research, Monitoring, Evaluation Needs

Regulatory Compliance (Process; NEPA, Permits, this EIS) *14*
- COR Coordination, Process, and Analysis
- MIT Mitigation Measures

Inupiat Culture *29*
- ICL Inupiat Culture and Way of Life
- UTK Use of Traditional Knowledge

General *31*
- ACK Comment Acknowledged

Effects

HAB	**Habitat - Comments associated with habitat requirements, or potential habitat impacts from seismic activities and exploratory drilling. Comment focus is habitat, not animals.**
HAB 1	Thetis Island, Cross Island, and Camden Bay provide important feeding and resting habitat for migrating bowhead whales.
HAB 2	The Arctic is facing a variety of threats that need to be addressed: climate change (sea ice is receding in the summertime, the quality of the sea ice is changing and there's less multi-year ice than there used to be); ocean acidification; and industrial development.
HAB 3	Loss of sea ice in the Arctic may increase human activities, such as: oil and gas activity, mining, commercial shipping, and commercial fishing.

MMI	**Marine Mammal and other Wildlife Impacts - General comments related to potential impacts to marine mammals or wildlife, unrelated to subsistence resource concepts.**
MMI 1	Oil and gas activities (such as seismic exploration and drilling) negatively impact marine species including: diverting whales, making animals shy away, covering ice with mud usually confined to the bottom of the ocean, forcing ice dependent animals out of their habitat, and destroying their habitat. These impacts may have lasting effects for animals over multiple years.
MMI 2	Animals impacted by oil and gas activities should be given a protected status, including seals, whales, other marine mammals, fish, ducks, and sea birds.
MMI 3	The EIS should acknowledge the evidence in peer-reviewed literature, which indicates that seismic exploration has not affected the health or reproductive fitness of marine mammal populations.
MMI 4	Special consideration should be given to disturbances that might separate a dependent infant from its caregiver. For example, bowhead cow-calf pairs.
MMI 5	Sounds levels do not have to be very high to adversely impact marine mammals, including causing them to abandon their young.
MMI 6	Cumulative exposure of marine mammals to oil and gas activity (including seismic exploration and drilling) should be considered, as species may encounter operations in multiple areas during one season. For example, bowhead whale migration routes may expose them to drilling activity in the Beaufort Sea and Chukchi Sea.

MMI 7 Studies reveal that female baleen whales show a heightened response to noise and disturbance and that fall migrating bowheads demonstrate greater avoidance than bowheads engaged in activities such as feeding.

MMI 8 The environmental record of the offshore exploration and production industry should be analyzed as part of the EIS. It documents that geophysical surveys are not likely to have discernable adverse effects on marine mammal stocks.

MMI 9 Studies have been unable to show a link between exposure to sound and adverse effects on marine mammal populations. Furthermore, There is no scientific evidence to suggest that the seismic activities associated with Beaufort and Chukchi Seas exploration, with use of a 180dB/190dB exclusion zone and other routine mitigation and monitoring requirements, will have an adverse population-level impact the bowhead whale stock.

MMI 10 Acidification will introduce a fundamental shift in the biogeochemical cycling of the Arctic Ocean. Impacts may include carbon ion depletion and its related effects, increased ocean noise, which could exacerbate the impacts of noise from industrial activity, changing the growth rates of photosynthetic phytoplankton, the toxicity of the marine toxins, the availability of ammonia for uptake by marine plants, and the efficiency of respiration in fish and other marine organisms. Animals at risk include mollusks, crustaceans, echinoderms, encrusting algae, and certain types of marine phytoplankton.

MMI 11 Increased vessel traffic increases the likelihood that marine mammals may be injured or killed from vessel strikes.

MMI 12 Mitigation measures to protect marine mammals are successful. For example, not one lethal take of polar bear has occurred since the incidental take authorizations regulations were put into place.

MMI 13 NMFS should reevaluate the impacts to marine mammals from noise exposure using the latest literature. Specific requests/examples include:
• Reevaluate permanent threshold shift of auditory injury for marine mammals.
• Recent literature indicates that very significant impacts to individuals and populations may occur at levels well below the 160 dB that MMS considers the minimum level at which behavioral harassment occurs.
• Thresholds employed should account for longer-term effects of noise exposure and not be based solely on immediate marine mammal responses.

MMI 14 Changes in Arctic conditions are resulting in the introduction of new marine mammal species, including: humpback, fin, and killer whales; narwhals, and porpoises.

MMI 15 Deflection of whales, and the resultant impacts to individuals and populations, fits squarely within the definition of "harassment" as defined in the Marine Mammal Protection Act.

MMI 16 Seismic and other sound sources result in detrimental impacts to marine species. Specific examples provided include:
• Killing fish eggs, larvae, and fry or retarding their growth and hinder their survival
• Causing changes in whale behavior including disturbed or "skittish" behavior, and coming up vertically for air
• Deflecting migrating whales
• Abandoning or avoiding impacted areas (e.g. mother polar bears abandoning dens, whales abandoning or avoiding feeding areas, and walrus abandoning haul outs)
• Masking of biologically important sounds
• Harming availability and viability of prey species
• Permanent and temporary hearing loss or auditory threshold shift in marine mammals and fish
• Alarm behavior in fish, and
• Impacts to tomcod.

NED **National Energy Demand and Supply - Comments related to meeting national energy demands, supply of energy.**

NED 1 The U.S. needs stable sources of energy from oil and natural gas to meet its increasing energy demands. Access to domestic supplies, such as those located on the Alaska Arctic Outer Continental Shelf, is important to meeting this demand. Other benefits could include decreased reliance on foreign sources.

NED 2 The Inupiat people are being forced to bear a disproportionate share of the burdens of our nation's energy consumption.

NED 3 Current resource estimates may understate Outer Continental Shelf supply potential because the areas are largely unexplored and the estimates have not benefited from the use of new seismic and computer modeling technology.

OSR **Oil Spill Risks - Concerns about potential for oil spill, ability to clean up spills in various conditions, potential impacts to resources or environment from spills.**

OSR 1 State and Federal agencies need to develop and implement an effective oil spill response/contingency plan prior to any more oil and gas activities.

OSR 2 Technology and industry standards have evolved to play a critical role in achieving prevention of oil spills through engineering, design, personnel training, and well planning.

OSR 3 A large oil spill in the extreme conditions present in Arctic waters would be extremely difficult or impossible to clean up.

OSR 4	The U.S. Coast Guard does not have federal funding for oil spill response and is not present in Arctic waters year round.
OSR 5	Although all phases of oil and gas activities increase the potential for an oil spill, a significant amount of major spills occur during the exploration phase.
OSR 6	Due to mismanagement of operations and maintenance on existing oil and gas developments in Alaska, industry has increased the risk of an oil spill.
OSR 7	In the last 20 years, industry has made proactive efforts regarding prevention but it is still not enough.
OSR 8	Most oil spills result from tankers, not pipelines.
OSR 9	Technology is not advanced enough for an oil spill clean up on the ice or in ice infested waters. Industry and the government agencies need to work together to develop this technology.
OSR 10	If there was an oil spill, it would be felt globally due to the ocean currents and migratory patterns of not only marine mammals but terrestrial species too.
OSR 11	There are four key actions needed to prevent and respond to oil spills in the Arctic Ocean: 1) Conduct an Arctic Oil Spill Risk Assessment 2) Assess Arctic Oil Spill Response Capacity 3) Conduct an Arctic Oil Spill Response Gap Analysis 4) Ensure the Process is Transparent and Scientifically Rigorous.

SEI	**Socioeconomic Impacts - Comments on economic impacts to local communities, regional economy, and national economy, can include changes in the social or economic environments (MONEY, JOBS).**
SEI 1	It is expensive to prepare for whaling and impacts from industry are only going to make it more expensive. These costs affect whole communities, not just whaling crews.
SEI 2	The oil and gas industry and other related business would benefit from predictability in permitting processes (such as issuance of incidental harassment authorizations). Long-term business decisions are made on the assumption that permits will be issued.
SEI 3	The State of Alaska and the entire nation benefit economically from offshore oil and gas development through job creation and generation of local, state, and federal revenues. Related economic issues identified include: • Lawsuits and regulations that hinder this development hurt the ability of Alaska residents (including Alaska native communities) to earn an income and provide for their families. • New natural gas production in the Alaska Arctic Outer Continental Shelf would enhance the economic viability of the proposed natural gas pipeline from Alaska to the Lower 48.

• Diminished access to domestic energy supplies, particularly in the form of natural gas has already had an impact on a number of important sectors of the economy.
• Regulators, industry, and the communities of the Arctic must work together to prevent economic impacts.

SRP	**Subsistence Resource Protection - Comments on need to protect subsistence resources and potential impacts to these resources. Can include ocean resources as our garden, contamination (SUBSISTENCE ANIMALS, HABITAT).**
SRP 1	Industry activities should have little to no impact on subsistence hunting and harvest in the Chukchi Sea as these activities do not occur in the same areas. Subsistence hunting activities occur within 20 miles of the coast as opposed to exploration activities that would be occurring further offshore. Conditions are different in the Beaufort Sea.
SRP 2	Aircraft traffic (including support activity) associated with oil and gas activities occurs in the same area as subsistence users and has and may continue to affect subsistence resources including polar bears, walrus, seals, caribou, and coastal and marine birds, making it more difficult for hunters to obtain these resources. Aircraft disturbance in caribou migratory pathways from oil and gas operations and tourism near the coast displaces caribou inland and may be have a cumulative impact on harvest.
SRP 3	Drilling muds have been observed on icebergs by subsistence hunters who have expressed concern that such discharges may adversely impact subsistence resources such as bowheads and other marine mammals.
SRP 4	Cumulative impacts to subsistence resources may occur as a result not only from exploration activities but also from indirect activities including support vessels and aircraft traffic. The potential for increased commercial vessel traffic through the Arctic Ocean or from a Northwest Passage route could cumulatively impact subsistence resources.
SRP 5	Increased exploration activity and industry vessel traffic could potentially endanger subsistence hunters during poor weather conditions if the hunters are required to travel further than 30 miles offshore to spot whales that may be deflected due to industry activities.
SRP 6	Noise from seismic operations, drilling and potential development/production may cause bowhead whales to become more difficult to hunt. Activities related to seismic exploration and related air and vessel traffic may negatively impact subsistence harvest by causing displacement of caribou and birds.

SRP 7 Protection of subsistence resources and lifestyle is important to sustaining food sources and the culture of Alaska Natives for future generations.

SRP 8 Increased vessel traffic, including barge traffic between the communities, is impacting subsistence bowhead hunters as a result of whales being deflected from the area and loss of potential strikes and harvest. Subsistence bowhead hunters would like the EIS to consider impacts of increased vessel traffic and regulating vessel traffic in areas during whaling so that interference during the hunt from vessel traffic does not occur.

SRP 9 Impacts of exploratory drilling activities offshore that could impact subsistence activities related to the harvest of bowhead whales that should be evaluated include:

• Impacts of exploration and potential development and production could cause deflection of bowheads up to 30 miles offshore that would impact subsistence hunters and ability to safety tow whales back to shore and cause loss of opportunity for harvest of allotted quota. Changes in bowhead whale behavior as a result of industry activity may cause the whales to become less available to hunters.

• Increase in vessel and barge traffic (crew, fuel, and supply runs) between existing offshore structures and onshore development leads to increased deflection of whales from traditional hunting areas that then causes whalers to travel further offshore to hunt.

• Discharge of drilling muds that enter currents and migratory pathways of the bowheads can also cause the whales to divert from migratory pathways/currents and areas that subsistence hunters traditionally use causing whalers to travel further offshore to hunt.

• Concern that displacement of bowheads from migratory routes in the Beaufort and Chukchi Seas may impact other communities that also depend on bowheads for subsistence.

• Subsistence hunters concerned that bowheads that are continually deflected from normal migratory routes due to noise and discharges encountered in currents will eventually abandon traditional habitats all together.

SRP 10 Impacts of exploratory drilling activities offshore that could impact subsistence activities related to the harvest of seals and other marine mammals that should be evaluated include:

• Bearded seals may be displaced by icebreaking activities for exploration which would impact subsistence hunters and potential harvest of these seals.

• Cross Island and Thetis Island in the Beaufort Sea are important seal hunting areas for subsistence users and hunting and harvest could be disturbed by increased industry activities. Consider protection of these islands during subsistence activities/hunts.

• Exploration activities resulting in subsistence hunters having to travel further offshore to hunt bearded seals.

SRP 11 Impacts of exploratory drilling activities offshore that could impact subsistence resources should also evaluate:

• Bowhead whales and seals are not the only subsistence resource that Alaska Native communities rely upon. Fishing is also an important resource and different species are hunted throughout the year. Subsistence users have expressed concern that causeways and activities to support offshore exploration will change migratory patterns of fish and terrestrial animals that occur along the coastlines.

• Subsistence users concerns that impacts of an offshore oil spill could adversely affect subsistence resources.

• Protection of subsistence resources and impacts to subsistence lifestyle need to be considered before exploration activities can occur offshore.

• Research and monitoring of existing discharges and the impacts to migratory patterns of subsistence resources and impacts to subsistence users has not occurred.

WAQ Water and Air Quality - Comments regarding water and air quality, including potential to impact or degrade these resources.

WAQ 1 Oil and gas activities can release numerous pollutants into the atmosphere. Greater emissions of nitrogen oxides and carbon monoxide could triple ozone levels in the Arctic, and increased black carbon emissions would result in reduced ice reflectivity that could exacerbate the decline of sea ice. The emission of fine particulate matter (PM 2.5), including black carbon, is a human health threat. Cumulative impacts will need to be assessed.

WAQ 2 Water pollution could cause toxins to bioaccumulate in top predators, including humans. There needs to be more information about the potential risks to human health.

WAQ 3 Water stratification during summer months may inhibit the dispersal of discharged pollutants, potentially confining pollutants to the shallow upper section of the ocean, where marine mammals are more likely to be affected.

WAQ 4 Thermal discharge from cooling water may impair water quality by directly altering the benthic community or killing marine organisms, by changing the behavior and physiology of marine organisms, and by potentially releasing toxins into the marine environment.

WAQ 5 Vessels used to conduct seismic surveys or exploration drilling can discharge numerous pollutants while operating, during refueling spills, or in other accidents.

WAQ 6 The oil and gas industry does not possess the technical ability to pursue development in a way that avoids contamination of nearby waters.

Available Information

DATA	Data - Comments referencing scientific studies that should be considered.
DATA 1	NMFS should review and consider the comments received on the previous Draft EIS.
DATA 2	NMFS should consider the following documents in its analysis of cumulative impacts: • Draft CEQ guidance on addressing green house gas emissions in NEPA documents available at: http://cep.hss.doe.lrov/nepa/regs/Consideration of Effects of GHG Draft NEPA Guidance FI NAL 02182010.pdf • Arctic Marine Shipping Assessment available at:http://web.arcticportal.org/uploads/L9/LP/L9LPqHzJZ88Zp4EOdasTcA/AMSA_Scenarios_NEW.pdf • Canter, L. W., and Kamath, J. (1995). Questionnaire checklist for cumulative impacts. Environmental Impact Assessment Review, 15(4): 3 11-339. available at: http://www.sciencedirect.com/science/journal/01959255 • Council on Environmental Quality (CEQ). (1997). Considering cumulative effects under NEPA. Online: http://ceq.eh.doe.gov/nepa/ccenepa/ccenepa.htm. • National Research Council (2003). Cumulative effects of oil and gas activities on Alaska's North Slope. Online: http://darwin.nap.edu/books/0309087376/html/R1.html • Consideration of Cumulative Impacts in EPA Review of NEPA Documents, available at: http://www.epa.gov/compliance/resources/nepa.html.
DATA 3	NMFS should reference air quality studies currently being undertaken by the National Park Service and Alaska Department of Environmental Conservation on cruise ships in Alaska.
DATA 4	Expertise and information on conducting Health Impact Assessments is available from tribal, local, state, and federal health agencies. In addition, guidelines for conducting Health Impact Assessments are available from various sources including: • http://www.who.int/hia.about/guides/en/, and • http://www.ifc.org/ifcext/sustainability.nsf/Content/PublicComment_HealthImpactAssessment.
DATA 5	NMFS should consider the following whale surveys/studies: • The latest aerial surveys of the Chukchi Offshore Monitoring in Drilling Area program (COMIDA). • The satellite tagging study being conducted by Lori Quackenbush of the Alaska Department of Fish and Game with assistance from the North Slope Borough's Department of Wildlife Management and the whaling captains of AEWC. • The 2010 bowhead whale population estimate currently under development.

DATA 6 NMFS should refer to submittal by Walt Rosenbusch of the International Association of Geophysical Contractors which provides specific information on the geographic locations, types and number of geophysical activities estimated to occur over a 5-year time period (2011-2015). The submittal also provides detailed information on seismic sound sources, which should be considered.

DATA 7 NMFS should consider the following sources of information on invasive species:
• Gollasch, S. (2002): The importance of ship hull fouling as a vector of species introductions into the North Sea. Biofouling 18(2), 105-121.
• Studies by Dr. Greg Ruiz, Marine Invasion Research Laboratory, Smithsonian Environmental Research Center.
• A guide regarding how to deal with invasive species in the oil and gas industry developed by the International Petroleum Industry Environmental Conservation Association/The International Association of Oil and Gas Producers (IPIECA/OGP) Biodiversity Working Group, and Statoil.

DATA 8 NMFS should review and consider the documents and lists of references provided by the following commenters:
• Shell Exploration and Production Company
• Environmental Protection Agency

DATA 9 Sources of pertinent information on exploratory drilling include:
• Neff, J. M. 2010. Fates and Effects of Water Based Drilling Muds and Cuttings in Cold-Water Environments (under development).
• Authorization to Discharge Under the National Pollutant Discharge Elimination System (NPDES) for Oil And Gas Exploration Facilities on the Outer Continental Shelf and Contiguous State Waters, available at: http://yosemite.epa.gov/R10/Water.NSF/NPDES+Permits/General+NPDES+Permits#Oil%20and%20 Gas.
• Statoil would be happy to provide information on drilling standards employed by the industry in Norway and their potential relevance in Alaska.

DATA 10 NMFS should consider the following sources of information pertaining to marine life:
• The research program by ConocoPhillips, Shell, and Statoil (results of data collected so far clearly indicate a significant variation in the species and biomasses encountered from year to year in the Chukchi Sea).
• Policy papers published by the American Fisheries Society (AFS) addressing such issues as the protection of marine fish stocks, biodiversity, introduction of aquatic species, and modifications to habitat available at: http://www.fisheries.org/afs/policy_statements.html

RME	Research, Monitoring, Evaluation - Comments on baseline research, monitoring, and evaluation needs
RME 1	The EIS needs to consider that the Arctic contains some of the world's last remaining intact marine ecosystems and impacts to this baseline from climate change, ocean acidification, and increasing industrial activities.
RME 2	Sufficient baseline data currently exists to support exploratory drilling programs.
RME 3	There is insufficient information, monitoring and baseline data available for decision makers to determine if oil and gas activity will have an impact on the Arctic. Comments include: • Authorizations for permits should not be made until adequate baseline information is available. • NMFS must ensure that any industrial activity authorized in the Arctic does not substantially change the existing baseline conditions until such time as adequate information is available. • Population level effects cannot be estimated without reliable population data. NMFS should proceed cautiously in evaluating impacts to marine mammals when there is so much uncertainty. • NMFS should establish an existing baseline that will provide for a comparison of impacts in order to determine the effects of oil and gas activity. • Instead of relying on positions based on insufficient information, continuing research to obtain such information should be carried out.
RME 4	Information and baseline data on marine mammal populations and distribution is inadequate to support informed decision making including: • More information is need on the health of females and young calves. • Knowledge of bowhead use of the Chukchi is limited. Suggestion that at least 2 -3 years of baseline data be collected to support decisions made. • Ice seal populations are more than 15 to 20 years old. • There is no population estimates for polar bears or walrus in the Chukchi Sea. • Data is not current for abundance, reproduction/breeding areas, habitat use, or feeding areas. • Information specifically on the impacts of noise to marine mammals is lacking and there is inadequate monitoring of the effects.
RME 5	Lease sales were conducted lacking established baselines for the environment which is not in compliance with regulatory statutes.
RME 6	Regarding climate change the EIS needs to acknowledge that the environmental baseline of the region is changing, and that the effects of later-occurring activities may have to be measured against a different baseline than the effects of earlier-occurring activities.

RME 7 Specific data needs identified included:
• Studying the ocean currents and impacts of an oil spill(s), including impacts to fisheries and establishing a baseline before an oil spill occurs.
• Studies related to migratory patterns of Arctic cisco that occur between the Mackenzie and Colville rivers.
• Studies related to the lower levels of oxygenation in sea water in the northwestern area.
• More studies relating to areas surrounding Cross and Thetis Island in the Beaufort Sea.

RME 8 Conduct environmental analyses for all planning areas. For those areas which already have existing work done, it was recommend a tiered approach be used to supplement that work.

RME 9 In developing the EIS, NMFS should recognize and consider existing scientific research including:
• Research and development around marine sound and environmental impact being conducted by the E&P Sound and Marine Life Joint Industry Programme administered by the International Association of Oil and Gas Producers.
• Significant research on oil spill prevention, detection, and response has occurred in the last few years.
• Review projects to gather information being undertaken by oil companies as well as other organizations either independently, through Joint Industry Projects or as part of an industry association to enhance spill response capabilities in remote and challenging regions such as the Alaskan Arctic.
• Review industry published studies on the environmental effects of and best management practices for pollution prevention technology, emissions from offshore platforms that include produced waters, drilling discharges, air emissions, the effects of sound on marine life that includes whales and fish, weather and oceanographic studies, and improved design standards for severe weather multi-year acoustic monitoring in both the Chukchi and Beaufort seas.

RME 10 A data gap analysis needs to be conducted in order to evaluate the current level of understanding of the Arctic environment to support a sound decision making process. This analysis would provide a basis for a comprehensive research and monitoring plan that could be used by decision makers. The analysis should:
• Include a discussion of lack of baseline information on several species and what steps can be taken to address deficiencies.
• Provide the public with an understanding of existing data gaps of the baseline and current conditions.
• Identify ongoing research that would provide missing information.
• Identify priorities for additional information to support decision making.
• Include environmental review, marine spatial and planning regarding industry activity and climate change and potential direct/indirect and cumulative impacts.
• Recommend how necessary additional research and monitoring could be collected in the near term and on an on-going basis.

• Synthesize existing scientific data and understanding of the area and monitoring and research plans.

RME 11 This EIS needs to carry out a balanced and objective review of scientifically sound and peer-reviewed literature that examines the effects of offshore oil and gas activities on marine mammals that occur in this environment. Speculation and bias about potential effects should be avoided. Effects should be described with references made that are scientifically supported with peer reviewed literature and technical reports.

RME 12 Use local hires to perform baseline gathering tasks.

RME 13 Methodology for collecting baseline data that could guide decisions makers should consider:
• Integration and synthesis of data that provides a basis for modeling or predicting the effects of future activities under different scenarios of climate change and development.
• Gathering additional data using satellite tags so decision makers can develop mitigation measures as activity is occurring in the Beaufort and Chukchi seas.
• Reevaluate current methodology for assessing conditions in limited areas during periods of breaks in exploration activities as this may not be reflective of the actual baseline.
• Consider the use of a modeling tool called Acoustic Integration Model that would estimate how many animals may be exposed to specific levels of sound.

RME 14 Research is needed in order to describe the cumulative effects of noise to bowhead whales and marine mammals in the Beaufort and Chukchi seas.

Regulatory Compliance (Process; NEPA, Permits, this EIS)

COR	Coordination, Process and Analysis - Comments on compliance with other statues, laws or regulations that should be considered; coordinating with Federal, state, local agencies or organizations; permitting requirements.
COR 1	The following suggestions were made about the roles and responsibilities of organizations in the EIS: • The Environmental Protection Agency should be invited to participate as a cooperating agency in the EIS given the agencies permitting authority and known expertise in resources critical to a full analysis of the issues underlying this EIS, particularly air and water quality. • The Minerals Management Service should continue to be a joint lead agency for the EIS rather than a cooperating agency their legal responsibility (including permitting) for the proposed action and expertise that can contribute to the NEPA process. • The North Slope Borough should be invited to participate as a cooperating agency in the EIS given their status as a locally affected jurisdiction closest to the majority of activities contemplated by the analysis, their jurisdiction by law over aspects of the actions falling within the scope of the proposed analysis, and their special expertise regarding resources (specifically wildlife) critical to NMFS' analysis. • Affected Tribal governments should be invited to participate in the EIS as a cooperating agency. This would provide for the establishment of a mechanism for addressing inter-governmental issues throughout the EIS development process.
COR 2	Naval activities, specifically the use of active sonar from naval submarines, should be included in the scope of the EIS. Oil and gas activity may lead to national defense assets being deployed to protect oil and gas activity in the Arctic Ocean. In this instance sonar is going to be one of the biggest harassment effects on marine wildlife.
COR 3	The scope of the EIS should not be limited to the issuance of incidental take authorizations and should be expanded to include an evaluation of all reasonably foreseeable offshore exploration, development, and production activities during both open water and ice-covered seasons including: • Winter season drilling from bottom-founded structures in shallower waters of the outer continental shelf • Nearshore and offshore construction operations • Facility installation and abandonment • Laying of gathering lines and pipelines • Development drilling and production operations • Transportation, specifically marine or aircraft traffic associated with re-supply and crew transfers, and • Distribution to market.

COR 4 The non-exclusive data business model used by many oil and gas companies should be considered when developing the scope of the EIS. The business model for acquiring non-exclusive geophysical data takes advantage of economies of scale in our industry by spreading the costs of data acquisition and processing over time and multiple customers who desire to make use of the data.

COR 5 The scope of the EIS should include electromagnetic, gravity, magnetic, and gravity gradiometry surveys.

COR 6 NMFS should take a precautionary approach in its analysis of impacts of oil and gas activities and in the selection of a preferred alternative. Comments include:
• A precautionary approach is required as there is insufficient information on Arctic ecosystems.
• A precautionary approach is required to ensure that adverse impacts to subsistence resources are minimized and mitigated.
• Activities should only be authorized when the science clearly demonstrates that those activities will not harm marine mammals or interference with subsistence activities and with the full involvement of the people most affected.
• Adopt a similar approach to that outlined in the North Pacific Fishery Management Council's Arctic Fishery Management Plan.

COR 7 The EIS should include an analysis of the impacts of oil and gas activities on air quality. Comments include:
• Clearly specify emission sources and quantity of emissions including from marine vessels.
• Disclose whether air toxics emissions would result from project activities, discuss the cancer and non-cancer health effects associated with air toxics and diesel particulate matter, and identify sensitive receptor populations and individuals that may to be exposed to these emissions.
• Consider production emissions from gas flaring volatilization of petroleum fractions, machinery exhaust emissions, volatilization during evaporation, and landfarming.
• Determine potential and actual impacts at individual sites.
• Include detailed information about ambient air conditions and national ambient air quality standards, a detailed project emission inventory, specific information about pollution from mobile and stationary sources.
• Include an Equipment Emissions Mitigation Plan that identifies actions to reduce diesel particulate, carbon monoxide, hydrocarbons, and NOx associated with construction and operation activities.
• Include mitigation measures to reduce identified air quality impacts.
• If air quality impacts are identified, NMFS should document the approach used to analyze and predict air quality impacts in an Air Quality Modeling Protocol and fully vet this approach with the Environmental Protection Agency.

COR 8 The EIS cumulative impacts analysis should include an evaluation of:
• Resources of concern that are at risk and are significantly impacted by the proposed project before mitigation
• All non-oil and gas activities
• Present and reasonably foreseeable projects and actions proximate to the project area, such as North Slope on-shore oil and gas activities, and reasonably foreseeable oil and gas development and production activities, both on- and offshore
• Multiple types of oil and gas activities including, concurrent seismic surveys, exploration drilling, shallow hazard surveys, site clearance surveys, icebreaking, and other activities and should assess the impacts of sound on marine life, impacts of discharges from exploration drilling (drilling fluids and cuttings), potential oil spills, and disturbance from relevant facilities, support vessels and aerial traffic linked to the operations
• Evaluate potential consequences of the proposed project "outside" the project area boundaries including impacts to other wildlife and aquatic resources.
• The effects of climate change and ocean acidification
• Potential commercial fisheries
• Increased international vessel traffic
• Water and air quality impacts, and
• Baseline pressure on subsistence resources from population growth in North Slope communities.

COR 9 The EIS cumulative impacts analysis should not include:
• Non-oil and gas activities in the Arctic. The focus of the EIS is to study potential impacts of oil and gas activities. Other activities outside the industry do not fit in this EIS analysis.
• Impacts occurring outside Alaska on marine mammals, given activities that may impact them abroad (for example, Russia) are managed under different laws and regulatory regimes, and may not be subject to the extensive mitigation measures required in Alaska.

COR 10 The EIS should include an analysis of impacts associated with climate change and ocean acidification including:
• Addressing threats to species and associated impacts for the bowhead whale, pacific walrus, and other Arctic species
• Effects of loss of sea ice cover, seasonally ice-free conditions on the availability of subsistence resources to Arctic communities, and
• Increased community stress.

COR 11 The EIS should follow an ecosystem approach in its evaluation of impacts to biological resources and their habitats including nested layers (taxonomic, population, genetic) of all biodiversity.

COR 12 The EIS should take into account that the issuance of incidental take authorizations are in accordance with the Marine Mammal Protection Act, but are also consistent with the Federal Administration's energy exploration and development policies and requirements.

COR 13 The EIS should include an analysis of the impacts associated with the introduction of invasive non-native species through oil and gas activities and outline mitigation measures to address identified impacts. Comments include:
• Authorizing agencies must comply with Executive Order 13112 regarding executive invasive non-native species.
• Authorizing agencies should work with other agencies to minimize the risk of introducing invasive non-native species.
• Fully analyze impacts of introducing non-native species that may become aquatic invasive species; use relevant programs and authorities to prevent the introduction of aquatic invasive species; develop the means to detect and respond rapidly to and control populations of such species; and monitor aquatic invasive species populations accurately and reliably; not authorize, fund, or carry out actions it believes are likely to cause or promote the introduction or spread of aquatic invasive species in the U.S.

COR 14 The EIS should include an analysis of the impacts associated with potential oil spills from oil and gas exploration, development and production activities and outline mitigation measures to reduce identified impacts. Comments include:
• The assessment should be based on realistic spill scenarios and distribution modeling, taking current state of the art technologies for preventing spills into consideration.
• The EIS should review the adequacy and environmental impacts of anticipated spill response measures, such as dispersants or in-situ burning, in the Arctic environment.
• The EIS should explain the extent to which lack of baseline scientific information would hinder post-spill recovery and rehabilitation efforts, including efforts to detect adverse environmental impacts.
• The context within which NMFS should examine the potential for oil spills should be a coordinated effort with other agencies that share responsibility for oil spill research, response, and prevention in the Arctic.
• The EIS should contain a detailed discussion of the potential impacts of oil spills on marine mammals and other Arctic wildlife, including migratory birds.
• The EIS should consider the potential impacts associated with leaving oil in the water and ice over the winter season.

COR 15 The EIS should include an analysis of the socio-cultural impacts associated with oil and gas activities in the Arctic. The scope of impacts to these resources should include the direct, indirect, and cumulative impacts to: subsistence users, sacred sites, traditional cultural properties or landscapes, hunting, fishing, gathering areas, access to subsistence hunting or fishing areas, historical or current travel routes, and historic properties, districts or landscapes.

COR 16 The EIS should include an analysis of the impacts of oil and gas activities on water quality. Comments include:
• The EIS should describe the current condition of waters in the project area and disclose which waters may potentially be affected by the proposed project, the nature of potential impacts, and specific pollutants likely to impact those waters.
• The EIS should document the project's consistency with applicable wastewater permitting requirements (as required by NPDES and/or ADPES programs) and should discuss specific mitigation measures that may be necessary or beneficial in reducing adverse impacts to water quality.
• Potential short and long-term water quality impacts may be caused by a variety of activities associated with seismic and exploratory operations, including wastewater discharges from vessels and other infrastructure, and deposition of air emissions on water.
• The EIS should include an analysis of zero discharge of drilling muds.

COR 17 The proposed EIS should analyze impacts associated with increases in vessel traffic associated with oil and gas operations in the Arctic.

COR 18 The EIS should include site-specific information on each resource and analyze the differential impacts that would occur for each location where activities may take place.

COR 19 The EIS should include an analysis of impacts on fish including the effects of noise on hearing, eggs, larvae, and fry.

COR 20 The EIS should include an analysis of the impacts of oil and gas activities to subsistence resources, and the impacts to the people that utilize those resources. NMFS must ensure oil and gas activities do not reduce the availability of any affected population or species to a level insufficient to meet subsistence needs (50 CFR 216.103). Comments include:
• Clearly identify and separate potential effects from seismic surveys on bowhead whale population health from potential effects on the availability of the bowhead whales for subsistence hunting.
• Include a thorough discussion of beluga subsistence hunting, and potential impacts of seismic surveys and associated activities on that hunting and present clear conclusions about the likelihood of significant and/or adverse impacts on belugas.
• Analyze the potential impacts of oil spills to subsistence resources, and the impacts to the people that utilize those resources.

COR 21 The EIS should include an analysis of all impacts of oil and gas activities on marine mammals and outline mitigation measures to address identified impacts. Comments include:
• The analysis should cover all marine mammals, including bowhead whales, beluga whales, walrus, seals, and polar bears.
• The analysis should consider impacts to marine mammals occurring in other

parts of the United States, as some stocks that occur in the Chukchi and Beaufort seas are migratory.
• Include a thorough discussion about relevant studies of the impacts of oil and gas activities to marine mammals, including noise and other impacts from seismic surveys, drilling, vessels, and aircraft.

COR 22 The EIS should include an analysis of the impacts of noise from oil and gas activities on marine species. Comments include:
• Include a discussion of strandings and other non-auditory physical injuries; temporary or permanent loss of hearing; avoidance behavior; disruption of biologically important behaviors; masking of biologically meaningful sounds; chronic stress; and reasonably expected declines in the availability and viability of prey species.
• Assessment of potential impacts of sound on marine life should be based on best available knowledge.
• The analysis should include information on actual dB levels, extent over time (periodic or continuous), and geographic area that will be disturbed.

COR 23 The EIS should include an analysis of the benefits of oil and gas exploration activities and the following facts:
• Since 2005, the federal government has collected over $3 billion for leases in these waters.
• New offshore development and environmental protection are not mutually exclusive.
• OCS development has an outstanding safety and environmental record spanning decades.
• Development has coexisted with other industries, including fishing, in the North Sea, the Gulf of Mexico, and Cook Inlet.
• With regard to the Alaskan OCS, exploration is not new. Approximately 30 wells have been drilled in the Beaufort Sea and five in the Chukchi Sea.

COR 24 The EIS should be a concise and uncomplicated document that contains maps and graphics explaining the proposal, alternatives, and locations of key fish and wildlife resources and subsistence resources and activities.

COR 25 A supplemental or revised draft EIS is more appropriate than a new draft. Reasons include:
• Very substantial effort was involved in preparation of the previous draft EIS and its record.
• Ordinarily, deficiencies in a draft EIS or changes in the proposed action warrant a revised or supplemental draft, not a wholly new NEPA effort.
• The NEPA regulations provide only for supplemental drafts, and make no mention of withdrawal and preparation of a new draft.
• Preparation of a wholly new EIS will make it difficult for stakeholders and the public to sort out the revisions and to determine what changes are significant or are regarded as significant from the agency's point of view.
• A supplemental draft could explain the significant changes that have been

made to the database supporting the draft EIS and to the analysis of impacts and alternatives, thereby greatly assisting the comments process.

COR 26 NMFS should reformulate this question in its Notice of Intent, “(4) Available new technology for monitoring or obtaining seismic/drilling data” to consider new technology that reduce the potential impacts of seismic and exploratory activities.”

COR 27 NMFS and MMS should issue a Federal Register notice of data availability detailing the "new information" asserted in the Notice of Intent to warrant starting over the NEPA process.

COR 28 Based on the Notice of Intent, it appears that NMFS will not be conducting site-specific analyses or decisions for this project. As such this EIS may be programmatic in nature and should be identified as a programmatic EIS.

COR 29 The EIS should be completed expeditiously with definite time limits.

COR 30 Individual projects should be reviewed on a case-by-case basis and should not be deferred until after the EIS is complete so as not to delay projects that have been under development since before the Notice of Intent. Also because the regulatory program has long been in place, and the agencies have years of experience with offshore oil and gas exploration activities.

COR 31 The EIS should not take the place of sites specific analyses. It is certainly possible if not likely that individual activities, depending on the mitigation measures that are put in place, could have significant impacts to the environment and that an EIS still might be warranted for some of these individual activities.

COR 32 Given the nature of this project a concise purpose and need statement is of critical importance to setting up the analysis of alternatives, which could range from too tightly focused to too broad, depending on how the statement is written. Given the uncertainty of the range, duration and frequency of future incidental take authorizations, the EIS will need to clearly explain the need of the proposed project.

COR 33 NMFS should objectively review data from peer-reviewed scientific literature and not speculation to assess potential impacts of geophysical activities on the environment.

COR 34 The EIS should ensure the environmental justice requirements of Executive Order 12898 (Federal Actions to Address Environmental Justice in Minority and Low-Income Populations) are being met. Comments include:
• Disclose what efforts were taken to ensure effective public participation in the scoping process and throughout the development of the EIS.
• The sources of data utilized for these analyses, and the references utilized for establishing the criteria.

• NMFS must take into account the unique interests of local Inupiat communities and must fully evaluate any disproportionate impacts placed upon the Inupiat people. NMFS must endeavor to make information available in understandable and accessible terminology, and NMFS should also be sensitive to the burdens placed on local communities when multiple decisions are being made at the same time.
• Particular attention should be given to consideration of the dependence of local communities on local and regional subsistence resources, access to those resources, and perception of the quality of those resources, as well as how project information is disseminated to the community.

COR 35 A Health Risk Assessment or Health Impact Assessment should then be conducted, in conjunction with the EIS, to determine the direct, indirect, and cumulative impacts of oil and gas activities on human health. Comments include:
• NMFS should partner directly with local, state, tribal, and federal health officials to conduct the appropriate health analysis and determine effective mitigation measures for any health impacts.
• The community health issue must receive the same level of analysis that other environmental concerns receive throughout the NEPA process.
• NMFS should utilize the best available methodology to assess human health impacts for the draft EIS (as required under NEPA and Executive Orders 12898 and 13045).
• The health analysis should include: 1) A description of the baseline health status of affected communities 2) An analysis of potential health consequences of the alternatives 3) Identification of potential mitigation measures 4) A discussion of whether the impacts may disproportionately affect low income or minority communities, or children 5) An analysis of the cumulative effects of the proposed action and alternatives.
• There are increasing concerns from local residents regarding human health impacts from proposed oil and gas exploration, development and production activities.

COR 36 NMFS must ensure that the monitoring and mitigation measures imposed are implemented and performed effectively. There needs to be enough funding to allow for better enforcement of stipulations, and consequences for permit violations.

COR 37 NMFS needs to develop and implement a comprehensive, science-based management plan to effectively regulate industrial activity in the Arctic Ocean. An Arctic comprehensive management plan would provide a more complete understanding of how the Arctic ecosystem functions, and what impacts industrial activities have on marine mammals and subsistence communities. NMFS should coordinate its work on the draft EIS with the work of the Task Force in developing an Arctic comprehensive management plan, and should limit the number and scope of activities that are authorized until this plan has been implemented.

COR 38 The following suggestions were made about the range of alternatives in the EIS:

• NMFS should consider a multi-step process that will reduce the initial list of alternatives to a final list that will undergo full evaluation in the draft EIS.
• NMFS should explain the reasoning for evaluating a no action alternative (i.e. no seismic or exploratory drilling) since this is beyond the authority of the participating agencies; the Secretary of Interior has the authority to nominate areas for oil and gas activities under the Outer Continental Shelf Lands Act.
• There are significant economic consequences to be examined in the "no action" scenario analysis. By not undertaking exploration activities in the Arctic and other areas of the outer continental shelf, the U.S. will be obliged to import additional oil from foreign sources.
• NMFS should consider a sufficient range of alternatives to provide for maximum flexibility in determining the final course of action pursuant to the purpose and need statement.
• The alternatives should treat the Chukchi and Beaufort seas separately and adopt a flexible program with realistic operating scenarios.
• The alternatives should adopt a flexible approach to the various seismic and drilling activities taking place within a defined area and evaluate the impacts of proposed operations on an annual basis.
• The proposed EIS should consider alternatives that address shortcomings in monitoring and mitigation measures.
• NMFS should consider a broader range of exploration scenarios, given that industry estimates are not always reflective of actual activity into the future.

COR 39 The EIS should include a list of Conflict Avoidance Agreements for all native groups in Alaska and adopt similar requirements to minimize impacts on subsistence hunting activities.

COR 40 NMFS must ensure that the EIS complies with the following regulations and guidance:

• Information Quality Act (peer review and document standards)
• Marine Mammal Protection Act
• Endangered Species Act
• National Environmental Policy Act
• Council on Environmental Quality guidance on analysis of bio-diversity, and
• EPA guidance on analysis of air quality impacts from emissions.

COR 41 Inupiat Community of the Arctic Slope, the Alaska Eskimo Whaling Commission, and Northwestern Arctic Borough request a copy of the Draft EIS.

COR 42 Because MMS regulations (30 CFR Part 251) state that geological and geophysical activities cannot create or cause hazardous or unsafe conditions, any mitigation and monitoring measures imposed on seismic surveys by NMFS and MMS must not result in hazardous or unsafe conditions.

COR 43 Changes in the EIS analyses over time, coupled with misperceptions of the underlying statutory standards, have culminated in a worst-case scenario impacts analysis presented in the draft EIS.

COR 44 The perception of representation on behalf of communities regarding input and concerns by environmental groups, Inupiat Community of the Arctic Slope, North Slope Borough, and Alaska Eskimo Whaling Commission is not always accurate or inclusive of an actual community's concerns.

COR 45 Northwest Arctic Borough requests to be involved with future consultations.

COR 46 The EIS process causes social impacts to Alaska Native communities participating in the process by taking time away from families, subsistence activities, and work to attend meetings and provide comments. Village governments do not have the budgets to allocate staff time to review and comment on EIS documents.

COR 47 Communities expressed concern that they are inundated with multiple projects to review and attend meetings by different government agencies. Comment periods often conflict with subsistence activities (particularly whaling season) and as a result communities are unable to fully participate. Communities do not have the staff/resources, expertise or time to allocate a through read of each EIS that is occurring on the North Slope. As a result Alaska Native communities are unable to participate in the process and a majority of their potential comments are not included in the decision making process which may have negative future impacts for these communities.

COR 48 Consultation with Alaska Native communities needs to consider:
• Working with each community to hear their concerns about potential impacts and addressing these concerns in the document.
• Working with these communities needs to be flexible with regard to impacts to traditional lifestyle, involvement of elders, and schedules that do not interfere with subsistence activities.
• Villages need adequate preparation time to accommodate meetings and participate in the decision making process as they are overwhelmed by having to participate in multiple decisions and EISs.
• NMFS should work with stakeholders in the communities and Alaska Native organizations to gather input for alternatives for the EIS to consider.
• Communities would like to get same information that is presented in each community across the North Slope.

COR 49 Government to government consultation needs to include:
• Consider potentially affected federally recognized tribal governments to participate in the EIS development process as cooperating agencies.
• Consider development of a government to government consultation plan that would be helpful in conducting consultation meetings to avoid conflict with subsistence seasons, and such a plan could be developed in collaboration with affected tribal governments.

• Consult with Inupiat Community of the Arctic Slope on a government to government basis and consult with Alaska Eskimo Whaling Commission pursuant to cooperative agreements and continue to accept input from local villages
• Consultation, particularly at the scoping level, should be initiated from NOAA/NMFS and not through their contractor. Meetings should be in person.
• Keep organizations such as the Kaktovik Whaling Captains Association involved in government to government consultation through coordination with Native Village of Kaktovik.
• Provide at least 30 days notice for government to government consultation meetings so that communities are able to review and process what is being presented to them for their consideration.

COR 50 The Record of Decision should not be completed until the Section 106 consultation process has been fully completed. If adverse effects to traditional cultural properties, sacred sites, or other areas of cultural resource concern are identified, any Memorandum of Agreement developed to resolve these concerns under Section 106 should be addressed in the Record of Decision.

COR 51 NMFS should not issue incidental take authorizations unless they can ensure that mitigation measures will remove the potential for serious injuries or mortality to marine mammals from activities associated with oil and gas operations.
• Other commenters suggest that authorizations should not be issued until the EIS process is complete.

COR 52 The agency should exercise its best judgment in granting incidental take authorizations and consider:
• Adopting a five year regulation letter of authorization or consider perhaps a 2 to 3 year permit in consideration of the rapidly changing Arctic environment.
• Consider a one year permit of performance and if compliance is sufficient than authorize a five permit.
• Alternatives that consider five year permits should provide for notice and public comment on an annual basis, particularly with concern to subsistence users.
• Consider limits on activities to protect key habitat and subsistence areas in five year regulations based on best available science.

COR 53 Oil and gas activity in the Arctic should not be authorized in until after the EIS has been completed. Baseline conditions will have already been affected by the time the EIS is completed and it will not be possible to assess the impacts to the Arctic. This has been demonstrated in other oil and gas developments such as:
• Prudhoe Bay
• The Gulf of Mexico (in reference to the BP oil spill).

COR 54 The agency should exercise its best judgment in granting incidental take

authorizations and consider that overly restrictive incidental take authorizations could discourage industry investment, future exploration and production of energy resources in the Arctic. The process is too lengthy and uncertain which can make it difficult for industry to plan and execute responsible and effective programs.

COR 55 The EIS should not seek to establish any such limit on incidental take authorizations; instead it should propose data development and an evaluation system that would be carried out in cooperation with the permit applicants. This would provide sufficient information to make these judgments on an annual basis.

COR 56 NMFS should develop a mechanism to ensure that there is a coordinated effort by federal and state agencies, industry, affected communities, and non governmental organizations and stakeholders to integrate as much as possible physical, biological and social information and data that is applicable to oil and gas exploration and establishes a comprehensive ecosystem baseline.

COR 57 Data and results that are gathered should be shared throughout the impacted communities. Often, adequate data is not shared and therefore perceived inaccurate.

COR 58 The determination whether or not non-exclusive surveys are employed should be left to free-market (competitive) forces.

MIT Mitigation Measures - Comments related to suggestions for or implementation of mitigation measures.

MIT 1 The best available technology should be used to minimize impacts. Specific suggestions include:
• Vibroseis
• Extended reach drilling
• Zero discharge technology (as implemented in Norway)
• Gravity, magnetic, and gravity gradiometry data collection, and
• Low-sulfur fuel.

MIT 2 Areas of high sociocultural, ecological, or biological significance should be protected with seasonal restrictions on the types of activities that can occur there. Specific areas suggested include:
• Critical feeding and resting grounds near Camden Bay in the mid-Beaufort
• Critical feeding grounds in the eastern Beaufort and near Barrow Canyon in the western Beaufort
• Nearshore areas (within 50 miles of the coast)
• Areas that are important for denning, feeding, and/or migration for Arctic species such as Pacific walrus, bowhead whales, beluga whales, or polar bears
• Ledyard Bay critical habitat area for spectacled eiders; and
• Subsistence use areas, such as:

• Areas used by the Village of Kaktovik in the eastern Beaufort
• Areas around Cross Island used by the Village of Nuiqsut
• Areas used by the Village of Barrow in the western Beaufort
• Areas used by Wainwright and Point Lay along the Chukchi Sea coast, and
• Kotzebue Sound (through July 10).

MIT 3 A buffer zone should be established at Cross Island similar to the one currently in place in the Chukchi Sea.

MIT 4 Establish a cap to limit the total number of oil and gas activities that may occur in planning area on a per season basis.

MIT 5 Oil and gas activities should be limited in duration to the minimum required.

MIT 6 Required mitigation measures, specifically safety and exclusion zones, should be adaptive and based on sound research, and must be reasonable and feasible. Specific suggestions include:
• Exclusion zones and other regulatory threshold criteria (e.g. 180/190) should be adjusted upwards to 230 dB re: 1 uPa (peak, flat) for cetaceans and 218 dB re: 1 uPa (peak, flat) for pinnipeds.
• NMFS should use the noise exposure criteria as proposed in Southall et al. (2007) to determine the thresholds for sound exposure and exclusion zones for cetaceans during seismic surveys.

MIT 7 Seismic surveys should be coordinated and use standardized methodologies to reduce the need for duplicative surveys by different companies.

MIT 8 The mitigation measures identified in the Programmatic Environmental Assessment should be incorporated into the current Environmental Impact Statement.

MIT 9 Existing restrictions are adequate to mitigate potential impacts from planned oil and gas activities.

MIT 10 Mitigation measures are needed to minimize or avoid introduction of non-indigenous species. Suggested measures include:
• Ships should be required to clean their hulls and overboard gear before entering Alaska waters.
• Ships should also exchange ballast water before entering Alaska waters.

MIT 11 The effectiveness of exclusion zone monitoring (marine mammal observers, acoustic monitoring, and aerial surveys) is limited by a number of factors including weather, daylight (glare or darkness), sea state, distance, and marine mammal behavior, and safety factors. NMFS should address these limitations.

MIT 12 Marine mammal monitoring should be required for oil and gas activities. Technologies/methods suggested include:
• Acoustic recorders
• Aerial monitoring

• Satellite tagging, and
• On-board marine mammal observers.

MIT 13 NMFS should run the marine mammal observer program as it does on fishing vessels to ensure that the data is unbiased and accurate.

MIT 14 Local residents are well suited to carry out the duties of marine mammal observers and should be employed for this task accordingly.

MIT 15 Noise associated with oil and gas activities should be minimized. Suggested measures include:
• Utilize technologies or methods that minimize horizontal propagation of noise.
• Require minimum noise levels; only that which can be defended as necessary and not wide open to whatever technology can be brought to bear.
• Require justification of the need to use proposed methods as opposed to other, if any, less invasive means of obtaining the desired physical data.

MIT 16 A sound cap or budget that limits the total amount of noise allowed per season should be considered as a mitigation measure.

MIT 17 Safety and exclusion zone distances should be calculated based on peak levels of sound generated by the oil and gas equipment.

MIT 18 Require fuel spill reporting and clean up protocols and sufficient equipment for worse case scenarios.

MIT 19 Arbitrary restrictions on concurrent operations could undermine a lessee's ability to explore its leases.

MIT 20 Proposed access routes should be surveyed for ice seal lairs, breathing holes, and resting locales to avoid disturbance of these animals.

MIT 21 Mitigation measures are needed to minimize or avoid ship strikes of marine mammals. Suggested measures include:
• Designating specific shipping lanes
• Implementing seasonal restrictions to protect marine mammals during their migration, and
• Establishing speed restrictions.

MIT 22 Require the use of fish finding equipment and procedures to shut down seismic activity when large schools of fish are encountered.

MIT 23 Consider barring surveys during periods of low visibility to decrease the risks of harm to marine mammals and birds.

MIT 24 Comprehensive monitoring is needed to evaluate population changes that may be occurring not only from the proposed project, but natural and cumulative factors.

MIT 25 NMFS should compile a complete, region-by-region account of all biological stipulations, Notices to Lessees and Operators, and mitigation measures in effect, along with summary information on whether or not these measures have appeared to work, and whether or not any direct studies have been conducted to verify their effectiveness. NMFS should address any identified shortcomings through consultation with stakeholders.

MIT 26 NMFS should consider a non-exclusive survey program that facilitates sharing of information between entities to reduce exploration related impacts.

MIT 27 NMFS must analyze impacts to marine mammals and ensure proposed mitigation and monitoring requirements meet the provisions of the Marine Mammal Protection Act, namely that they will result in "the least practicable impact" on protected species and their availability for subsistence use.

Inupiat Culture

ICL	Inupiat Culture and Way of Life - Comments related to potential cultural impacts or desire to maintain traditional practices (PEOPLE).
ICL 1	Alaska Native communities are not compensated for impacts that result from oil and gas activities.
ICL 2	Industrial activities (such as oil and gas exploration and production) jeopardize the long-term health and culture of native communities. Specific concerns include: • Impacts to Arctic ecosystems and the associated subsistence resources from pollutants, noise, and vessel traffic • Restriction of access to subsistence resources (hunting and fishing areas). • Community and family level cultural impacts related to the subsistence way of life • Decreased availability of subsistence foods encourages consumption of store-bought food with less nutritional value • Subsistence resources from the Arctic Ocean are shared with communities throughout Alaska so impacts to these resources would be felt throughout the state • Direct impacts to health resulting from pollutants, and • Anthropogenic noise is widespread and disturbs daily life in Alaska Native communities.
ICL 3	Alaska Native communities need to find a compromise with oil and gas companies to protect subsistence resources and provide jobs.
ICL 4	One benefit of the oil activity is that the noise may cause whales to move in closer to shore and provide subsistence users with better access.
ICL 5	Although commercial fishing is currently prohibited the Chukchi and Beaufort seas, fishing is growing at the margins of the Arctic. Directly or indirectly, large-scale commercial fishing could compete with subsistence hunters for the limited productivity of Arctic waters.
ICL 6	The Northwest Arctic Borough Assembly opposes Outer Continental Shelf leasing with Resolution 08-04. This resolution emphasizes the importance of subsistence foods to the Inupiat way of life. It also recognized the critical need for baseline data, environmental and wildlife monitoring, and filling large data gaps for the area.

UTK	Use of Traditional Knowledge - Comments regarding how traditional knowledge (TK) is used in the document or decision making process, need to incorporate TK, or processes for documenting TK.
UTK 1	Although communities have been providing comments on oil and gas exploration and development for many years, it has not been documented well.
UTK 2	Native people have expressed concerns regarding the impacts of oil and gas activities on their communities for a long time however these concerns are not being addressed.
UTK 3	The use of traditional knowledge will assist in documenting the when, where, and at what time the different communities are subsistence hunting, and that will assist in the efforts to avoid conflict between industry and the communities.
UTK 4	The development of the EIS needs to incorporate and analyze local and traditional knowledge about impacts of previous offshore oil and gas activities on marine mammals as well as the impacts of other activities that may be relevant.
UTK 5	Traditional knowledge is going to be important for you to get some of the migration routes for beluga whales.
UTK 6	People would like to have a workshop in each community to identify traditional knowledge data gaps that need to be included in the process.
UTK 7	While the importance of scientific knowledge is widely recognized, the value of local and traditional knowledge should be equally recognized and included in the EIS process as validation to science.
UTK 8	Observations and/or studies provided by the communities has not been incorporated or accepted as valid information in the reporting process.
UTK 9	More needs to be done to ensure that traditional knowledge is widely available. One way of ensuring that is incorporation in the EIS process.
UTK 10	NMFS needs to consider the extensive, previously collected traditional knowledge, regarding the climate, ecological processes, and resource presence and use on the North Slope gathered over the last few decades in the EIS.

General

ACK Comment Acknowledged - Entire submission determined not to be substantive and warranted only a “comment acknowledged” response.

Government-To-Government Meetings

Comment Analysis Report

During the scoping period for the *Environmental Impact Statement (EIS) on the Effects of Oil and Gas Activities in the Arctic Ocean*, the National Marine Fisheries Service (NMFS) participated in government-to-government consultations with Barrow, Kotzebue, Nuiqsut, Point Lay, and Wainwright. Two meetings were also held with the Inupiat Community of the Arctic Slope. The body of this document contains Statements of Concern (SOCs) developed to summarize comments made at these meetings. The SOCs are ordered according to the original grouping of issues categories, as outlined below.

In most cases the comments were directly captured in SOCs from Appendix C of the Final Scoping Report for the *Environmental Impact Statement (EIS) on the Effects of Oil and Gas Activities in the Arctic Ocean* and the identifying number of each SOC was kept consistent. For instance, MMI 13 in this government-to-government Comment Analysis Report is the same as MMI 13 in Appendix C of the Final Scoping Report. Blue text indicates instances in which additional text was added to an SOC or if a new SOC has been developed (e.g. HAB 4).

Group Page

Effects *2*
- HAB Habitat
- MMI Marine Mammal and other Wildlife Impacts
- SEI Socioeconomic Impacts
- SRP Subsistence Resource Protection

Available Information *6*
- RME Research, Monitoring, Evaluation Needs

Regulatory Compliance (Process; NEPA, Permits, this EIS) *7*
- COR Coordination, Process, and Analysis
- MIT Mitigation Measures

Inupiat Culture *15*
- ICL Inupiat Culture and Way of Life
- UTK Use of Traditional Knowledge

Effects

HAB	**Habitat - Comments associated with habitat requirements, or potential habitat impacts from seismic activities and exploratory drilling. Comment focus is habitat, not animals.**
HAB 4	Walrus, beluga whales and bowhead whales are all use the same areas in the Chukchi Sea. The Hannah Shoal area is a particular hot spot for animals to feed.
MMI	**Marine Mammal and other Wildlife Impacts - General comments related to potential impacts to marine mammals or wildlife, unrelated to subsistence resource concepts.**
MMI 13	NMFS should reevaluate the impacts to marine mammals from noise exposure using the latest literature. Specific requests/examples include: • Reevaluate permanent threshold shift of auditory injury for marine mammals. • Recent literature indicates that very significant impacts to individuals and populations may occur at levels well below the 160 dB that MMS considers the minimum level at which behavioral harassment occurs. • Thresholds employed should account for longer-term effects of noise exposure and not be based solely on immediate marine mammal responses.
MMI 16	Seismic and other sound sources result in detrimental impacts to marine species. Specific examples provided include: • Killing fish eggs, larvae, and fry or retarding their growth and hinder their survival • Causing changes in whale behavior including disturbed or "skittish" behavior, and coming up vertically for air • Deflecting migrating whales • Abandoning or avoiding impacted areas (e.g. mother polar bears abandoning dens, whales abandoning or avoiding feeding areas, and walrus abandoning haul outs) • Masking of biologically important sounds • Harming availability and viability of prey species • Permanent and temporary hearing loss or auditory threshold shift in marine mammals and fish • Alarm behavior in fish • Impacts to tomcod, and • Impacts to salmon.

SEI	**Socioeconomic Impacts - Comments on economic impacts to local communities, regional economy, and national economy, can include changes in the social or economic environments (MONEY, JOBS).**
SEI 4	There is some support in North Slope communities for oil and gas activities in the Arctic because of the long term financial benefits and employment opportunities.
SEI 5	The oil and gas industry takes away the profits, jobs, and resources without providing services, resources, or infrastructure to the North Slope communities.
SRP	**Subsistence Resource Protection - Comments on need to protect subsistence resources and potential impacts to these resources. Can include ocean resources as our garden, contamination (SUBSISTENCE ANIMALS, HABITAT).**
SRP 3	Subsistence hunters have expressed concerns that drilling muds and water discharges may adversely impact subsistence resources including: • Drilling mud has been observed on icebergs which may be encountered by marine mammals. • Drilling mud settles on the ocean floor which may impact marine mammals that use the ocean floor such as walrus (clam digging) and belugas. • Water discharge may be affecting ice formation.
SRP 4	Cumulative impacts to subsistence resources may occur as a result not only from exploration activities but also from indirect activities including support vessels and aircraft traffic. The potential for increased commercial vessel traffic through the Arctic Ocean or from a Northwest Passage route could cumulatively impact subsistence resources.
SRP 5	Increased exploration activity and industry vessel traffic could potentially endanger subsistence hunters during poor weather conditions if the hunters are required to travel further than 30 miles offshore to spot whales that may be deflected due to industry activities.
SRP 7	Protection of subsistence resources and lifestyle is important to sustaining food sources and the culture of Alaskan Natives for future generations. The Inupiat people are determined to protect their resources because it provides food for a large number of their communities and population. The ocean is the garden for the Inupiat people and should be left alone.
SRP 8	Increased vessel traffic, including barge traffic between the communities, is impacting subsistence bowhead hunters as a result of whales being deflected from the area and loss of potential strikes and harvest. Subsistence bowhead

hunters would like the EIS to consider impacts of increased vessel traffic and regulating vessel traffic in areas during whaling so that interference during the hunt from vessel traffic does not occur.

SRP 9 Impacts of exploratory drilling activities offshore that could impact subsistence activities related to the harvest of bowhead whales that should be evaluated include:

• Impacts of exploration and potential development and production could cause deflection of bowheads up to 30 miles offshore that would impact subsistence hunters and ability to safety tow whales back to shore and cause loss of opportunity for harvest of allotted quota. Changes in bowhead whale behavior as a result of industry activity may cause the whales to become less available to hunters.

• Increase in vessel and barge traffic (crew, fuel, and supply runs) between existing offshore structures and onshore development leads to increased deflection of whales from traditional hunting areas that then causes whalers to travel further offshore to hunt.

• Discharge of drilling muds that enter currents and migratory pathways of the bowheads can also cause the whales to divert from migratory pathways/currents and areas that subsistence hunters traditionally use causing whalers to travel further offshore to hunt.

• Concern that displacement of bowheads from migratory routes in the Beaufort and Chukchi seas may impact other communities that also depend on bowheads for subsistence.

• Subsistence hunters concerned that bowheads that are continually deflected from normal migratory routes due to noise and discharges encountered in currents will eventually abandon traditional habitats all together.

SRP 10 Impacts of exploratory drilling activities offshore that could impact subsistence activities related to the harvest of seals and other marine mammals that should be evaluated include:

• Bearded seals may be displaced by icebreaking activities for exploration which would impact subsistence hunters and potential harvest of these seals.

• Cross Island and Thetis Island in the Beaufort Sea are important seal hunting areas for subsistence users and hunting and harvest could be disturbed by increased industry activities. Consider protection of these islands during subsistence activities/hunts.

• Exploration activities resulting in subsistence hunters having to travel further offshore to hunt bearded seals.

SRP 12 If the Bering Strait is opened up to international shipping increased vessel traffic may have an impact on beluga and walrus as a subsistence resource.

SRP 13 Concurrent seismic surveys in U.S. and international waters may impact subsistence resource species by not allowing them refuge from these activities.

SRP 14	There are concerns that subsistence species composition and abundance has been altered by human activities and that these instances have not been investigated as the communities do not have adequate resources. Examples include: • Tomcod were not available at Point Hope for two years. This species is eaten by beluga whale and ice seals. • A large plume of dead krill was noticed at Wainwright last year. • Five miles of fingerling fish that washed up four years ago (location not specified).

Available Information

RME	Research, Monitoring, Evaluation - Comments on baseline research, monitoring, and evaluation needs
RME 3	There is insufficient information, monitoring, and baseline data available for decision makers to determine if oil and gas activity will have an impact on the Arctic. Comments include: • Authorizations for permits should not be made until adequate baseline information is available. • NMFS must ensure that any industrial activity authorized in the Arctic does not substantially change the existing baseline conditions until such time as adequate information is available. • Population level effects cannot be estimated without reliable population data. NMFS should proceed cautiously in evaluating impacts to marine mammals when there is so much uncertainty. • NMFS should establish an existing baseline that will provide for a comparison of impacts in order to determine the effects of oil and gas activity. • Instead of relying on positions based on insufficient information, continuing research to obtain such information should be carried out.
RME 10	A data gap analysis needs to be conducted in order to evaluate the current level of understanding of the Arctic environment to support a sound decision making process. This analysis would provide a basis for a comprehensive research and monitoring plan that could be used by decision makers. The analysis should: • Include a discussion of lack of baseline information on several species and what steps can be taken to address deficiencies. • Provide the public with an understanding of existing data gaps of the baseline and current conditions. • Identify ongoing research that would provide missing information. • Identify priorities for additional information to support decision making. • Include environmental review, marine spatial and planning regarding industry activity and climate change and potential direct/indirect and cumulative impacts. • Recommend how necessary additional research and monitoring could be collected in the near term and on an on-going basis. • Synthesize existing scientific data and understanding of the area and monitoring and research plans.
RME 15	MMS and NOAA should fund studies of beluga abundance and habitat use in the Chukchi Sea, as well as studies on the effects of seismic survey, vessel, and other industrial noises on belugas.

Regulatory Compliance (Process; NEPA, Permits, this EIS)

COR	Coordination, Process and Analysis - Comments on compliance with other statues, laws or regulations that should be considered; coordinating with Federal, state, local agencies or organizations; permitting requirements.
COR 7	The EIS should include an analysis of the impacts of oil and gas activities on air quality. Comments include: • Clearly specify emission sources and quantity of emissions including from marine vessels. • Disclose whether air toxics emissions would result from project activities, discuss the cancer and non-cancer health effects associated with air toxics and diesel particulate matter, and identify sensitive receptor populations and individuals that may to be exposed to these emissions. • Consider production emissions from gas flaring volatilization of petroleum fractions, machinery exhaust emissions, volatilization during evaporation, and landfarming. • Determine potential and actual impacts at individual sites. • Include detailed information about ambient air conditions and national ambient air quality standards, a detailed project emission inventory, specific information about pollution from mobile and stationary sources. • Include an Equipment Emissions Mitigation Plan that identifies actions to reduce diesel particulate, carbon monoxide, hydrocarbons, and NOx associated with construction and operation activities. • Include mitigation measures to reduce identified air quality impacts. • If air quality impacts are identified, NMFS should document the approach used to analyze and predict air quality impacts in an Air Quality Modeling Protocol and fully vet this approach with the Environmental Protection Agency.
COR 8	The EIS cumulative impacts analysis should include an evaluation of: • Resources of concern that are at risk and are significantly impacted by the proposed project before mitigation • All non-oil and gas activities • Present and reasonably foreseeable projects and actions proximate to the project area, such as North Slope on-shore oil and gas activities, and reasonably foreseeable oil and gas development and production activities, both on- and offshore • Multiple types of oil and gas activities including, concurrent seismic surveys, exploration drilling, shallow hazard surveys, site clearance surveys, icebreaking, and other activities and should assess the impacts of sound on marine life, impacts of discharges from exploration drilling (drilling fluids and cuttings), potential oil spills, and disturbance from relevant facilities, support vessels and aerial traffic linked to the operations • Evaluate potential consequences of the proposed project "outside" the project area boundaries including impacts to other wildlife and aquatic resources

• The effects of climate change and ocean acidification
• Potential commercial fisheries
• Increased international vessel traffic
• Water and air quality impacts, and
• Baseline pressure on subsistence resources from population growth in North Slope communities.

COR 10 The EIS should include an analysis of impacts associated with climate change and ocean acidification including:
• Addressing threats to species and associated impacts for the bowhead whale, Pacific walrus, and other Arctic species
• Effects of loss of sea ice cover, seasonally ice-free conditions on the availability of subsistence resources to Arctic communities, and
• Increased community stress.

COR 11 The EIS should follow an ecosystem approach in its evaluation of impacts to biological resources and their habitats including nested layers (taxonomic, population, genetic) of all biodiversity.

COR 13 The EIS should include an analysis of the impacts associated with the introduction of invasive non-native species through oil and gas activities and outline mitigation measures to address identified impacts. Comments include:
• Authorizing agencies must comply with Executive Order 13112 regarding executive invasive non-native species.
• Authorizing agencies should work with other agencies to minimize the risk of introducing invasive non-native species.
• Fully analyze impacts of introducing non-native species that may become aquatic invasive species; use relevant programs and authorities to prevent the introduction of aquatic invasive species; develop the means to detect and respond rapidly to and control populations of such species; and monitor aquatic invasive species populations accurately and reliably; not authorize, fund, or carry out actions it believes are likely to cause or promote the introduction or spread of aquatic invasive species in the U.S.

COR 16 The EIS should include an analysis of the impacts of oil and gas activities on water quality. Comments include:
• The EIS should describe the current condition of waters in the project area and disclose which waters may potentially be affected by the proposed project, the nature of potential impacts, and specific pollutants likely to impact those waters.
• The EIS should document the project's consistency with applicable wastewater permitting requirements (as required by NPDES and/or ADPES programs) and should discuss specific mitigation measures that may be necessary or beneficial in reducing adverse impacts to water quality.
• Potential short and long-term water quality impacts may be caused by a variety of activities associated with seismic and exploratory operations, including wastewater discharges from vessels and other infrastructure, and

deposition of air emissions on water.
• The EIS should include an analysis of zero discharge of drilling muds.
• Independent water quality issues from the Chukchi and Bering seas may combine to detrimental effect.

COR 19 The EIS should include an analysis of impacts on fish and fish stocks including the behavioral changes and impacts of noise on hearing, eggs, larvae, and fry.

COR 20 The EIS should include an analysis of the impacts of oil and gas activities to subsistence resources, and the impacts to the people that utilize those resources. NMFS must ensure oil and gas activities do not reduce the availability of any affected population or species to a level insufficient to meet subsistence needs (50 CFR 216.103). Comments include:
• Clearly identify and separate potential effects from seismic surveys on bowhead whale population health from potential effects on the availability of the bowhead whales for subsistence hunting.
• Include a thorough discussion of beluga subsistence hunting, and potential impacts of seismic surveys and associated activities on that hunting and present clear conclusions about the likelihood of significant and/or adverse impacts on belugas.
• Analyze the potential impacts of oil spills to subsistence resources, and the impacts to the people that utilize those resources.

COR 21 The EIS should include an analysis of all impacts of oil and gas activities on marine mammals and outline mitigation measures to address identified impacts. Comments include:
• The analysis should cover all marine mammals, including bowhead whales, beluga whales, walrus, seals, and polar bears.
• The analysis should consider impacts to marine mammals occurring in other parts of the United States, as some stocks that occur in the Chukchi and Beaufort seas are migratory.
• Include a thorough discussion about relevant studies of the impacts of oil and gas activities to marine mammals, including noise and other impacts from seismic surveys, drilling, vessels and aircraft.
• Describe the potential disturbance that seismic surveys may have on mother walrus and dependent young. And identify the range at which mother and dependent young may detect and avoid seismic operations, or account for the possibility that dependent young may become separated from their mothers as a result of disturbance from seismic operations.

COR 22 The EIS should include an analysis of the impacts of noise from oil and gas activities on marine species. Comments include:
• Include a discussion of strandings and other non-auditory physical injuries; temporary or permanent loss of hearing; avoidance behavior; disruption of biologically important behaviors; masking of biologically meaningful sounds; chronic stress; and reasonably expected declines in the availability and viability of prey species.

• Assessment of potential impacts of sound on marine life should be based on best available knowledge.
• The analysis should include information on actual dB levels, extent over time (periodic or continuous), and geographic area that will be disturbed.

COR 24 The EIS should be a concise and uncomplicated document that contains maps and graphics explaining the proposal, alternatives, and locations of key fish and wildlife resources and subsistence resources and activities.

COR 38 The following suggestions were made about the range of alternatives in the EIS:
• NMFS should consider a multi-step process that will reduce the initial list of alternatives to a final list that will undergo full evaluation in the draft EIS.
• NMFS should explain the reasoning for evaluating a no action alternative (i.e. no seismic or exploratory drilling) since this is beyond the authority of the participating agencies; the Secretary of Interior has the authority to nominate areas for oil and gas activities under the Outer Continental Shelf Lands Act.
• There are significant economic consequences to be examined in the "no action" scenario analysis. By not undertaking exploration activities in the Arctic and other areas of the Outer Continental Shelf, the U.S. will be obliged to import additional oil from foreign sources.
• NMFS should consider a sufficient range of alternatives to provide for maximum flexibility in determining the final course of action pursuant to the purpose and need statement.
• The alternatives should treat the Chukchi and Beaufort seas separately and adopt a flexible program with realistic operating scenarios.
• The alternatives should adopt a flexible approach to the various seismic and drilling activities taking place within a defined area and evaluate the impacts of proposed operations on an annual basis.
• The proposed EIS should consider alternatives that address shortcomings in monitoring and mitigation measures.
• NMFS should consider a broader range of exploration scenarios, given that industry estimates are not always reflective of actual activity into the future.

COR 39 The EIS should include a list of Conflict Avoidance Agreements for all native groups in Alaska and adopt similar requirements to minimize impacts on subsistence hunting activities. Comment include:
• Incidental harassment authorizations should not allow oil and gas exploration and development in the Beaufort Sea until the Nuiqsut whalers catch their quota in October.
• The Federal Government should abide by the condition to ensure that interference with will not take place to Nuiqsut harvesting until after August 25th.
• Blackout dates for oil and gas activity will be moved in the event that Wainwright or Point Lay goes whaling in the fall.

COR 46 The EIS process causes social impacts to Alaska Native communities participating in the process by taking time away from families, subsistence activities, and work to attend meetings and provide comments. The rapidity of the process is risking many of the communities of the Arctic slope. Village governments do not have the budgets to allocate staff time to review and comment on EIS documents.

COR 47 Communities and Government's expressed concern that they are inundated with multiple projects to review and attend meetings by different government agencies. Comment periods often conflict with subsistence activities (particularly whaling season) and as a result communities are unable to fully participate. Communities do not have the staff/resources, expertise or time to allocate a through read of each EIS that is occurring on the North Slope. As a result Alaska Native communities are unable to participate in the process and a majority of their potential comments are not included in the decision making process which may have negative future impacts for these communities.

COR 48 Consultation with Alaska Native communities needs to consider:
• Working with each community to hear their concerns about potential impacts and addressing these concerns in the document.
• Working with these communities needs to be flexible with regard to impacts to traditional lifestyle, involvement of elders, and schedules that do not interfere with subsistence activities.
• Villages need adequate preparation time to accommodate meetings and participate in the decision making process as they are overwhelmed by having to participate in multiple decisions and EISs.
• NMFS should work with stakeholders in the communities and Alaska Native organizations to gather input for alternatives for the EIS to consider.
• Communities would like to get same information that is presented in each community across the North Slope.
• Artic slope communities and Government's have limited funding for their involvement in EIS consultation processes.

COR 49 Government to government consultation needs to include:
• Consider potentially affected federally recognized tribal governments to participate in the EIS development process as cooperating agencies.
• Consider development of a government to government consultation plan that would be helpful in conducting consultation meetings to avoid conflict with subsistence seasons, and such a plan could be developed in collaboration with affected tribal governments.
• Consult with Inupiat Community of the Arctic Slope on a government to government basis and consult with Alaska Eskimo Whaling Commission pursuant to cooperative agreements and continue to accept input from local villages
• Consultation, particularly at the scoping level, should be initiated from NOAA/NMFS and not through their contractor. Meetings should be in person.
• Keep organizations such as the Kaktovik Whaling Captains Association

	involved in government to government consultation through coordination with Native Village of Kaktovik. • Provide at least 30 days notice for government to government consultation meetings so that communities are able to review and process what is being presented to them for their consideration. • The Native Village of Barrow would prefer to have a public workshop rather than being updated with reports and regular meetings with NMFS.
COR 53	Oil and gas activity in the Arctic should not be authorized in until after the EIS has been completed. Baseline conditions will have already been affected by the time the EIS is completed and it will not be possible to assess the impacts to the Arctic. This has been demonstrated in other oil and gas developments such as: • Prudhoe Bay • The Gulf of Mexico (in reference to the BP oil spill).
COR 59	There should be less process and more outcome driven NEPA.
COR 60	The Native Village of Barrow is opposed to offshore oil and gas activities because of the impacts on subsistence hunting and resources.
COR 61	The EIS should not rely on false, misleading or dated information including from other EISs or skewed industry studies. NMFS and MMS should ensure that data from industry studies are accurate. Research on the impacts of oil and gas activity should be independent of the industry funded research.
COR 62	The Inupiat Community of the Arctic Slope suggest having a workshop with NMFS and MMS with the aim of developing a Memorandum of Agreement for developing baseline data for the EIS process.

MIT	**Mitigation Measures - Comments related to suggestions for or implementation of mitigation measures.**
MIT 1	The best available technology should be used to minimize impacts. Specific suggestions include: • Vibroseis • Extended reach drilling • Zero discharge technology (as implemented in Norway) • Gravity, magnetic, and gravity gradiometry data collection, and • Low-sulfur fuel.
MIT 2	Areas of high sociocultural, ecological, or biological significance should be protected with seasonal restrictions on the types of activities that can occur there. NMFS should provide adequate grounds for considering any alternative that would not set specific geographic restrictions to these protect resources. Specific areas suggested include: • Critical feeding and resting grounds near Camden Bay in the mid-Beaufort

• Critical feeding grounds in the eastern Beaufort and near Barrow Canyon in the western Beaufort
• Nearshore areas (within 50 miles of the coast)
• Areas that are important for denning, feeding, and/or migration for Arctic species such as Pacific walrus, bowhead whales, beluga whales, or polar bears
• Ledyard Bay critical habitat area for spectacled eiders
• Subsistence use areas, such as:
• Areas used by the Village of Kaktovik in the eastern Beaufort
• Areas around Cross Island used by the Village of Nuiqsut
• Areas used by the Village of Barrow in the western Beaufort
• Areas used by Wainwright and Point Lay along the Chukchi Sea coast, and
• Kotzebue Sound (through July 10).

MIT 6 Required mitigation measures, specifically safety and exclusion zones, should be adaptive and based on sound research, and must be reasonable and feasible. Specific suggestions include:
• Exclusion zones and other regulatory threshold criteria (e.g. 180/190) should be adjusted upwards to 230 dB re: 1 uPa (peak, flat) for cetaceans and 218 dB re: 1 uPa (peak, flat) for pinnipeds.
• NMFS should use the noise exposure criteria as proposed in Southall et al. (2007) to determine the thresholds for sound exposure and exclusion zones for cetaceans during seismic surveys.
• The thresholds employed should account for longer term effects of noise exposure and not be based solely on immediate marine mammal responses, such as alteration of migration. The use of lesser thresholds ignores more subtle behavior impacts on marine mammals, which might be expected to occur after weeks, months, or even years of seismic activities.

MIT 7 Seismic surveys should be coordinated and use standardized methodologies and share survey information to reduce the need for duplicative and redundant surveys by different companies.

MIT 12 Marine mammal monitoring should be required for oil and gas activities. Technologies/methods suggested include:
• Real time passive acoustic recorders to compliment marine mammal observer data
• Aerial monitoring
• Satellite tagging, and
• On-board marine mammal observers.

MIT 15	Noise associated with oil and gas activities should be minimized. Suggested measures include: • Utilize technologies or methods that minimize horizontal propagation of noise. • Require minimum noise levels; only that which can be defended as necessary and not wide open to whatever technology can be brought to bear. • Require justification of the need to use proposed methods as opposed to other, if any, less invasive means of obtaining the desired physical data.
MIT 18	Require fuel spill reporting and clean up protocols and sufficient equipment for worse case scenarios.
MIT 22	Mitigation measures should be implemented to protect fish including: • Require the use of fish finding equipment and procedures to shut down seismic activity when large schools of fish are encountered. • Establish adequate corridors for fish.
MIT 23	Consider barring surveys during periods of low visibility to decrease the risks of harm to marine mammals and birds.
MIT 28	Aircraft should be required to maintain a 1,000 foot minimum when flying over marine mammals.
MIT 29	All seismic surveys should be required to have scientifically sound monitoring programs. The results of these programs should be available for review within 90 days of the termination of seismic surveys.
MIT 30	Native communicators should be required on oil and gas vessels.
MIT 31	Cut-off criteria should be established to stop oil and gas activity in the Arctic when a certain level of impact has occurred.

Inupiat Culture

ICL	**Inupiat Culture and Way of Life - Comments related to potential cultural impacts or desire to maintain traditional practices (PEOPLE).**
ICL 2	Industrial activities (such as oil and gas exploration and production) can jeopardize the long-term health, culture and quality of life of native communities. Specific concerns include: • Impacts to Arctic ecosystems and the associated subsistence resources from pollutants, noise, and vessel traffic • Restriction of access to subsistence resources (hunting and fishing areas). • Community and family level cultural impacts related to the subsistence way of life • Decreased availability of subsistence foods encourages consumption of store-bought food with less nutritional value • Subsistence resources from the Arctic Ocean are shared with communities throughout Alaska so impacts to these resources would be felt throughout the state • Direct impacts to health resulting from pollutants • Anthropogenic noise is widespread and disturbs daily life in native communities, and • Waste from drill rigs can be carried by the wind and cause respiratory illness in Nuiqsut. Drill rigs should be required to shut down if the wind is blowing in the direction of this community.
UTK	**Use of Traditional Knowledge - Comments regarding how traditional knowledge (TK) is used in the document or decision making process, need to incorporate TK, or processes for documenting TK.**
UTK 1	Although communities have been providing comments on oil and gas exploration and development for many years, it has not been documented well.
UTK 8	Observations and/or studies provided by the communities has not been incorporated or accepted as valid information in the reporting process. The communities of the Arctic slope have shown for generations that there have been impacts to subsistence resources. Western science has sometimes taken decades to prove that these concerns are founded.

UTK 11	The following information was provided regarding subsistence practices of the Point Lay community: • Beluga whales are hunted at the end of June to mid July but hunts may occur earlier in the season. The first pods of beluga whales that migrate past Point Lay are harvested; these contain larger animals and are all males. Mothers and calves are not usually hunted. The beluga season is getting worse throughout the years with harvests reducing from 70 animals to 30 or 40 perhaps less. • Spotted Seals and bearded seals are hunted from mid June to mid July (approximately June 20 to July 15). Bearded seals are hunted around the ice after all the silt or sediment from the rivers goes out. The bearded hunt was occurred earlier one year to allow Shell to conduct their activities as outlined in a conflict avoidance agreement. • The spring bowhead whale hunt occurs from the end of April to mid May. • It is getting more difficult to hunt Pacific walrus because they are not found on the ice anymore.

APPENDIX D

Cooperating Agencies and Government to Government Letters: Memorandum of Understanding between the National Marine Fisheries Service and the Minerals Management Service; and Memorandum of Understanding between the National Marine Fisheries Service and North Slope Borough

---

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

JAN 29 2010

Fredricka Stalker
President
Native Village of Point Lay
P.O. Box 59031
Point Lay, Alaska 99759

Re: National Marine Fisheries Service Environmental Impact Statement on the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas)

Dear Ms. Stalker:

The National Marine Fisheries Service (NMFS) is initiating preparation of an Environmental Impact Statement (EIS) that will consider the effects of offshore geophysical seismic surveys and exploratory drilling in the Federal and state waters of the U.S. Chukchi and Beaufort Seas. The purpose of this letter is to initiate government-to-government consultations, and to invite you and members of your tribe to participate in the scoping process for the development of the EIS. The EIS will consider the potential consequences for authorizing these activities and will evaluate the potential for development of a long-term planning process including regulations developed under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

It is our goal to work collaboratively with Tribal Governments and coastal communities of the U.S. Chukchi and Beaufort Seas in order to explore ways that the energy development in the Arctic can best co-exist with the subsistence culture and lifestyle. NMFS recognizes that it has a special obligation to consult and coordinate with Alaska tribal organizations in the spirit of Executive Order 13175 and welcomes your participation in this effort. Furthermore, NMFS values the contribution that Alaska Native knowledge and experience can provide the EIS team with regard to marine mammals and the environment in general. We will be contacting and soliciting comments from other Alaska Native organizations as well.

The process of preparing the EIS will take approximately 18 months and is anticipated to be completed in June 2011. Public scoping and agency meetings will be held in coastal Alaskan communities of the Arctic including Kotzebue, Point Lay, Wainwright, Point Hope, Barrow, Nuiqsut, and Kaktovik, as well as Anchorage, Alaska, in February and March of this year. A brief description of the project is presented below:

- The past several years has seen an increased interest in oil and gas exploration in the Chukchi and Beaufort Seas. These activities, along with the heightened

Printed on Recycled Paper

awareness of the global issues facing the Arctic, have focused attention on the possible consequences of human-related activities on marine mammals and other fish and wildlife species important to subsistence, as well as the availability of species such as bowhead whales, beluga, walrus and seals to the subsistence hunters of these communities.

- Under the MMPA, NMFS is responsible for permitting or exempting the "take" of marine mammals through annual authorizations (Incidental Harassment Authorizations [IHAs]) or multiple-year authorizations (Letters of Authorization [LOAs]). In order to issue such authorizations, NMFS must determine that the activity will take only 'small' numbers of marine mammals and that the level of taking will have no more than a "negligible impact" on marine mammal species or stocks and will not have an "unmitigable adverse impact" on subsistence uses of these species.
- Currently, oil and gas exploratory activities, such as drilling and seismic surveys that may take marine mammals pursuant to the MMPA, are applied for and authorized on an annual basis (i.e., IHAs). NMFS is proposing to implement a long-term planning process in order to reduce uncertainties and inconsistencies in the current process. We believe many of the concerns regarding the potential impacts of oil and gas activities on the annual subsistence harvests can be remedied through the development and implementation of regulations that would be in place for five-year periods of time, based on a defined level of activity. Also, under rulemaking, mitigation and monitoring requirements would be consistent or built upon from year to year, rather than determined on an annual basis.
- We are aware that North Slope residents have testified many times with regard to concerns over offshore development. It is our goal to gain a more complete understanding of the concerns that have been voiced previously, so that any questions we may pose to you related to this project will be more focused and useful for what we hope to achieve.

We look forward to working with you through the completion of the project. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 713-2289, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

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

JAN 29 2010

Caroline Cannon
President
Native Village of Point Hope
P.O. Box 266
Point Hope, Alaska 99766

Re: National Marine Fisheries Service Environmental Impact Statement on the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas)

Dear Ms. Cannon:

The National Marine Fisheries Service (NMFS) is initiating preparation of an Environmental Impact Statement (EIS) that will consider the effects of offshore geophysical seismic surveys and exploratory drilling in the Federal and state waters of the U.S. Chukchi and Beaufort Seas. The purpose of this letter is to initiate government-to-government consultations, and to invite you and members of your tribe to participate in the scoping process for the development of the EIS. The EIS will consider the potential consequences for authorizing these activities and will evaluate the potential for development of a long-term planning process including regulations developed under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

It is our goal to work collaboratively with Tribal Governments and coastal communities of the U.S. Chukchi and Beaufort Seas in order to explore ways that the energy development in the Arctic can best co-exist with the subsistence culture and lifestyle. NMFS recognizes that it has a special obligation to consult and coordinate with Alaska tribal organizations in the spirit of Executive Order 13175 and welcomes your participation in this effort. Furthermore, NMFS values the contribution that Alaska Native knowledge and experience can provide the EIS team with regard to marine mammals and the environment in general. We will be contacting and soliciting comments from other Alaska Native organizations as well.

The process of preparing the EIS will take approximately 18 months and is anticipated to be completed in June 2011. Public scoping and agency meetings will be held in coastal Alaskan communities of the Arctic including Kotzebue, Point Lay, Wainwright, Point Hope, Barrow, Nuiqsut, and Kaktovik, as well as Anchorage, Alaska, in February and March of this year. A brief description of the project is presented below:

- The past several years has seen an increased interest in oil and gas exploration in the Chukchi and Beaufort Seas. These activities, along with the heightened awareness of the global issues facing the Arctic, have focused attention on the

Printed on Recycled Paper

possible consequences of human-related activities on marine mammals and other fish and wildlife species important to subsistence, as well as the availability of species such as bowhead whales, beluga, walrus and seals to the subsistence hunters of these communities.

- Under the MMPA, NMFS is responsible for permitting or exempting the "take" of marine mammals through annual authorizations (Incidental Harassment Authorizations [IHAs]) or multiple-year authorizations (Letters of Authorization [LOAs]). In order to issue such authorizations, NMFS must determine that the activity will take only 'small' numbers of marine mammals and that the level of taking will have no more than a "negligible impact" on marine mammal species or stocks and will not have an "unmitigable adverse impact" on subsistence uses of these species.
- Currently, oil and gas exploratory activities, such as drilling and seismic surveys that may take marine mammals pursuant to the MMPA, are applied for and authorized on an annual basis (i.e., IHAs). NMFS is proposing to implement a long-term planning process in order to reduce uncertainties and inconsistencies in the current process. We believe many of the concerns regarding the potential impacts of oil and gas activities on the annual subsistence harvests can be remedied through the development and implementation of regulations that would be in place for five-year periods of time, based on a defined level of activity. Also, under rulemaking, mitigation and monitoring requirements would be consistent or built upon from year to year, rather than determined on an annual basis.
- We are aware that North Slope residents have testified many times with regard to concerns over offshore development. It is our goal to gain a more complete understanding of the concerns that have been voiced previously, so that any questions we may pose to you related to this project will be more focused and useful for what we hope to achieve.

We look forward to working with you through the completion of the project. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 713-2289, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

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

JAN 29 2010

Doreen Lampe
President, Inupiat Community of the Arctic Slope
P.O. Box 934
Barrow, Alaska 99723

Re: National Marine Fisheries Service Environmental Impact Statement on the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas)

Dear Ms. Lampe:

The National Marine Fisheries Service (NMFS) is initiating preparation of an Environmental Impact Statement (EIS) that will consider the effects of offshore geophysical seismic surveys and exploratory drilling in the Federal and state waters of the U.S. Chukchi and Beaufort Seas. The purpose of this letter is to initiate government-to-government consultations, and to invite you and members of your tribe to participate in the scoping process for the development of the EIS. The EIS will consider the potential consequences for authorizing these activities and will evaluate the potential for development of a long-term planning process including regulations developed under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

It is our goal to work collaboratively with Tribal Governments and communities of the U.S. Chukchi and Beaufort Seas in order to explore ways that the energy development in the Arctic can best co-exist with the subsistence culture and lifestyle. NMFS recognizes that it has a special obligation to consult and coordinate with Alaska tribal organizations in the spirit of Executive Order 13175 and welcomes your participation in this effort. Furthermore, NMFS values the contribution that Alaska Native knowledge and experience can provide the EIS team with regard to marine mammals and the environment in general. We will be contacting and soliciting comments from other Alaska Native organizations as well.

The process of preparing the EIS will take approximately 18 months and is anticipated to be completed in June 2011. Public scoping and agency meetings will be held in coastal Alaskan communities of the Arctic including Kotzebue, Point Lay, Wainwright, Point Hope, Barrow, Nuiqsut, and Kaktovik, as well as Anchorage, Alaska, in February and March of this year. A brief description of the project is presented below:

- The past several years has seen an increased interest in oil and gas exploration in the Chukchi and Beaufort Seas. These activities, along with the heightened awareness of the global issues facing the Arctic, have focused attention on the possible consequences of human-related activities on marine mammals and other fish and wildlife species important to subsistence, as well as the availability of

Printed on Recycled Paper

species such as bowhead whales, beluga, walrus and seals to the subsistence hunters of these communities.

- Under the MMPA, NMFS is responsible for permitting or exempting the "take" of marine mammals through annual authorizations (Incidental Harassment Authorizations [IHAs]) or multiple-year authorizations (Letters of Authorization [LOAs]). In order to issue such authorizations, NMFS must determine that the activity will take only 'small' numbers of marine mammals and that the level of taking will have no more than a "negligible impact" on marine mammal species or stocks and will not have an "unmitigable adverse impact" on subsistence uses of these species.
- Currently, oil and gas exploratory activities, such as drilling and seismic surveys that may take marine mammals pursuant to the MMPA, are applied for and authorized on an annual basis (i.e., IHAs). NMFS is proposing to implement a long-term planning process in order to reduce uncertainties and inconsistencies in the current process. We believe many of the concerns regarding the potential impacts of oil and gas activities on the annual subsistence harvests can be remedied through the development and implementation of regulations that would be in place for five-year periods of time, based on a defined level of activity. Also, under rulemaking, mitigation and monitoring requirements would be consistent or built upon from year to year, rather than determined on an annual basis.
- We are aware that North Slope residents have testified many times with regard to concerns over offshore development. It is our goal to gain a more complete understanding of the concerns that have been voiced previously, so that any questions we may pose to you related to this project will be more focused and useful for what we hope to achieve.

We look forward to working with you through the completion of the project. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 713-2289, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

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

JAN 29 2010

Thomas Olemaun
President, Inupiat Traditional Government
Native Village of Barrow
P.O. Box 1130
Barrow, Alaska 99723

Re: National Marine Fisheries Service Environmental Impact Statement on the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas)

Dear Mr. Olemaun:

The National Marine Fisheries Service (NMFS) is initiating preparation of an Environmental Impact Statement (EIS) that will consider the effects of offshore geophysical seismic surveys and exploratory drilling in the Federal and state waters of the U.S. Chukchi and Beaufort Seas. The purpose of this letter is to initiate government-to-government consultations, and to invite you and members of your tribe to participate in the scoping process for the development of the EIS. The EIS will consider the potential consequences for authorizing these activities and will evaluate the potential for development of a long-term planning process including regulations developed under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

It is our goal to work collaboratively with Tribal Governments of the coastal communities of the U.S. Chukchi and Beaufort Seas in order to explore ways that the energy development in the Arctic can best co-exist with the subsistence culture and lifestyle. NMFS recognizes that it has a special obligation to consult and coordinate with Alaska tribal organizations in the spirit of Executive Order 13175 and welcomes your participation in this effort. Furthermore, NMFS values the contribution that Alaska Native knowledge and experience can provide the EIS team with regard to marine mammals and the environment in general. We will be contacting and soliciting comments from other Alaska Native organizations as well.

The process of preparing the EIS will take approximately 18 months and is anticipated to be completed in June 2011. Public scoping and agency meetings will be held in coastal Alaskan communities of the Arctic including Kotzebue, Point Lay, Wainwright, Point Hope, Barrow, Nuiqsut, and Kaktovik, as well as Anchorage, Alaska, in February and March of this year. A brief description of the project is presented below:

- The past several years has seen an increased interest in oil and gas exploration in the Chukchi and Beaufort Seas. These activities, along with the heightened awareness of the global issues facing the Arctic, have focused attention on the possible consequences of human-related activities on marine mammals and other

Printed on Recycled Paper

fish and wildlife species important to subsistence, as well as the availability of species such as bowhead whales, beluga, walrus and seals to the subsistence hunters of these communities.

- Under the MMPA, NMFS is responsible for permitting or exempting the "take" of marine mammals through annual authorizations (Incidental Harassment Authorizations [IHAs]) or multiple-year authorizations (Letters of Authorization [LOAs]). In order to issue such authorizations, NMFS must determine that the activity will take only 'small' numbers of marine mammals and that the level of taking will have no more than a "negligible impact" on marine mammal species or stocks and will not have an "unmitigable adverse impact" on subsistence uses of these species.
- Currently, oil and gas exploratory activities, such as drilling and seismic surveys that may take marine mammals pursuant to the MMPA, are applied for and authorized on an annual basis (i.e., IHAs). NMFS is proposing to implement a long-term planning process in order to reduce uncertainties and inconsistencies in the current process. We believe many of the concerns regarding the potential impacts of oil and gas activities on the annual subsistence harvests can be remedied through the development and implementation of regulations that would be in place for five-year periods of time, based on a defined level of activity. Also, under rulemaking, mitigation and monitoring requirements would be consistent or built upon from year to year, rather than determined on an annual basis.
- We are aware that North Slope residents have testified many times with regard to concerns over offshore development. It is our goal to gain a more complete understanding of the concerns that have been voiced previously, so that any questions we may pose to you related to this project will be more focused and useful for what we hope to achieve.

We look forward to working with you through the completion of the project. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 713-2289, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

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

JAN 29 2010

Mr. Isaac Akootchook
President, Native Village of Kaktovik
P.O. Box 130
Kaktovik, Alaska 99747

Re: National Marine Fisheries Service Environmental Impact Statement on the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas)

Dear Mr. Akootchook:

The National Marine Fisheries Service (NMFS) is initiating preparation of an Environmental Impact Statement (EIS) that will consider the effects of offshore geophysical seismic surveys and exploratory drilling in the Federal and state waters of the U.S. Chukchi and Beaufort Seas. The purpose of this letter is to initiate government-to-government consultations, and to invite you and members of your tribe to participate in the scoping process for the development of the EIS. The EIS will consider the potential consequences for authorizing these activities and will evaluate the potential for development of a long-term planning process including regulations developed under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

It is our goal to work collaboratively with Tribal Governments of the coastal communities of the U.S. Chukchi and Beaufort Seas in order to explore ways that the energy development in the Arctic can best co-exist with the subsistence culture and lifestyle. NMFS recognizes that it has a special obligation to consult and coordinate with Alaska tribal organizations in the spirit of Executive Order 13175 and welcomes your participation in this effort. Furthermore, NMFS values the contribution that Alaska Native knowledge and experience can provide the EIS team with regard to marine mammals and the environment in general. We will be contacting and soliciting comments from other Alaska Native organizations as well.

The process of preparing the EIS will take approximately 18 months and is anticipated to be completed in June 2011. Public scoping and agency meetings will be held in coastal Alaskan communities of the Arctic including Kotzebue, Point Lay, Wainwright, Point Hope, Barrow, Nuiqsut, and Kaktovik, as well as Anchorage, Alaska, in February and March of this year. A brief description of the project is presented below:

- The past several years has seen an increased interest in oil and gas exploration in the Chukchi and Beaufort Seas. These activities, along with the heightened awareness of the global issues facing the Arctic, have focused attention on the possible consequences of human-related activities on marine mammals and other fish and wildlife species important to subsistence, as well as the availability of

Printed on Recycled Paper

species such as bowhead whales, beluga, walrus and seals to the subsistence hunters of these communities.

- Under the MMPA, NMFS is responsible for permitting or exempting the "take" of marine mammals through annual authorizations (Incidental Harassment Authorizations [IHAs]) or multiple-year authorizations (Letters of Authorization [LOAs]). In order to issue such authorizations, NMFS must determine that the activity will take only 'small' numbers of marine mammals and that the level of taking will have no more than a "negligible impact" on marine mammal species or stocks and will not have an "unmitigable adverse impact" on subsistence uses of these species.
- Currently, oil and gas exploratory activities, such as drilling and seismic surveys that may take marine mammals pursuant to the MMPA, are applied for and authorized on an annual basis (i.e., IHAs). NMFS is proposing to implement a long-term planning process in order to reduce uncertainties and inconsistencies in the current process. We believe many of the concerns regarding the potential impacts of oil and gas activities on the annual subsistence harvests can be remedied through the development and implementation of regulations that would be in place for five-year periods of time, based on a defined level of activity. Also, under rulemaking, mitigation and monitoring requirements would be consistent or built upon from year to year, rather than determined on an annual basis.
- We are aware that North Slope residents have testified many times with regard to concerns over offshore development. It is our goal to gain a more complete understanding of the concerns that have been voiced previously, so that any questions we may pose to you related to this project will be more focused and useful for what we hope to achieve.

We look forward to working with you through the completion of the project. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 713-2289, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

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

JAN 29 2010

Ms. Bernice Kaigelak
President, Native Village of Nuiqsut
P.O. Box 89169
Nuiqsut, Alaska 99789

Re: National Marine Fisheries Service Environmental Impact Statement on the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas)

Dear Ms. Kaigelak:

The National Marine Fisheries Service (NMFS) is initiating preparation of an Environmental Impact Statement (EIS) that will consider the effects of offshore geophysical seismic surveys and exploratory drilling in the Federal and state waters of the U.S. Chukchi and Beaufort Seas. The purpose of this letter is to initiate government-to-government consultations, and to invite you and members of your tribe to participate in the scoping process for the development of the EIS. The EIS will consider the potential consequences for authorizing these activities and will evaluate the potential for development of a long-term planning process including regulations developed under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

It is our goal to work collaboratively with Tribal Governments and coastal communities of the U.S. Chukchi and Beaufort Seas in order to explore ways that the energy development in the Arctic can best co-exist with the subsistence culture and lifestyle. NMFS recognizes that it has a special obligation to consult and coordinate with Alaska tribal organizations in the spirit of Executive Order 13175 and welcomes your participation in this effort. Furthermore, NMFS values the contribution that Alaska Native knowledge and experience can provide the EIS team with regard to marine mammals and the environment in general. We will be contacting and soliciting comments from other Alaska Native organizations as well.

The process of preparing the EIS will take approximately 18 months and is anticipated to be completed in June 2011. Public scoping and agency meetings will be held in coastal Alaskan communities of the Arctic including Kotzebue, Point Lay, Wainwright, Point Hope, Barrow, Nuiqsut, and Kaktovik, as well as Anchorage, Alaska, in February and March of this year. A brief description of the project is presented below:

- The past several years has seen an increased interest in oil and gas exploration in the Chukchi and Beaufort Seas. These activities, along with the heightened awareness of the global issues facing the Arctic, have focused attention on the possible consequences of human-related activities on marine mammals and other fish and wildlife species important to subsistence, as well as the availability of

Printed on Recycled Paper

species such as bowhead whales, beluga, walrus and seals to the subsistence hunters of these communities.

- Under the MMPA, NMFS is responsible for permitting or exempting the "take" of marine mammals through annual authorizations (Incidental Harassment Authorizations [IHAs]) or multiple-year authorizations (Letters of Authorization [LOAs]). In order to issue such authorizations, NMFS must determine that the activity will take only 'small' numbers of marine mammals and that the level of taking will have no more than a "negligible impact" on marine mammal species or stocks and will not have an "unmitigable adverse impact" on subsistence uses of these species.
- Currently, oil and gas exploratory activities, such as drilling and seismic surveys that may take marine mammals pursuant to the MMPA, are applied for and authorized on an annual basis (i.e., IHAs). NMFS is proposing to implement a long-term planning process in order to reduce uncertainties and inconsistencies in the current process. We believe many of the concerns regarding the potential impacts of oil and gas activities on the annual subsistence harvests can be remedied through the development and implementation of regulations that would be in place for five-year periods of time, based on a defined level of activity. Also, under rulemaking, mitigation and monitoring requirements would be consistent or built upon from year to year, rather than determined on an annual basis.
- We are aware that North Slope residents have testified many times with regard to concerns over offshore development. It is our goal to gain a more complete understanding of the concerns that have been voiced previously, so that any questions we may pose to you related to this project will be more focused and useful for what we hope to achieve.

We look forward to working with you through the completion of the project. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 713-2289, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

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

JAN 29 2010

Ms. June Childress
President, Wainwright Traditional Council
P.O. Box 143
Wainwright, Alaska 99782

Re: National Marine Fisheries Service Environmental Impact Statement on the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas)

Dear Ms. Childress:

The National Marine Fisheries Service (NMFS) is initiating preparation of an Environmental Impact Statement (EIS) that will consider the effects of offshore geophysical seismic surveys and exploratory drilling in the Federal and state waters of the U.S. Chukchi and Beaufort Seas. The purpose of this letter is to initiate government-to-government consultations, and to invite you and members of your tribe to participate in the scoping process for the development of the EIS. The EIS will consider the potential consequences for authorizing these activities and will evaluate the potential for development of a long-term planning process including regulations developed under section 101(a)(5)(A) of the Marine Mammal Protection Act (MMPA).

It is our goal to work collaboratively with Tribal Governments and coastal communities of the U.S. Chukchi and Beaufort Seas in order to explore ways that the energy development in the Arctic can best co-exist with the subsistence culture and lifestyle. NMFS recognizes that it has a special obligation to consult and coordinate with Alaska tribal organizations in the spirit of Executive Order 13175 and welcomes your participation in this effort. Furthermore, NMFS values the contribution that Alaska Native knowledge and experience can provide the EIS team with regard to marine mammals and the environment in general. We will be contacting and soliciting comments from other Alaska Native organizations as well.

The process of preparing the EIS will take approximately 18 months and is anticipated to be completed in June 2011. Public scoping and agency meetings will be held in coastal Alaskan communities of the Arctic including Kotzebue, Point Lay, Wainwright, Point Hope, Barrow, Nuiqsut, and Kaktovik, as well as Anchorage, Alaska, in February and March of this year. A brief description of the project is presented below:

- The past several years has seen an increased interest in oil and gas exploration in the Chukchi and Beaufort Seas. These activities, along with the heightened awareness of the global issues facing the Arctic, have focused attention on the possible consequences of human-related activities on marine mammals and other

Printed on Recycled Paper

fish and wildlife species important to subsistence, as well as the availability of species such as bowhead whales, beluga, walrus and seals to the subsistence hunters of these communities.

- Under the MMPA, NMFS is responsible for permitting or exempting the "take" of marine mammals through annual authorizations (Incidental Harassment Authorizations [IHAs]) or multiple-year authorizations (Letters of Authorization [LOAs]). In order to issue such authorizations, NMFS must determine that the activity will take only 'small' numbers of marine mammals and that the level of taking will have no more than a "negligible impact" on marine mammal species or stocks and will not have an "unmitigable adverse impact" on subsistence uses of these species.
- Currently, oil and gas exploratory activities, such as drilling and seismic surveys that may take marine mammals pursuant to the MMPA, are applied for and authorized on an annual basis (i.e., IHAs). NMFS is proposing to implement a long-term planning process in order to reduce uncertainties and inconsistencies in the current process. We believe many of the concerns regarding the potential impacts of oil and gas activities on the annual subsistence harvests can be remedied through the development and implementation of regulations that would be in place for five-year periods of time, based on a defined level of activity. Also, under rulemaking, mitigation and monitoring requirements would be consistent or built upon from year to year, rather than determined on an annual basis.
- We are aware that North Slope residents have testified many times with regard to concerns over offshore development. It is our goal to gain a more complete understanding of the concerns that have been voiced previously, so that any questions we may pose to you related to this project will be more focused and useful for what we hope to achieve.

We look forward to working with you through the completion of the project. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 713-2289, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits, Conservation and Education Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Price Leavitt Sr, Executive Director	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Inupiat Community of the Arctic Slope	DATE: December 22, 2011
FAX NO: (907) 852-4246	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Price Leavitt Sr.
President
Inupiat Community of the Arctic Slope
P.O. Box 934
Barrow, AK 99723

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Sir:

As we introduced in a prior letter (dated January 29, 2010), the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential

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

consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Barrow in late January or early February of 2012 to discuss the project in person, and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Thomas Olemaun, President	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Native Village of Barrow	DATE: December 22, 2011
FAX NO: (907) 852-8844	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Thomas Olemaun
President
Native Village of Barrow
PO Box 1130
Barrow, AK 99723

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Sir:

As we introduced in a prior letter (dated January 29, 2010), the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential

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

consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Barrow in late January or early February of 2012 to discuss the project in person, and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Isaac Akootchook, President	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Native Village of Kaktovik	DATE: December 22, 2011
FAX NO: (907) 640-2044	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Isaac Akootchook
President
Native Village of Kaktovik
PO Box 130
Kaktovik, AK 99747

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Sir:

As we introduced in a prior letter (dated January 29, 2010), the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential

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

consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Kaktovik in late January or early February of 2012 to discuss the project in person, and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Millie Hawly, President	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Native Village of Kivalina	DATE: December 22, 2011
FAX NO: (907) 645-2193	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Millie Hawly
President
Native Village of Kivalina
P.O. Box 50051
Kivalina, AK 99750

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Madame:

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential

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

level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Kivalina in late January or early February of 2012 to discuss the project in person and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Margaret Hansen, Chairman	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Native Village of Kotzebue	DATE: December 22, 2011
FAX NO: (907) 442-2162	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Guy Adams
Chairman
Native Village of Kotzebue
P.O. Box 296
Kotzebue, AK 99752-0296

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Sir:

The National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential

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

level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Kotzebue in late January or early February of 2012 to discuss the project in person and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Bernice Kaigelak	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Native Village of Nuiqsut	DATE: December 22, 2011
FAX NO: (907) 480-2714	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Bernice Kaigelak
President
Native Village of Nuiqsut
P.O. Box 89169
Nuiqsut, AK 99789

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Madame:

As we introduced in a prior letter (dated January 29, 2010), the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential

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

consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Nuiqsut in late January or early February of 2012 to discuss the project in person and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Caroline Cannon, President	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Native Village of Point Hope	DATE: December 22, 2011
FAX NO: (907) 368-2332	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).**

The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Caroline Cannon
President
Native Village of Point Hope
P.O. Box 109
Point Hope, AK 99766

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Madame:

As we introduced in a prior letter (dated January 29, 2010), the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential

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

consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Point Hope in late January or early February of 2012 to discuss the project in person and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: Julius Rexford, President	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Native Village of Point Lay	DATE: December 22, 2011
FAX NO: (907) 833-2576	PAGE: 1 of 3

SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

Julius Rexford
President
Native Village of Point Lay
P.O. Box 59031
Point Lay, AK 99759

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Sir:

As we introduced in a prior letter (dated January 29, 2010), the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential

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

consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Point Lay in late January or early February of 2012 to discuss the project in person and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

FAX TRANSMITTAL

URS

700 G STREET, SUITE 500
ANCHORAGE, ALASKA 99501
TEL: (907) 562-3366 FAX (907) 562-1297

TO: June Childress, President	FROM: Amy Rosenthal, Project Manager
ORGANIZATION: Wainwright Traditional Council	DATE: December 22, 2011
FAX NO: (907) 763-2563	PAGE: 1 of 3
SUBJECT: Government to Government Consultation for the National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)	

Hello,

This fax includes a letter from the National Marine Fisheries Service (NMFS). They would like to schedule government-to-government consultation during the public comment period for the **Draft EIS on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas).** The public comment period is from December 30 until February 13, 2012 (45 days).

The document is available online at http://www.nmfs.noaa.gov/pr/permits/eis/arctic.htm or additional copies or further information can be requested from Michael Payne, Office of Protected Resources, NMFS, at (301) 427-8401 or via email at arcticeis.comments@noaa.gov.

We would like to call you to set-up a time to visit Barrow in late January or early February to discuss the project in person.

Thank you,

Amy Rosenthal, Project Manager
URS Corporation

CONFIDENTIALITY NOTICE
The information in this facsimile transmission is intended solely for the stated recipient of this transmission. If you have received this fax in error, please notify the sender immediately by telephone. If you are not the intended recipient, please be advised the dissemination, distribution, or copying of the information contained in this fax is strictly prohibited.

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

December 22, 2011

June Childress
President
Wainwright Traditional Council
P.O. Box 184
Wainwright, AK 99782

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Madame:

As we introduced in a prior letter (dated January 29, 2010), the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) and the Bureau of Ocean Energy Management (BOEM) have prepared an Environmental Impact Statement (EIS) that considers the effects of offshore geophysical seismic surveys and exploratory drilling in the federal and state waters of the U.S. Beaufort and Chukchi seas. The purpose of this letter is to announce the availability of the Draft EIS (on December 30, 2011) for review and to invite government-to-government consultation on this project.

This EIS analyzes a range of management alternatives to assist NMFS and BOEM in carrying out their statutory responsibilities to authorize or permit these activities within a five year period from the completion of the Final EIS. The statutory responsibilities include BOEM's issuance of permits and authorizations under the Outer Continental Shelf Lands Act for seismic surveys and ancillary activities and NMFS' issuance of incidental take authorizations (ITAs) under Section 101(a)(5) of the Marine Mammal Protection Act for the take of marine mammals incidental to conducting seismic surveys, ancillary activities, and exploratory drilling.

A geological and geophysical (G&G) permit must be obtained from BOEM in order to conduct G&G exploration activities for oil and gas resources when operations occur on unleased lands or on lands leased to a third party. NMFS issues ITAs for oil and gas exploration activities because of the potential for seismic and exploratory drilling activities to result in the disturbance of marine mammals through sound, discharge of pollutants, and/or the physical presence of vessels. Because of the potential for these activities to "take" marine mammals, oil and gas operators may choose to apply for an ITA.

NMFS has evaluated five alternatives in the DEIS, but has not identified a preferred alternative at this stage. In this DEIS, NMFS and BOEM present and assess a range of reasonably likely G&G, ancillary, and exploratory drilling activities expected to occur over a five-year period, as well as a reasonable range of mitigation measures, in order to accurately assess the potential

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

consequences of issuing ITAs under the MMPA and permits under the OCSLA. The potential level of activity described by each alternative is based on recent federal and state lease planning and recent industry plans for both seismic surveys and exploratory drilling programs in the Beaufort and Chukchi seas. Each alternative also includes an analysis of a suite of standard and additional mitigation measures that have been identified to reduce impacts to marine mammals and to ensure no unmitigable adverse impact on the availability of marine mammals for subsistence uses.

NMFS understands that maintaining the availability of subsistence species and stocks and opportunities for continuing a subsistence way of life are of utmost importance to the people of Alaska's northern coastal communities. We have reviewed several large databases and compilations of Traditional Knowledge that have been gathered in the North Slope communities over the years and have incorporated recommendations into the suite of mitigation measures evaluated in the Draft EIS and the analysis of effects. We welcome your comments and suggestions on this document.

We would like to schedule our government-to-government consultation during the public comment period for this Draft EIS. The comment period is open for 45 days (until February 13, 2012), and we welcome the opportunity to discuss these questions with you at any point during this time. We would like to visit Wainwright in late January or early February of 2012 to discuss the project in person and will contact you again once a specific date is set.

Thank you for your consideration of these discussion topics, and I look forward to meeting with you. If you have any questions, please feel free to contact me at the address below, by telephone at (301) 427-8401, or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief

Permits and Conservation Division
National Marine Fisheries Service
1315 East-West Highway, Room 13705
Silver Spring, MD 20910

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

FEB 2 9 2012

Isaac Akootchook
President
Native Village of Kaktovik
P.O. Box 130
Kaktovik, AK 99747

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Sir:

In a letter dated December 22, 2011, the National Marine Fisheries Service (NMFS) indicated the release of its Draft Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean (Draft EIS), provided some background information on the Draft EIS, and invited government-to-government consultation on the project. Unfortunately, due to circumstances beyond our control (i.e., flights were cancelled due to extreme cold), we were unable to fly to Kaktovik for our scheduled meeting date of February 2, 2012. Should you wish to reschedule the government-to-government consultation, we would be happy to convene a teleconference with the Native Village of Kaktovik.

Please let us know by Friday, March 9, 2012, if you would like to schedule a teleconference with us for a government-to-government consultation on the aforementioned Draft EIS. You may contact me by telephone at 301-427-8401 or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service

Printed on Recycled Paper

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

Bernice Kaigelak
President
Native Village of Nuiqsut
P.O. Box 89169
Nuiqsut, AK 99789

FEB 29 2012

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Madame:

In a letter dated December 22, 2011, the National Marine Fisheries Service (NMFS) indicated the release of its Draft Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean (Draft EIS), provided some background information on the Draft EIS, and invited government-to-government consultation on the project. Unfortunately, due to circumstances beyond our control (i.e., flights were cancelled due to extreme cold), we were unable to fly to Nuiqsut for our scheduled meeting date of February 2, 2012. Should you wish to reschedule the government-to-government consultation, we would be happy to convene a teleconference with the Native Village of Nuiqsut.

Please let us know by Friday, March 9, 2012, if you would like to schedule a teleconference with us for a government-to-government consultation on the aforementioned Draft EIS. You may contact me by telephone at 301-427-8401 or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service

Printed on Recycled Paper

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

FEB 29 2012

Julius Rexford
President
Native Village of Point Lay
P.O. Box 59031
Point Lay, AK 99759

Re: National Marine Fisheries Service Draft Environmental Impact Statement on the effects of oil and gas activities in the Arctic Ocean (U.S. Beaufort and Chukchi seas)

Dear Sir:

In a letter dated December 22, 2011, the National Marine Fisheries Service (NMFS) indicated the release of its Draft Environmental Impact Statement on the Effects of Oil and Gas Activities in the Arctic Ocean (Draft EIS), provided some background information on the Draft EIS, and invited government-to-government consultation on the project. Unfortunately, due to circumstances beyond our control (i.e., flights were cancelled due to visibility conditions), we were unable to fly to Point Lay for our scheduled meeting date of February 8, 2012. Should you wish to reschedule the government-to-government consultation, we would be happy to convene a teleconference with the Native Village of Point Lay.

Please let us know by Friday, March 9, 2012, if you would like to schedule a teleconference with us for a government-to-government consultation on the aforementioned Draft EIS. You may contact me by telephone at 301-427-8401 or by email at Michael.Payne@noaa.gov.

Sincerely,

P. Michael Payne, Chief
Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service

Printed on Recycled Paper

EFFECTS OF OIL AND GAS ACTIVITIES (SEISMIC SURVEYS AND OFFSHORE EXPLORATORY DRILLING ACTIVITIES) IN THE ARCTIC OCEAN (U.S. CHUKCHI AND BEAUFORT SEAS) ENVIRONMENTAL IMPACT STATEMENT

MEMORANDUM OF UNDERSTANDING BETWEEN

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE FISHERIES SERVICE, THE LEAD AGENCY
AND
THE U.S. MINERALS MANAGEMENT SERVICE, A COOPERATING AGENCY

I. PURPOSE

This memorandum of understanding (MOU) outlines the roles and responsibilities of the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) and the U.S. Minerals Management Service (MMS) with respect to preparation of the Draft Environmental Impact Statement (DEIS) and the Final Environmental Impact Statement (FEIS) for the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas). This EIS is being prepared under the National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Part 1500-1508), and NOAA's Administrative Order 216-6 (NAO 216-6), Environmental Review Procedures for Implementing NEPA.

II. NOAA (Lead Federal Agency) RESPONSIBILITIES

A. NOAA has primary responsibility for meeting requirements of NEPA, including preparation of the DEIS and FEIS. In this capacity, NOAA will ensure that the EIS includes information needed to address state and Federal compliance requirements.

B. NOAA will consult with MMS regarding issues of concern, range of EIS alternatives, and mitigation and monitoring measures to be analyzed in the EIS.

C. NOAA will provide MMS with copies of the preliminary draft(s) of the DEIS and FEIS and interim work products, such as individual EIS sections, in a timely manner.

D. NOAA shall provide a minimum of 15 working days (unless a different, agreed upon time frame is established) for review of the preliminary draft of the DEIS and a minimum of 15 working days (unless a different, agreed upon time frame is established) for review of the preliminary draft of the FEIS. In the event there are additional drafts of either the DEIS or the FEIS, a mutually agreed upon time frame will be established.

E. NOAA will revise preliminary drafts of the DEIS and FEIS in response to comments/concerns/issues identified by MMS.

F. NOAA will ensure that MMS receives copies of all comments received on the DEIS and FEIS during the public comment periods and provide an initial identification of those comments pertaining to MMS' expertise or regulatory authority, which may require MMS to prepare a written response for inclusion in the EIS.

G. NOAA will ensure that the DEIS and FEIS cover pages identify MMS as a cooperating agency.

III. MMS (Cooperating Agency) RESPONSIBILITIES

A. MMS will actively participate in development of the EIS.

B. MMS will serve as the agency of expertise with regard to describing the technologies used to conduct seismic surveys, offshore exploratory drilling, and other ancillary activities on Outer Continental Shelf leases and MMS statutory and regulatory mandates.

C. MMS will review preliminary documents and provide comments to NOAA in accordance with specified timelines.

D. MMS will manage and be responsible for its own resources, such as people, time, and money to assist NOAA in the development of the EIS.

E. MMS will provide NOAA with timely identification of significant issues, range of EIS alternatives, and mitigation and monitoring measures for NOAA to consider for inclusion in the DEIS and FEIS related to MMS' responsibilities and authorities.

IV. PRINCIPAL POINTS OF CONTACT

James H. Lecky
NOAA/NMFS
1315 East West Highway, Rm. 13821
Silver Spring, Maryland 20910
(301) 713-2332

James Kendall
MMS
381 Elden Street
Herndon, Virginia 20170
(703) 787-1652

John Goll
MMS
3801 Centerpoint Drive #500
Anchorage, Alaska 99502
(907) 334-5200

Either NOAA or MMS may terminate this agreement at any time by providing written notice to the other party.

NOAA AND MMS AGREE TO THIS MOU AS OF THE LATTER OF THE THREE DATES WRITTEN BELOW:

Date: FEB 01 2010 By: _____
James H. Lecky
Director, Office of Protected Resources
NOAA/NMFS

Date: 2/3/2010 By: _____
James Kendall
Chief, Environmental Division
MMS

Date: 2/3/2010 By: _____
John Goll
Regional Director, Alaska
MMS

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

Edward S. Itta
Mayor
North Slope Borough
P.O. Box 69
Barrow, Alaska 99723

JUL 20 2010

Dear Mayor Itta:

On May 21, 2010, the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) invited the North Slope Borough to be a cooperating agency during the preparation of an environmental impact statement (EIS) regarding the effects of oil and gas activities (seismic surveys and offshore drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas). Attached to the May 21 letter was a Memorandum of Understanding (MOU) generally outlining the roles and responsibilities of NOAA and NSB. At that time, NMFS asked for NSB to provide comments on the draft agreement.

On July 9, 2010, NSB accepted NMFS' invitation to become a cooperating agency on the subject EIS. At that time, NSB provided some comments and revisions to the draft MOU. NMFS has incorporated those comments and revisions and has attached a revised MOU for your signature. Once you have signed the MOU, we would appreciate it if you could scan the signature page and email it to Candace Nachman at Candace.Nachman@noaa.gov for our records.

If you have any questions, please contact Mr. P. Michael Payne by phone at (301) 713-2289 ext. 110 or by email at Michael.Payne@noaa.gov.

Sincerely,

James H. Lecky, Director
Office of Protected Resources

Enclosure

Printed on Recycled Paper

EFFECTS OF OIL AND GAS ACTIVITIES (SEISMIC SURVEYS AND OFFSHORE EXPLORATORY DRILLING ACTIVITIES) IN THE ARCTIC OCEAN (U.S. CHUKCHI AND BEAUFORT SEAS) ENVIRONMENTAL IMPACT STATEMENT

MEMORANDUM OF UNDERSTANDING BETWEEN

THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION, NATIONAL MARINE FISHERIES SERVICE, THE LEAD AGENCY AND THE NORTH SLOPE BOROUGH, A COOPERATING AGENCY

I. PURPOSE

This memorandum of understanding (MOU) outlines the roles and responsibilities of the National Oceanic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS) and the North Slope Borough (NSB) with respect to preparation of the Draft Environmental Impact Statement (DEIS) and the Final Environmental Impact Statement (FEIS) for the effects of oil and gas activities (seismic surveys and offshore exploratory drilling activities) in the Arctic Ocean (U.S. Chukchi and Beaufort Seas). This EIS is being prepared under the National Environmental Policy Act (NEPA), the Council on Environmental Quality Regulations for Implementing the Procedural Provisions of NEPA (40 CFR Part 1500-1508), and NOAA's Administrative Order 216-6 (NAO 216-6), Environmental Review Procedures for Implementing NEPA.

II. NOAA (Lead Federal Agency) RESPONSIBILITIES

A. NOAA has primary responsibility for meeting requirements of NEPA, including preparation of the DEIS and FEIS. In this capacity, NOAA will ensure that the EIS includes information needed to address state and Federal compliance requirements.

B. NOAA will consult with NSB regarding issues of concern, range of EIS alternatives, and mitigation and monitoring measures to be analyzed in the EIS.

C. NOAA will provide NSB with copies of the preliminary draft(s) of the DEIS and FEIS and interim work products, such as individual EIS sections, in a timely manner.

D. NOAA shall provide a minimum of 30 working days (unless a different, agreed upon time frame is established) for review of the preliminary draft of the DEIS and a minimum of 30 working days (unless a different, agreed upon time frame is established) for review of the preliminary draft of the FEIS. In the event there are

additional drafts of either the DEIS or the FEIS, a mutually agreed upon time frame will be established.

E. NOAA will revise preliminary drafts of the DEIS and FEIS in response to comments/concerns/issues identified by NSB.

F. NOAA will ensure that NSB receives copies of all comments received on the DEIS and FEIS during the public comment periods and provide an initial identification of those comments pertaining to NSB's expertise, interests, or regulatory authority. NOAA and NSB will collaborate to develop responses to those comments.

III. NSB (Cooperating Agency) RESPONSIBILITIES

A. NSB will actively participate in development of the EIS.

B. NSB will serve as the agency of expertise with regard to describing concerns about impacts to and interests of locally affected jurisdictions, statutory and regulatory mandates for NSB, and potential impacts to resources critical to NOAA's analysis.

C. NSB will review preliminary documents and provide comments to NOAA in accordance with specified timelines.

D. NSB will manage and be responsible for its own resources, such as people, time, and money to assist NOAA in the development of the EIS.

E. NSB will provide NOAA with timely identification of significant issues, range of EIS alternatives, and mitigation and monitoring measures for NOAA to consider for inclusion in the DEIS and FEIS related to NSB's responsibilities and authorities.

IV. PRINCIPAL POINTS OF CONTACT

James H. Lecky	Edward S. Itta
NOAA/NMFS	NSB
1315 East West Highway, Rm. 13821	P.O. Box 69
Silver Spring, Maryland 20910	Barrow, Alaska 99723
(301) 713-2332	(907) 852-2611

Either NOAA or NSB may terminate this agreement at any time by providing written notice to the other party.

NOAA AND NSB AGREE TO THIS MOU AS OF THE LATTER OF THE TWO DATES WRITTEN BELOW:

Date: JUL 2 0 2010 By: _____

James H. Lecky
Director, Office of Protected Resources
NOAA/NMFS

Date: 07-30-10 By: _____

Edward S. Itta
Mayor
NSB

APPENDIX E

Standard and Additional Mitigation Measures

TABLE OF CONTENTS

Appendix E: Standard and Additional Mitigation Measures Addressing Impacts to Marine Mammals and Subsistence Activities..... 1

NMFS Standard Mitigation Measures.....1

A. DETECTION-BASED MEASURES INTENDED TO REDUCE NEAR-SOURCE ACOUSTIC EXPOSURES AND IMPACTS ON MARINE MAMMALS WITHIN A GIVEN DISTANCE OF THE SOURCE 1

B. NON-DETECTION-BASED MEASURES INTENDED TO MORE BROADLY LESSEN THE SEVERITY OF ACOUSTIC IMPACTS ON MARINE MAMMALS OR REDUCE OVERALL NUMBERS TAKEN BY ACOUSTIC SOURCE 3

C. MEASURES INTENDED TO REDUCE/LESSEN NON-ACOUSTIC IMPACTS ON MARINE MAMMALS.....4

D. MEASURES INTENDED TO ENSURE NO UNMITIGABLE ADVERSE IMPACT TO SUBSISTENCE USES 5

Additional Mitigation Measures 7

A. DETECTION-BASED MEASURES INTENDED TO REDUCE NEAR-ARRAY ACOUSTIC EXPOSURES AND IMPACTS ON MARINE MAMMALS WITHIN A GIVEN DISTANCE OF THE SOURCE 7

B. NON-DETECTION-BASED MEASURES INTENDED TO MORE BROADLY LESSEN THE SEVERITY OF ACOUSTIC IMPACTS ON MARINE MAMMALS OR REDUCE OVERALL NUMBERS TAKEN BY ACOUSTIC SOURCE 9

C. MEASURES INTENDED TO REDUCE/LESSEN NON-ACOUSTIC IMPACTS ON MARINE MAMMALS.....9

D. MEASURES INTENDED TO ENSURE NO UNMITIGABLE ADVERSE IMPACT TO SUBSISTENCE USES 10

List of Tables

Table E-1 Proposed Time/Area closure locations under Additional Mitigation Measure B1. This table identifies the species and subsistence hunts that would be mitigated by implementing these closures.....11

Appendix E: Standard and Additional Mitigation Measures Addressing Impacts to Marine Mammals and Subsistence Activities

NMFS Standard Mitigation Measures

The mitigation measures[1] (and the identified mitigation monitoring needed to support them) listed below are planned for inclusion as a requirement under every MMPA ITA issued for the relevant activity type. Sections 4.5.2.4.16 and 4.5.3.2.3 in Chapter 4 of this FEIS note the applicable activity types for each measure described below.

A. DETECTION-BASED MEASURES INTENDED TO REDUCE NEAR-SOURCE ACOUSTIC EXPOSURES AND IMPACTS ON MARINE MAMMALS WITHIN A GIVEN DISTANCE OF THE SOURCE

Mitigation Measure A1. Establishment and execution of 180 dB shutdown/power down radius for cetaceans and 190 dB shutdown/power down radius for ice seals.

NMFS has recommended and included shutdown/powerdown zones at the 180/190 dB isopleths as standard required mitigation measures in MMPA authorizations for seismic surveys for several years. Language that would be included in an ITA includes:

- Establish and have trained Protected Species Observers (PSOs) monitor a preliminary exclusion zone for cetaceans surrounding the airgun array on the source vessel where the received level would be 180 dB or greater. The radius for the zone will vary based on the airgun array used, water depth, and numerous other factors related to the water and seafloor properties.
- Establish and monitor a preliminary exclusion zone for pinnipeds surrounding the airgun array on the source vessel where the received level would be at or above 190 dB with trained PSOs. The radius for the zone will vary based on the airgun array used, water depth, and numerous other factors related to the water and seafloor properties.
- Immediately power-down the seismic airgun array and/or other acoustic sources, whenever any cetaceans are sighted approaching close to or within the area delineated by the 180 dB, or pinnipeds are sighted approaching close to or within the area delineated by the 190 dB isopleth.
- If the power-down operation cannot reduce the received sound pressure level at the cetacean or pinniped to less than 180 dB or 190 dB, respectively, then the holder of the ITA must immediately shutdown the seismic airgun array and/or other acoustic sources.
- The seismic airgun array cannot be powered up unless the marine mammal exclusion zones are visible and no marine mammals are detected within the appropriate safety zones for a minimum of 15 minutes (small odontocetes, pinnipeds) or 30 minutes (for mysticetes). The seismic array can be ramped up once the PSOs have no further visual detection of the animal(s) within the exclusion zone, and they are confident that no marine mammals remain within the appropriate exclusion zone.

[1] These measures have been included in past ITAs issued by NMFS in the Arctic Ocean or have been deemed appropriate to include in all future ITAs based on the analysis contained in the FEIS.

Mitigation Measure A2. Specified ramp-up procedures for airgun arrays.

Ramp-up is the gradual introduction of sound to deter marine mammals from potentially damaging sound intensities and from approaching the exclusion zone. This technique involves the gradual increase (usually approximately 5-6 dB per 5-minute interval or by doubling the number of guns firing at 5-minute intervals when very small arrays are used) in emitted sound levels, beginning with firing a single airgun and gradually adding airguns over a period of 20 to 40 minutes, until the desired operating level of the full array is obtained. Ramp-up procedures are instituted based on the assumption that any marine mammals in the vicinity of seismic operations will become aware of the sound source before it rises to potentially harmful levels and to leave the area. The 180- and 190-dB exclusion zones described in the previous measure are used for the ramp-up procedures as well. Language that would be included in an ITA includes:

- Conduct a 30-minute period of marine mammal observations by at least two trained PSOs to verify that the exclusion zone is clear prior to commencing ramp-up at the commencement of seismic operations and at any time the airgun array has been shut down for a certain period of time. The period of shutdown requiring a full ramp-up is based on the size of the airgun array but is typically between 8 and 10 minutes.
- Do not commence ramp-up if the entire exclusion zones are not visible for at least 30 minutes prior to ramp-up in either daylight or nighttime and do not commence ramp-up at night unless the seismic source has maintained a sound pressure level at the source of at least 180 dB during the interruption of full seismic survey operations. If a sound source of at least 180 dB has been maintained during the interruption of seismic operations, then the 30 minute pre-ramp-up visual survey is waived.
- Ramp-up the airgun arrays at no greater than 6 dB per 5-minute interval or by doubling the number of guns firing at 5-minute intervals when very small arrays are used starting with the smallest airgun in the array and then adding additional guns in sequence until the full array is firing if no marine mammals are observed in the exclusion zones and periods specified above. Ramp-up procedures should be used at the commencement of seismic operations and any time after the airgun array has been shut down for a certain period of time.

Mitigation Measure A3. Protected Species Observers (PSOs) required on all seismic source vessels and ice breakers, as well as on dedicated monitoring vessels.

PSOs are a key component both for the purposes of implementing mitigation measures, such as shutdowns and ramp-ups, and for gathering information pursuant to the monitoring requirements of the ITA (latter addressed separately). Mitigation monitoring requirements in ITAs include:

- The holder of the ITA must designate trained, NMFS-approved, individuals (PSOs) to be onboard the source vessel and icebreakers to conduct the visual monitoring programs required under the ITA and to record the effects of seismic surveys and/or icebreaking operations and the resulting noise on marine mammals.
- To the extent possible, PSOs should be on duty for four consecutive hours or less, although more than-one four-hour shift per day is acceptable. PSOs will not work more than three shifts in a 24-hour period (i.e. 12 hours total per 24-hour period).
- Monitoring is to be conducted by the PSOs onboard the active seismic vessel or icebreaker (including in-ice surveys), to (A) ensure that no marine mammals enter the appropriate exclusion zone whenever the seismic sources are on or active icebreaking is occurring, and (B) to record marine mammal activity. At least two observers must be on watch the 30 minutes prior to full ramp up, during ramp ups, and for as much of the other

operating hours as possible. At all other times, at least one observer must be on active watch (1) whenever the seismic source is operating or active icebreaking is occurring during the daytime; (2) during any nighttime power-ups of the airguns; and (3) at night, whenever one or more power-down situations the preceding day were due to marine mammal presence.

- At all times, the crew must be instructed to keep watch for marine mammals. If any are sighted, the bridge watch-stander must immediately notify the PSO(s) on-watch. If a marine mammal is within or closely approaching its designated exclusion zone, the seismic acoustic sources must be immediately powered down or shutdown.
- Monitoring will consist of recording: (A) the species, group size, age/size/sex categories (if determinable), the general behavioral activity, heading (if consistent), bearing and distance from seismic vessel or icebreaker, sighting cue, behavioral pace, and apparent reaction of all marine mammals seen near the seismic vessel and/or its airgun array or the icebreaker (e.g. none, avoidance, approach, paralleling, etc.); (B) the time, location, heading, speed, and activity of the vessel (shooting or not), along with sea state, visibility, cloud cover and sun glare at (1) any time a marine mammal is sighted, (2) at the start and end of each watch, and (3) during a watch (whenever there is a change in one or more variable); and, (C) the identification of all vessels that are visible within 5 km (3.1 mi) of the seismic-vessel or icebreaker whenever a marine mammal is sighted, and the time observed, bearing, distance, heading, speed and activity of the other vessel(s).

Mitigation Measure A4. All on-ice activities must be conducted at least 152 m (500 ft) from any observed ringed seal lair. No energy source may be placed over a ringed seal lair. Operators will use trained seal-lair sniffing dogs or a comparable method to locate the seal structures before initiation of activities.

- This measure requires survey crews to be trained in seal detection and to search for ringed seal lairs around intended seismic survey operation sites and prohibits seismic activities and impact work within a 152 m (500 ft) radius of ringed seal subnivean lairs. Operators shall use trained seal-lair sniffing dogs or a comparable method in areas with water deeper than 3 m (9.8 ft) depth contour to locate the seal structures before the initiation of activities. Additionally, while traveling on ice roads, the area shall be monitored for marine mammals, especially ringed seal lairs.
- No ice roads may be built between the mobile camp and work site. Travel between mobile camp and work site shall also be monitored for marine mammals and be done by vehicles driving through on a snow road. Vehicles must avoid any pressure ridges, ice ridges, and ice deformation areas where seal structures are likely to be present.

B. NON-DETECTION-BASED MEASURES INTENDED TO MORE BROADLY LESSEN THE SEVERITY OF ACOUSTIC IMPACTS ON MARINE MAMMALS OR REDUCE OVERALL NUMBERS TAKEN BY ACOUSTIC SOURCE

Mitigation Measure B1. Specified flight altitudes for all support aircraft except for take-off, landing, and emergency situations.

- Aircraft shall not operate below 457 m (1,500 ft) unless the aircraft is engaged in approaching, landing or taking off, or unless engaged in providing assistance to a whaler

or in poor weather (low ceilings) or any other emergency situations. Aircraft shall not operate below 305 m (1,000 ft) during marine mammal monitoring when operating outside of active subsistence areas. Aircraft engaged in marine mammal monitoring shall not operate below 457 m (1,500 ft) in areas of active subsistence use; such areas are to be identified through communications with the Communication Centers.

- Except for airplanes engaged in marine mammal monitoring, aircraft shall use a flight path that keeps the aircraft at least five miles inland until the aircraft is directly (south) of its offshore destination, then at that point it shall fly directly to its destination. This is applicable to the Beaufort Sea only.
- Helicopters shall not hover or circle above groups of marine mammals or within 457 m (1,500 ft) of such groups.
- When weather conditions do not allow a 457 m (1,500 ft) flying altitude, such as during severe storms or when cloud cover is low, aircraft may be operated below the 457 m (1,500 ft) altitude. However, when aircraft are operated at altitudes below 457 m (1,500 ft) because of weather conditions, the operator must avoid whale concentrations and concentration areas and should take precautions to avoid flying directly over or within 1,372 m (4,501 ft) of groups of whales.

C. MEASURES INTENDED TO REDUCE/LESSEN NON-ACOUSTIC IMPACTS ON MARINE MAMMALS

Mitigation Measure C1. Specified procedures for changing vessel speed and/or direction to avoid collisions with marine mammals.

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

- Reduce vessel speed to less than 5 knots when within 274 m (900 ft) of whales.
- Vessels capable of steering around the whales should do so.
- Vessels may not be operated in such a way as to separate members of a group of whales from other members of the group.
- Avoid multiple changes in direction and speed when within 274 m (900 ft) of whales. In addition, operators should check the waters immediately adjacent to a vessel to ensure that no whales will be injured when the vessel's propellers (or screws) are engaged.

When weather conditions require, such as when visibility drops, adjust vessel speed accordingly, but not to exceed 5 knots, to avoid the likelihood of injury to whales.

D. MEASURES INTENDED TO ENSURE NO UNMITIGABLE ADVERSE IMPACT TO SUBSISTENCE USES

Mitigation Measure D1. Shutdown of exploration activities occurring in specific areas of the Beaufort Sea corresponding to the start and conclusion of the fall bowhead whale hunts in Nuiqsut (Cross Island) and Kaktovik beginning on August 25. Language to be included in ITAs to account for fall bowhead whaling in the central Beaufort Sea includes:

- No geophysical or exploratory drilling activity from the Canadian Border to the Canning River (146 deg. 4 min. W) from August 25 to close of the fall bowhead whale hunts in Kaktovik and Nuiqsut.
- The bowhead whale subsistence hunt will be considered closed for a particular village when the village Whaling Captains' Association declares the hunt ended or the village quota has been exhausted (as announced by the village Whaling Captains' Association or the Alaska Eskimo Whaling Commission [AEWC]), whichever occurs earlier.
- From Pt. Storkerson (~148 deg. 42 min. W) to Thetis Island (~150 deg. 10.2 min. W);
    - Inside the Barrier Islands: No geophysical activity prior to July 25. Geophysical activity is allowed from July 25 until completion of operations. Geophysical activity allowed in this area after August 25 shall include a source array of no more than 12 airguns, a source layout no greater than 8 m x 6 m (26.2 ft x 19.7 ft), and a single source volume no greater than 14.4 liters (880 in^3).
    - Outside the Barrier Islands: No geophysical or exploratory drilling activity from August 25 to close of fall bowhead whale hunting in Nuiqsut. Geophysical activity is allowed at all other times.
- From Canning River (~146 deg. 4 min. W) to Pt. Storkerson (~148 deg. 42 min. W), no geophysical or exploratory drilling activity from August 25 to the close of bowhead whale subsistence hunting in Nuiqsut.

Mitigation Measure D2. Establishment and utilization of Communication Centers in subsistence communities to address potential interference with marine mammal hunts on a real-time basis throughout the season.

To address potential interference with marine mammal hunts on a real-time basis, exploration companies shall participate in the establishment and interaction with Communication Centers in affected subsistence communities. The Communication Centers are to be operated on a 24-hour basis during the fall bowhead whale hunting season.

- Upon notification by a Communication Center operator of an at-sea emergency, the holder of the ITA shall provide such assistance as necessary to prevent the loss of life, if conditions allow the holder of the ITA to safely do so.
- Upon request for emergency assistance made by a subsistence whale hunting organization, or by a member of such an organization, in order to prevent the loss of a whale, the holder of the ITA shall assist towing of a whale taken in a traditional subsistence whale hunt, if conditions allow the holder of the ITA to safely do so.

Mitigation Measure D3. For exploratory drilling operations in the Beaufort Sea east of Cross Island, no drilling equipment or related vessels used for at-sea oil and gas operations shall be onsite at any offshore drilling location east of Cross Island from August 25 until the close of the bowhead whale hunt in Nuiqsut and Kaktovik.

However, such equipment may remain within the Beaufort Sea in the vicinity of 71 deg. 25 min. N and 146 deg. 4 min. W or at the edge of the Arctic ice pack, whichever is closer to shore.

Mitigation Measure D4. No transit of oil and gas exploration vessels into the Chukchi Sea prior to July 1.Any oil and gas exploration vessel transiting through the Chukchi Sea on or after July 1 shall remain at least 8 km (5 mi) offshore during transit except for emergencies or human/navigation safety or for any vessel actively engaged in transit to or from a coastal community to conduct crew changes or logistical support operations.

Mitigation Measure D5. Shutdown of exploration activities in the Beaufort Sea and within 100 miles of the coastline in the Chukchi Sea from Pitt Point on the east side of Smith Bay (~152 deg. 15 min. W) to a location about half way between Barrow and Peard Bay (~157 deg. 20 min. W) from September 15 to the close of the fall bowhead whale hunt in Barrow.

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

BOEM Standard Mitigation Measures

The following measures are typically required by BOEM in G&G permits issued under the OCS Lands Act. These measures are not standardized in regulations. However, they have typically been required in recent years and are adjusted periodically, as needed.

- No solid or liquid explosives shall be used without specific approval.
- Permittee operations shall be conducted in a manner to ensure that they will not cause pollution, cause undue harm to aquatic life, create hazardous or unsafe conditions, or unreasonably interfere with other uses of the area. If any difficulties are encountered with other uses of the area or any of the above mentioned scenarios occur during operations under this permit, they shall be reported to the Regional Supervisor, Resource Evaluation. Serious or emergency conditions shall be reported without delay.
- Permittee operators shall use the lowest sound levels feasible to accomplish their data-collection needs.
- When any operator becomes aware of the potentially harassing effects of operations on whales, or when any operator is unsure of the best course of action to avoid harassment of whales, every measure to avoid further harassment shall be taken until NMFS is consulted for instructions or directions. However, human safety shall take precedence at all times over the guidelines and distances recommended herein for the avoidance of disturbance and harassment of whales.
- The Permittee shall notify BOEM, NMFS, and U.S. Fish and Wildlife Service (USFWS) in the event of any loss of cable, streamer, or other equipment that could pose a danger to marine mammals and other wildlife resources.
- To help avoid causing bird collisions with seismic survey and support vessels, seismic and surface support vessels will minimize the use of high-intensity work lights, especially within the 20-meter-bathymetric contour. High-intensity lights will be used only as necessary to illuminate active, on-deck work areas during periods of darkness or inclement weather (such as rain or fog), otherwise they shall be turned off. Deck lights, interior lights, and lights used during navigation could remain on for safety. Nothing in this mitigation measure is intended to reduce personnel

safety or prevent compliance with other regulatory requirements (e.g., U.S. Coast Guard or Occupational Safety and Health Administration) for marking or lighting of equipment and work areas.

- All bird collisions (with vessels and aircraft) shall be documented and reported within 3 days to BOEM. Minimum information shall include species, date, time, location and weather, identification of the vessel or aircraft involved, and its operational status when the strike occurred. Bird photographs are not required, but would be helpful in verifying species. Permittees/operators are advised that the USFWS does not recommend recovery or transport of dead or injured birds due to avian influenza concerns.

Additional Mitigation Measures

The following mitigation measures (and mitigation monitoring needed to support them) are evaluated in Chapter 4 and may be required by NMFS in ITAs or by BOEM in G&G permits or ancillary activity notices to make the necessary findings under the MMPA and OCSLA, respectively, for the relevant activity type. Sections 4.5.2.4.17 and 4.5.3.2.5 in Chapter 4 of this FEIS note the applicable activity types for each measure described below.

A. DETECTION-BASED MEASURES INTENDED TO REDUCE NEAR-ARRAY ACOUSTIC EXPOSURES AND IMPACTS ON MARINE MAMMALS WITHIN A GIVEN DISTANCE OF THE SOURCE

Additional Mitigation Measure A1. Prior to conducting the authorized seismic survey or drilling program, the operator shall conduct SSV tests for their airgun array configurations, drilling units, other acoustic sources, icebreakers engaged in icebreaking, and support vessels in the area in which the survey or drilling program is proposed to occur and report the broadband received levels of 190 dB, 180 dB, 160 dB, and 120 dB radii from the sound sources to the authorizing entity within 10 days of completion of the SSV tests.

This measure may be applied to all, or only a subset, of the sound sources listed above. Before conducting the activity, the operators shall conduct sound source verification (SSV) tests to verify the radii of the exclusion and monitoring zones within real-time conditions in the field, providing for more accurate radii to be used. The purpose of this mitigation measure is to establish and monitor more accurate exclusion zones based on empirical measurements, as compared to the zones based on modeling and extrapolation from different datasets. Using a hydrophone system, the vessel operator is required to conduct SSV tests for all airgun array configurations, drilling units, other acoustic sources, icebreakers engaged in icebreaking, and support vessels and, at a minimum, report the following preliminary results to NMFS within 10 days of completing the test:

- The empirical distances from the measured acoustic sources utilized during the effectiveness of the ITA to broadband received levels of 190 dB down to 120 dB in 10 dB increments and the radiated sounds vs. distance from the source vessel.
- Measurements are to be made at the beginning of the survey for locations not previously modeled in the U.S. Beaufort and Chukchi Seas.

Additional Mitigation Measure A2. All PSOs shall be provided with and use appropriate ocular equipment in order to detect marine mammals within the exclusion zones. This may include the use of night-vision devices (e.g. Forward Looking Infrared

[FLIR] imaging devices, 360° thermal imaging devices), Big Eyes, and reticulated and/or laser range finding binoculars.

- This measure would be required for all activities requiring the use of PSOs.
- All PSOs could be provided with and use appropriate night-vision devices, Big Eyes, and reticulated and/or laser range finding binoculars in order to detect marine mammals within the exclusion zone.

Additional Mitigation Measure A3. Operators shall limit seismic airgun operations in situations of low visibility when the entire exclusion radius cannot be observed (e.g., nighttime or bad weather) and ocular equipment, such as FLIR or 360° thermal imaging devices, are not being used to increase the probability of marine mammal detection. These limitations could mean the cessation of airgun operations entirely, a reduction of the time that operations are conducted in this limited visibility situation, or a reduction of the number of airguns operating so that the exclusion radius is minimized and entirely visible.

Additional Mitigation Measure A4. Seismic operators shall use passive acoustic monitoring systems, in addition to visual monitoring, to detect marine mammals approaching or within the exclusion zone and trigger the shutdown of airguns.

Additional Mitigation Measure A5. Enhancement of monitoring protocols and mitigation shutdown zones to minimize impacts in specific biologic situations (for example, but not limited to, expansion of shutdown zone to 120 dB or 160 dB when cow/calf groups and feeding or resting aggregations are detected, respectively).

- Some characteristic mitigation language that has been used in past ITAs regarding shutdown zones for cow/calf groups and feeding or resting aggregations has proven to be ineffective. NMFS will consider future measures on a case-by-case basis.

Additional Mitigation Measure A6. PSOs required on all drill ships (including rigs and ships).

- PSO requirements would be the same as those identified for Standard Mitigation Measure A3. PSOs are required on all types of drilling units and all support vessels. PSOs will watch during active drilling operations and transits.

Additional Mitigation Measure A7. Operators are required to implement specific procedures for use of the mitigation airgun during seismic activities.

- When utilizing the mitigation airgun, operators shall use a reduced duty cycle (e.g., 1 shot/minute).
- The mitigation airgun shall not be operated for an extended period of time (e.g., more than 2 or 3 hours) during daylight hours and good visibility.
- In cases when the next start-up after the turn is expected to be during lowlight or low visibility, use of the mitigation airgun may be initiated 30 minutes before darkness or low visibility conditions occur and may be operated until the start of the next seismic acquisition line. However, the mitigation airgun must still be operated at a reduced duty cycle.

B. NON-DETECTION-BASED MEASURES INTENDED TO MORE BROADLY LESSEN THE SEVERITY OF ACOUSTIC IMPACTS ON MARINE MAMMALS OR REDUCE OVERALL NUMBERS TAKEN BY ACOUSTIC SOURCE

Additional Mitigation Measure B1. Temporal/spatial limitations to minimize impacts in particular important habitats, including Kaktovik, Cross Island, Barrow Canyon and the western Beaufort Sea, Hanna Shoal, the shelf break of the Beaufort Sea, Point Franklin to Barrow, Kasegaluk Lagoon, and Ledyard Bay.

All, or a subset of, oil and gas activities would be limited (e.g., either completely prohibited, or the overall time reduced) in the areas specified here during the listed timeframes. Additionally, buffer zones around these time/area closures could potentially be included. Buffer zones would require that activities emitting pulsed sounds would need to operate far enough away from these closure areas so that sounds at 160 dB do not propagate into the area or that activities emitting continuous sounds would need to operate far enough away from these closure areas so that sounds at 120 dB do not propagate into the area. In the event that a buffer zone of this size was impracticable, a smaller buffer zone avoiding the ensonification of the important habitat above a higher level could be used (e.g., 180 dB, or something else that was though to minimize the likelihood of auditory injurious exposures). Table E-1 below outlines the time/area closure locations, dates, and species or subsistence hunts that would be protected by the closures.

C. MEASURES INTENDED TO REDUCE/LESSEN NON-ACOUSTIC IMPACTS ON MARINE MAMMALS

Additional Mitigation Measure C1. Specified transit routes of vessels and aircraft involved in oil and gas exploration activities with an associated MMPA Incidental Take Authorization to minimize impacts in particular important habitat in areas where marine mammals may occur in high densities.

Additional Mitigation Measure C2. Requirements to ensure reduced, limited, or zero discharge of any or all of the specific discharge streams identified with potential impacts to marine mammals or marine mammal prey or habitat.

Discharge streams identified with potential impacts to marine mammals or marine mammal habitat include the following:

- Drill cuttings;
- Drilling fluids;
- Sanitary waste;
- Bilge water;
- Ballast water; and
- Domestic waste (i.e. gray water).

Additional Mitigation Measure C3. Operators are required to recycle drilling muds to the extent practicable based on operational considerations (e.g., whether mud properties have deteriorated to the point where they cannot be used further).

- Operators are required to recycle drilling muds (e.g. use those muds on multiple wells) based on operational considerations to reduce discharges.

D. MEASURES INTENDED TO ENSURE NO UNMITIGABLE ADVERSE IMPACT TO SUBSISTENCE USES

Additional Mitigation Measure D1. From August 25 until the close of the fall bowhead whale hunts by the communities of Kaktovik and Nuiqsut, vessels transiting east of Bullen Point to the Canadian border should remain at least 8 km (5 mi) offshore during transit along the coast, provided ice and sea conditions allow, except for emergencies or human/navigation safety or for any vessel engaged in transit to or from a coastal community to conduct crew changes or logistical support operations.

Additional Mitigation Measure D2. For exploratory drilling operations in the Beaufort Sea west of Cross Island, no drilling equipment or related vessels used for at-sea oil and gas operations shall be moved onsite at any location outside the barrier islands west of Cross Island from September 15 until the close of the fall bowhead whale hunt in Barrow.

Additional Mitigation Measure D3. All oil and gas industry exploration vessels shall complete operations in time to allow such vessels to complete transit through the Bering Strait to a point south of 59 degrees N latitude no later than November 15.

- Any vessel that encounters weather or ice that will prevent compliance with the November 15 date shall coordinate its transit through the Bering Strait to a point south of 59 degrees N latitude with the appropriate Communication Centers (see Standard Mitigation Measure D2).
- All industry vessels shall, weather and ice permitting, transit east of St. Lawrence Island and no closer than 16 km (10 mi) from the shore of St. Lawrence Island.

Table E-1 Proposed Time/Area closure locations under Additional Mitigation Measure B1. This table identifies the species and subsistence hunts that would be mitigated by implementing these closures

	Kaktovik	Barrow Canyon and the Western Beaufort Sea	Beaufort Sea Shelf Break	Hanna Shoal	Point Franklin to Barrow	Kasegaluk Lagoon and Ledyard Bay
Proposed closure period	August 25 - September 15	Mid-July - October	Mid-July - late September	September 15 - early October	June to September	Mid-June - mid-July for the Lagoon and July 1 – November 15 for the LBCHU
Bowhead Whale	Migrating and feeding: late August - October	Migrating and feeding: late August - October	Migrating: late August - October	Part of migratory corridor: September - October	Feeding and milling: September – October; May occur June – July	Do not occur (migrate offshore)
Beluga Whale	Uncommon	Migrating and feeding: mid-July - late August	Feeding: mid-July - late September	Unknown	Occasional: July, August, October	Feeding, molting, calving: June and July
Gray Whale	Uncommon	Feeding, milling: June – October	Present	Present	Feeding, calving, milling: June – October	Feeding, calving: June – October
Spotted Seal	Present	Present	Present	Present	Present	Present; Some feeding habitat
Pacific Walrus	Not present	Not present	Not Present	Feeding: July - August	Present: June, July, September	Resting habitat: Spring and early winter
Whaling Hunts	Bowhead whales: late August - mid-September	Bowhead whales: September - October	Uncommon	None	Bowhead whales: September-October	Beluga whales: mid-June - mid-July in the Lagoon only

	Kaktovik	Barrow Canyon and the Western Beaufort Sea	Beaufort Sea Shelf Break	Hanna Shoal	Point Franklin to Barrow	Kasegaluk Lagoon and Ledyard Bay
Sealing Hunts	Mostly October - June	Mostly November - January and spring	Uncommon	None	Mostly November – January and spring – summer	Mostly October - June

Mitigation Measures Considered but Not Carried Forward

The mitigation measures listed here were considered in the DEIS and/or SEIS as additional mitigation measures. Based on public comments and further analysis, NMFS determined that these measures should not be included in any future MMPA ITAs. The full analysis and explanation is contained in sections 4.5.2.4.18 and 4.5.3.2.7.

- Restriction of number of surveys (of same level of detail) that can be conducted in the same area in a given amount of time (i.e. to avoid needless collection of identical data).
- Separate seismic surveys are prohibited from operating within 145 km (90 mi) of one another.
- Vessels and aircraft avoidance of concentrations of groups of ice seals by 0.8 km (0.5 mi).
- Shutdown of exploration activities in the Beaufort Sea for the Nuiqsut (Cross Island) and Kaktovik bowhead whale hunts based on real-time reporting of whale presence and hunting activity rather than a fixed date.
- Shutdown of exploration activities in the Chukchi Sea for the Barrow (the area circumscribed from the mouth of Tuapaktushak Creek due north to the coastal zone boundary, to Cape Halkett due east to the coastal zone boundary) and Wainwright (the area circumscribed from Point Franklin due north to the coastal zone boundary, to the Kuk River mouth due west to the coastal zone boundary) bowhead whale hunts based on real-time reporting of whale presence and hunting activity rather than a fixed date.
- Shutdown of exploration activities in the Chukchi Sea for the Point Hope and Point Lay bowhead whale hunts based on real-time reporting of whale presence and hunting activity rather than a fixed date.
- Transit restrictions into the Chukchi Sea modified to allow offshore travel under certain conditions (e.g. 32 km [20 mi] from the coast) if beluga whale, fall bowhead whale (Barrow and Wainwright), and other marine mammal hunts would not be affected.

APPENDIX F

Cumulative and Chronic Effects in the Beaufort and Chukchi Seas: Estimating Reduction of Listening Area and Communication Space due to Seismic and Exploratory Drilling Activities in Support of the NMFS PEIS

Cumulative and Chronic Effects in the Beaufort and Chukchi Seas

Estimating Reduction of Listening Area and Communication Space due to Seismic and Exploratory Drilling Activities in Support of the NMFS PEIS

Submitted to:

Jolie Harrison
National Marine Fisheries Service
Contract: GS-10F-0105K/EA-133F-13-NC-0782

13 January 2016
Document # 01072
Version 1.0

Prepared by:

JASCO Applied Sciences (Canada) Ltd.
2305–4464 Markham Street
Victoria, BC V8Z 7X8 Canada
Tel: +1-250-483-3300
Fax: +1-250-483-3301
www.jasco.com

Suggested citation:

Matthews, M-N. R., A. Schlesinger, and D. Hannay. 2016. *Cumulative and Chronic Effects in the Beaufort and Chukchi Seas: Estimating Reduction of Listening Area and Communication Space due to Seismic and Exploratory Drilling Activities in Support of the NMFS PEIS*. JASCO Document # 01072. Technical report by JASCO Applied Sciences for AECOM.

Authors:

Marie-Noël R. Matthews, JASCO
Angela Schlesinger, JASCO
David Hannay, JASCO

Reviewers/Editors:

Dave Hannay, JASCO
Erin Dunable, AECOM

Contents

EXECUTIVE SUMMARY 1
1. INTRODUCTION 2
1.1. Acoustic Metrics 12
1.1.1. Root-Mean-Square Sound Pressure Level 12
1.1.2. Sound Exposure Level 12
1.1.3. Energy Equivalent Sound Pressure Level 13
1.2. Marine Species and Auditory Bands 14
1.3. Cumulative and Chronic Effects 14
2. MODELING METHODOLOGY 15
2.1. Acoustic Source Models 15
2.1.1. Airgun Arrays 15
2.1.2. Drilling and Support Vessels 16
2.2. Transmission Loss Model 16
2.3. Chronic and Cumulative Exposure (CCE) Calculator 17
2.3.1. Survey Distribution 18
2.3.2. Removal of Top 10% of Pulse Exposures 18
2.4. Ambient Levels 19
2.5. Listening Area 20
2.6. Bowhead Whale Communication Space 22
3. MODELED PARAMETERS 23
3.1. Acoustic Environment 23
3.1.1. Bathymetry 23
3.1.2. Sound Speed Profiles 23
3.1.3. Geoacoustic Profiles 24
3.2. Acoustic Sources 26
3.2.1. 3-D Seismic Survey 27
3.2.2. 2-D Seismic Survey 29
3.2.3. Ocean-bottom Cable Survey 31
3.2.4. Shallow Hazards Survey 33
3.2.5. Exploratory Drilling 35
3.3. Transmission Loss and CCE calculator 35
3.4. Bowhead Whale Communication Space 35
4. RESULTS 36
4.1. Cumulative Sound Exposure Levels 37
4.2. Time-Averaged Equivalent Sound Pressure Levels 39
4.3. Listening Area 42
4.4. Bowhead Whale Communication Space 45
5. DISCUSSION AND CONCLUSION 51
5.1. Site-specific Results 51

ACKNOWLEDGMENTS 53
LITERATURE CITED 54

Figures

Figure 1. PEIS project area and modeled receiver sites 3
Figure 2. Alternative 2 Scenario 1 6
Figure 3. Alternative 2 Scenario 2 7
Figure 4. Alternative 3 Scenario 1 8
Figure 5. Alternative 3 Scenario 2 9
Figure 6. Alternative 4 Scenario 1 10
Figure 7. Alternative 4 Scenario 2 11
Figure 8. The N×2-D and maximum-over-depth modeling approach used by MONM. 17
Figure 9. One-third-octave-band spectra of unfiltered ambient levels associated with each receiver site 19
Figure 10. Schematic representation of changes in listening area around a marine mammal. 20
Figure 11. Seasonal average (July to September) sound speed profiles for the three regions of the project area. 24
Figure 12. Comparison of maximum 1/3-octave-band source levels for all representative sources. 26
Figure 13. 3200 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. 27
Figure 14. 3200 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 μPa^2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. 28
Figure 15. 4500 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. 29
Figure 16. 4500 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 μPa2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. 30
Figure 17. 640 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. 31
Figure 18. 640 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 μPa^2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. 32
Figure 19. 40 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. 33
Figure 20. 40 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 μPa2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. 34

Tables

Table 1. Modeled receiver site locations and water depths. 2
Table 2. Modeled number of activities associated with each alternative in each sea. 4
Table 3. Activity types and sources used to represent the modeled activities. 5
Table 4. Estimated geoacoustic profile for Sites 1–6 25
Table 5. Estimated geoacoustic profile for Site 8 25
Table 6. Estimated geoacoustic profile for Sites 7, 9, and 10 25
Table 7. Broadband (10–5000 Hz) ambient SPL (dB re 1 μPa) for each receiver site. 36
Table 8. Alternative 2: Cumulative SEL (dB re 1 μPa^{2}s) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 37

Table 9. Alternative 3: Cumulative SEL (dB re 1 μPa^{2}s) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 37
Table 10. Alternative 4: Cumulative SEL (dB re 1 μPa^{2}s) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 38
Table 11. Alternative 2: Time-averaged equivalent sound pressure levels (L_{eq}) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 39
Table 12. Alternative 2: Time-averaged equivalent sound pressure levels (L_{eq}) above ambient at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting..... 39
Table 13. Alternative 3: Time-averaged equivalent sound pressure levels (L_{eq}) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 40
Table 14. Alternative 3: Time-averaged equivalent sound pressure levels (L_{eq}) above ambient at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting..... 40
Table 15. Alternative 4: Time-averaged equivalent sound pressure levels (L_{eq}) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 41
Table 16. Alternative 4: Time-averaged equivalent sound pressure levels (L_{eq}) above ambient at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting..... 41
Table 17. Alternative 2 relative to Alternative 1 (no activity): Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 42
Table 18. Alternative 3 relative to Alternative 1 (no activity): Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 42
Table 19. Alternative 4 relative to Alternative 1 (no activity): Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 43
Table 20. Alternative 2 relative to Alternative 3: Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 43
Table 21. Alternative 2 relative to Alternative 4: Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 44
Table 22. Alternative 3 relative to Alternative 4: Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting. 44
Table 23. Ambient (no activity) SPL (dB re 1 μPa) for 160 Hz for each receiver site. 45
Table 24. Alternative 2 relative to Alternative 1 (no activity): Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas. 45
Table 25. Alternative 3 relative to Alternative 1 (no activity): Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas. 46
Table 26. Alternative 4 relative to Alternative 1 (no activity): Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas. 47
Table 27. Alternative 2 relative to Alternative 3: Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas. 48
Table 28. Alternative 2 relative to Alternative 4: Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas. 49
Table 29. Alternative 3 relative to Alternative 4: Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas. 50

Executive Summary

This report presents the results of a cumulative and chronic effects assessment of noise exposures caused by oil and gas exploration activities corresponding with the four levels-of-activity considered in the Alternatives for the National Marine Fisheries Service (NMFS) Effects of Oil and Gas Exploration in the Arctic Ocean Final Programmatic Environmental Impact Statement (PEIS) (NMFS In progress). Two relatively new analysis methods were used to assess changes in listening area and communication space, specific to bowhead whales (*Balaena mysticetus*), (See Sections 2.5 and 2.6).

The listening area method follows an approach applied to an effects assessment for in-air sounds to birds (Barber et al. 2009), but it had not previously been applied to underwater noise and marine fauna. To our knowledge, this study, and a related assessment of cumulative and chronic effects of noise in the Gulf of Mexico, are the first applications of the listening area method to underwater sounds. The communication space assessment implemented the methods previously used for assessing anthropogenic noise effects on blue (*Balaenoptera musculus*) and fin (*Balaenoptera physalus*) whales by Clark et al. (2009).

The term “listening area” refers to the region of ocean over which sources of sound can be detected by an animal at the center of a space. Sound sources considered by this method can be the same species (such as calls from conspecifics), a different species (such as a predator or prey species), natural sounds (such as breaking surface waves), and anthropogenic sounds. The change in listening area method applied by Barber et al. (2009) calculates a fractional reduction in listening area due to the addition of anthropogenic noise to the environment. It does not provide absolute areas or volumes, as does the communication space method; however, a benefit of the change in listening area method is that it does not require the signal source levels. The method only depends on the rate of sound transmission loss. Changes in listening space can be related to the effects of anthropogenic noise on marine fauna.

The communication space assessment considers the region within the ocean surrounding a calling bowhead whale, in which other bowhead whales can detect its calls. The relationship between communication space and the well-being of bowhead whales is presently unknown. However, it is reasonable to assume that bowhead whale communications serve an important purpose, as it does in other marine mammals (e.g., attracting mates, identifying and locating offspring, and maintaining group structure) and that a reduction in communication space could affect a marine mammal’s health on an individual and possibly a population level. Bowhead whale communication space is limited by the masking of their calls due to natural ambient sounds and/or anthropogenic noise. Communication space is larger for louder calls. Adding ambient and especially anthropogenic noise to the environment surrounding the bowhead whales, leads to a decrease in communication space. Hence, the possible effects of anthropogenic noise on bowhead whales can be inferred by examining the reduction in communication space.

The key findings of this acoustic effects assessment are:

- Receiver sites along the Chukchi Sea coast that are far from the primary anthropogenic activities (Sites 1, 2, 5, and 6) experienced minimal reduction in listening area and communication space for bowhead whales.
- Receiver sites along the Beaufort Sea coast (Sites 7–10) showed greater effects from the activities modeled here than at the Chukchi coastal sites.
- The introduction of closure areas (Scenario 2) had a minimal effect on the change in listening area and bowhead whale communication space for all modeled alternatives. The effect is greatest for Site 7, located in the Barrow Canyon closure area.

1. Introduction

This study evaluates potential cumulative and chronic effects to marine mammals from noise exposures caused by oil and gas exploration activities in the Beaufort and Chukchi Seas in support of the National Marine Fisheries Service (NMFS) Effects of Oil and Gas Exploration in the Arctic Ocean Programmatic Environmental Impact Statement (PEIS) (NMFS In progress). The methods for calculating changes to listening area by Barber et al. (2009) and to communication space by Clark et al. (2009) were applied here. Both of these methods require knowledge of ambient and anthropogenic noise levels at receiver positions. JASCO Applied Sciences (JASCO) developed a framework to calculate cumulative sound exposure levels (SELs) produced by large numbers of geographically distributed acoustic sources, such as the seismic pulses from multiple seismic surveys using airgun arrays and continuous noise from exploratory drilling activities. SELs at ten receiver sites were calculated for several scenarios for three months of activities in the Alaskan Beaufort and Chukchi seas. The framework was implemented using scripted Excel spreadsheets, which incorporated acoustic transmission loss tables from sound propagation modeling of airgun arrays, drilling vessels, and shallow hazard geotechnical operations.

For the purpose of this assessment, ten receiver sites were selected (Table 1 and Figure 1) based on marine mammal breeding and feeding areas, subsistence hunting areas, as well as the migration patterns of several marine mammals including bowhead (*Balaena mysticetus*), beluga (*Delphinapterus leucas*), and gray whales (*Eschrichtius robustus*), walrus (*Odobenus rosmarus*), and various seals and porpoises (Section 3.2.4 of the Supplemental Draft Environmental Impact Statement (SDEIS); NMFS 2013).

Table 1. Modeled receiver site locations and water depths.

Site	Receiver Site	Latitude	Longitude	Water Depth (m)
1	West of Cape Lisburne	68.62	−167.91	51
2	Point Lay	69.82	−163.37	19
3	Chukchi leases	71.13	−162.43	44
4	Hanna Shoal	72.15	−163.33	32
5	Point Franklin	70.96	−159.62	55
6	Peard Bay	71.26	−157.30	55
7	East of Barrow	71.52	−154.85	31
8	Beaufort Sea shelf slope	71.54	−150.31	1854
9	Cross Island	70.56	−147.90	9
10	Kaktovik	70.28	−143.69	40

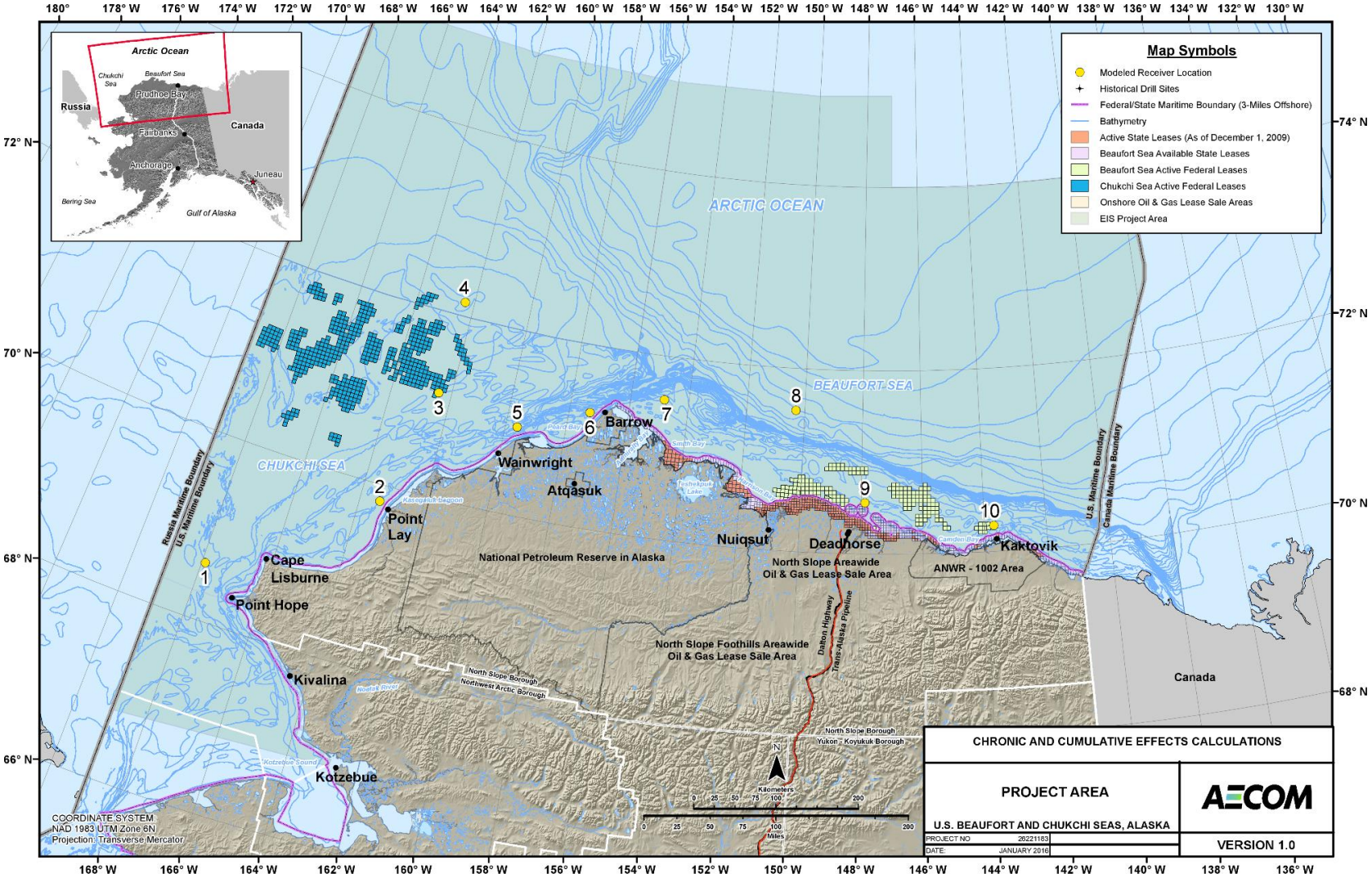


Figure 1. PEIS project area and modeled receiver sites (yellow dots).

The activity level alternatives considered here are based on the alternatives evaluated in the SDEIS (NMFS 2013)[1]:

- Alternative 1: No Activity
- Alternative 2: Authorization for level 1 exploration activity
- Alternative 3: Authorization for level 2 exploration activity
- Alternative 4: Authorization for level 3 exploration activity
- Alternative 5: Authorization for level 3 exploration activity with additional required time/area closures
- Alternative 6: Authorization for level 3 exploration activity with use of alternative technologies.

The modeled alternatives include a no-activity alternative (Alternative 1) and three activity levels (Alternatives 2–4) of increasing seismic and exploratory drilling activity (Table 2). Two scenarios were considered for each alternative: the first scenario assumed no closure areas. For the second scenario, activity that would occur within the closure areas of Kaktovik, Cross Island, Barrow Canyon, Hanna Shoal, Kasegaluk Lagoon, and Ledyard Bay were removed. Activities that would occur within a spatial buffer surrounding these closure areas were also removed to maintain sound pressure levels (SPL) below 160 dB re 1 μPa (90% rms) at the closure area boundaries, since this threshold is currently applied by NMFS as a marine mammal disturbance criterion for impulsive-type sounds. The omitted activities were not redistributed elsewhere.

Scenario 1 for Alternatives 1–4 in this report corresponds to Alternatives 1–4 of the SDEIS. Scenario 2 for Alternative 4 in this report corresponds to Alternative 5 of the SDEIS. Scenario 2 for Alternatives 2 and 3 were modeled for comparison purposes; they do not have an equivalent alternative in the SDEIS. Alternative 6 of the SDEIS, is not considered in this report.

Activities in each alternative include pre-defined 2-D and 3-D seismic surveys, 3-D ocean bottom cable surveys, shallow hazard surveys, and exploratory drilling activities. The number of activities modeled in this analysis (Table 2) were based on the conceptual examples provided in the SDEIS (Figures 4.3-1 to 4.5-3; NMFS 2013). Sources representing each type of seismic survey activity (Table 3) were modeled with JASCO's Airgun Array Source Model (AASM; MacGillivray 2006); source levels for exploratory drilling activities were based on measurements of a drillship and various support vessels (Austin et al. 2015). The selected airgun array sizes used for seismic exploration sources are representative of those used in the Arctic since 2006 (Austin et al. 2015).

Table 2. Modeled number of activities associated with each alternative in each sea.

Activity	Alternative 1		Alternative 2		Alternative 3		Alternative 4	
	Beaufort	Chukchi	Beaufort	Chukchi	Beaufort	Chukchi	Beaufort	Chukchi
2-D/3-D seismic survey	-	-	1	1	2	2	4	4
3-D ocean bottom cable survey	-	-	1	-	2	-	2	-
Shallow hazard survey	-	-	1	1	2	3	3	4
Exploration drilling	-	-	1	1	2	2	4	4

[1] Following the completion of this report, NMFS will finalize the PEIS (NMFS In progress). The definition of alternatives and closure areas for the PEIS were not finalized at the time of this analysis.

Table 3. Activity types and sources used to represent the modeled activities.

Activity	Representative Source	Pulse Spacing (m)
3-D seismic survey	3200 in^3 airgun array	37.5
2-D seismic survey	4500 in^3 airgun array	25
3-D ocean bottom cable survey	640 in^3 airgun array	25
Shallow hazard survey	40 in^3 airgun array	12.5
Exploration drilling	Mobile offshore drilling unit with 8–12 support vessels	-

The locations of the activities for each scenario are shown in Figures 2 to 7. In these figures, the closure areas are shown as hashed regions and surrounding buffer zones are marked as grey lines.

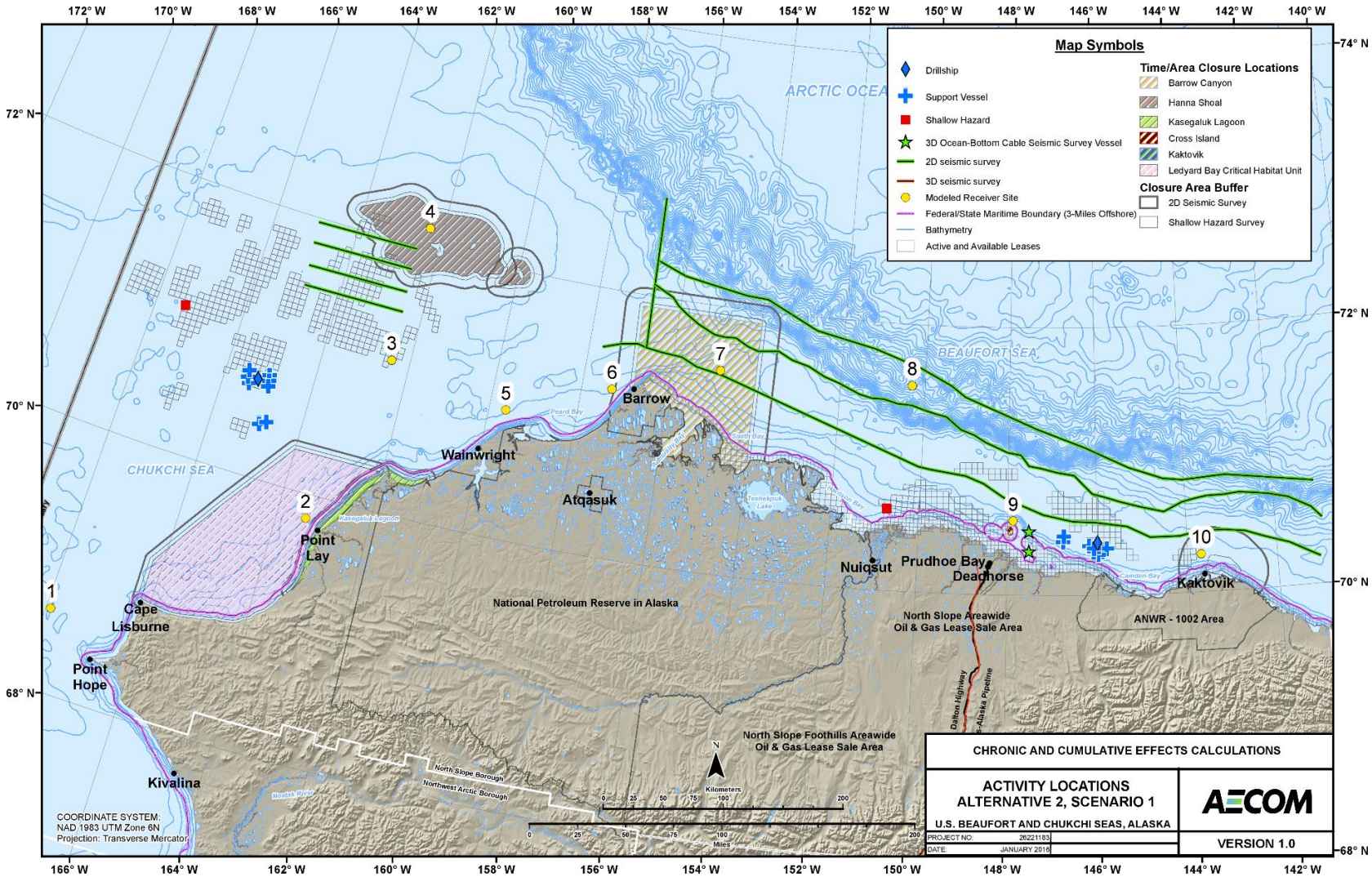


Figure 2. Alternative 2 Scenario 1: Activities include 2-D seismic surveys (green lines), drilling operations (blue cross and diamond), shallow hazard surveys (red square) and ocean bottom cable surveys (green stars). The ten receiver locations (yellow dots) and temporal closure areas with buffer zones (hashed colors and surrounding grey lines) are also shown.

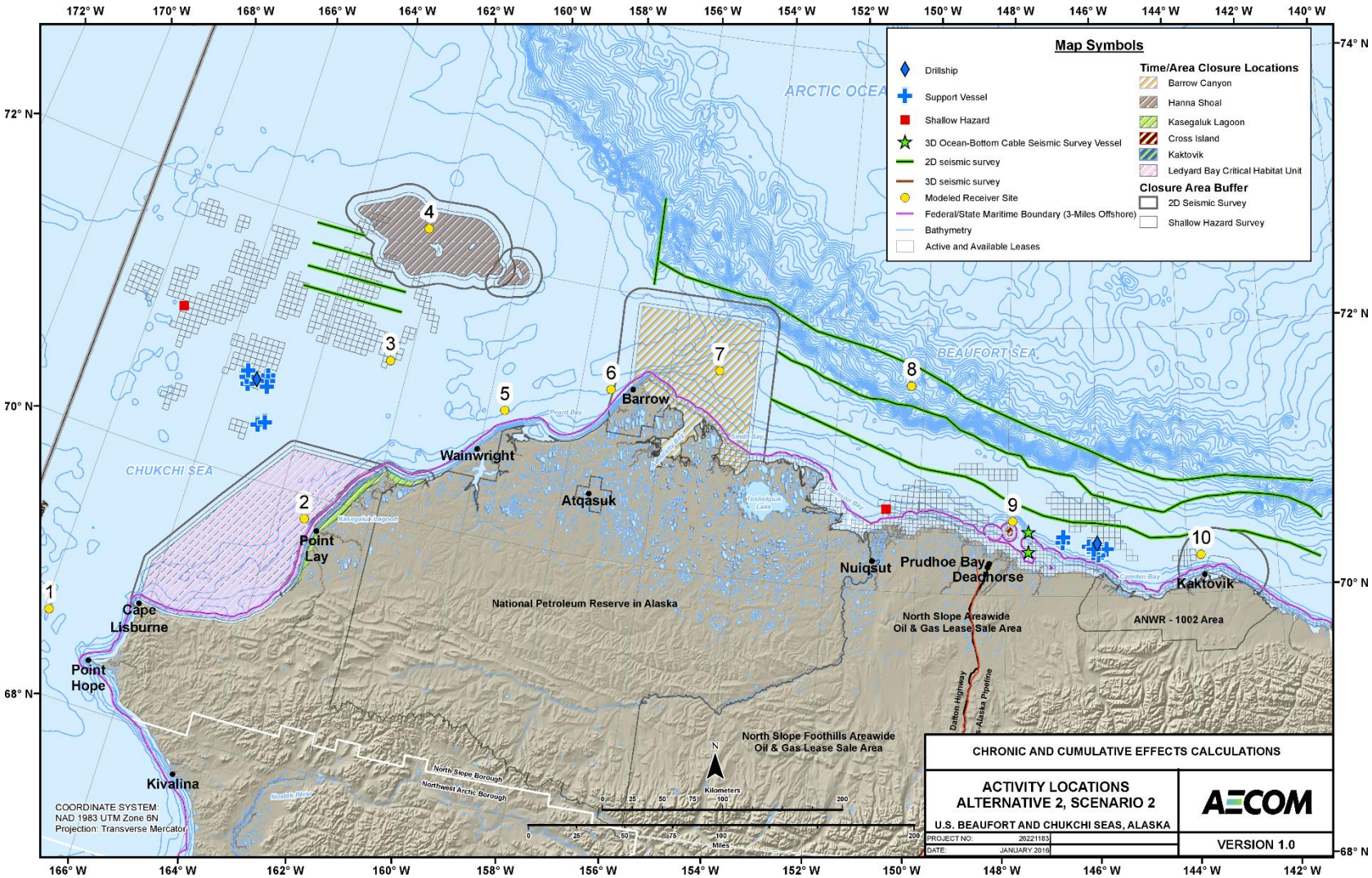


Figure 3. Alternative 2 Scenario 2: Activities include 2-D seismic surveys (green lines), drilling operations (blue cross and diamond), shallow hazard surveys (red square) and ocean bottom cable surveys (green stars). The ten receiver locations (yellow dots) and temporal closure areas with buffer zones (hashed colors and surrounding grey lines) are also shown.

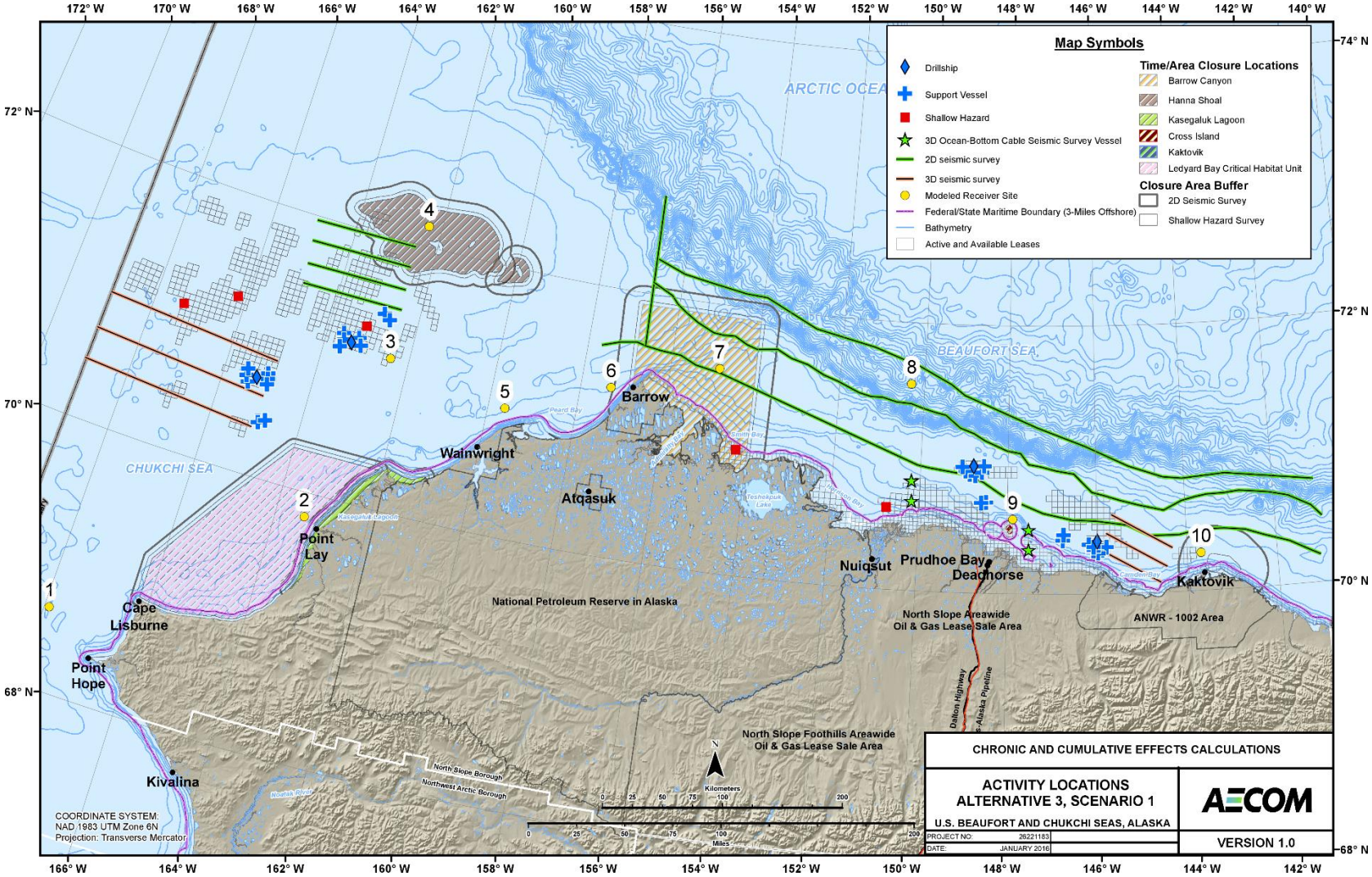


Figure 4. Alternative 3 Scenario 1: Activities include seismic 2-D surveys (green lines), seismic 3-D surveys (orange lines), drilling operations (blue cross and diamond), and shallow hazard (red square) and ocean bottom cable surveys (green stars). The ten receiver locations (yellow dots) and temporal closure areas with buffer zones are shown in hashed colors.

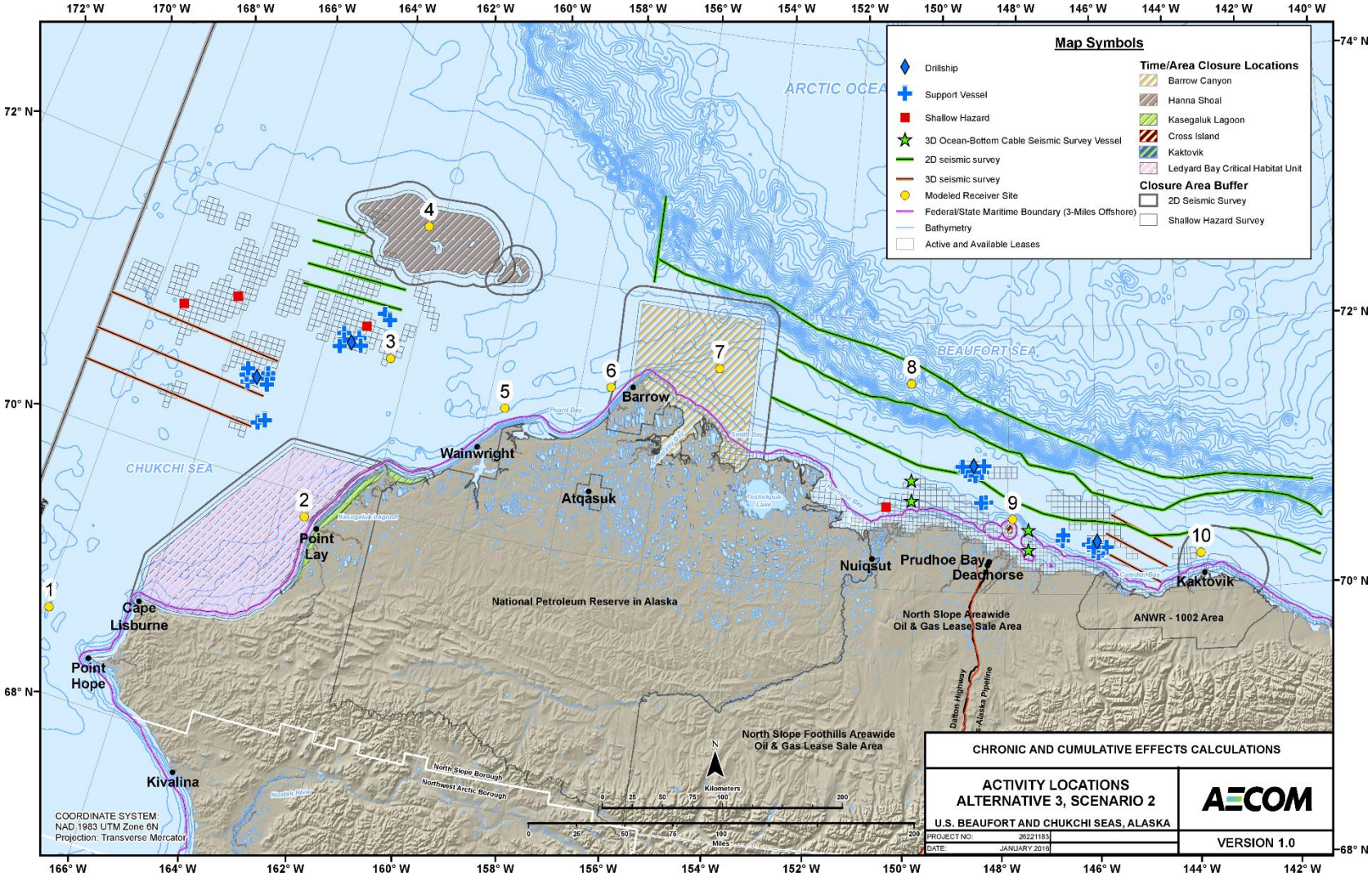


Figure 5. Alternative 3 Scenario 2: Activities include seismic 2-D surveys (green lines), seismic 3-D surveys (orange lines), drilling operations (blue cross and diamond), and shallow hazard (red square) and ocean bottom cable surveys (green stars). The ten receiver locations (yellow dots) and temporal closure areas with buffer zones are shown in hashed colors.

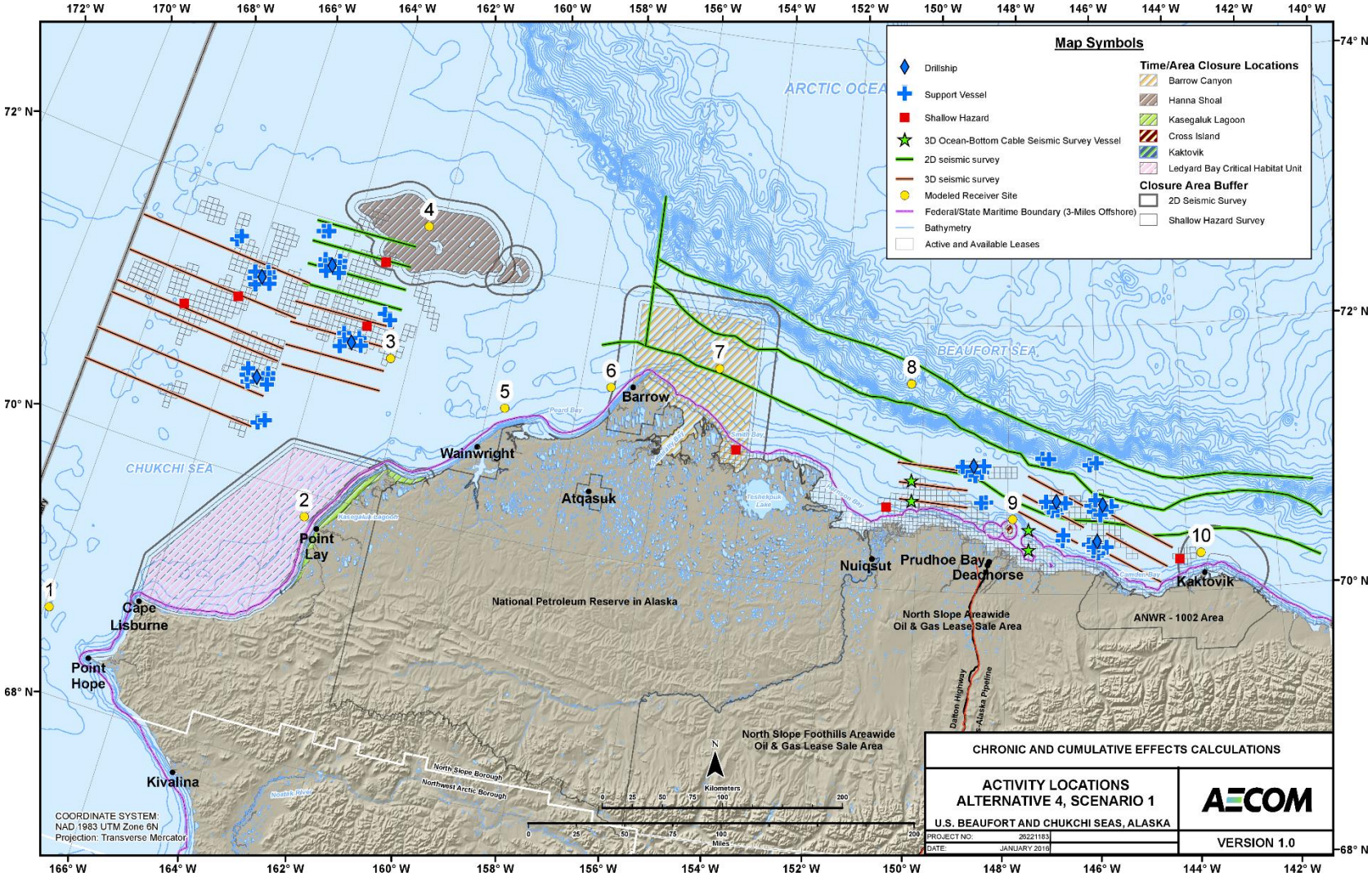


Figure 6. Alternative 4 Scenario 1: Activities include seismic 2-D surveys (green lines), seismic 3-D surveys (orange lines), drilling operations (blue cross and diamond), and shallow hazard (red square) and ocean bottom cable surveys (green stars). The ten receiver locations (yellow dots) and temporal closure areas with buffer zones are shown in hashed colors.

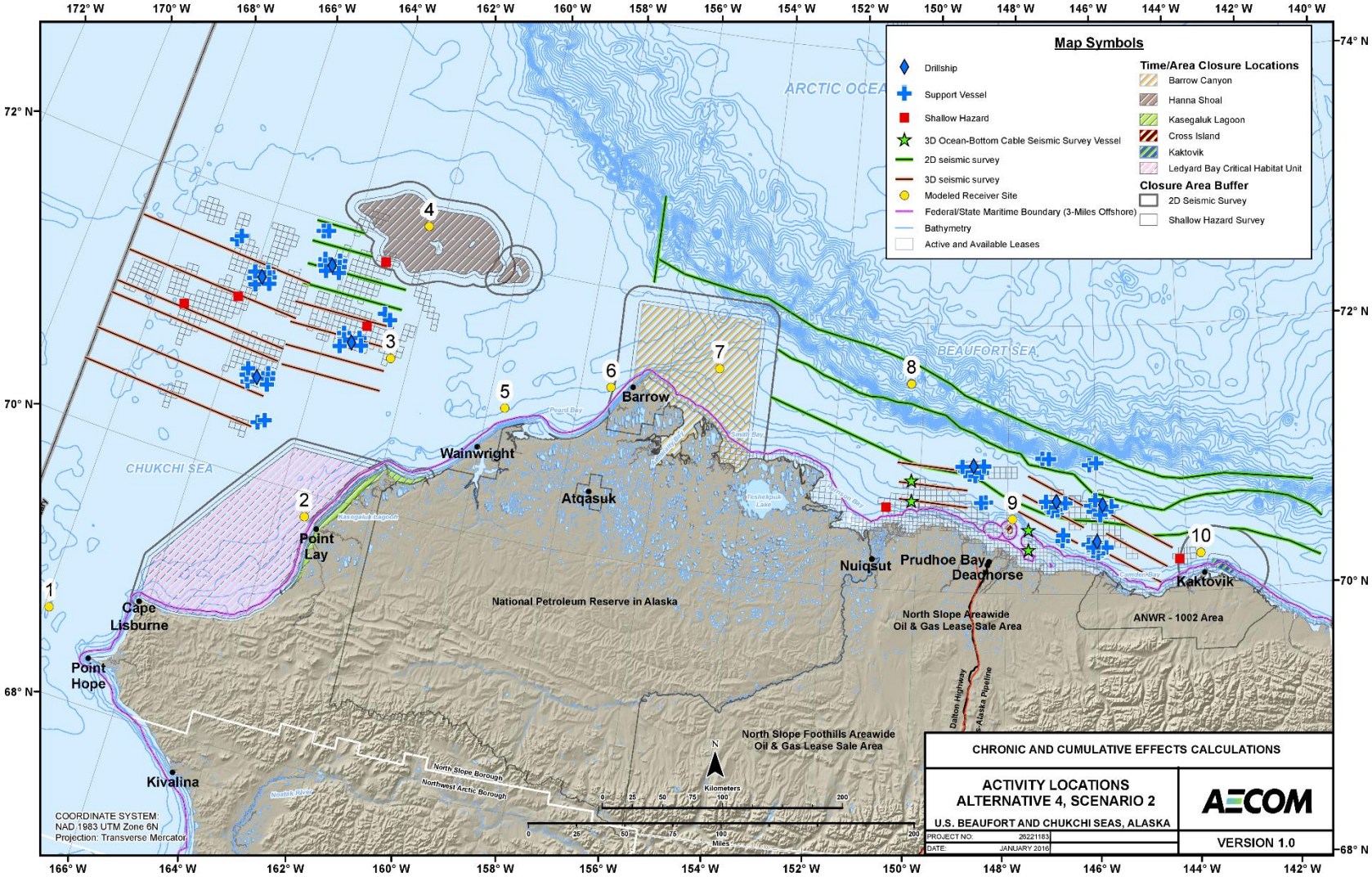


Figure 7. Alternative 4 Scenario 2: Activities include seismic 2-D surveys (green lines), seismic 3-D surveys (orange lines), drilling operations (blue cross and diamond), and shallow hazard (red square) and ocean bottom cable surveys (green stars). The ten receiver locations (yellow dots) and temporal closure areas with buffer zones are shown in hashed colors.

1.1. Acoustic Metrics

Underwater sound pressure amplitude is commonly measured in decibels (dB) relative to a fixed reference pressure of p_o = 1 µPa. Because the loudness and other exposure effects of impulsive (pulsed) noise, e.g., pulses from seismic airguns, are not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate impulsive sound effects on marine life.

1.1.1. Root-Mean-Square Sound Pressure Level

The root-mean square (rms) SPL (L_p, dB re 1 µPa) is the rms pressure level in a stated frequency band over a time window (T, s) containing the pulse:

$$L_p = 10\log_{10}\left(\frac{1}{T}\int_T p^2(t)dt \Big/ p_o^2\right) \quad (1)$$

The rms SPL can be thought of as a measure related to the average sound intensity or as the effective pressure intensity over the duration of an acoustic event, such as the emission of one acoustic pulse. Because the time window length, T, is a divisor, pulses having the same total acoustic energy, but more spread out in time, will have a lower rms SPL. The value of T for the purpose of the rms SPL calculation can be selected using different approaches. According to one, T is defined as the 90% energy pulse duration, containing the central 90% (from 5% to 95% of the total) of the cumulative square pressure (or sound exposure level) of the pulse, rather than over a fixed time window (Malme et al. 1986, Greene 1997, McCauley et al. 1998). The 90% rms SPL (L_{p90}, dB re 1 µPa) in a stated frequency band is calculated over this 90% energy time window, T_{90}:

$$L_{p90} = 10\log_{10}\left(\frac{1}{T_{90}}\int_{T_{90}} p^2(t)dt \Big/ p_o^2\right) \quad (2)$$

The other approach for rms SPL calculation of a pulse is to use a fixed time window. In this study, a sliding window was used to calculate rms SPL values for a series of fixed window lengths within the pulse. The maximum value of rms SPL over all time window positions is taken to represent the rms SPL of the pulse.

1.1.2. Sound Exposure Level

The sound exposure level (SEL) (L_E, dB re 1 µPa^2·s) is the time integral of the squared pressure in a stated frequency band over a stated time interval or event. The per-pulse SEL is calculated over the time window containing the entire pulse (i.e., 100% of the acoustic energy), T_{100}:

$$L_E = 10\log_{10}\left(\int_{T_{100}} p^2(t)dt \Big/ T_o p_o^2\right) \quad (3)$$

where T_o is a reference time interval of 1 s by convention. The per-pulse SEL, with units of dB re 1 µPa·√s, or equivalently dB re 1 µPa^2·s, is related, at least numerically, to the total acoustic energy flux density delivered over the duration of the acoustic event at a receiver location. SEL, unlike energy flux density, neglects the acoustic impedance of the medium (here water), which depends on density, sound speed, and proximity to reflective surfaces and position within refractive environments. SEL is a measure of sound exposure through time rather than just sound pressure.

SEL is a cumulative metric; it can be accumulated over a single pulse, or calculated over periods containing multiple pulses. To accumulate multiple pulse cumulative SEL (L_{Ec}), the single pulse SELs are summed. If there are N such pulses having individual SELs of (L_{Ei}), then:

$$L_{Ec} = 10\log_{10}\left(\sum_{i=1}^{N} 10^{\frac{L_{Ei}}{10}}\right) \tag{4}$$

The SEL is related to the total acoustic energy flux density delivered over the duration of the set period of time, i.e., 24 h. It is a representation of the accumulated SEL delivered by multiple acoustic events, e.g., multiple pulses of a single acoustic source.

Because the rms SPL and SEL of a single pulse are computed from the same time integral of square pressure, these metrics are related numerically by a simple expression, which depends only on the duration of the 90% energy time window T_{90}:

$$L_E = L_{p90} + 10\log_{10}(T_{90}) + 0.458\,, \tag{5}$$

where the factor of 0.458 dB accounts for the missing 10% of SEL due to consideration of just 90% of the cumulative square pressure in the L_{p90} calculation. It is important to note that the decibel reference units of L_E and L_{p90} are not the same, so this expression must be interpreted only in a numerical sense. No similar relationship exists when SPL is calculated using fixed time windows shorter than the full pulse duration, T_{100}; however, if the window length T is equal to or greater than T_{100} then the relationship is simply:

$$L_E = L_p + 10\log_{10}(T) \tag{6}$$

1.1.3. Energy Equivalent Sound Pressure Level

Energy equivalent sound pressure levels (SPLs) (dB re 1 µPa, denoted L_{eq}) are the measure of the average amount of energy carried by a time-dependent pressure wave, $p(t)$, over a period of time T. It is defined as the rms SPL over a fixed duration time window:

$$L_{eq} = 10\log_{10}\left(\frac{1}{T}\int_T p^2(t)dt \Big/ p_o^2\right) \tag{7}$$

The L_{eq} is numerically equal to the rms SPL of a steady sound that has the same total energy as the sound measured over the given time window. The expressions for L_p and L_{eq} are numerically identical; conceptually, the difference between the two metrics is that the former is computed over short time periods, usually less than one second, and tracks the fluctuations of a non-steady acoustic signal, whereas the latter reflects the average SPL of an acoustic signal over tens of seconds or longer.

1.2. Marine Species and Auditory Bands

A number of species with a variety of hearing acuities and frequency-dependent sensitivities were considered when calculating changes in listening space. Fifteen marine mammal species, including nine cetaceans, occur in the Beaufort and Chukchi Seas (Table 3.2-5 of the SDEIS; NMFS 2013). All cetaceans present in the project area, except harbor porpoises, fall under the categories of low- and mid-frequency cetaceans as defined by Southall et al. (2007). Hence, the corresponding M-weighting filters for these groups were applied in the assessment of change in listening area. Harbor porpoises were not considered here as their sensitive hearing frequencies are above the predominant bandwidth of anthropogenic sounds. Still, a future assessment for that species may be useful.

Only bowhead whales were addressed in the communication space assessment. Baleen whale hearing sensitivity to low frequency anthropogenic sounds is believed to be greater than for other cetaceans and their calls generally occur in the same frequency bands. The communication space assessment applied here considered bowheads' moan-type calls that occur at frequencies where shipping and oil and gas exploration-related sounds are predominant. Moan-type calls are the primary call type used by bowheads during the summer and fall months when they are anticipated to be in the PEIS project area.

1.3. Cumulative and Chronic Effects

Historically, most acoustic effects studies on marine mammals have focused on short-term and acute effects from high-intensity sounds (e.g., the near-field sounds from seismic airguns, sonar, and pile driving). Recently there has been more interest in the effects of sound exposures received by marine mammals over larger spatial and temporal extents (Clark et al. 2009, Hatch et al. 2012). These long-term exposures, and the resulting chronic effects, may in some cases be more relevant to marine animals than short-term acute effects, especially for communications between conspecifics (e.g. Hatch et al. 2012).

This study attempts to quantify the effects on marine mammal communication and listening regions over relatively long duration (several months) exposures to anthropogenic sounds. The listening area and communication space methods are employed for these assessments.

2. Modeling Methodology

2.1. Acoustic Source Models

2.1.1. Airgun Arrays

The source levels and directivity of the airgun array were predicted with JASCO's Airgun Array Source Model (AASM; MacGillivray 2006). This model is based on the physics of oscillation and radiation of airgun bubbles described by Ziolkowski (1970). The model solves the set of parallel differential equations that govern bubble oscillations. The AASM also accounts for nonlinear pressure interactions between airguns, port throttling, bubble damping, and generator-injector (GI) gun behavior that are discussed by Dragoset (1984), Laws et al. (1990), and Landro (1992). AASM includes four empirical parameters that were tuned so model output matches observed airgun behavior. The model parameters fit to a large library of empirical airgun data using a "simulated annealing" global optimization algorithm. These airgun data are measurements of the signatures of Bolt 600/B guns ranging in volume from 5 to 185 in^3 (Racca and Scrimger 1986).

The AASM produces a set of "notional" signatures for each array element based on:

- array layout;
- volume, tow depth, and firing pressure of each airgun; and
- interactions between different airguns in the array.

These notional signatures are the pressure waveforms of the individual airguns at a standard reference distance of 1 m; they account for the interactions with the other airguns in the array. The signatures are summed with the appropriate phase delays to obtain the far-field source signature of the entire array in all directions. This far-field array signature is filtered into 1/3-octave-bands to compute the source levels of the array as a function of the frequency band and azimuthal angle in the horizontal plane (at the source depth), after which it is considered a directional point source in the far field.

A seismic array consists of many sources and the point-source assumption is invalid in the near field where the array elements add incoherently. The maximum extent of the near field of an array (R_{nf}) is:

$$R_{\mathrm{nf}} < \frac{l^2}{4\lambda} \tag{8}$$

where λ is the sound wavelength and l is the longest dimension of the array (Lurton 2002, §5.2.4). For example, an airgun array length of l = 16 m yields a near-field range of 85 m at 2 kHz and 17 m at 100 Hz. Beyond this R_{nf} range, the array is assumed to radiate like a directional point source and is treated as such for propagation modeling.

The interactions between individual elements of the array create directionality in the overall acoustic emission. Generally, this directionality is prominent mainly at frequencies in the mid-range between tens of hertz to several hundred hertz. At lower frequencies, with acoustic wavelengths much larger than the inter-airgun separation distances, the directionality is small. At higher frequencies, the pattern of lobes is too finely spaced to be resolved and the effective directivity is less.

2.1.2. Drilling and Support Vessels

Underwater sound that radiates from vessels is produced mainly by propeller and thruster cavitation, with a smaller fraction of noise produced by sound transmitted through the hull, such as by engines, gearing, and other mechanical systems. Sound levels tend to be the highest when thrusters are used to position a vessel and when a vessel is transiting at high speeds. A vessel's sound signature depends on the vessel's size, power output, propulsion system (e.g., conventional propellers vs. Voith Schneider propulsion), and the design characteristics of the given system (e.g., blade shape and size). A vessel produces broadband acoustic energy with most of the energy emitted below a few kilohertz. Sound from onboard machinery, particularly sound below 200 Hz, dominates the sound spectrum before cavitation begins—normally around 8–12 knots on many commercial vessels (Spence et al. 2007). Noise from vessels typically raises the background sound level by tenfold or more (Arveson and Vendittis 2000).

In this study, averaged source levels for vessels used to represent exploratory drilling activities were derived from measured sound levels of various surrogate vessels (see Section 3.2.5).

2.2. Transmission Loss Model

The acoustic fields at the receiver sites were modeled at frequencies from 10 Hz to 5 kHz for sources up to 500 km away, using JASCO's Marine Operations Noise Model (MOMN; Racca et al. 2015). The MONM computes received per-pulse SEL for directional impulsive sources at a specified source depth.

The MONM computes acoustic propagation via a wide-angle parabolic equation solution to the acoustic wave equation (Collins 1993) based on a version of the U.S. Naval Research Laboratory's Range-dependent Acoustic Model (RAM), which has been modified to account for a solid seabed (Zhang and Tindle 1995).

The parabolic equation method has been extensively benchmarked and is widely employed in the underwater acoustics community (Collins et al. 1996). The MONM accounts for the additional reflection loss at the seabed due to partial conversion of incident compressional waves to shear waves at the seabed and sub-bottom interfaces, and it includes wave attenuations in all layers. The version of the MONM used in this assessment was validated with real data from marine seismic survey projects near Sakhalin Island (Racca et al. 2015) that used large airgun arrays similar to the ones considered in this report.

JASCO's MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modeled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

The MONM computes acoustic fields in three dimensions by modeling transmission loss within two-dimensional (2-D) vertical planes aligned along radials covering a 360° swath from the source, an approach commonly referred to as N×2-D. These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ number of planes (Figure 8).

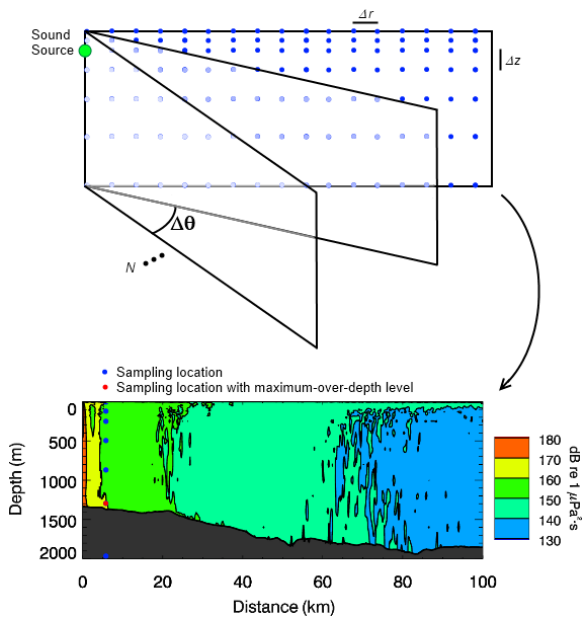


Figure 8. The N×2-D and maximum-over-depth modeling approach used by MONM.

The MONM treats frequency dependence by computing acoustic transmission loss at the center frequencies of 1/3-octave-bands. Sufficiently many 1/3-octave-bands, starting at 10 Hz, are modeled to include the majority of acoustic energy emitted by the source. At each center frequency, the transmission loss is modeled within each of the N vertical planes as a function of depth and range from the source. To compute the 1/3-octave-band received per-pulse SELs, the band transmission loss values were subtracted from the directional source level in that frequency band. Composite broadband received SELs are then computed by summing the received 1/3-octave-band levels.

The received per-pulse SEL sound field within each vertical radial plane is sampled at various ranges from the source, generally with a fixed radial step size. At each sampling range along the surface, the sound field is sampled at various depths, with the step size between samples increasing with depth below the surface.

2.3. Chronic and Cumulative Exposure (CCE) Calculator

A Chronic and Cumulative Exposure (CCE) calculator was developed to assist with assessing chronic seismic exploration noise received by marine mammals at the 10 receiver sites. This calculator is implemented as Microsoft Excel spreadsheets with scripting to provide a flexible tool for evaluating cumulative SELs generated by scenarios of seismic activity distributed over wide areas. The modeling geometry implemented in the CCE calculator makes use of acoustic reciprocity, whereby the model was run with the source and receiver positions interchanged—an efficient approach when there are more potential source sites than receiver sites.

The acoustic transmission loss results and the modeled source levels for each activity type are stored in the spreadsheets of the CCE calculator. The CCE calculator contains sets of marine mammal hearing frequency weighting filter coefficients that can be applied to the received levels. For change in listening space calculations, we applied filters for low- and mid-frequency cetaceans as defined by Southall et al. (2007). The CCE calculator also contains baseline (ambient) level spectra for all receiver sites and depths (Section 2.4).

The CCE calculator computes three values: cumulative SELs, L_{eq}, and L_{eq} above ambient at the selected receiver site resulting from all pulses from the seismic surveys specified for each alternative.

2.3.1. Survey Distribution

The location of the seismic surveys and exploratory drilling operations in the Beaufort and Chukchi Sea were based on the conceptual examples presented in the SDEIS (NMFS 2013). The total number of seismic pulses for the 2-D and 3-D surveys were calculated based on the geographical extent of each survey and the pulse spacing associated with the representative source (Table 3). Rather than modeling every pulse position, the seismic surveys were divided into several survey cells, each representing a portion of survey. These survey cells become individual source entries in the CCE calculator. The number of pulses contained within each cell was based on the average pulse density of the survey and the cell's area. The coordinates of the geometric center of each cell is entered into the CCE calculator, along with the number of pulses contained within the cell. The cumulative levels estimated using this approach are accurate when the cell dimensions are small, relative to the source-receiver separation.

In a similar manner, the ocean bottom cable surveys were represented by one survey cell, centered on the midpoint between the two vessels locations provided in the SDEIS conceptual examples. A survey extent of 16 × 32 km with in-line spacing of 300 m was assumed as representative parameters. The total number of seismic pulses was calculated based on the geographic extent of the survey and the pulse spacing associated with the representative source (Table 3).The shallow seismic hazard surveys were represented by one survey cell, centered on the coordinates provided in the SDEIS (NMFS 2013). A survey extent equivalent to 392 km of survey trackline was assumed as representative parameters (Chapter 2 in the SDEIS; NMFS 2013). The total number of seismic pulses was calculated based on the geographic extent of the survey and the pulse spacing associated with the representative source (Table 3).

The locations of each mobile offshore drilling unit and its support vessels were based on the conceptual examples presented in the SDEIS (NMFS 2013).

2.3.2. Removal of Top 10% of Pulse Exposures

A feature of underwater sound propagation is that nearby sources generally contribute substantially more to the cumulative SEL than more distant sources of the same type, since the exposure levels decay approximately with the square of distance from the source. This causes cumulative SEL received from moving seismic sources to be dominated by the source pulses generated closest to a receiver. However, the time period of exposures from nearby sources is typically quite short. While exposures from nearby sources are important for assessing acute effects, their inclusion in a chronic effects assessment can be unrepresentative. To avoid this problem, this analysis neglected the highest seismic pulse exposures received during a fraction (10%) of the three-month-long analysis period.

The specific method for removing the highest pulse contributions involved first sorting cells according to their received per-pulse SEL. The top SEL-ordered cells corresponding to 10% of the total for the three-month study duration (11 days) were neglected prior to calculating cumulative SEL, L_{eq}, and L_{eq} above ambient.

2.4. Ambient Levels

To estimate changes in listening area and communication space for various levels of exploration activities, a representative ambient noise level must be defined. In this study, ambient noise levels were calculated from measured natural sounds, produced mainly by wind and waves. Ambient levels for the Chukchi Sea were estimated using mean ambient levels recorded in the Chukchi Sea over the 2014 open-water season when very little anthropogenic activity occurred within a fairly large distance of the recording stations (Delarue et al. 2015). Ambient levels in the Beaufort Sea were also estimated based on measurements in the Chukchi Sea (Delarue et al. 2015), since the levels are expected to be similar for equivalent water depths (Seger et al. 2015).

Mean broadband ambient levels (10–5000 Hz) varied between 98.9 and 105.7 dB re 1 µPa, depending on the receiver location. Mean ambient spectra in 1/3-octave-bands were assigned to each receiver site based on proximity to the actual recorder sites where ambient noise was measured and on the similarity in water depth between the recorded and modeled receiver sites (Figure 9). These spectra were used in the CCE calculator to calculate L_{eq} and L_{eq} above ambient with low- and mid-frequency cetacean filters and without frequency weighting.

Ambient levels in the 160 Hz 1/3-octave-band, which varied between 86.2–91.9 dB re 1 µPa, were used to calculate bowhead whale communication space for Alternative 1 (no activity).

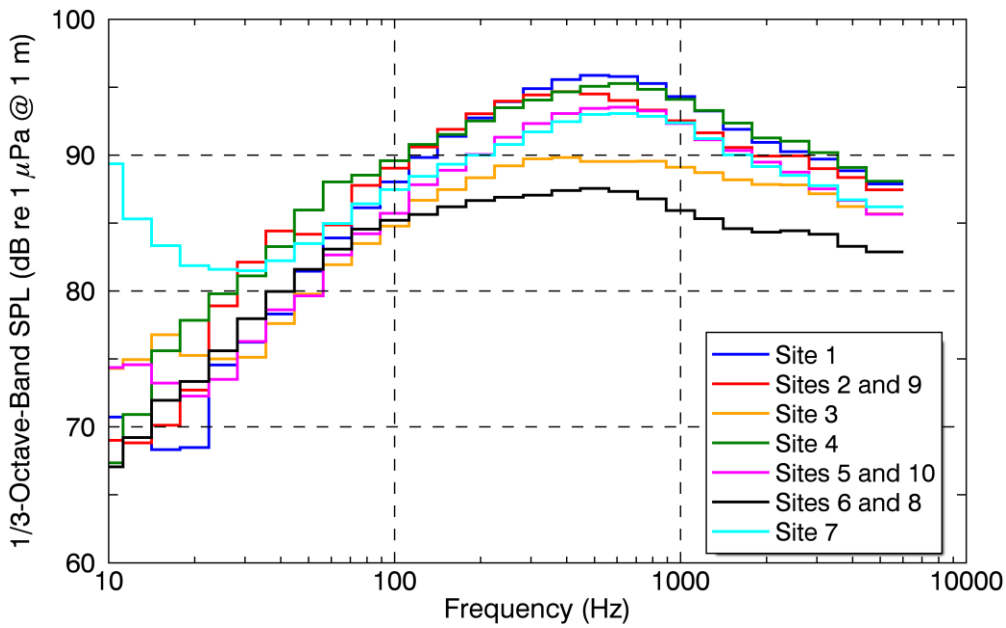


Figure 9. One-third-octave-band spectra of unfiltered ambient levels associated with each receiver site.

2.5. Listening Area

The term listening area refers to the area associated with the maximum detection distance of a signal by an animal. A listening area assessment considers the region of ocean where marine fauna can detect sounds from conspecifics, as well as from predators and prey (Figure 10). The introduction of noise in the same frequency band as the signal may reduce an animal's ability to detect the signal, and therefore decreases the maximum detection distance and reduces the listening area.

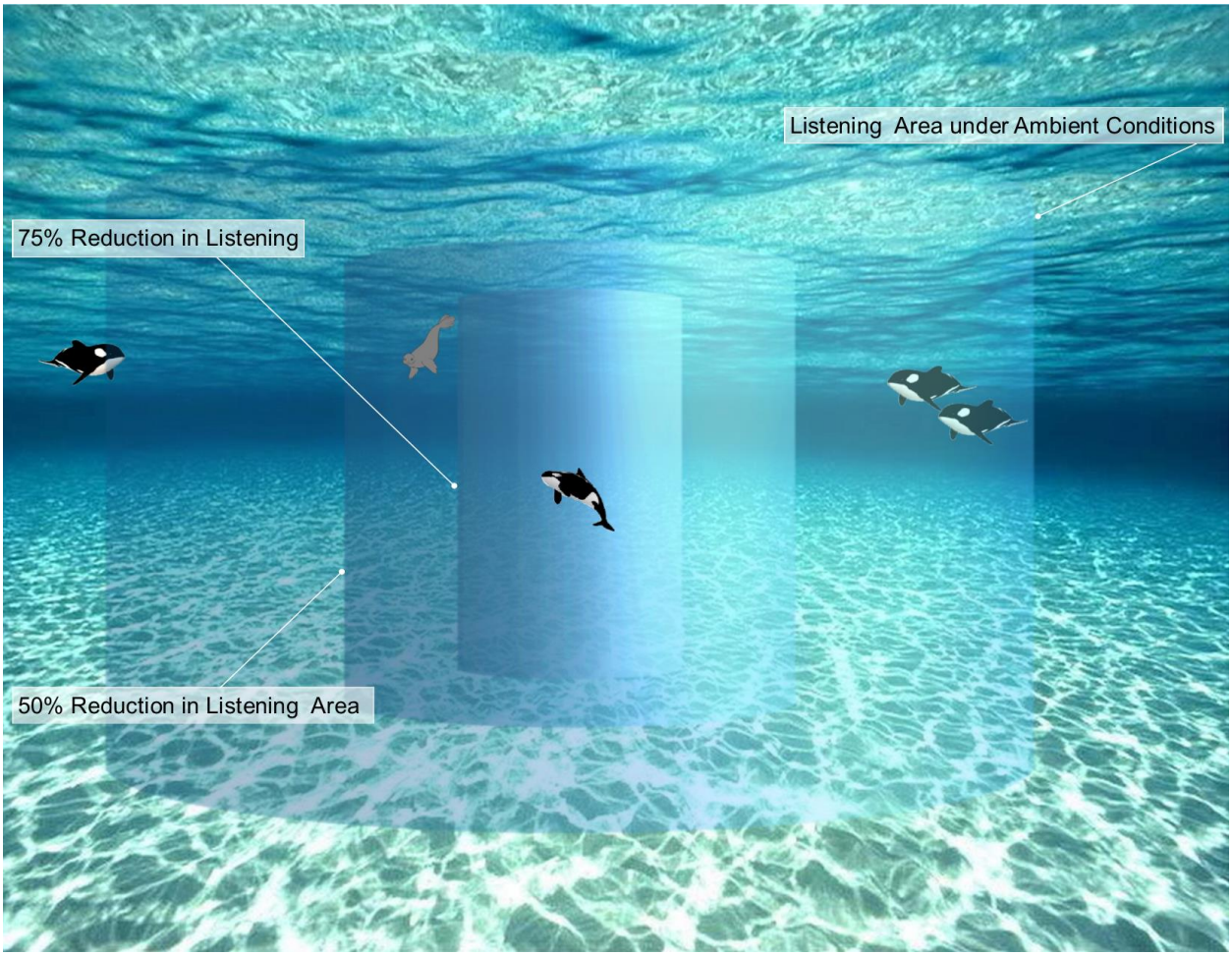


Figure 10. Schematic representation of changes in listening area around a marine mammal. Under ambient conditions, an animal may be able to listen to conspecifics, as well as predators and preys. When the noise level increases, the listening space area is reduced. (Figure adapted from NPS 2010.)[2,3,4]

[2] Seal [online image]. Retrieved November 2015, from http://fursealworld.com/?p=128.
[3] Killer whales [online images] Retrieved November 2015 from clip art.
[4] Background [online image]. Retrieved November 2015 from http://theartmad.com/wp-content/uploads/2015/09/Ocean-Underwater-Wallpaper-Widescreen-3.jpg.

The remaining fraction of the listening area due to an increase in noise level can be calculated without prior knowledge of the signal source level and detection distance by approximating the transmission loss (*TL*) as:

$$TL = N \log_{10}(R). \tag{9}$$

The maximum detection distance of the signal (R_o), associated with a source level, *SL*, will result in a received level RL_o:

$$RL_o = SL - N \log_{10}(R_o). \tag{10}$$

The maximum detection distance (*R*) associated with an increase in noise level will result in a received level (*RL*):

$$RL = SL - N \log_{10}(R). \tag{11}$$

The remaining fraction of listening area after an increase in noise level is therefore:

$$\begin{aligned} \frac{\pi R^2}{\pi R_o^2} &= \frac{10^{2(RL-SL)/N}}{10^{2(RL_o-SL)/N}} \\ &= 10^{-2\Delta/N} \end{aligned} . \tag{12}$$

where Δ is equal to the increase in noise level, in dB. Results are presented in fractions (percentage) of the listening area that is left after an increase in noise level.

This concept was applied by Barber et al. (2009) to terrestrial organisms, but to our knowledge, this concept has not yet been applied to marine animals. Unlike the assessment of communication space (Section 2.6), the assessment of change in listening area does not required prior knowledge parameters such as the signal source levels, detection thresholds based on the receiver perception capabilities, signal directivity, noise and signal duration, and band-specific (spectral) noise levels. This assessment can be done for specific frequency bands, or by taking into consideration the animal's auditory system and applying a relevant filter to the noise level.

This equation is expected to overestimate the reduction in listening area at most sites, where the transmission loss (*TL*) is better estimated by an equation of the form:

$$TL = N \log_{10}(R) - \alpha R . \tag{13}$$

In this study, we estimated *N* at each of the receiver sites by curve fitting the modeled *TL* from the receiver at ranges ≤ 75 km. The noise level increase, Δ, is the difference between the estimated ambient level and L_{eq} or between two alternatives being compared. The approach considers the additive nature of ambient noise to L_{eq} in decibel space (for example, if L_{eq} and ambient levels were equal, then Δ would be 3 dB). While that may seem counterintuitive, recall that the decibel sum of two equal sound levels is their individual value plus 3 dB. Changes in listening area were calculated for unfiltered broadband (10–5000 Hz) noise levels, as well as by applying low- and mid-frequency cetacean weighting to the noise levels.

2.6. Bowhead Whale Communication Space

A communication space assessment considers the region of ocean within marine fauna can detect calls from conspecifics. Masking can be defined as a reduction in communication space (active acoustic space) that an individual experiences due to an increase in background noise (ambient and anthropogenic) in the frequency bands relevant for communicating. Reductions in communication space due to anthropogenic sounds cannot be determined based on the broadband cumulated sound exposure level, because the effect depends on the spectral noise level within the frequency band of the sounds in question and therefore varies dynamically with receiver distance from the sound (noise) source. To estimate the communication space quantitatively, it is necessary to account for parameters such as call source levels, detection thresholds based on the receiver perception capabilities, signal directivity, band-specific (spectral) noise levels, and noise and signal duration.

The communication space for bowhead whales was estimated using a similar approach to that employed by Clark et al. (2009). The primary difference is that we applied the analysis in a single representative 1/3-octave-band, rather than to broadband levels. This approach is based on a form of the sonar equation that considers the maximum distance an animal can detect a signal in the presence of masking noise. The form of the sonar equation employed here was:

$$SE = SL - TL - NL - DT + DI + SG \ . \tag{14}$$

The signal excess (*SE*) is the signal excess above detectability. The source level (*SL*) is the animal call source level. Transmission loss (*TL*) is the acoustic transmission loss between the calling and listening bowhead whales (a function of the distance of their separation). The noise level (*NL*) in the same frequency band as the source level. The detection threshold (*DT*) of the animal represents the amount above ambient level the sound must be in order for it to be detected. The directivity index (*DI*) represents the animal's ability to discriminate sounds coming from a specific direction, in the presence of masking noise arriving uniformly from all directions. The signal gain (*SG*) indicates the animal's ability to use its knowledge of the time-frequency structure of the call to differentiate it from background noise.

3. Modeled Parameters

3.1. Acoustic Environment

3.1.1. Bathymetry

Bathymetry data used by the transmission loss model was obtained from the University of Alaska's Geographic Information Network of Alaska (GINA) gridded bathymetry dataset. GINA data consists of a combination of topography and bathymetry information from three publicly available gridded datasets, sampled and merged into identically registered 30 s latitude/longitude grids (Lindquist et al. 2004). Because of the extent of the project area, four bathymetry grids were extracted from GINA, converted into UTM coordinates (Zones 3 to 6) and interpolated onto a regular x/y grid with a 250 m resolution. Transmission loss was modeled using the bathymetry grid most appropriate to each receiver's location.

3.1.2. Sound Speed Profiles

To model the seasonal average transmission loss, three sound speed profiles were applied for whole project area (Figure 11).

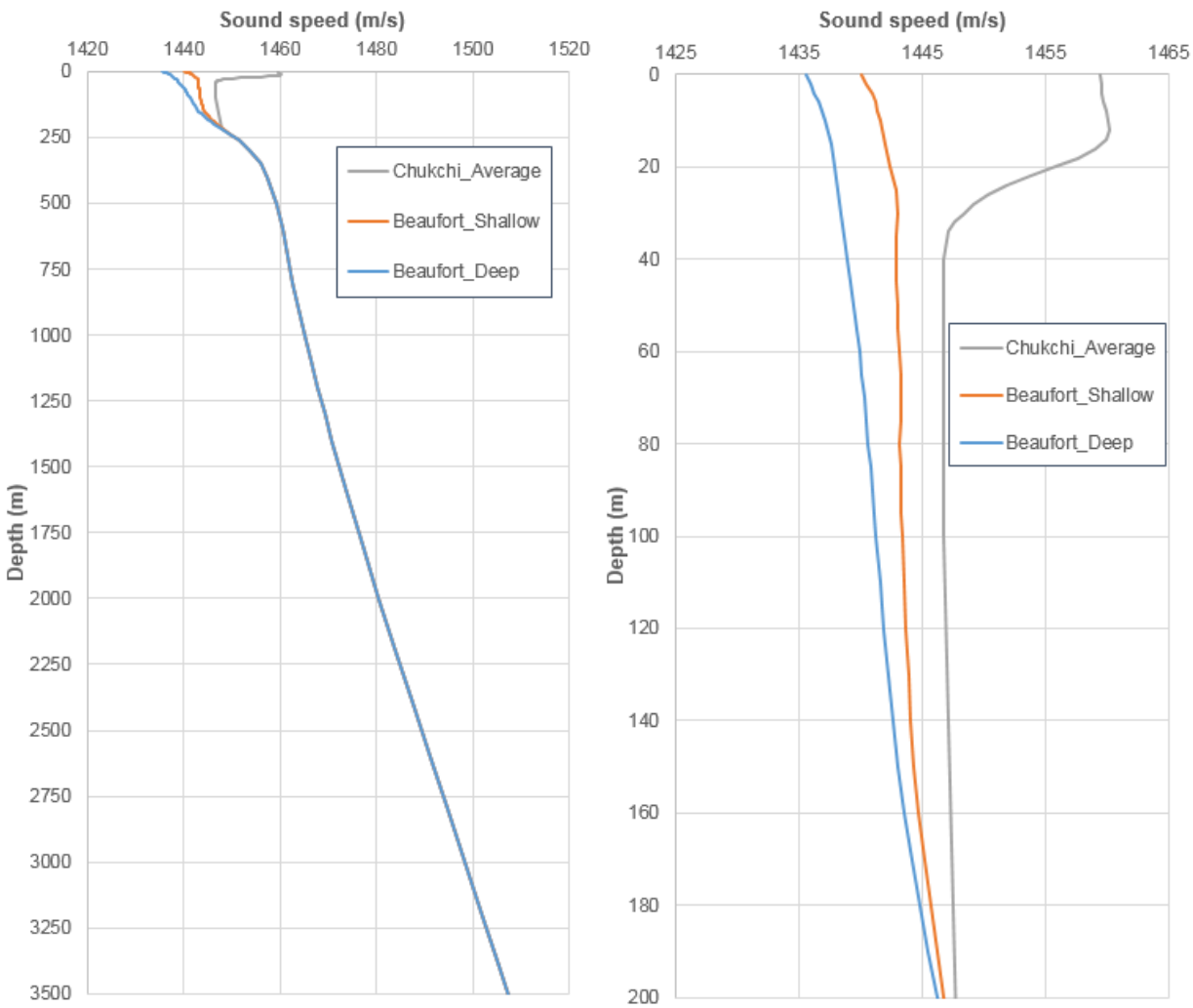
A generalized profile was created using principal component analysis over 1395 measurements (CTD casts; Austin et al. 2015) to represent the seasonal averaged sound speed profiles in the Chukchi Sea. This average sound speed profile is typical of the Chukchi Sea: it features a mixed surface layer over temperatures decreasing with depth, down to approximately 40 m (grey line in Figure 11).

A shallow area and a deep area profile were calculated to represent the Beaufort Sea. These profiles were derived from temperature and salinity profiles from the U.S. Naval Oceanographic Office's Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). The GDEM provides an ocean climatology of temperature and salinity for the world's oceans on a latitude-longitude grid with 0.25° resolution, with a temporal resolution of one month, based on global historical observations from the U.S. Navy's Master Oceanographic Observational Data Set (MOODS). The climatology profiles include 78 fixed depth points to a maximum depth of 6800 m (where the ocean is that deep). The GDEM temperature-salinity profiles were converted to sound speed profiles according to the equations of Coppens (1981):

$$
\begin{aligned}
c(z,T,S,\phi) &= 1449.05 + 45.7t - 5.21t^2 - 0.23t^3 \\
&\quad + \left(1.333 - 0.126t + 0.009t^2\right)\left(S - 35\right) + \Delta \\
\Delta &= 16.3Z + 0.18Z^2 \ , \\
Z &= \frac{z}{1000}\left[1 - 0.0026\cos\left(2\phi\right)\right], \\
t &= \frac{T}{10}
\end{aligned}
\tag{15}
$$

where z is water depth (m), T is temperature (°C), S is salinity (psu), and ϕ is latitude (radians).

Mean monthly sound speed profiles were derived from the GDEM profiles for July to September at 198 locations throughout the Beaufort Sea. All profiles located where the water depth is ≤ 100 m were averaged and smoothed to create the average Beaufort Sea shallow water profile (orange line in in Figure 11). The remaining profiles were averaged and smoothed to create the average Beaufort Sea deep profile (blue line in in Figure 11).



(a) (b)

Figure 11. Seasonal average (July to September) sound speed profiles for the three regions of the project area. The plots present the same profiles with (a) full and (b) reduced depth ranges (y-axis).

3.1.3. Geoacoustic Profiles

Seabed properties are important for acoustic modeling, particularly for shallower environments where sounds increasingly interact with the seabed. The geoacoustic properties of the surficial layer strongly depend on the type of the sediment. As the porosity decreases from clay sediments to silt and sand, the density and compressional velocity increase, and compressional attenuation decreases.

To model transmission loss in the Chukchi Sea, the geoacoustic parameters were derived from core samples in the NMFS database from survey cruises, the Woods Hole Oceanographic Institute data from the Healy cruises, and results from previous JASCO projects. The profile used in the present study (Table 4) was derived and used in past JASCO modeling projects (Austin et al. 2006, Austin et al. 2015); it represents medium-reflectivity sediment, which is assumed to produce conservative results without consistently overestimating sound propagation in the Chukchi Sea.

Table 4. Estimated geoacoustic profile for Sites 1–6 (Chukchi Sea sites) representing sandy silt and silty sand bottom.

Depth Below Seafloor (m)	Density (g/cm^3)	Compressional Sound Speed (m/s)	Compressional Attenuation (dB/λ)	Shear Sound Speed (m/s)	Shear Attenuation (dB/λ)
0–4	1.8	1600	0.4	200	4.0
4–500	2.2	1800	0.5		
>500	2.3	3000	0.2		

For modeling transmission loss in the Beaufort Sea, the seabed geoacoustic parameters were estimated using Buckingham's sediment grain-shearing model (Buckingham 2005), which computes the acoustic properties of the sediments from porosity and grain-size measurements. The geoacoustic parameters predicted by the grain-shearing model are: density, compressional speed, compressional attenuation coefficient, shear wave speed, and shear wave attenuation coefficient. The model's input parameters were the bottom type (and derived grain size) and sediment porosity. The bottom type was chosen based on Deck41 bottom samples database (Bershad and Weiss 1975). The porosity values were estimated using generalized porosity/density curves (Einsele 2000) in accordance with the sediment grain size.

Clay is prominently found throughout both regions, but sand is also found along the shallow continental shelf. Therefore, two profiles were developed to represent the shallow and deep water regions of the Beaufort Sea: a deep clay bottom (Site 8, Table 5) and a shallow clay/sand bottom (Sites 7, 9, and 10, Table 6).

Table 5. Estimated geoacoustic profile for Site 8 (Beaufort Sea deep site) representing a clay bottom.

Depth Below Seafloor (m)	Density (g/cm^3)	Compressional Sound Speed (m/s)	Compressional Attenuation (dB/λ)	Shear Sound Speed (m/s)	Shear Attenuation (dB/λ)
0–15	1.60–2.09	1500–2000	0.32	200	0.3
15–100	2.09–2.40	2000–2400	0.14		
100–200	2.40–2.50	2400–2700	0.50		
>200	2.50	2700	0.50		

Table 6. Estimated geoacoustic profile for Sites 7, 9, and 10 (Beaufort Sea shallow sites) representing a clay/sand bottom.

Depth Below Seafloor (m)	Density (g/cm^3)	Compressional Sound Speed (m/s)	Compressional Attenuation (dB/λ)	Shear Sound Speed (m/s)	Shear Attenuation (dB/λ)
0–15	1.70–2.09	1560–2000	0.29	200	0.4
15–100	2.09–2.40	2000–2400	0.14		
100–200	2.40–2.50	2400–2700	0.50		
>200	2.50	2700	0.50		

3.2. Acoustic Sources

The source levels and directivity of the airgun arrays were predicted with JASCO's Airgun Array Source Model (AASM; MacGillivray 2006). Source levels for the drillship and support vessels involved in exploratory drilling activities were derived from measured sound levels. Figure 12 presents the maximum 1/3-octave-band source levels (maximized over azimuth) for all representative sources. Sections 3.2.1 to 3.2.5 present the parameters used in estimating these levels.

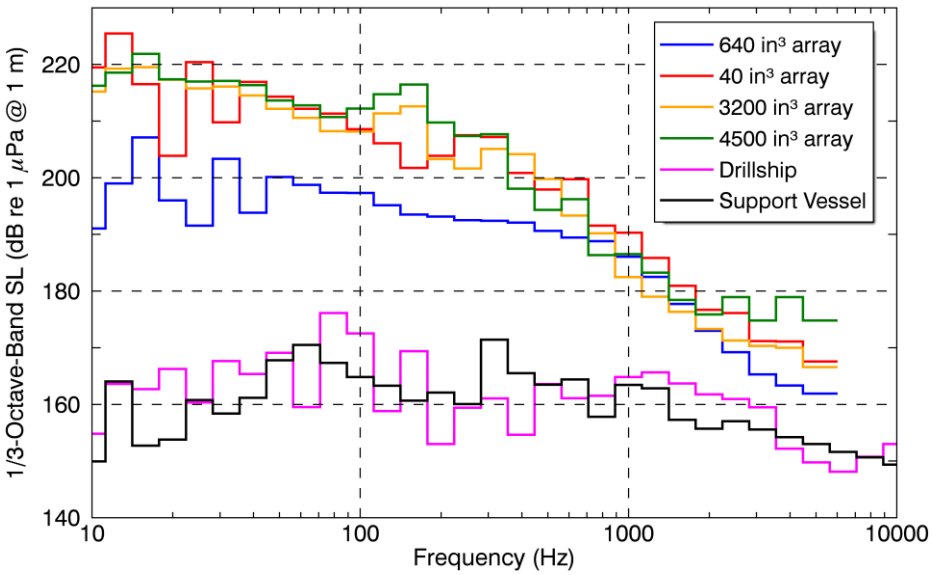


Figure 12. Comparison of maximum 1/3-octave-band source levels for all representative sources. One-third-octave-bands for the airgun array sources were maximized over azimuth.

3.2.1. 3-D Seismic Survey

The 3200 in^3 airgun array for the 3-D seismic survey was formerly used in modeling of sound propagation in shallow Arctic water (Austin et al. 2015). The individual gun volumes varied between 40 and 250 in^3. The gun volumes were adjusted to achieve a total volume of 3200 in^3, and the array depth was 6 m.

Figure 13 shows the far-field sound pressure signature and power spectral density in the horizontal broadside and endfire directions predicted by AASM. Higher sound levels are emitted directly below the array, but this vertical component of the total sound energy is characterized by steep propagation angles that are only dominant in the sound field at very close ranges. Figure 14 shows the horizontal directivity of the array as a function of frequency. Source directivity is insignificant at 40 Hz or less, but is quite prominent for higher frequencies.

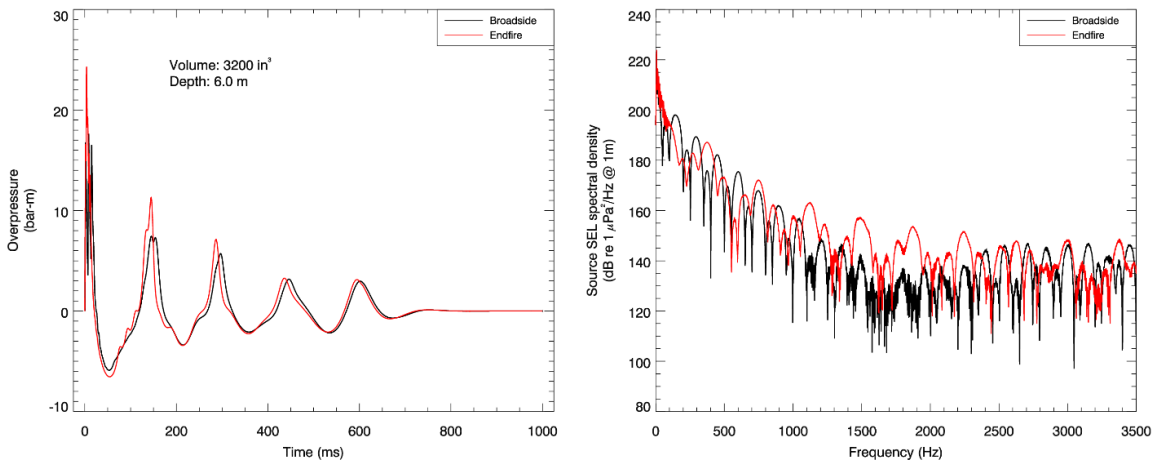


Figure 13. 3200 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. Surface ghosts (effects of the pulse reflection at the water surface) are not included in these signatures.

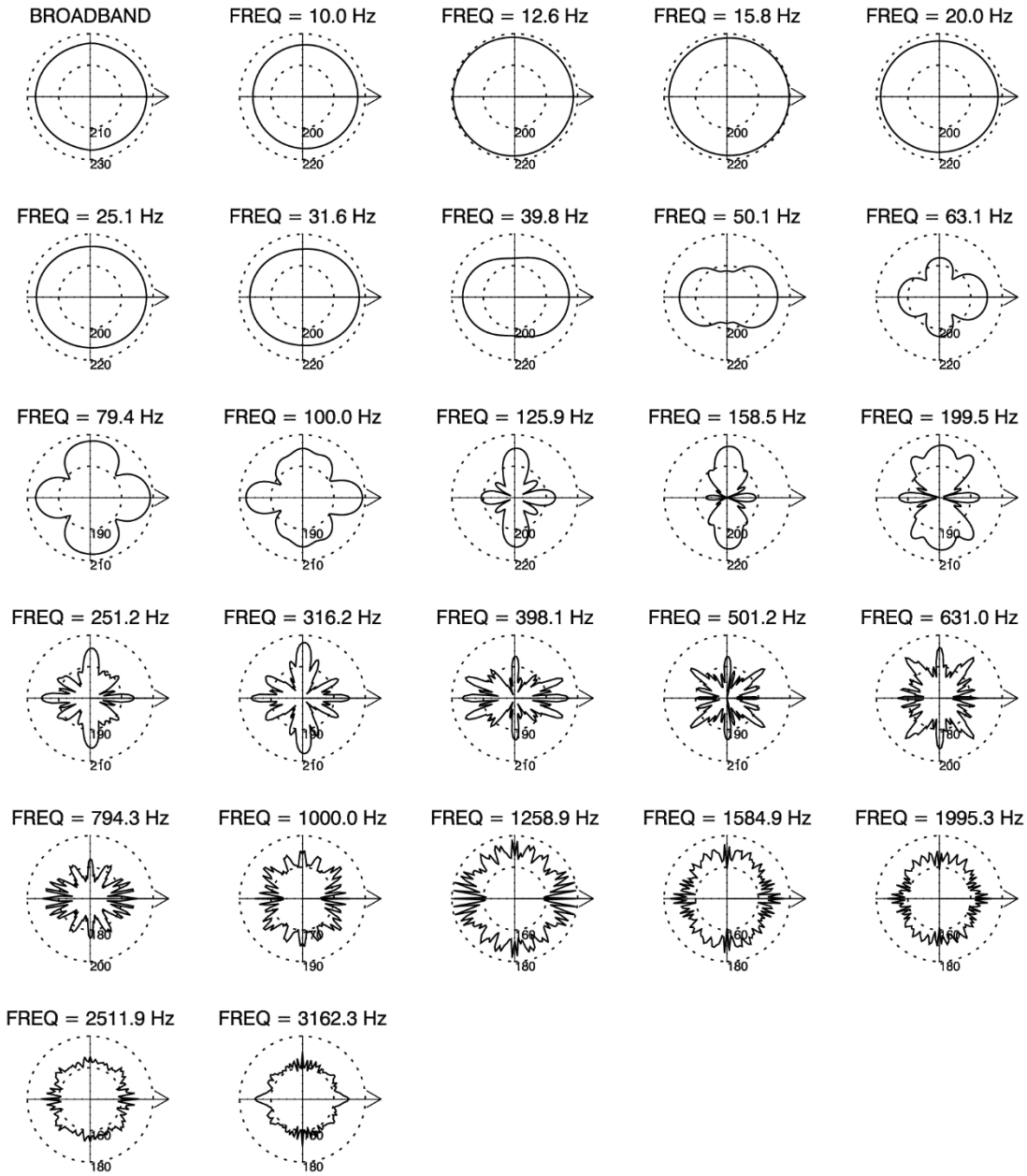


Figure 14. 3200 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 μPa^2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. Arrows indicate the array tow direction.

3.2.2. 2-D Seismic Survey

The 4500 in^3 airgun array for the 2-D seismic survey was used in modeling of sound propagation in shallow Arctic water (Austin et al. 2015). The individual gun volumes varied between 40 and 300 in^3 and the modeled depth was 8.5 m, a common depth used in Arctic 2-D marine seismic surveys.

Figure 15 shows the far-field sound pressure signature and power spectral density in the horizontal broadside and endfire directions predicted by AASM. Higher sound levels are emitted directly below the array, but this vertical component of the total sound energy is characterized by steep propagation angles that are only dominant in the sound field at very close ranges. Figure 16 shows the horizontal directivity of the array as a function of frequency. Source directivity is insignificant at 63 Hz or less, but is quite prominent for higher frequencies.

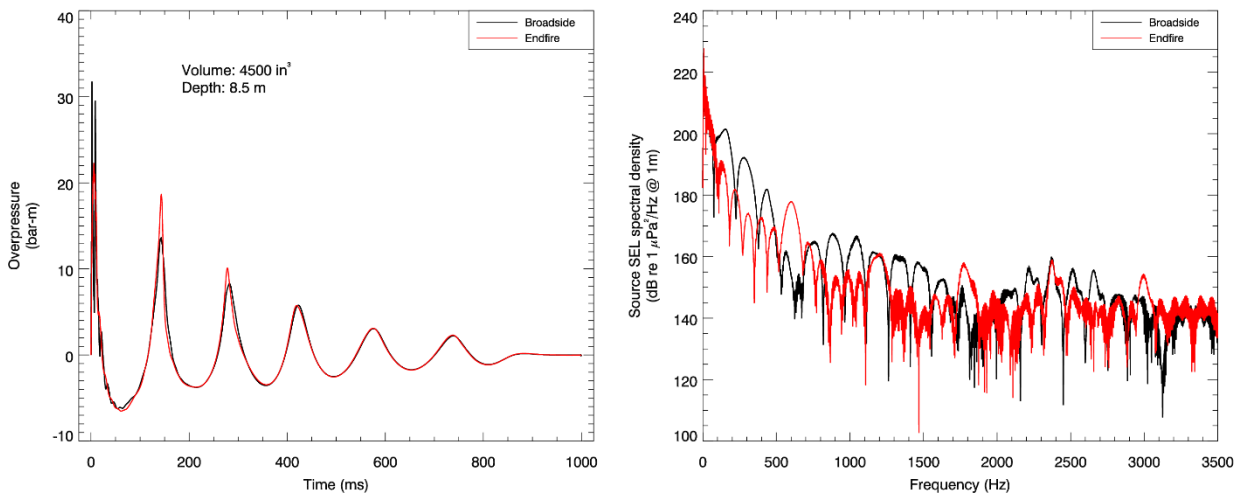


Figure 15. 4500 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. Surface ghosts (effects of the pulse reflection at the water surface) are not included in these signatures.

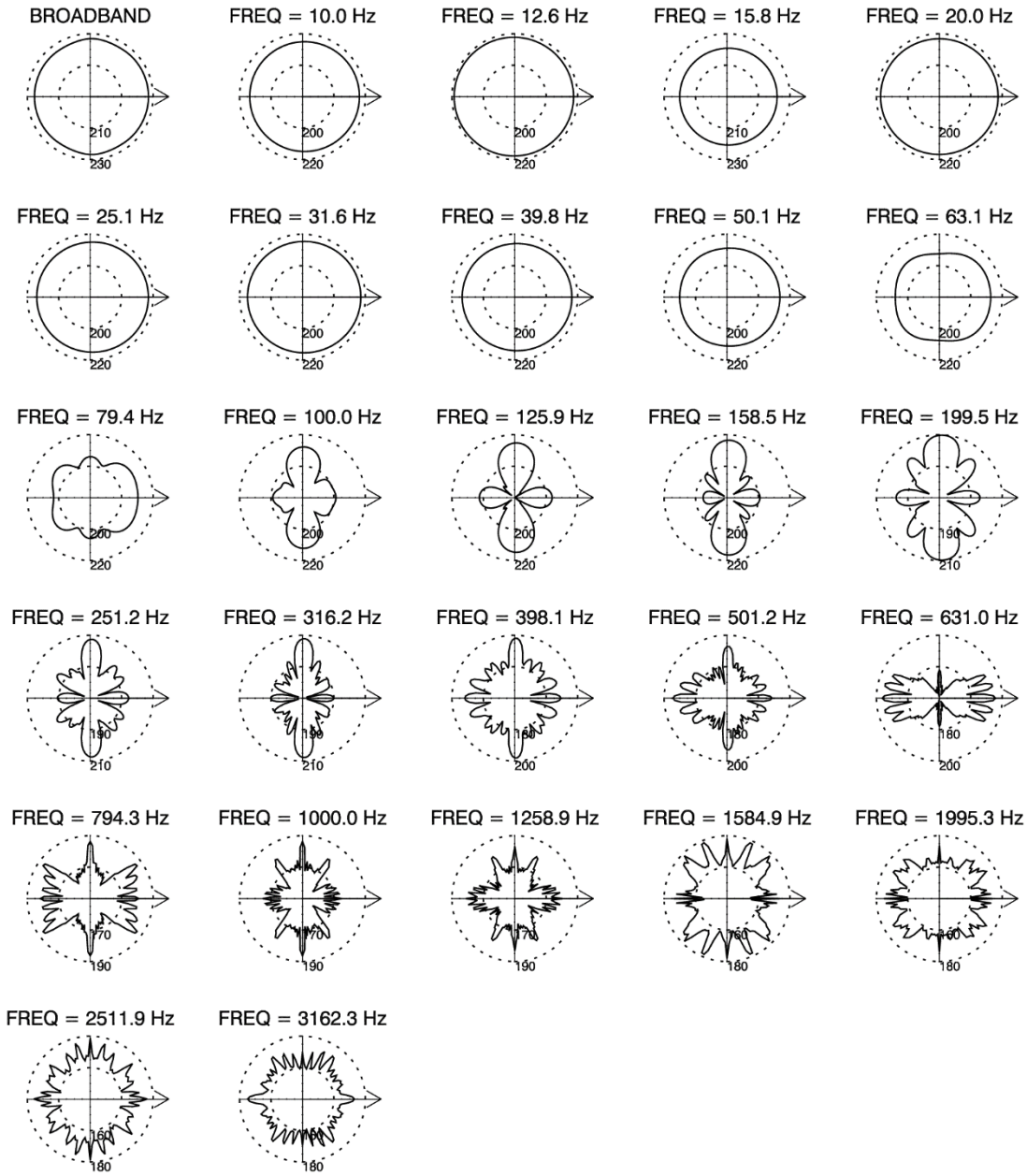


Figure 16. 4500 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 µPa2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. Arrows indicate the array tow direction.

3.2.3. Ocean-bottom Cable Survey

The airgun array proposed for the ocean-bottom cable surveys in the Beaufort Sea has a total volume of 640 in^3 and consists of two strings, each with eight 40 in^3 airguns. This array size and configuration is consistent with arrays used for ocean-bottom cable surveys in shallow Arctic water (e.g. Warner and Hipsey 2012). The towed depth was modeled at a water depth of 2 m.

AASM was run to compute the sources signatures and 1/3-octave-band levels in the horizontal directions. Figure 17 shows the broadside and endfire overpressure signatures and corresponding power spectrum levels for each source. Figure 18 shows the horizontal 1/3-octave-band directionality plots for each source. The directionality for the array became significant at frequencies greater than 125 Hz. Consequently, the directionality of the resulting sound field not only depends on the environment, but on the tow direction.

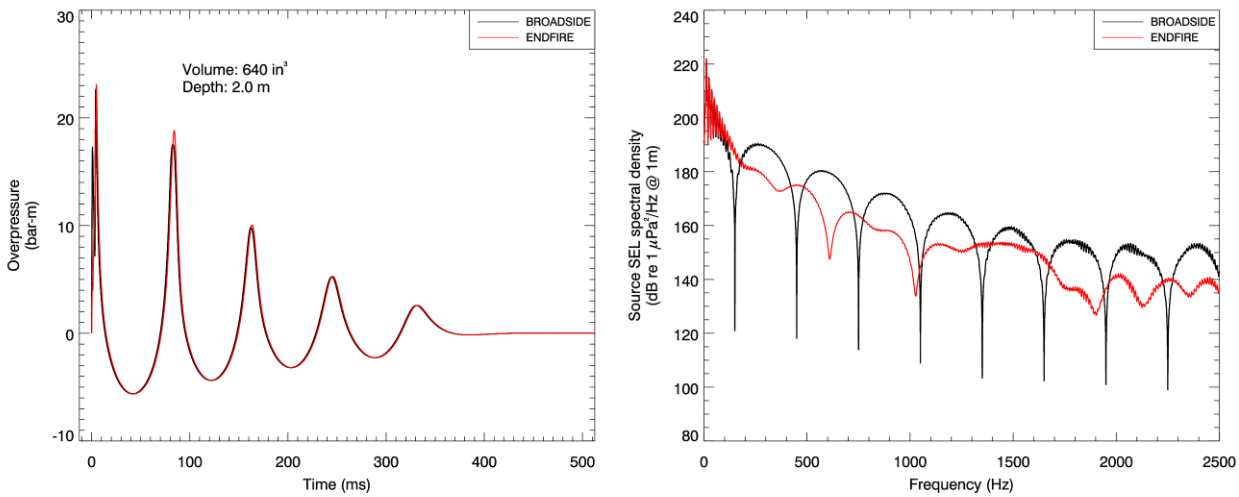


Figure 17. 640 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. Surface ghosts (effects of the pulse reflection at the water surface) are not included in these signatures.

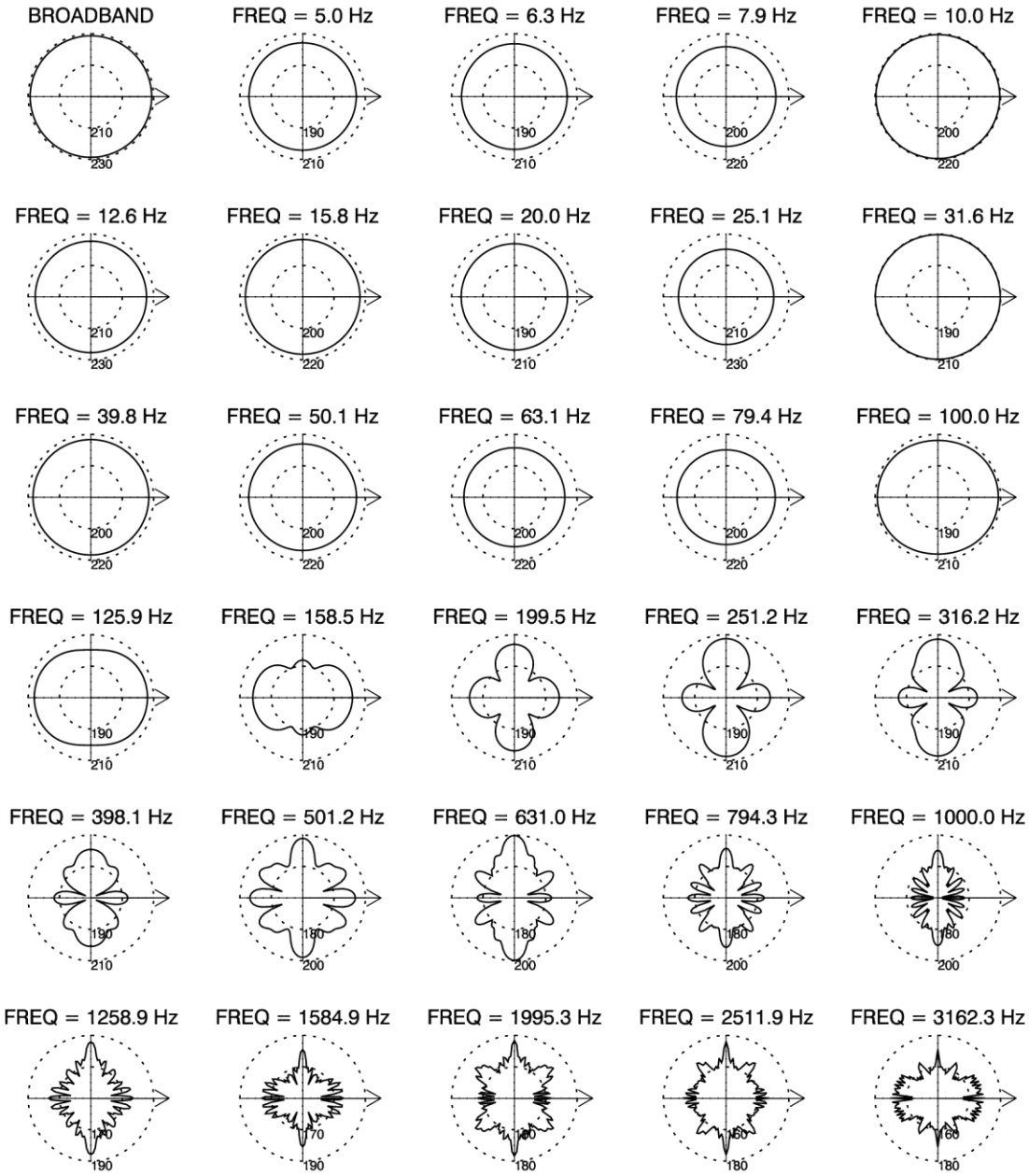


Figure 18. 640 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 μPa^2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. Arrows indicate the array tow direction.

3.2.4. Shallow Hazards Survey

An airgun array layout was defined based on geohazard seismic survey arrays with a total volume of 40 in^3, that were recently used in shallow Arctic waters (Austin et al. 2015). The current array layout consisted of four 10 in^3 guns, with two at 1.75 m water depth and two directly below them at 2.25 m.

Figure 19 shows the far-field sound pressure signature and power spectral density in the horizontal, broadside, and endfire directions predicted by AASM. Higher sound levels are emitted directly below the array, but this vertical component of the total sound energy is characterized by steep propagation angles that are only dominate the sound field at very close ranges. Figure 20 shows the horizontal directivity of the array as a function of frequency, which is insignificant at 500 Hz or less, but is quite prominent for higher frequencies.

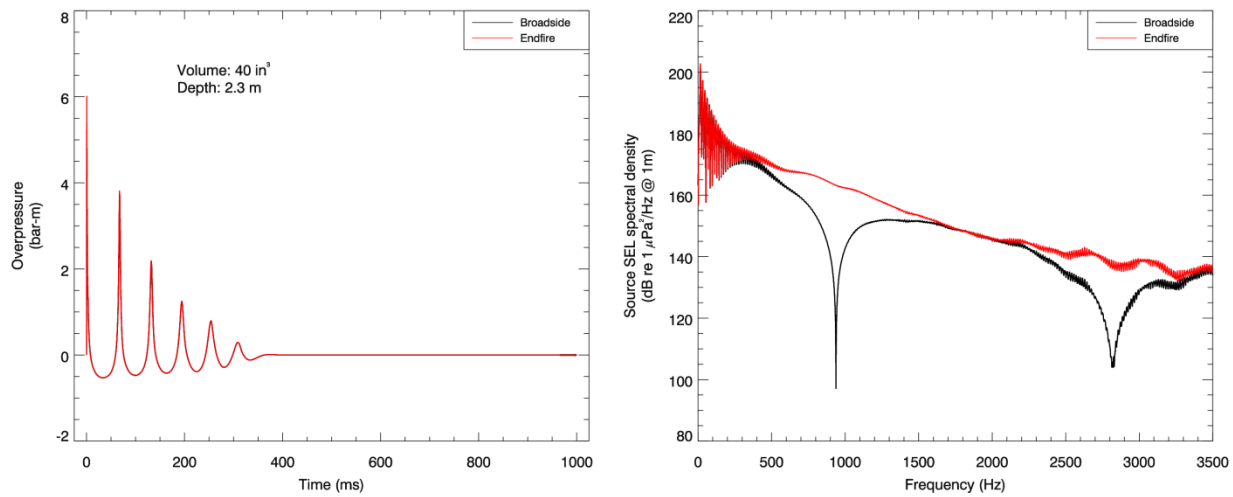


Figure 19. 40 in^3 airgun array: (Left) horizontal far-field pressure signatures and (right) power spectra in the broadside and forward-endfire directions. Surface ghosts (effects of the pulse reflection at the water surface) are not included in these signatures.

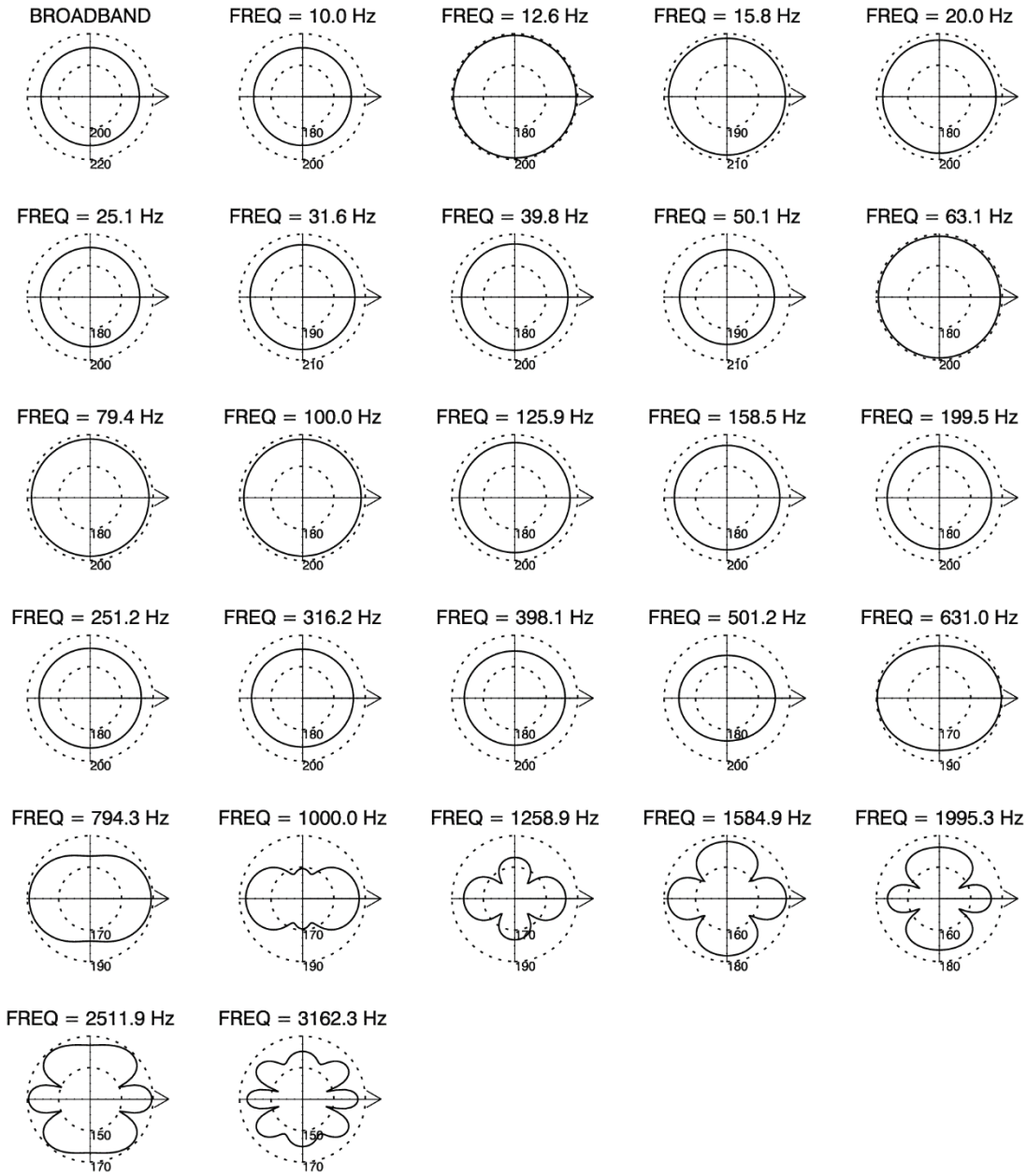


Figure 20. 40 in^3 airgun array: Azimuthal directivity pattern of source level (dB re 1 μPa2·s) in the broadband direction and in 1/3-octave-bands with center frequencies from 10 Hz to 3 kHz. Arrows indicate the array tow direction.

3.2.5. Exploratory Drilling

Source levels for the mobile offshore drilling unit were estimated using measured sound levels from the drillship *Noble Discoverer* while drilling top holes into the seafloor in the Chukchi Sea (Austin et al. 2015). This drillship is 157 m in length and has a draft of 8.5 m. The acoustic source depth used for estimating source levels was 3 m. Source levels for the support vessels in station around the mobile offshore drilling unit were estimated using measurements of support vessels in dynamic positioning mode. The *Ocean Pioneer*, *Fennica*, and *Nordica* were recorded in the Chukchi Sea during Shell's 2010 and 2012 exploration programs. The results were presented in the 90-day reports to NMFS for those programs and are summarized in Austin et al. (2015). Source levels were estimated from the mean 1/3-octave-band levels for each vessel and averaged across all vessels (Austin et al. 2015). The final 1/3-octave-band spectra represent a typical support vessel in dynamic positioning mode. The modeled acoustic source depth was 5.25 m.

3.3. Transmission Loss and CCE calculator

Sixty-four vertical planes were modeled around each receiver site, providing an angular spacing of 5.6 degrees. The modeled radial lengths were limited to 500 km. Seismic pulses originating more than 500 km from a specified receiver were estimated to have little influence on the cumulative sound field and were excluded. Receiver depths were modeled at 5 and 30 m. The different seismic sources (40, 640, 3200, and 4500 in^3) were modeled at 2, 6, and 8.5 m depths. The drillship was modeled at 3 m and the support vessels at 5.25 m.

The L_{eq} was based on a three-month accumulation period, and T was 9.331×10^6 seconds.

3.4. Bowhead Whale Communication Space

A representative source level for bowhead whale calls was estimated from the median bowhead source level for moan-type calls reported by Cummings and Holliday (1987). We specified a 1/3-octave-band sound level of 156 dB re 1 µPa at 1 m based on their broadband source level for bowhead moans of 159 dB re 1 µPa at 1 m, under the assumption that the call bandwidth spanned two 1/3-octave-bands. Transmission loss was obtained at each receiver site, directly from the MONM results. Noise levels were calculated with the CCE calculator as described above. The detection threshold was assumed to be 10 dB (Clark et al. 2009). The detection index was assumed to be zero (Clark et al. 2009). The signal processing gain ($SG = 10\log(TW)$), which accounts for the animal's ability to not only detect but recognize a signal from an animal of the same species, was estimated as 14.90 dB, based on an median frequency bandwidth (W) of 36 Hz and call length (T) of 0.86 s (Delarue et al. 2015).

4. Results

This section first presents the modeled results for the cumulative sound exposure levels (SELs; Tables 8 to 10) and the time-averaged equivalent sound pressure levels (L_{eq} and L_{eq} above ambient; Tables 11 to 16) for all modeled alternatives and scenarios. Table 7 presents filtered and unfiltered broadband (10–5000 Hz) ambient levels (Alternative 1) at each receiver location.

Relative differences in cumulative SEL and L_{eq} results were calculated and tabulated: Tables 17 to 19 present the results of changes in listening area, Tables 24 to 29 present the results of changes in communication space for bowhead whales. Changes in listening areas were calculated using broadband (10–5000 Hz) levels with and without M-weighting filters. Communication space for bowhead whales were calculated for the 160 Hz 1/3-octave frequency band (without M-weighting filters); Table 23 presents the ambient levels in the 160 Hz 1/3-octave-band used to calculate communication space results for Alternative 1 (no activity).

Table 7. Broadband (10–5000 Hz) ambient SPL (dB re 1 µPa) for each receiver site.

Hearing Group	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Low-frequency cetaceans	105.64	104.91	101.04	105.56	103.44	98.87	103.54	98.87	104.91	103.44
Mid-frequency cetaceans	104.48	103.40	99.74	104.22	102.31	97.03	102.05	97.03	103.40	102.31
Unweighted	105.68	104.96	101.11	105.61	103.49	98.94	103.72	98.94	104.96	103.49

4.1. Cumulative Sound Exposure Levels

Tables 8 to 10 present the results for cumulative SELs (dB re 1 μPa^{2}s) for each receiver site and depth for all modeled alternatives and scenarios. These levels were filtered for low- and mid-frequency cetaceans. These results are based on the total number of pulses for a three-month duration

Table 8. Alternative 2: Cumulative SEL (dB re 1 μPa^{2}s) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	82.6	121.5	144.0	139.1	100.8	87.7	172.2	177.9	185.2	176.8
	30	95.2	117.5	144.1	138.3	116.7	105.1	158.9	177.3		174.8
Mid-frequency cetaceans	5	82.5	121.2	143.8	137.8	98.0	85.5	172.0	177.6	184.9	176.6
	30	95.0	117.3	141.9	136.5	113.5	104.1	158.4	176.5		174.1
Unweighted	5	82.6	121.5	144.1	139.2	100.8	87.7	172.2	177.9	185.2	176.8
	30	95.2	117.6	144.2	138.3	116.7	105.1	158.9	177.3		174.8
Scenario 2											
Low-frequency cetaceans	5	82.6	121.5	143.5	134.2	97.5	79.9	172.2	177.8	185.2	176.8
	30	95.2	117.5	140.6	132.0	113.7	101.3	158.9	177.2		174.8
Mid-frequency cetaceans	5	82.5	121.2	143.4	133.5	95.6	78.9	172.0	177.5	184.9	176.6
	30	95.0	117.3	139.9	129.9	110	100.8	158.4	176.4		174.1
Unweighted	5	82.6	121.5	143.6	134.2	97.6	79.9	172.2	177.9	185.2	176.8
	30	95.2	117.6	140.6	132.0	113.7	101.3	158.9	177.2		174.8

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 9. Alternative 3: Cumulative SEL (dB re 1 μPa^{2}s) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	84.6	121.5	173.6	140.6	125.5	111.2	172.7	179.1	185.5	179.0
	30	99.7	117.6	168.2	139.3	133.9	120.4	159.9	179.2		176.9
Mid-frequency cetaceans	5	84.2	121.3	173.3	139.6	125.1	111.0	172.5	178.7	185.2	178.7
	30	98.4	117.3	167.0	137.9	133.3	119.5	159.3	177.4		176.2
Unweighted	5	84.7	121.5	173.6	140.6	125.5	111.3	172.8	179.1	185.5	179.0
	30	99.7	117.6	168.2	139.3	133.9	120.4	159.9	179.2		176.9
Scenario 2											
Low-frequency cetaceans	5	84.6	121.5	173.6	137.7	125.5	111.2	172.7	179.1	185.5	179.0
	30	99.7	117.6	168.1	135.3	133.8	120.2	159.7	179.0		176.9
Mid-frequency cetaceans	5	84.2	121.3	173.3	137.3	125.1	111.0	172.5	178.7	185.2	178.7
	30	98.4	117.3	167.0	134.2	133.2	119.3	159.1	177.4		176.2
Unweighted	5	84.7	121.5	173.6	137.7	125.5	111.2	172.7	179.0	185.5	179.0
	30	99.7	117.6	168.2	135.4	133.8	120.2	159.7	179.1		176.9

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 10. Alternative 4: Cumulative SEL (dB re 1 µPa2s) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	85.4	121.7	173.7	149.8	125.8	111.4	173.1	179.5	185.6	179.2
	30	100.3	117.8	169.1	145.8	134.4	121.6	160.2	179.5		177.1
Mid-frequency cetaceans	5	85.1	121.5	173.4	149.5	125.3	111.2	172.8	179.1	185.3	178.9
	30	99.2	117.6	167.5	145.3	133.8	120.5	159.6	177.8		176.4
Unweighted	5	85.5	121.7	173.7	149.8	125.8	111.5	173.1	179.5	185.7	179.2
	30	100.4	117.8	169.1	145.8	134.4	121.6	160.2	179.6		177.1
Scenario 2											
Low-frequency cetaceans	5	85.4	121.7	173.7	149.5	125.7	111.4	173.0	179.4	185.6	179.2
	30	100.3	117.8	168.6	145.2	134.2	121.0	160.1	179.4		177.1
Mid-frequency cetaceans	5	85.1	121.5	173.4	149.3	125.3	111.1	172.8	179.1	185.3	178.9
	30	99.2	117.6	167.3	144.8	133.6	120	159.5	177.8		176.3
Unweighted	5	85.5	121.7	173.7	149.5	125.7	111.4	173.0	179.4	185.7	179.2
	30	100.4	117.8	168.6	145.2	134.2	121.0	160.1	179.5		177.1

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

4.2. Time-Averaged Equivalent Sound Pressure Levels

Tables 11 to 16 present the time-averaged equivalent SPLs for each receiver site and depth for all modeled alternatives. The time-averaged equivalent SPLs were calculated by applying the cumulative SELs and the filtered ambient noise levels (Table 7) with a time average of 31.45 × 10^6 seconds. The values in the tables represent time-averaged equivalent SPLs above and below the ambient levels

Table 11. Alternative 2: Time-averaged equivalent sound pressure levels (L_{eq}) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	105.6	104.9	101.0	105.6	103.4	98.9	106.0	108.7	115.8	108.7
	30	105.6	104.9	101.0	105.6	103.4	98.9	103.7	108.1		107.3
Mid-frequency cetaceans	5	104.5	103.4	99.7	104.2	102.3	97.0	105.2	108.2	115.5	108.2
	30	104.5	103.4	99.7	104.2	102.3	97.0	102.3	107.2		106.5
Unweighted	5	105.7	105.0	101.1	105.6	103.5	98.9	106.2	108.7	115.9	108.7
	30	105.7	105.0	101.1	105.6	103.5	98.9	103.9	108.1		107.4
Scenario 2											
Low-frequency cetaceans	5	105.6	104.9	101.0	105.6	103.4	98.9	106.0	108.6	115.8	108.7
	30	105.6	104.9	101.0	105.6	103.4	98.9	103.7	108.1		107.3
Mid-frequency cetaceans	5	104.5	103.4	99.7	104.2	102.3	97.0	105.2	108.2	115.5	108.2
	30	104.5	103.4	99.7	104.2	102.3	97.0	102.3	107.2		106.5
Unweighted	5	105.7	105.0	101.1	105.6	103.5	98.9	106.2	108.6	115.9	108.7
	30	105.7	105.0	101.1	105.6	103.5	98.9	103.9	108.1		107.4

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 12. Alternative 2: Time-averaged equivalent sound pressure levels (L_{eq}) above ambient at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	0	0	0	0	0	0	2.5	9.8	10.9	5.3
	30	0	0	0	0	0	0	0.2	9.2		3.9
Mid-frequency cetaceans	5	0	0	0	0	0	0	3.1	11.2	12.1	5.9
	30	0	0	0	0	0	0	0.2	10.2		4.2
Unweighted	5	0	0	0	0	0	0	2.5	9.8	10.9	5.2
	30	0	0	0	0	0	0	0.2	9.2		3.9
Scenario 2											
Low-frequency cetaceans	5	0	0	0	0	0	0	2.5	9.7	10.9	5.3
	30	0	0	0	0	0	0	0.2	9.2		3.9
Mid-frequency cetaceans	5	0	0	0	0	0	0	3.1	11.2	12.1	5.9
	30	0	0	0	0	0	0	0.2	10.2		4.2
Unweighted	5	0	0	0	0	0	0	2.5	9.7	10.9	5.2
	30	0	0	0	0	0	0	0.2	9.2		3.9

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 13. Alternative 3: Time-averaged equivalent sound pressure levels (L_{eq}) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	105.6	104.9	105.7	105.6	103.4	98.9	106.3	109.8	116.1	110.3
	30	105.6	104.9	102.9	105.6	103.4	98.9	103.7	109.8		108.7
Mid-frequency cetaceans	5	104.5	103.4	105.1	104.2	102.3	97.0	105.5	109.3	115.7	109.8
	30	104.5	103.4	101.7	104.2	102.3	97.0	102.3	108.1		107.9
Unweighted	5	105.7	105.0	105.7	105.6	103.5	98.9	106.4	109.8	116.1	110.3
	30	105.7	105.0	103.0	105.6	103.5	98.9	103.9	109.9		108.8
Scenario 2											
Low-frequency cetaceans	5	105.6	104.9	105.7	105.6	103.4	98.9	106.3	109.7	116.1	110.3
	30	105.6	104.9	102.9	105.6	103.4	98.9	103.7	109.7		108.7
Mid-frequency cetaceans	5	104.5	103.4	105.1	104.2	102.3	97.0	105.5	109.3	115.7	109.8
	30	104.5	103.4	101.7	104.2	102.3	97.0	102.3	108.0		107.9
Unweighted	5	105.7	105.0	105.7	105.6	103.5	98.9	106.4	109.7	116.1	110.3
	30	105.7	105.0	103.0	105.6	103.5	98.9	103.9	109.8		108.8

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 14. Alternative 3: Time-averaged equivalent sound pressure levels (L_{eq}) above ambient at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	0	0	4.7	0	0	0	2.8	10.9	11.2	6.9
	30	0	0	1.9	0	0	0	0.2	10.9		5.3
Mid-frequency cetaceans	5	0	0	5.4	0	0	0	3.4	12.3	12.3	7.5
	30	0	0	2.0	0	0	0	0.2	11.1		5.6
Unweighted	5	0	0	4.6	0	0	0	2.7	10.9	11.1	6.8
	30	0	0	1.9	0	0	0	0.2	11.0		5.3
Scenario 2											
Low-frequency cetaceans	5	0	0	4.7	0	0	0	2.8	10.8	11.2	6.9
	30	0	0	1.9	0	0	0	0.2	10.8		5.3
Mid-frequency cetaceans	5	0	0	5.4	0	0	0	3.4	12.3	12.3	7.5
	30	0	0	2.0	0	0	0	0.2	11.0		5.6
Unweighted	5	0	0	4.6	0	0	0	2.7	10.8	11.1	6.8
	30	0	0	1.9	0	0	0	0.2	10.9		5.3

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 15. Alternative 4: Time-averaged equivalent sound pressure levels (L_{eq}) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	105.6	104.9	105.8	105.6	103.4	98.9	106.4	110.1	116.3	110.4
	30	105.6	104.9	103.3	105.6	103.4	98.9	103.7	110.2		108.9
Mid-frequency cetaceans	5	104.5	103.4	105.2	104.2	102.3	97.0	105.7	109.7	115.9	110
	30	104.5	103.4	101.8	104.2	102.3	97.0	102.4	108.4		108.0
Unweighted	5	105.7	105.0	105.8	105.6	103.5	98.9	106.6	110.1	116.3	110.5
	30	105.7	105.0	103.3	105.6	103.5	98.9	103.9	110.2		108.9
Scenario 2											
Low-frequency cetaceans	5	105.6	104.9	105.8	105.6	103.4	98.9	106.4	110.1	116.3	110.4
	30	105.6	104.9	103.1	105.6	103.4	98.9	103.7	110		108.9
Mid-frequency cetaceans	5	104.5	103.4	105.2	104.2	102.3	97.0	105.6	109.6	115.9	110
	30	104.5	103.4	101.8	104.2	102.3	97.0	102.3	108.4		108.0
Unweighted	5	105.7	105.0	105.8	105.6	103.5	98.9	106.5	110.1	116.3	110.5
	30	105.7	105.0	103.2	105.6	103.5	98.9	103.9	110.1		108.9

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 16. Alternative 4: Time-averaged equivalent sound pressure levels (L_{eq}) above ambient at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	0	0	4.8	0.012	0	0	2.9	11.2	11.4	7.0
	30	0	0	2.3	0.005	0	0	0.2	11.3		5.5
Mid-frequency cetaceans	5	0	0	5.5	0.016	0	0	3.6	12.7	12.5	7.7
	30	0	0	2.1	0.006	0	0	0.3	11.4		5.7
Unweighted	5	0	0	4.7	0.012	0	0	2.9	11.2	11.3	7.0
	30	0	0	2.2	0.005	0	0	0.2	11.3		5.4
Scenario 2											
Low-frequency cetaceans	5	0	0	4.8	0.011	0	0	2.9	11.2	11.4	7.0
	30	0	0	2.1	0.004	0	0	0.2	11.1		5.5
Mid-frequency cetaceans	5	0	0	5.5	0.015	0	0	3.5	12.6	12.5	7.7
	30	0	0	2.1	0.005	0	0	0.2	11.4		5.7
Unweighted	5	0	0	4.7	0.011	0	0	2.8	11.2	11.3	7.0
	30	0	0	2.1	0.004	0	0	0.2	11.2		5.4

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

4.3. Listening Area

Tables 17 to 19 present the calculated change in listening area for each receiver site and depth for all modeled alternatives.

Table 17. Alternative 2 relative to Alternative 1 (no activity): Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	100	100	99.8	100	100	100	42	3.1	2.0	17
	30	100	100	99.8	100	100	100	95	3.8		27
Mid-frequency cetaceans	5	100	100	99.7	100	100	100	35	1.9	1.3	14
	30	100	100	99.8	100	100	100	94	2.7		24
Unweighted	5	100	100	99.8	100	100	100	43	3.1	2.1	17
	30	100	100	99.8	100	100	100	95	3.8		27
Scenario 2											
Low-frequency cetaceans	5	100	100	99.8	100	100	100	42.4	3.2	2.0	17
	30	100	100	99.9	100	100	100	94.8	3.9		27
Mid-frequency cetaceans	5	100	100	99.7	100	100	100	35.0	1.9	1.3	14
	30	100	100	99.9	100	100	100	93.6	2.7		24
Unweighted	5	100	100	99.8	100	100	100	43.6	3.1	2.1	17
	30	100	100	99.9	100	100	100	95.0	3.9		27

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 18. Alternative 3 relative to Alternative 1 (no activity): Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	100	100	33.0	100	100	100	39.0	2.1	1.8	10
	30	100	100	63.4	100	100	100	93.5	2.1		17
Mid-frequency cetaceans	5	100	100	27.8	100	100	100	31.8	1.3	1.2	8
	30	100	100	62.6	100	100	100	92.3	2.0		15
Unweighted	5	100	100	33.3	100	100	100	40.1	2.1	1.9	10
	30	100	100	63.8	100	100	100	93.8	2.0		17
Scenario 2											
Low-frequency cetaceans	5	100	100	33.0	100	100	100	39.3	2.1	1.8	10
	30	100	100	63.5	100	100	100	93.8	2.2		17
Mid-frequency cetaceans	5	100	100	27.8	100	100	100	31.9	1.3	1.2	8
	30	100	100	62.7	100	100	100	92.6	2.0		15
Unweighted	5	100	100	33.3	100	100	100	40.4	2.2	1.9	10
	30	100	100	63.9	100	100	100	94.1	2.1		17

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 19. Alternative 4 relative to Alternative 1 (no activity): Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	100	100	32.3	99.7	100	100	37.0	1.9	1.7	9
	30	100	100	58.4	99.9	100	100	93.0	1.8		16
Mid-frequency cetaceans	5	100	100	27.3	99.6	100	100	30.1	1.1	1.2	7
	30	100	100	60.1	99.9	100	100	91.8	1.7		15
Unweighted	5	100	100	32.6	99.7	100	100	38.1	1.9	1.8	9
	30	100	100	58.8	99.9	100	100	93.3	1.8		16
Scenario 2											
Low-frequency cetaceans	5	100	100	32.3	99.7	100	100	37.4	1.9	1.7	9
	30	100	100	60.9	99.9	100	100	93.2	1.9		16
Mid-frequency cetaceans	5	100	100	27.3	99.7	100	100	30.2	1.1	1.2	7
	30	100	100	61.2	99.9	100	100	91.9	1.8		15
Unweighted	5	100	100	32.6	99.7	100	100	38.5	1.9	1.8	9
	30	100	100	61.3	99.9	100	100	93.5	1.9		16

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 20. Alternative 2 relative to Alternative 3: Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	100	100	33.1	100	100	100	92.2	68.3	91.5	57.4
	30	100	100	63.5	100	100	100	98.7	54.0		62.1
Mid-frequency cetaceans	5	100	100	27.9	100	100	100	91.2	68.7	91.4	56.8
	30	100	100	62.7	100	100	100	98.7	73.8		62.7
Unweighted	5	100	100	33.4	100	100	100	92.4	69.4	91.5	57.5
	30	100	100	63.9	100	100	100	98.7	53.9		62.3
Scenario 2											
Low-frequency cetaceans	5	100	100	33.1	100	100	100	92.5	67.4	91.5	57.4
	30	100	100	63.6	100	100	100	99.0	56.2		62.1
Mid-frequency cetaceans	5	100	100	27.9	100	100	100	91.3	68.0	91.4	56.8
	30	100	100	62.7	100	100	100	98.9	74.0		62.6
Unweighted	5	100	100	33.4	100	100	100	92.7	68.4	91.5	57.5
	30	100	100	63.9	100	100	100	99.0	54.9		62.3

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 21. Alternative 2 relative to Alternative 4: Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	100	100	32.3	99.7	100	100	87.4	60.5	86.0	54.8
	30	100	100	58.5	99.9	100	100	98.2	48.2		59.7
Mid-frequency cetaceans	5	100	100	27.4	99.7	100	100	86.4	60.7	86.2	54.2
	30	100	100	60.2	99.9	100	100	98.1	65.0		60.3
Unweighted	5	100	100	32.6	99.7	100	100	87.7	61.4	86.0	54.9
	30	100	100	58.9	99.9	100	100	98.2	48.1		59.9
Scenario 2											
Low-frequency cetaceans	5	100	100	32.4	99.7	100	100	88.1	59.6	86.0	54.8
	30	100	100	60.9	99.9	100	100	98.4	49.9		59.7
Mid-frequency cetaceans	5	100	100	27.4	99.7	100	100	86.4	60.0	86.2	54.2
	30	100	100	61.2	99.9	100	100	98.2	65.1		60.3
Unweighted	5	100	100	32.7	99.7	100	100	88.4	60.4	86.0	54.9
	30	100	100	61.3	99.9	100	100	98.4	48.8		59.9

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 22. Alternative 3 relative to Alternative 4: Remainder of listening area (%) at each receiver site with M-weighting for low- and mid-frequency cetaceans and without weighting.

Hearing Group	Receiver Depth (m)	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9*	Site 10
Scenario 1											
Low-frequency cetaceans	5	100	100	97.8	99.8	100	100	94.8	88.5	94.0	95.5
	30	100	100	92.1	99.9	100	100	99.5	89.2		96.1
Mid-frequency cetaceans	5	100	100	98.2	99.7	100	100	94.7	88.4	94.3	95.4
	30	100	100	96.0	99.9	100	100	99.4	88.1		96.2
Unweighted	5	100	100	97.8	99.8	100	100	94.9	88.4	94.0	95.5
	30	100	100	92.2	99.9	100	100	99.5	89.2		96.1
Scenario 2											
Low-frequency cetaceans	5	100	100	98.0	99.8	100	100	95.3	88.4	94.0	95.5
	30	100	100	95.9	99.9	100	100	99.4	88.9		96.1
Mid-frequency cetaceans	5	100	100	98.3	99.7	100	100	94.7	88.3	94.3	95.4
	30	100	100	97.6	99.9	100	100	99.3	88.0		96.2
Unweighted	5	100	100	98.0	99.8	100	100	95.4	88.3	94.0	95.5
	30	100	100	95.9	99.9	100	100	99.4	89.0		96.1

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

4.4. Bowhead Whale Communication Space

Tables 24 to 29 present the relative changes in bowhead whale communication space for all modeled alternatives based on communication in the 1/3-octave-band centered at 160 Hz. The ambient levels (SPLs for Alternative 1, Table 23) used in these comparisons were calculated for the same frequency band.

Table 23. Ambient (no activity) SPL (dB re 1 µPa) for 160 Hz for each receiver site.

Hearing Group	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10
Bowhead whale	69.51	69.01	73.43	69.38	72.01	74.70	71.57	74.70	69.01	72.01

Table 24. Alternative 2 relative to Alternative 1 (no activity): Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas.

Site	Receiver Depth (m)	Scenario 1				Scenario 2			
		Alternative 1 area (km^2)	Alternative 2 area (km^2)	Δ area (km^2)	% of original area	Alternative 1 area (km^2)	Alternative 2 area (km^2)	Δ area (km^2)	% of original area
1	5	253.8	253.8	0	100	253.8	253.8	0	100
	30	309.3	309.3	0	100	309.3	309.3	0	100
2	5	187.2	187.2	0	100	187.2	187.2	0	100
	19	201.6	201.6	0	100	201.6	201.6	0	100
3	5	337.5	337.5	0	100	337.5	337.5	0	100
	30	356.0	356.0	0	100	356.0	356.0	0	100
4	5	242.1	242.1	0	100	242.1	242.1	0	100
	30	317.9	317.9	0	100	317.9	317.9	0	100
5	5	331.9	331.9	0	100	331.9	331.9	0	100
	30	382.5	382.5	0	100	382.5	382.5	0	100
6	5	368.5	368.5	0	100	368.5	368.5	0	100
	30	390.6	390.6	0	100	390.6	390.6	0	100
7	5	359.9	359.9	0	100	359.9	359.9	0	100
	30	372.7	372.7	0	100	372.7	372.7	0	100
8	5	242.7	224.2	18.5	92.4	242.7	224.2	18.5	92.4
	30	290.9	233.4	57.5	80.2	290.9	233.4	57.5	80.2
9*	5	125.0	123.8	1.3	99.0	125.0	123.8	1.3	99.0
10	5	368.3	367.7	0.6	99.8	368.3	367.7	0.6	99.8
	30	385.1	384.1	1.0	99.7	385.1	384.1	1.0	99.7

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 25. Alternative 3 relative to Alternative 1 (no activity): Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas.

Site	Receiver Depth (m)	Scenario 1				Scenario 2			
		Alternative 1 area (km^2)	Alternative 3 area (km^2)	Δ area (km^2)	% of original area	Alternative 1 area (km^2)	Alternative 3 area (km^2)	Δ area (km^2)	% of original area
1	5	253.8	253.8	0	100	253.8	253.8	0	100
	30	309.3	309.3	0	100	309.3	309.3	0	100
2	5	187.2	187.2	0	100	187.2	187.2	0	100
	19	201.6	201.6	0	100	201.6	201.6	0	100
3	5	337.5	336.1	1.4	99.6	337.5	336.1	1.4	99.6
	30	356.0	346.4	9.6	97.3	356.0	347.9	8.1	97.7
4	5	242.1	242.1	0	100	242.1	242.1	0	100
	30	317.9	317.9	0	100	317.9	317.9	0	100
5	5	331.9	331.9	0	100	331.9	331.9	0	100
	30	382.5	382.5	0	100	382.5	382.5	0	100
6	5	368.5	368.5	0	100	368.5	368.5	0	100
	30	390.6	390.6	0	100	390.6	390.6	0	100
7	5	359.9	359.9	0	100	359.9	359.9	0	100
	30	372.7	372.7	0	100	372.7	372.7	0	100
8	5	242.7	223.9	18.8	92.3	242.7	223.9	18.8	92.3
	30	290.9	220.4	70.5	75.8	290.9	222.2	68.7	76.4
9*	5	125.0	123.8	1.3	99.0	125.0	123.8	1.3	99.0
10	5	368.3	367.3	1.0	99.7	368.3	367.3	1.0	99.7
	30	385.1	383.4	1.7	99.6	385.1	383.4	1.7	99.6

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 26. Alternative 4 relative to Alternative 1 (no activity): Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas.

Site	Receiver Depth (m)	Scenario 1				Scenario 2			
		Alternative 1 area (km^2)	Alternative 3 area (km^2)	Δ area (km^2)	% of original area	Alternative 1 area (km^2)	Alternative 3 area (km^2)	Δ area (km^2)	% of original area
1	5	253.8	253.8	0	100	253.8	253.8	0	100
	30	309.3	309.3	0	100	309.3	309.3	0	100
2	5	187.2	187.2	0	100	187.2	187.2	0	100
	19	201.6	201.6	0	100	201.6	201.6	0	100
3	5	337.5	335.4	2.1	99.4	337.5	335.8	1.8	99.5
	30	356.0	330.9	25.1	93.0	356.0	341.0	15.0	95.8
4	5	242.1	242.1	0	100	242.1	242.1	0	100
	30	317.9	317.9	0	100	317.9	317.9	0	100
5	5	331.9	331.9	0	100	331.9	331.9	0	100
	30	382.5	382.5	0	100	382.5	382.5	0	100
6	5	368.5	368.5	0	100	368.5	368.5	0	100
	30	390.6	390.6	0	100	390.6	390.6	0	100
7	5	359.9	359.9	0	100	359.9	359.9	0	100
	30	372.7	372.7	0	100	372.7	372.7	0	100
8	5	242.7	219.2	23.5	90.3	242.7	219.9	22.7	90.6
	30	290.9	209.9	81.1	72.1	290.9	214.6	76.3	73.8
9*	5	125.0	123.8	1.3	99.0	125.0	123.8	1.3	99.0
10	5	368.3	367.0	1.2	99.7	368.3	367.0	1.2	99.7
	30	385.1	382.9	2.2	99.4	385.1	382.9	2.2	99.4

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 27. Alternative 2 relative to Alternative 3: Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas.

Site	Receiver Depth (m)	Scenario 1				Scenario 2			
		Alternative 2 area (km^2)	Alternative 3 area (km^2)	Δ area (km^2)	% of original area	Alternative 2 area (km^2)	Alternative 3 area (km^2)	Δ area (km^2)	% of original area
1	5	253.8	253.8	0	100	253.8	253.8	0	100
	30	309.3	309.3	0	100	309.3	309.3	0	100
2	5	187.2	187.2	0	100	187.2	187.2	0	100
	19	201.6	201.6	0	100	201.6	201.6	0	100
3	5	337.5	336.1	1.4	99.6	337.5	336.1	1.4	99.6
	30	356.0	346.4	9.6	97.3	356.0	347.9	8.1	97.7
4	5	242.1	242.1	0	100	242.1	242.1	0	100
	30	317.9	317.9	0	100	317.9	317.9	0	100
5	5	331.9	331.9	0	100	331.9	331.9	0	100
	30	382.5	382.5	0	100	382.5	382.5	0	100
6	5	368.5	368.5	0	100	368.5	368.5	0	100
	30	390.6	390.6	0	100	390.6	390.6	0	100
7	5	359.9	359.9	0	100	359.9	359.9	0	100
	30	372.7	372.7	0	100	372.7	372.7	0	100
8	5	224.2	223.9	0.3	99.9	224.2	223.9	0.3	99.9
	30	233.4	220.4	13.0	94.4	233.4	222.2	11.2	95.2
9*	5	123.8	123.8	0	100	123.8	123.8	0	100.0
10	5	367.7	367.3	0.3	99.9	367.7	367.3	0.3	99.9
	30	384.1	383.4	0.7	99.8	384.1	383.4	0.7	99.8

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 28. Alternative 2 relative to Alternative 4: Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas.

Site	Receiver Depth (m)	Scenario 1				Scenario 2			
		Alternative 2 area (km^2)	Alternative 4 area (km^2)	Δ area (km^2)	% of original area	Alternative 2 area (km^2)	Alternative 4 area (km^2)	Δ area (km^2)	% of original area
1	5	253.8	253.8	0	100	253.8	253.8	0	100
	30	309.3	309.3	0	100	309.3	309.3	0	100
2	5	187.2	187.2	0	100	187.2	187.2	0	100
	19	201.6	201.6	0	100	201.6	201.6	0	100
3	5	337.5	335.4	2.1	99.4	337.5	335.8	1.8	99.5
	30	356.0	330.9	25.1	93.0	356.0	341.0	15.0	95.8
4	5	242.1	242.1	0	100	242.1	242.1	0	100
	30	317.9	317.9	0	100	317.9	317.9	0	100
5	5	331.9	331.9	0	100	331.9	331.9	0	100
	30	382.5	382.5	0	100	382.5	382.5	0	100
6	5	368.5	368.5	0	100	368.5	368.5	0	100
	30	390.6	390.6	0	100	390.6	390.6	0	100
7	5	359.9	359.9	0	100	359.9	359.9	0	100
	30	372.7	372.7	0	100	372.7	372.7	0	100
8	5	224.2	219.2	5.0	97.8	224.2	219.9	4.3	98.1
	30	233.4	209.9	23.5	89.9	233.4	214.6	18.8	92.0
9*	5	123.8	123.8	0	100	123.8	123.8	0	100
10	5	367.7	367.0	0.6	99.8	367.7	367.0	0.6	99.8
	30	384.1	382.9	1.2	99.7	384.1	382.9	1.2	99.7

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

Table 29. Alternative 3 relative to Alternative 4: Bowhead whale communication space at all receiver sites for this Alternative without (Scenario 1) and with (Scenario 2) closure areas.

Site	Receiver Depth (m)	Scenario 1				Scenario 2			
		Alternative 3 area (km^2)	Alternative 4 area (km^2)	Δ area (km^2)	% of original area	Alternative 3 area (km^2)	Alternative 4 area (km^2)	Δ area (km^2)	% of original area
1	5	253.8	253.8	0	100	253.8	253.8	0	100
	30	309.3	309.3	0	100	309.3	309.3	0	100
2	5	187.2	187.2	0	100	187.2	187.2	0	100
	19	201.6	201.6	0	100	201.6	201.6	0	100
3	5	336.1	335.4	0.6	99.8	336.1	335.8	0.3	99.9
	30	346.4	330.9	15.5	95.5	347.9	341.0	6.8	98.0
4	5	242.1	242.1	0	100	242.1	242.1	0	100
	30	317.9	317.9	0	100	317.9	317.9	0	100
5	5	331.9	331.9	0	100	331.9	331.9	0	100
	30	382.5	382.5	0	100	382.5	382.5	0	100
6	5	368.5	368.5	0	100	368.5	368.5	0	100
	30	390.6	390.6	0	100	390.6	390.6	0	100
7	5	359.9	359.9	0	100	359.9	359.9	0	100
	30	372.7	372.7	0	100	372.7	372.7	0	100
8	5	223.9	219.2	4.7	97.9	223.9	219.9	4.0	98.2
	30	220.4	209.9	10.6	95.2	222.2	214.6	7.6	96.6
9*	5	123.8	123.8	0	100	123.8	123.8	0	100
10	5	367.3	367.0	0.3	99.9	367.3	367.0	0.3	99.9
	30	383.4	382.9	0.5	99.9	383.4	382.9	0.5	99.9

* Site 9 is located in an area too shallow to place a receiver at the 30 m depth.

5. Discussion and Conclusion

This assessment applies acoustic models to determine changes in listening space and in bowhead whale communication space caused by the sounds generated by various seismic and exploratory drilling activities in the Beaufort and Chukchi Seas. To obtain these results, acoustic transmission loss was modeled at 10 receiver sites (Table 1, Figure 1). Cumulative sound exposure levels (SEL) and the time-averaged equivalent sound pressure levels (L_{eq}, and L_{eq} above ambient level) were calculated at the same ten sites for four alternatives of increasing survey activity: Alternative 1 represents no activity and Alternatives 2–4 include exploration activities. Two scenarios (with and without closure areas) were analyzed for Alternatives 2–4. Changes in listening area and in bowhead whale communication space were calculated for each alternative and scenario. The results for changes in listening area are presented in Tables 17 to 19 and the results for bowhead whale communication space are presented in Tables 24 to 29.

The key findings of this acoustic effects assessment are:

- Receiver sites along the Chukchi Sea coast that are far from the primary anthropogenic activities (Sites 1, 2, 5, and 6) experienced minimal reduction in listening area and communication space for bowhead whales.
- Receiver sites along the Beaufort Sea coast (Sites 7–10) showed greater effects than at the Chukchi coast sites.
- The introduction of closure areas (Scenario 2) had a minimal effect on the change in listening area and bowhead whale communication space for all alternatives. The effect is greatest at Site 7, located in the Barrow Canyon closure area.

5.1. Site-specific Results

- Sites 1, 2, 5, and 6 (Cape Lisburne, Point Lay, Point Franklin and Peard Bay) showed no listening area or communication space reductions for any of the modeled alternatives.
- Site 3 (Chukchi leases, 44 m water depth), located in the Chukchi Sea lease area, showed minimal reductions (0.3%) to listening area for Alternative 2, but showed up to 72.2% reduction for Alternative 3, and up to 72.7% reduction for Alternative 4, relative to Alternative 1 (no-activity). Corresponding communication space reductions were up to 2.3% for Alternative 3, and up to 7% for Alternative 4. Alternative 4 with area closures (Scenario 2), had up to a 4.2% reduction in communication space (instead of 7% without area closures).
- Site 4 (Hanna Shoal, 32 m water depth) showed minimal (< 0.5%) listening area reductions and no reduction in communication space for any of the alternatives. Although this site is relatively close to seismic and exploratory drilling activities in the Chukchi Sea, the downward refracting sound speed profile prevented long-range propagation and resulted in a low sound level above ambient (< 0.02 dB; Table 16) in shallow water over the Hanna Shoal area.
- Site 7 (east of Barrow, 31 m water depth) showed listening area reductions of up to 65% (35% of the original area remained) for Alternative 2 and area reductions up to 70% for Alternative 4. Interestingly, no corresponding reductions to communication space were observed. This apparent inconsistency occurs because bowhead whale communication space relies only on the 160 Hz 1/3-octave frequency band, while the listening area assessment considered broadband sound levels. The modeled environment in the Beaufort Sea does not promote long-range propagation in the 160 Hz band to the extent of higher frequency bands. Thus the changes in bowhead whale communication space were not as important as the changes in listening area using these approaches.
- Site 8 (Beaufort Sea shelf slope, 1854 m water depth) experienced substantial listening area reductions due to exploration activity sounds. Listening areas were reduced up to 98.1% for

Alternative 2, leaving as little as 1.9% of the original listening area. The corresponding reduction in the listening area for Alternatives 3 and 4 were up to 98.8%. The reductions in bowhead whale communication space were less: up to 19.8% for Alternative 2, 24.2% for Alternative 3, and 27.9% for Alternative 4. The sensitivity of this site to exploration activity sounds appears to be due to an upward refracting sound speed profile in the deep water environment that traps sound from more distant sources in the upper water column. These sounds can propagate with relatively low transmission loss over long distances.

- Site 9 (Cross Island, 9 m water depth) also showed substantial listening area reductions. The listening area was reduced by up to 98.7% (1.3% of the original listening area remained) for Alternative 2. The reduction was by up to 98.8% for Alternatives 3 and 4. These substantial listening area losses appear to be due to the presence of 12 drilling support vessels within 40 km of the receiver site. Those received vessel sounds exceed ambient levels, which are quite low in this area, by more than 10 dB. Reductions to communication space at this site are interestingly much less than those for listening area; they are reduced by 1% for all 3 Alternatives.
- Site 10 (Kaktovik, 40 m water depth) also showed substantial listening area reductions, but minimal bowhead whale communication space reductions. The reduced listening area was up to 86% for Alternative 2 (14% of the Alternative 1 space remained), up to 92% for Alternative 3, and up to 93% for Alternative 4. The communication space reductions were 0.3% for Alternative 2, 0.4% for Alternative 3, and 0.6% for Alternative 4.

Acknowledgments

With much appreciation, we thank Erin Dunable for her help on the interpretation and editorial review of this report, and Jolie Harrison and Leila Hatch for their insights and contributions to developing the analysis approaches.

Literature Cited

[NMFS] National Marine Fisheries Service. 2013. *Effects of Oil and Gas Activities in the Arctic Ocean: Supplemental Draft Environmental Impact Statement*. Prepared by United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. 60 pp.

[NMFS] National Marine Fisheries Service. In progress. *Effects of Oil and Gas Activities in the Arctic Ocean: Programmatic Environmental Impact Statement*. Prepared by United States Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources.

[NPS] National Park Service. 2010. *Zion National Park. Soundscape Management Plan*.

Arveson, P.T. and D.J. Vendittis. 2000. Radiated noise characteristics of a modern cargo ship. *Journal of the Acoustical Society of America* 107(1): 118-129.

Austin, M., A. MacGillivray, D. Hannay, and M. Zykov. 2006. *Shell Exploration and Production Company Seismic Exploration of Selected Lease Areas in the Alaskan Beaufort Sea and Chukchi Sea, Acoustics Pre-season Estimate Modeling Report*. Prepared for LGL Limited by JASCO Research Ltd. 120 pp.

Austin, M., C. O'Neill, G. Warner, and J. Wladichuk. 2015. *Chukchi Sea Analysis and Acoustic Propagation Modeling: Task 1 Deliverable*. Document Number 965, Version 2.0. Technical report by JASCO Applied Sciences for AECOM/URS Group, Inc., Anchorage, AK. 12 pp.

Barber, J.R., K.R. Crooks, and K.M. Fristrup. 2009. The costs of chronic noise exposure for terrestrial organisms. *Trends in Ecology and Evolution* 25(3): 180-189.

Bershad, S. and M. Weiss. 1975. *NOAA National Geophysical Data Center, Deck 41 surficial sediment database*. http://www.ngdc.noaa.gov/mgg/geology/deck41.html.

Buckingham, M.J. 2005. Compressional and shear wave properties of marine sediments: Comparisons between theory and data. *Journal of the Acoustical Society of America* 117(1): 137-152. http://link.aip.org/link/?JAS/117/137/1.

Carnes, M.R. 2009. *Description and Evaluation of GDEM-V 3.0*. Document Number NRL Memorandum Report 7330-09-9165. US Naval Research Laboratory, Stennis Space Center, MS. 21 pp.

Clark, C.W., W.T. Ellison, B.L. Southall, L. Hatch, S.M. Van Parijs, A. Frankel, and D. Ponirakis. 2009. Acoustic masking in marine ecosystems: Intuitions, analysis, and implication. *Marine Ecology Progress Series* 395: 201-222. http://www.int-res.com/abstracts/meps/v395/p201-222/

Collins, M.D. 1993. A split-step Padé solution for the parabolic equation method. *Journal of the Acoustical Society of America* 93: 1736-1742.

Collins, M.D., R.J. Cederberg, D.B. King, and S. Chin-Bing. 1996. Comparison of algorithms for solving parabolic wave equations. *Journal of the Acoustical Society of America* 100(1): 178-182.

Coppens, A.B. 1981. Simple equations for the speed of sound in Neptunian waters. *Journal of the Acoustical Society of America* 69(3): 862-863. http://link.aip.org/link/?JAS/69/862/1.

Cummings, W.C. and D.V. Holliday. 1987. Sounds and source levels from bowhead whales off Pt. Barrow, Alaska. *Journal of the Acoustical Society of America* 82(3): 814-821. http://scitation.aip.org/content/asa/journal/jasa/82/3/10.1121/1.395279.

Delarue, J., J. MacDonnell, K. Kowarski, B. Martin, X. Mouy, and D. Hannay. 2015. *Northeastern Chukchi Sea Joint Acoustic Monitoring Program 2013–2014.* Document Number 01023. Technical report by JASCO Applied Sciences for Shell Exploration & Production Company and ConocoPhillips Company.

Dragoset, W.H. 1984. A comprehensive method for evaluating the design of airguns and airgun arrays. *Proceedings, 16th Annual Offshore Technology Conference* Volume 3, May 7-9, 1984. OTC 4747, Houston, Houston. 75–84 pp.

Einsele, G. 2000. *Sedimentary basins; evolution, facies, and sediment budget*. 2nd, completely rev. and enlarged ed. edition. Springer. 792.

Greene, C.R., Jr. 1997. *Physical acoustics measurements*. *In*: Richardson, W.J. (ed.). *Northstar Marine Mammal Monitoring Program, 1996: Marine Mammal and Acoustical Monitoring of a Seismic Program in the Alaskan Beaufort Sea*. LGL Rep. 2121-2. Report from LGL Ltd., King City, ON, and Greeneridge Sciences Inc., Santa Barbara, CA, for BP Exploration (Alaska) Inc., Anchorage, AK, and National Marine Fisheries Services, Anchorage, AK, and Silver Spring, MD. 3-1 to 3-63 pp.

Hatch, L.T., C.W. Clark, S.M. Van Parijs, A.S. Frankel, and D.W. Ponirakis. 2012. Quantifying loss of acoustic communication space for right whales in and around a U.S. National Marine Sanctuary. *Conservation Biology* 26(5): 983-994.

Landro, M. 1992. Modeling of GI gun signatures. *Geophysical Prospecting* 40: 721–747.

Laws, M., L. Hatton, and M. Haartsen. 1990. Computer modeling of clustered airguns. *First Break* 8: 331–338.

Lindquist, K.G., K. Engle, D. Stahlke, and E. Price. 2004. Global topography and bathymetry grid improves research efforts. *Eos, Transactions American Geophysical Union* 85(19): 186. http://dx.doi.org/10.1029/2004EO190003.

Lurton, X. 2002. *An Introduction to Underwater Acoustics: Principles and Applications*. Springer, Chichester, U.K. 347.

MacGillivray, A.O. 2006. *Acoustic Modelling Study of Seismic Airgun Noise in Queen Charlotte Basin*. MSc Thesis. University of Victoria, Victoria, BC. 98 pp.

Malme, C.I., P.W. Smith, and P.R. Miles. 1986. *Characterisation of Geophysical Acoustic Survey Sounds*. Report by BBN Laboratories Inc. for Battelle Memorial Institute to the Minerals Management Service, Pacific Outer Continental Shelf Region.

McCauley, R.D., M. Jenner, C. Jenner, K. McCabe, and J. Murdoch. 1998. The response of humpback whales (*Megaptera novaeangliae*) to offshore seismic survey noise: Preliminary results of observations about a working seismic vessel and experimental exposures. *Australian Petroleum Production Exploration Association (APPEA) Journal* 38(1): 692-707.

Racca, R., M. Austin, A. Rutenko, and K. Bröker. 2015. Monitoring the gray whale sound exposure mitigation zone and estimating acoustic transmission during a 4-D seismic survey, Sakhalin

Island, Russia. *Endangered Species Research* 29: 131-146. http://www.int-res.com/articles/esr2016/29/n029p131.pdf.

Racca, R.G. and J.A. Scrimger. 1986. *Underwater Acoustic Source Characteristics of Air and Water Guns*. Document Number DREP Tech. Rep. 06SB 97708-5-7055. Report by JASCO Research Ltd. for Defence Research Establishment Pacific (Canada), Victoria, BC.

Seger, K.D., A.M. Thode, S.B. Blackwell, and K.H. Kim. 2015. A seven-year review of ambient acoustic environments in the Beaufort Sea. *Acoustical Society of America*. 2-6 November 2015, Jacksonville, Florida.

Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene, Jr., D. Kastak, D.R. Ketten, J.H. Miller, et al. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. *Aquatic Mammals* 33(4): 411-521.

Spence, J., R. Fischer, M. Bahtiarian, L. Boroditsky, N. Jones, and R. Dempsey. 2007. *Review of Existing and Future Potential Treatments for Reducing Underwater Sound from Oil and Gas Industry Activities*. NCE REPORT 07-001. Report prepared by Noise Control Engineering, Inc., for Joint Industry Programme on E&P Sound and Marine Life.

Teague, W.J., M.J. Carron, and P.J. Hogan. 1990. A comparison between the Generalized Digital Environmental Model and Levitus climatologies. *Journal of Geophysical Research* 95(C5): 7167-7183.

Warner, G. and S.J. Hipsey. 2012. *Acoustic Noise Modeling of BP's 2012 Seismic Program in Simpson Lagoon (Harrison Bay, AK). Version 2.0*. Technical report for OASIS Environmental Inc. by JASCO Applied Sciences. http://www.nmfs.noaa.gov/pr/pdfs/permits/bp_openwater_iha_application2012.pdf.

Zhang, Y. and C. Tindle. 1995. Improved equivalent fluid approximations for a low shear speed ocean bottom. *Journal of the Acoustical Society of America* 98(6): 3391-3396.

Ziolkowski, A. 1970. A method for calculating the output pressure waveform from an air gun. *Geophysical Journal of the Royal Astronomical Society* 21(2): 137-161.

APPENDIX G

Measured distances for seismic survey sounds to reach threshold levels of 190, 180, and 160re 1 µPa (rms), as well as 120 dB for illustrative purposes, at sites in the Beaufort and Chukchi seas

Table G-1 Measured distances for seismic survey sounds to reach threshold levels of 190, 180, and 160re 1 µPa (*rms*), as well as 120 dB for illustrative purposes, at sites in the Beaufort and Chukchi seas

Airgun array Vol (in^3)	Distance (m) to sound level (dB re 1 µPa; 90% rms SPL)							
	190		180		160		120	
	Best fit range (m)	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*
Shell Offshore Inc. 2009, Open Water Shallow Hazards and Site Clearance Surveys, Chukchi Sea, Alaska.								
Honeyguide Prospect site, Chukchi Sea (survey vessel M/V Mt. Mitchell)								
10 (single airgun)	17[1]	23[1]	39[1]	52[1]	210[1]	280	5900	7900
20 (2 x 10in^3)	28[1]	37[1]	66[1]	86[1]	360	460	11000	14000
40 (4 x 10in^3)	32[1]	41[1]	78[1]	99[1]	470	600	17000	22000[2]
Burger Prospect site, Chukchi Sea (survey vessel M/V Mt. Mitchell)								
10 (single airgun)	6[3]	8[3]	26[3]	34[3]	440	570	18000	19000
40 (4 x 10in^3)	32[4]	39[4]	120[4]	150[4]	1500	1800	29000[2]	31000[2]
Shell Offshore Inc. 2008, 3-D Seismic Surveys and Shallow Hazard Surveys, Beaufort and Chukchi Seas, Alaska. *Kakapo Site, Chukchi Sea (3-D seismic survey; vessel M/V Gilavar)*								
3147 *Endfire*	370	450	1100	1400	7900	9100	110000	120000
3147 *Broadside*	540	610	1700	2000	12000	13000	75000[6]	77000[6]
30 (single airgun)	140[7]	160[7]	320[7]	370[7]	1600[7]	1900[7]	40000	47000
Como Prospect Site, Beaufort Sea, Alaska (3-D seismic survey; vessel M/V Gilavar)								
3147 *Endfire*	24[8]	51[8]	210	440	6700	9600	54000	58000
3147 *Broadside*	770	920	2,500	2,900	9,000	9,500	≤ 45000[9]	≤ 45000[9]
30 (single airgun)	10[8]	13[8]	46	59	910	1,100	23000	24000
Camden Bay Site, Beaufort Sea, Alaska (Shallow Hazards survey; vessel Alpha Helix)								
20 (2 x 10 in^3)	34[10]	45[10]	91[10]	120[10]	630	830	15000	18000
10 (single airgun)	40[10]	53[10]	90[10]	120[10]	440	590	11000	14000
Camden Bay Site, Beaufort Sea, Alaska (Shallow Hazards survey; vessel Henry Christofferson)								
20 (2 x 10 in^3)	7[15]	10[15]	27[15]	37[15]	370	490	15000	16000
10 (single airgun)	4[15]	4[15]	14[15]	18[15]	230	280	14000	16000
Chukchi Sea Site (Shallow Hazards survey; vessel Cape Flattery)								
40 (4 x 10 in^3)	45[11]	50[11]	140[11]	160[11]	1200	1400	23000[12]	24000[12]
20 (2 x 10 in^3)	14[13]	17[13]	50[13]	62[13]	730	830	24000[12]	25000[12]
10 (single airgun)	7[14]	8[14]	28[14]	32[14]	380	440	15000	16000[12]

Airgun array Vol (in^3)	Distance (m) to sound level (dB re 1 µPa; 90% rms SPL)							
	190		180		160		120	
	Best fit range (m)	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*
Statoil USA E&P 2010, Open Water 3-D Seismic Survey, Chukchi Sea, Alaska. *Approximately 190 km (118 mi) northwest of Wainwright (Survey vessel R/V Geo-Celtic)*								
3000 *Endfire*	300	370	1000	1300	8600	10000	59000	61000
3000 *Broadside*	430	520	1400	1600	11000	13000	123000	130000
60 (single airgun)	11	13	57	68	1300	1500	25000	26000
ConocoPhillips 2006, Seismic Exploration Program, Chukchi Sea, Alaska. *Approximately 150 km west of Point Lay, (Survey vessel M/V Western Patriot)*								
3390 *Endfire*	-	514	-	1112	-	5086	-	65634
3390 *Broadside*	-	517	-	1628	-	11431	-	75370
3035 *Endfire*	-	499	-	1103	-	5148	-	56887
3035 *Broadside*	-	461	-	1471	-	10307	-	65207
105 (single airgun)	-	62	-	179	-	1449	-	30988
Eni Petroleum Company and PGS Seismic Survey. 2008, Nikaitchuq oil field, east of the Colville River Delta, Beaufort Sea, Alaska.								
Deep water site (nominal depth of 10 m; survey vessel MV Wiley Gunner)								
880 *Endfire*	67	100	170	260	1100	1600	13000	16000
880 *Broadside*	140[4]	180[4]	340	440	2000	2400	20000	21000
20 (single airgun)	59	87	140	210	750	1100	9800	12000
Deep water site (nominal depth of 10 m; survey vessel MV Shirley V)								
880 *Endfire*	66	180	320	640	1600	2200	11000	14000
880 *Broadside*	120[4]	160[4]	410	550	3200	3800	20000	22000
20 (single airgun)	52[4]	73[4]	110[4]	160[4]	510	720	7500	9400
Shallow water site (nominal depth of 2.5 m; Survey vessel MV Wiley Gunner)								
880 *Endfire*	140	220	220	340	510	800	2800	4400
880 *Broadside*	210[16]	270[16]	340[16]	430	870	1100	5700	7100
20 (single airgun)	27[17]	41[17]	81[17]	120	680	870	2200	2400
Shallow water site (nominal depth of 2.5 m; Survey vessel MV Shirley V)								
880 *Endfire*	190	270	290	420	680	970	3700	5300
880 *Broadside*	140	200	300	430	1200	1600	6900	7900
20 (single airgun)	2[18]	6[18]	29	67	500	640	2200	2300

Airgun array Vol (in^3)	Distance (m) to sound level (dB re 1 µPa; 90% rms SPL)							
	190		180		160		120	
	Best fit range (m)	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*
Shell Offshore Inc. 2007, Open water seismic exploration, Beaufort and Chukchi Seas, Alaska.								
Chukchi Sea (Vessel Gilavar)								
3147 *Endfire*		450		1140		7150		58400
3147 *Broadside*		545		2470		8100		66000
30 (single airgun)	<10[19]	<10[19]	55[19]	76[19]	1121	1360	36817	41100
Camden Bay, Beaufort Sea, Alaska (Vessel Gilavar)								
3147 *Endfire*		757		2245		13405		74813[20]
3147 *Broadside*		857		2088		10084		61887
30 (single airgun)	<10[4]	<10[4]	15[4]	24[4]	1261	1439	22911	24600
Beechey Point, Beaufort Sea, Alaska (Vessel Henry C)								
20 (2 x 10 in^3)		12		51		597		10700
10 (single airgun)		5		20		333		8130
Camden Bay, Beaufort Sea, Alaska (Vessel Henry Christoffersen)								
20 (2 x 10 in^3)		1[4]		7[4]		1000		25200
GXT. 2006, Chukchi Sea, Alaska.								
100 km offshore, west of Point Lay, Chukchi Sea, (depths of 40-46 m; M/V Discoverer)								
3320 *Endfire*	620		1460		7280		57530	
3320 *Broadside*	480		1770		10970		167000	
Shell Offshore Inc. 2006, open water seismic exploration in the Beaufort and Chukchi Seas, Alaska.								
Chukchi Sea (Seismic vessel M//V Gilavar)								
3147 *Endfire Bow*	460		1270		7990		67620[21]	
3147 *Endfire Stern*	360		980		6770		82890[21]	
3147 *Broadside*	420[21]		1400		-		-	
1049 *Endfire Bow*	270[21]		650		-		-	
1049 *Endfire Stern*	170[21]		450		3240		61400[21]	
1049 *Broadside*	420		1350[21]		-		-	
about 54 km east of Kaktovik, Beaufort Sea, Alaska (Vessel Henry Christoffersen)								
280 (4 x 70 in^3)	89		250		1750		22220[21]	

Airgun array Vol (in^3)	Distance (m) to sound level (dB re 1 µPa; 90% rms SPL)							
	190		180		160		120	
	Best fit range (m)	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*
Statoil. 2011, Shallow Hazards survey, Chukchi Sea, Alaska.								
Amundsen Prospect (M/V Duke)								
40 (4 x 10 in^3)	32	37	110	130	1300	1500	28000[3]	30000[3]
10 (single airgun)	13	15	50	59	720	840	27000[3]	29000[3]
BP Exploration Alaska, Inc. 2012, Simpson Lagoon OBC Seismic Survey, Beaufort Sea, Alaska.								
Simpson Lagoon–outside the barrier islands (M/V Resolution and M/V Margarita)								
640 *Broadside*	436	516	1223	1386	4334	4616	13270	13624
640 *Endfire*	355	502	891	1196	3483	4163	13150	14163
320 *e*	311	360	1019	1134	4058	4265	12771	13027
320 *Endfire*	224	318	550	760	2456	3078	12132	13313
40 (single airgun)	20	24	105	158[22]	1448	1602	8133	9221
Simpson Lagoon–inside the barrier islands (M/V Resolution, M/V Margarita and M/V Storm Warning)								
320 *Broadside*	203	260	368	472	1207	1545	12964	16598
320 *Endfire*	189	219	267	311	538	625	2177	2528
Simpson Lagoon–inside the barrier islands (M/V Storm Warning)								
40 (single airgun)	92	138	203	293	729	933	2907	3242
ION Geophysical. 2012, Marine Seismic Survey, Beaufort and Chukchi Seas, Alaska.								
Shallow site (M/V Geo Arctic and M/V Polar Prince)								
4380 *Broadside*	115[23]	141[23]	2010	2290	18100	18700	61200[24]	61900[24]
4380 *Endfire*	230[25]	287[25]	917[25]	1140	10800	12600	104000[26]	109000[26]
70 (single airgun)	20[27]	24[27]	76[27]	94[27]	1110	1360	48200	52000
Deep Site (M/V Geo Arctic and M/V Polar Prince)								
4380 *Broadside*	n/a	395[28]	n/a	1250[28]	5690	6260	119000[29]	131000[29]
4380 *Endfire*	n/a	81[30]	n/a	256[30]	n/a	2560[30]	82200[31]	90800[31]
70 (single airgun)	n/a	23[32]	n/a	74[32]	n/a	741[32]	25800[33]	3340[33]
Shell Gulf of Mexico, Inc. 2013, Shallow Hazards and Ice Gouge Survey, Chukchi Sea, Alaska.								
Snickers prospect Site (MSV Fennica and MSV Nordica)								
10 (single airgun)	10[34]	13[34]	33[34]	41[34]	320	400	17000	20000
20 *Broadside*	14[35]	15[35]	56	60	790	840	17000[35]	18000[35]
20 *Endfire*	21[35]	25[35]	66	79	640	760	20000[35]	22000[35]
40 *Broadside*	18[35]	20[35]	90	95	1200	1300	11000[35]	11000[35]
40 *Endfire*	17[35]	20[35]	56	67	620	720	27000[35]	29000[35]

Airgun array Vol (in^3)	Distance (m) to sound level (dB re 1 µPa; 90% rms SPL)							
	190		180		160		120	
	Best fit range (m)	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*	*Best fit range (m)*	*90th pctl fit (m)*
TGS-NOPEC Geophysical Company. 2013, 2D Seismic Survey, Chukchi Sea, Alaska.								
Offshore Ledyard Bay (M/V Geo Arctic and M/V Norseman)								
3280 *Broadside*	370[36]	390[36]	1100	1100	7500	8000	78000	80000
3280 *Endfire*	400[36]	460[36]	890	990	4400	5400	65000	68000
60 (single airgun)	6[37]	7[37]	38[37]	43[37]	1400	1600[38]	52000[38]	60000[38]
SAExploration Inc. 2014, 3D Seismic Survey, Colville River Delta, Beaufort Sea, Alaska								
CRD 3D 2014 Survey in the Beaufort Sea (M/V Peregrine and M/V Maxime)								
620	n/a	195	n/a	635	n/a	1818	n/a	n/a
40 (single airgun)	n/a	156	n/a	233	n/a	1098	n/a	n/a
10 (single airgun)	n/a	54	n/a	188	n/a	1049	n/a	n/a

[1]Extrapolated from minimum measurement range of 240 m (0.15 mi).

[2]Extrapolated from maximum measurement range of 20000 m (1.2 mi).

[3]Extrapolated from minimum measurement range of 275 m (0.17 mi).

[4]Extrapolated from minimum measurement range of 200 m (0.12 mi).

[5]Extrapolated beyond maximum measured range of 20 km

[6]Extrapolated from maximum measurement range of 34.9 km

[7]Extrapolated from minimum measurement range of 8 km (5 mi).

[8]Distances to the 190 dB re µPa level were extrapolated from data at longer ranges.

[9]The level of the interfering airgun signals on OBH D was approximately 120 dB re µPa. Therefore the 120 dB re 1 µPa threshold range for was constrained to less than 45 km, or 28 mi, from the array.

[10]Extrapolated from minimum measurement range of 190 m (620 ft.).

[11]Extrapolated from minimum measurement range of 194 m (640 ft.).

[12]Extrapolated from maximum measurement range of 15000 m (9.3 mi).

[13]Extrapolated from minimum measurement range of 208 m (680 ft.).

[14]Extrapolated from minimum measurement range of 199 m (653 ft.).

[15]Extrapolated from minimum measurement range of 90 m (295 ft.).

[16]Extrapolated from minimum measurement range of 375 m.

[17]Extrapolated from minimum measurement range of 85 m.

[18]Extrapolated from minimum measurement range of 14 m.

[19]Extrapolated from minimum measurement range of 80 m (260 ft.).

[20]Extrapolated from maximum measurement range of 58.7 km (36.5 mi).

[21]Empirical distance was based on an extrapolation of the fitted curve beyond the range of the measured data

[22]Actual maximum range from measurements

[23]Extrapolated beyond minimum measurement range of 401 m using the 90th percentile fit.

[24]Extrapolated beyond maximum measurement range of 19.6 km using the 90th percentile fit.

[25]Extrapolated beyond minimum measurement range of 1 km using the 90th percentile fit.

[26]Extrapolated beyond maximum measurement range of 76.8 km using the 90th percentile fit.

[27]Extrapolated beyond minimum measurement range of 401 m.

[28]Extrapolated by back-propagating the loudest measured pulse (175 dB re 1 μPa at 2240 m) using spherical spreading (i.e., 20LogR).

[29]Extrapolated beyond the farthest measurement range of 20.5 km using the 90th percentile fit.

[30]Extrapolated by back-propagating the loudest measured pulse (159 dB re 1 μPa at 3030 m) using spherical spreading (i.e., 20LogR).

[31]Extrapolated beyond the farthest measurement range of 30.4 km using the 90th percentile fit.

[32]Extrapolated by back-propagating the loudest measured pulse (150 dB re 1 μPa at 2230 m range) using spherical spreading (i.e., 20LogR).

[33]Extrapolated beyond the farthest measurement range of 7340 m using the 90th percentile fit.

[34]Extrapolated beyond the closest measurement.

[35]Extrapolated beyond the measurement range.

[36]Extrapolated beyond minimum measurement range of 826 m.

[37]Extrapolated beyond minimum measurement range of 43 m.

[38]Extrapolated beyond maximum measurement range of 1.5 km.