DRAFT

SUPPLEMENTAL OVERSEAS ENVIRONMENTAL ASSESSMENT

For

Office of Naval Research Arctic Research Activities in the
Beaufort Sea October 2021 – October 2022

August 2021
Abstract

Designation: Supplemental Overseas Environmental Assessment
Title of Proposed Action: Office of Naval Research Arctic Research Activities in the Beaufort Sea October 2021- October 2022
Project Location: Beaufort Sea
Lead Agency for the EA: Department of the Navy
Affected Region: Beaufort Sea, Arctic
Action Proponent: Office of Naval Research
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The Office of Naval Research (ONR) prepared this Supplemental Overseas Environmental Assessment (SOEA) in compliance with the Executive Order (E.O.) 12114, Department of Defense regulations found at 32 Code of Federal Regulations Part 187 and the Chief of Naval Operations Instruction 5090.1 and its accompanying manual (M-5090).

This SOEA updates and revises the OEA ONR prepared in 2018 and the supplement to that document prepared in 2019, both of which this SOEA incorporates by reference. This SOEA evaluates the potential harm to the environment from ONR Arctic Research Activities that would occur because of changes in the 2018 and 2019 Proposed Actions resulting from revised 2021-2022 research activities. The Naval requirement for this continuing scientific research still relates to the need to understand environmental conditions to ensure combat capable forces ready to deploy worldwide in accordance with Title 10 United States Code (U.S.C.) § 8062, and to support the aims of the Arctic Research and Policy Act (15 U.S.C. §§ 4101 et seq.). For the Arctic this consists of potential submarine and surface ship operations with active sonar for anti-submarine warfare and submarine/surface ship force protection. The characterization of the potential Arctic battlespace, given the changes in water properties and ice cover, is critical to performance predictions for active and passive acoustic systems. The year-round characterization of the Arctic environment requires the development of a navigation system for vehicles operating under the ice through the use of intermittent acoustic source transmissions, and rapid characterization of the environment by leave-behind sources. The purpose of the Proposed Action is still to conduct scientific research in the Arctic and to gather data on environmental conditions and acoustics in an Arctic environment. This SOEA evaluates three alternatives: the No Action Alternative and two Action Alternatives. The No Action Alternative would be limited to a cruise for the retrieval of previously deployed acoustic sources. Alternative 1, the Preferred Alternative, starting with the next research cruise scheduled for October 2021, reflects proposed changes and additions to the location and use of active acoustic sources to improve ONR’s ability to meet scientific objectives including a very low frequency source. Alternative 2 includes everything within the Preferred Alternative except the use of the very low frequency source.
In this SOEA, the Navy analyzes potential harm to the environment that could result from the updates to two Action Alternatives in comparison to the No Action Alternative. Only marine mammals were analyzed for potential for “significant harm” (as defined by E.O. 12114) by the Proposed Action updates.
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EXECUTIVE SUMMARY

Proposed Action

In accordance with Executive Order (E.O.) 12114, the United States (U.S.) Department of the Navy prepared an Overseas Environmental Assessment (OEA) in 2018 (hereafter referred to as the “2018 OEA”) for a Proposed Action by the Office of Naval Research (ONR), entitled Arctic Research Activities (ARA). The objectives in that document were to conduct scientific experiments in the Beaufort Sea from September 2018 to December 2021. These objectives included several scientific efforts in support of the ONR Arctic and Global Prediction Program, the ONR Ocean Acoustics Program and the Naval Research Laboratory (NRL) Acoustics Division. The scientific objectives included the Stratified Ocean Dynamics of the Arctic (SODA) project, Arctic Mobile Observing System project (AMOS), ONR Ocean Acoustics field work, and NRL experiments in rapid environmental characterization.

A Supplemental Overseas Environmental Assessment (SOEA) was prepared in 2019 (hereafter referred to as the “2019 Supplement” was prepared to address changes in ARA experiments to improve the ability to meet scientific objectives. The changes consisted of 1) a northward extension of the Study Area to accommodate deployment of a new very low frequency (VLF) acoustic source and 2) changes in the locations and number of active acoustic sources described in the 2018 OEA. These changes went into effect September 2019 and were to continue through December 2021 (the defined end date for the 2018 OEA). The deployment of a VLF source in the far north (81 N) from 2019 to 2020 to study acoustic propagation was given the specific project name of Coordinated Arctic Active Tomography Experiment (CAATEX). Only those resources potentially impacted by these changes were assessed in the 2019 Supplemental. This SOEA reflects this same approach.

This supplement addresses changes in the ARA experiments, which consist of two research cruises, aircraft operations used to deploy sources in the ice, and sources that are left behind. The changes Proposed Action from the previous analysis are:

- The retrieval of the CAATEX source in 2020, which completed that project.
- Preliminary testing of a navigation system with the incorporation of a VLF source into a multi-frequency navigation system designed for navigating unmanned underwater vehicles (UUV)’s and gliders under the ice. The combination of VLF (34 Hz), previous LF (900 Hz), and MF (8-14 kHz) sources on different platforms is being investigated as a means of performing navigation on different length scales (lower frequencies allowing navigation control further from the source). The VLF source, as described below, would also be advantageous in mitigating effects on ringed seals. For this proposed action, a single VLF source will be deployed on a ship for testing during the cruise.
- A geographic shift of the study area farther north, given that a previously planned mooring location closer to shore will not be utilized.
- The omission of previously-planned Spiral Wave Beacon source testing, which was included in the 2018 and 2019 documents did not occur and is no longer planned.
- Additional, limited source testing of the LF and MF sources on buoys and a UUV while the ship is still on site.
- The inclusion of a project (UpTempO) with two passive drifting buoys.
- The use of the R/V Sikuliaq, which is not an icebreaking ship, in the 2021 cruise. This is in contrast with previous cruises which required icebreaking.
A research cruise is planned for October 2022, and would probably involve the USGS Healy. This could be used to end the research process by recovering all equipment, but is more likely that the research will continue in some form. Ship availability also may require that the cruise take place in September 2022 or November 2022. Appropriate environmental planning and regulatory documents will be created depending on when the 2022 cruise occurs and what activities will take place during it.

Additionally, the Kaschner habitat based data previously used for the 2018 OEA and 2019 Supplement acoustic effects modeling has been supplemented with new density information from Duke University, a result of Navy-funded effort.

**Purpose of and Need for the Proposed Action**

ARA, as previously described in the 2018 OEA and as currently proposed, encompasses activities supported by the ONR Arctic and Global Prediction Program and the NRL. The purpose of the ONR activities is to use acoustic sources to aid in UUV navigation and use drifting sources to perform rapid environmental characterization. The Navy’s need for the modified Proposed Action, specifically the development of increased capability for environmental observations in the Arctic, is the same as for the Proposed Action in the 2018 OEA.

The need for the Proposed Action and new analysis stem from the need to employ multi-frequency navigation systems to allow unmanned vehicles that would be used to characterize the environment to operate effectively. A VLF source of the type used previously in the CAATEX project would now be included in a preliminary test of the multi-frequency navigation system as part of a research cruise. Sources on UUV’s have also been added to research activities during the cruise. A year-long test of a navigation system involving moored LF sources (900 Hz) would be performed as in previous years, but a drifting buoy has been added as part of the navigation system. Another objective of the analysis is to perform modeling on a VLF source closer to shore than previously deployed to determine whether significant environmental effect on bowhead whales would be introduced.

The NRL experiment is largely unchanged from previous years in terms of its methodology, but does involve the re-activation of existing sources already-deployed under the current supplemental OEA and a second deployment of sources in the spring of 2022.

The need for a supplemental OEA also derives from new density data for relevant species in the Beaufort Sea that has been obtained from Duke University.

**Alternatives Considered**

Based on the reasonable alternative screening factors identified in the 2018 OEA, carried forward into the 2019 Supplement, and to meet the purpose and need for 2021-22 activities, two action alternatives were identified and will be analyzed and compared to the No Action Alternative.

**Summary of Environmental Resources Evaluated in the 2018 OEA and 2019 Supplement**

Executive Order (E.O.) 12114 and Navy instructions for implementing E.O. 12114, specify that an OEA should address those resource areas potentially subject to harm, as defined by E.O. 12114. In addition, the level of analysis should be commensurate with the anticipated level of environmental impacts.

The following resources were addressed in the 2018 OEA: physical resources (atmospheric temperature, bathymetry, currents, circulation, water masses, water quality, and sea ice) and biological resources (invertebrates, marine birds, fish, Essential Fish Habitat, and marine mammals). The 2019 Supplement only required new analysis of acoustic effects on marine mammals. Based on looking at the changes in
the Proposed Action, there were no projected changes in the other resources and therefor the Navy only analyzed marine mammals.

Summary of Potential Environmental Consequences of the Action Alternatives and Major Mitigating Actions

The results of the analysis indicate that neither the No Action Alternative nor the Proposed Action Alternatives would significantly harm physical or biological resources. The Navy will consult with the National Marine Fisheries Service (NMFS) under section 7 for ringed seals under the Endangered Species Act (ESA). The Navy will also consult on other stressors for ringed and bearded seals (e.g. aircraft noise, vessel movement) that were identified in the 2018 OEA, as reflected in Appendix A of this supplemental. These determinations support an application for an Incidental Take Statement. The existing consultation completed in 2018 with the USFWS, suffices for polar bear.

Under the Proposed Action Alternatives, ringed seals and beluga whales, both of which are protected under the Marine Mammal Protection Act (MMPA), were predicted to be exposed to acoustic stressors (non-impulsive acoustic sources) that equated to behavioral exposures. The Navy will consult with NMFS to request Incidental Harassment Authorizations (IHA) for the predicted Level B exposures.

Under the No Action Alternative or either of the Action Alternatives, potential harm to physical and most biological resources (i.e., invertebrates, birds, fish, and Essential Fish Habitat) would remain the same as that described in the 2018 OEA. With mitigation measures, potential harm from the Proposed Action Alternatives would be temporary and/or minimal. The Proposed Action Alternatives are not expected to result in population-level impacts to marine mammals.
Supplemental Overseas Environmental Assessment
ONR Arctic Research Activities 2021-2022

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## Abbreviations and Acronyms

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<th>Definition</th>
<th>Acronym</th>
<th>Definition</th>
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<td>2018 OEA</td>
<td>Overseas Environmental Assessment prepared for Arctic Research Activities in 2018</td>
<td>km²</td>
<td>square kilometer(s)</td>
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<tr>
<td>ADCP</td>
<td>Acoustic Doppler Current Profiler</td>
<td>LF</td>
<td>Low Frequency</td>
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<tr>
<td>AMOS</td>
<td>Arctic Mobile Observing System</td>
<td>M</td>
<td>meter(s)</td>
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<td>ARA</td>
<td>Arctic Research Activities</td>
<td>MBTA</td>
<td>Migratory Bird Treaty Act</td>
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<tr>
<td>BRF</td>
<td>Behavioral Response Function</td>
<td>MF</td>
<td>Mid-Frequency</td>
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<td>CAATEX</td>
<td>Coordinated Arctic Active Tomography Experiment</td>
<td>MMPA</td>
<td>Marine Mammal Protection Act</td>
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<tr>
<td>CASS/GRAB</td>
<td>Comprehensive Acoustic System Simulation/Gaussian Ray Bundle</td>
<td>MSR</td>
<td>Marine Science Research</td>
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<td>CFR</td>
<td>Code of Federal Regulations</td>
<td>NAEMO</td>
<td>Navy Acoustic Effects Model</td>
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<tr>
<td>CGC</td>
<td>Coast Guard Cutter</td>
<td>Navy</td>
<td>United States Department of the Navy</td>
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<tr>
<td>cm</td>
<td>centimeter(s)</td>
<td>Nm</td>
<td>nautical miles</td>
</tr>
<tr>
<td>dB</td>
<td>decibel(s)</td>
<td>NMFS</td>
<td>National Marine Fisheries Service</td>
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<tr>
<td>dB re 1µPa</td>
<td>decibel(s) referenced to 1 micropascal</td>
<td>NRL</td>
<td>National Research Laboratory</td>
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<tr>
<td>dB re 1µPa²-s</td>
<td>decibel(s) referenced to 1 square micropascal-second</td>
<td>ONR</td>
<td>Office of Naval Research</td>
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<td>E.E.Z</td>
<td>Exclusive Economic Zone</td>
<td>PTS</td>
<td>Permanent Threshold Shift</td>
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<tr>
<td>E.O.</td>
<td>Executive Order</td>
<td>R/V</td>
<td>Research Vessel</td>
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<td>ESA</td>
<td>Endangered Species Act</td>
<td>SEL</td>
<td>sound exposure level</td>
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<tr>
<td>ft</td>
<td>foot/feet</td>
<td>SOEA</td>
<td>Supplemental Overseas</td>
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<tr>
<td>Hz</td>
<td>Hertz</td>
<td>SODA</td>
<td>Environmental Assessment</td>
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<tr>
<td>IHA</td>
<td>Incidental Harassment Authorization</td>
<td>SPL</td>
<td>sound pressure level</td>
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<tr>
<td>ln</td>
<td>inch(es)</td>
<td>TTS</td>
<td>temporary threshold shift</td>
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<tr>
<td>kHz</td>
<td>Kilohertz</td>
<td>UAS</td>
<td>Unmanned Aerial System</td>
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<tr>
<td>km</td>
<td>kilometer(s)</td>
<td>U.S.</td>
<td>United States</td>
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<td></td>
<td></td>
<td>USFWS</td>
<td>United States Fish and</td>
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<td></td>
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<td>Wildlife Service</td>
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<tr>
<td></td>
<td></td>
<td>UUV</td>
<td>Unmanned Underwater Vehicle</td>
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<tr>
<td></td>
<td></td>
<td>VLF</td>
<td>very low frequency</td>
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1 Purpose of and Need for the Proposed Action

1.1 Introduction

In accordance with Executive Order (E.O.) 12114, the United States (U.S.) Department of the Navy prepared an Overseas Environmental Assessment (OEA) in 2018 (hereafter referred to as the “2018 OEA”) for a Proposed Action by the Office of Naval Research (ONR), entitled Arctic Research Activities (ARA). The objectives in that document were to conduct scientific experiments in the Beaufort Sea from September 2018 to December 2021. These objectives included several scientific efforts in support of the ONR Arctic and Global Prediction Program, the ONR Ocean Acoustics Program and the Naval Research Laboratory (NRL) Acoustics Division. The scientific objectives included the Stratified Ocean Dynamics of the Arctic (SODA) project, Arctic Mobile Observing System project (AMOS), ONR Ocean Acoustics field work, and NRL experiments in rapid environmental characterization.

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This supplement addresses changes in the ARA experiments, which consist of two research cruises, aircraft operations used to deploy sources in the ice, and sources that are left behind. Below describes the changes in the Proposed Action from the previous analysis:

- The retrieval of the CAATEX source in 2020, which completed that project.
- Preliminary testing of a navigation system with the incorporation of a VLF source into a multi-frequency navigation system designed for navigating UUVs and gliders under the ice. The combination of a VLF (34 Hz) and previously used LF (900 Hz) and MF (8-14 kHz) sources is being investigated as a means of performing navigation on different length scales (lower frequencies allowing navigation control further from the source). VLF sources, as described below, would also be advantageous in mitigating effects on ringed seals. For the Proposed Action, a single ship-deployed VLF source would be used during the cruise.
- A geographic shift of the Study Area farther north, given that a previously planned mooring location closer to shore will not be utilized.
- The omission of previously-planned Spiral Wave Beacon source testing, which was included in the 2018 and 2019 documents. It did not occur and is no longer planned.
- Additional, limited source testing of the LF and MF sources on buoys and a UUV while the ship is still on site.
- The inclusion of a project (UpTempO) with two passive drifting buoys.
• The use of the R/V Sikuliaq, which is not an icebreaking ship, in the 2021 cruise. This is in contrast with previous cruises which required icebreaking.

A research cruise is planned for October 2022, and would probably involve the USGS Healy. This could be used to end the research process by recovering all equipment, but is more likely that the research will continue in some form. Ship availability also may require that the cruise take place in September 2022 or November 2022. Appropriate environmental planning and regulatory documents will be created depending on when the 2022 cruise occurs and what activities will take place during it.

Additionally, the Kaschner habitat based density data previously used for the 2018 OEA and 2019 Supplement acoustic effects modeling has been supplemented with new density information from Duke University, the result of Navy-funded effort.

1.2 Location

The Proposed Action would occur within the Study Area (Figure 1-1), which includes the U.S. Exclusive Economic Zone (EEZ), the global commons, and the Canadian EEZ. The Proposed Action would primarily occur in the Beaufort Sea, but the analysis considers the drifting of active sources on buoys into the Chukchi Sea. The closest point of the Study Area to the Alaska coast is 110 nautical miles (nm; 204 kilometers [km]). The Study Area is further from the coast than in previous years. To allow for the equipment drift or the need to navigate around ice, small areas of the Canadian EEZ are also included in the Study Area; the appropriate permission for conducting scientific research in the Canadian EEZ would be obtained from Canada in the form of a Marine Scientific Research permit. The map shows the positions of fixed sources and the initial positions at which drifting sources will transmit. The anticipated movement of drifting sources is included in the analysis. The anticipated movement of drifting sources is included in the analysis. Additional details regarding the specific experiments, timeframes and research are further detailed below in Section 2.1.
Figure 1-1. Revised Arctic Study Area
1.3 Purpose of and Need for the Proposed Action

ARA, as previously described in the 2018 OEA and as currently proposed, encompasses activities supported by the ONR Arctic and Global Prediction Program and the NRL. The purpose of the ONR activities is the use of acoustic sources to aid in unmanned underwater vehicle navigation and use drifting sources to perform rapid environmental characterization. The program is also conducting near-real time environmental characterization and the use of a field of sources to aid in unmanned underwater vehicle navigation. The Navy’s need for the modified Proposed Action, specifically the development of increased capability for environmental observations in the Arctic, is the same as for the Proposed Action in the 2018 OEA.

The need for the proposed action and new analysis stem from the need to employ multi-frequency navigation systems to allow unmanned vehicles that would be used to characterize the environment to operate effectively. A VLF source of the same type as used previously in the CAATEX project would now be included in a preliminary test of the multi-frequency navigation system as part of a research cruise. Sources on UUV’s have also been added to research activities during the cruise. A year-long test of a navigation system involving moored LF sources (900 Hz) would be performed as in previous years, but a drifting buoy has been added as part of the navigation system. Another objective of the analysis is to perform modeling on a VLF source closer to shore than previously to determine whether significant environmental effect on bowhead whales would be introduced.

The NRL experiment is largely unchanged from previous years in terms of its methodology, but does involve the re-activation of three of five drifting sources already deployed under the current supplemental OEA in (only three will continue to transmit due to mechanical issues) and a second deployment of five sources in March of 2022.

The need for a supplemental OEA also derives from new density data for relevant species in the Beaufort Sea that has been obtained from Duke University.

1.4 Scope of Environmental Analysis

This SOEA includes an analysis of potential environmental harm associated with the No Action Alternative and the Proposed Action Alternatives. The environmental resource areas analyzed in the 2018 OEA include: physical environment (atmospheric temperature, bathymetry, currents, circulation, and water masses, water quality, and sea ice) and biological resources (invertebrates, marine birds, fish, Essential Fish Habitat, and marine mammals). Only acoustic effects on marine mammals are analyzed in the SOEA, as they are the only resource that required additional analysis under the Proposed Action. Though the Study Area has been modified, the species within the Study Area would not change from the analysis within the 2018 OEA.

1.5 Relevant Laws and Regulations

The Navy has prepared this SOEA based upon federal statutes, regulations, and policies that are pertinent to the implementation of the Proposed Action, including the following:

- Endangered Species Act (ESA) (16 U.S.C. section 1531 et seq.)
- Marine Mammal Protection Act (MMPA) (16 U.S.C. section 1361 et seq.)
- E.O. 12114, Environmental Effects Abroad of Major Federal Actions

A description of the Proposed Action’s consistency with these laws, policies and regulations, as well as the names of regulatory agencies responsible for their implementation, is presented in Table 6-1.
Purpose of and Need for the Proposed Action
2 Proposed Action and Alternatives

2.1 Proposed Action

The Proposed Action would occur within the Study Area (Figure 1-1) which includes the U.S Exclusive Economic Zone (EEZ), the global commons, and the Canadian EEZ. The Proposed Action would primarily occur in the Beaufort Sea, but the analysis considers the drifting of active sources on buoys into the Chukchi Sea. The closest point of the Study Area to the Alaska coast is 110 nautical miles (nm; 204 kilometers [km]). ONR’s Proposed Action, called ARA, is to conduct scientific research in the Beaufort and Chukchi Seas from October 2021 to October 2022. This research comprises cruises that would occur in October 2021 and during the time frame of August-October 2022; acoustic testing would take place during the cruises, and a multi-frequency navigation system concept test would employ sources left behind during the first cruise. The 2021 cruise would begin on October 3, 2021. The Proposed Action includes multiple scientific objectives that support the Arctic and Global Prediction Program and the Acoustics Division of the Naval Research Laboratory (NRL). The Proposed Action constitutes the development of a new system under the ONR Arctic Mobile Observing System (AMOS) involving very-low-, low-, and mid-frequency transmissions (35 Hertz [Hz], 900 Hz, and 10 kilohertz [kHz] respectively). The AMOS project would utilize acoustic sources and receivers to provide a means of performing under-ice navigation for gliders and UUVs. This would allow for the possibility of year-round scientific observations of Arctic environmental phenomena. As an environment particularly affected by climate change, year-round observations under a variety of ice conditions are required to study the effects of this changing environment for military readiness, as well as the implications of environmental change to humans and animals. Very-low frequency technology is an important method of observing ocean warming, and the continued development of these types of acoustic sources would allow for characterization of larger areas. The technology also has the potential to allow for development of navigational systems that would not be heard by some marine mammal species, and therefore would be less impactful overall.

For the NRL project, three of the five drifting sources already deployed would be reactivated in October 2021 and continue until December 2021. A new set of five sources would be deployed in March 2022 and continue to transmit until August 2022. This project would use groups of drifting buoys with sources and receivers communicating oceanographic information to a satellite in near real time. These sources would employ low frequency transmissions only (900 Hz).

ONR is also supporting a project called UpTempO that would use two drifting buoys to observe oceanographic conditions in the seasonal ice zone. These buoys would not have active acoustic sources. They would be deployed during the 2021 and 2022 cruises.

The study area is further from the coast than the Study Areas in the 2018 OEA and 2019 supplement. To allow for the equipment drift or the need to navigate around ice, small areas of the Canadian EEZ are also included in the Study Area; the appropriate permission for conducting scientific research in the Canadian EEZ would be obtained from Canada in the form of a Marine Scientific Research permit. The map shows the positions of fixed sources and the initial positions at which drifting sources will transmit. The anticipated movement of drifting sources is included in the analysis.

2.2 Research Equipment and Platforms

Below are the descriptions of the equipment and platforms that are relevant to the Proposed Action.
2.2.1 Research Vessels

The research vessel (R/V) Sikuliaq would perform the research cruise in October 2021, and conduct testing of acoustic sources during the cruise, as well as leave sources behind to operate as a year-round navigation system. The ship to be used in 2022 is yet to be determined. The most probable option would be the Coast Guard Cutter (CGC) HEALY, so that ship is described here.

The R/V Sikuliaq has a maximum speed of approximately 12 knots with a cruising speed of 11 knots (University of Alaska Fairbanks 2014). The R/V Sikuliaq is not an icebreaking ship, but an ice strengthened ship. It would not be icebreaking and therefore acoustic signatures of icebreaking for the R/V Sikuliaq are not relevant. CGC HEALY travels at a maximum speed of 17 knots with a cruising speed of 12 knots (United States Coast Guard 2013), and a maximum speed of 3 knots when traveling through 3.5 feet (ft; 1.07 meters [m]) of sea ice (Murphy 2010). If it is necessary for the HEALY to perform icebreaking during the 2022 cruise, the appropriate environmental planning and regulatory documents will be created.

The R/V Sikuliaq, CGC HEALY, or any other vessel conducting a research cruise associated with the Proposed Action may perform the following activities during their research cruises:

- Deployment of moored and/or ice-tethered passive sensors (oceanographic measurement devices, acoustic receivers);
- Deployment of moored and/or ice-tethered active acoustic sources to transmit acoustic signals;
- Deployment of unmanned surface, underwater, and air vehicles;
- Deployment of drifting buoys, with or without acoustic sources; or,
- Recovery of equipment.

Additional oceanographic measurements would be made using ship-based systems, including the following:

- Modular Microstructure Profiler, a tethered profiler that would measure oceanographic parameters within the top 984 ft (300 m) of the water column;
- Shallow Water Integrated Mapping System, a winched towed body with a Conductivity Temperature Depth sensor, upward and downward looking Acoustic Doppler Current Profilers (ADCPs), and a temperature sensor within the top 328 ft (100 m) of the water column;
- Three dimensional Sonic Anemometer, which would measure wind stress from the foremast of the ship; and,
- Surface Wave Instrument Float with Tracking are freely drifting buoys measuring winds, waves, and other parameters with deployments spanning from hours to days.

2.2.2 Moored/Drifting Acoustic Sources

2.2.2.1 AMOS Project (ONR)

During the October 2021 cruise, acoustic sources would be deployed from the ship on UUVs or drifting buoys. This would be done for intermittent testing of the system components. The total amount of active source testing for ship-deployed sources used during the cruise would be 120 hours. The testing would take place in the vicinity of the seven source locations on Figure 1-1, with UUVs running tracks within the designated box. During this testing, 35 Hz, 900 Hz, and acoustic modems would be employed.

Up to seven fixed acoustic navigation sources transmitting at 900 Hz would remain in place for a year. These moorings would be anchored on the seabed and held in the water column with subsurface buoys.
All sources would be deployed by shipboard winches, which would lower sources and receivers in a controlled manner. Anchors would be steel “wagon wheels” typically used for this type of deployment. All navigation sources would be recovered. The purpose of the navigation sources is that they would be used to orient UUVs and gliders in situations when they are under ice and cannot communicate with satellites.

2.2.2.1.1 Rapid Environmental Characterization (NRL)

NRL deployed five drifting sources under the current 2021 IHA for ONR Arctic Research Activities. A maximum of three may still be available to be re-activated in October 2021 and transmit until December 2021. The purpose of the sources is near-real time environmental characterization, which is accomplished by communicating information from the drifting buoys to a satellite. These buoys were deployed in the ice (via fixed-wing aircraft) for purposes of buoy stability, but eventually drift in open water. An additional set of five buoys would be deployed on the ice in March 2022 using fixed- or rotary-wing aircraft, and transmit until August 2022. The sources can be turned on or off remotely in accordance with permitting requirements or when they drift outside of the Study Area.

The acoustic parameters of sources for the AMOS and NRL projects are given in Table 2-1. A distinction is made between sources that would have limited testing when the ship is on-site, and leave behind sources that would transmit for the full year.
<table>
<thead>
<tr>
<th>Source Name</th>
<th>Frequency (Hz)</th>
<th>Sound Pressure Level (dB re 1 µPa at 1 m)</th>
<th>Pulse Length (seconds)</th>
<th>Duty Cycle (Percent)</th>
<th>Source Type</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>AMOS Navigation Sources (LF) [leave behind]</td>
<td>900-950</td>
<td>180</td>
<td>30</td>
<td>&lt;1%</td>
<td>Moored</td>
<td>7 sources transmitting 30 seconds every 4 hours</td>
</tr>
<tr>
<td>AMOS Navigation sources (LF) [on-site; UUV and ship]</td>
<td>900-950</td>
<td>180</td>
<td>30</td>
<td>4%</td>
<td>Moving</td>
<td>2 sources, transmitting 5 times an hour with 30 sec pulse length</td>
</tr>
<tr>
<td>AMOS Navigation sources (LF) [onsite; buoy]</td>
<td>900-950</td>
<td>180</td>
<td>30</td>
<td>&lt;1%</td>
<td>Drifting</td>
<td>1 source, transmitting every 4 hours</td>
</tr>
<tr>
<td>AMOS VLF Navigation Source</td>
<td>35</td>
<td>190</td>
<td>600</td>
<td>1%</td>
<td>Ship</td>
<td>Deployed 2 times per day</td>
</tr>
<tr>
<td>NRL Real-Time Sensing Sources (2021)</td>
<td>900-1000</td>
<td>184</td>
<td>30</td>
<td>&lt;1%</td>
<td>Drifting</td>
<td>3 sources transmitting 30 seconds every 6 hours</td>
</tr>
<tr>
<td>NRL Real-Time Sensing Sources (2022)</td>
<td>850-1050</td>
<td>184</td>
<td>60</td>
<td>&lt;1%</td>
<td>Drifting</td>
<td>5 sources transmitting 1 minute every 8 hours</td>
</tr>
<tr>
<td>WHOI micromodem (on-site; UUV)</td>
<td>8-14 kHz</td>
<td>185</td>
<td>4</td>
<td>10%</td>
<td>Moving</td>
<td>Medium duty cycle acoustic communications</td>
</tr>
</tbody>
</table>

Note: Hz = Hertz; dB re 1 µPa = decibels referenced to 1 microPascal
2.2.3 De minimis Sources

De minimis sources are described in the 2018 OEA and there are no changes associated with the Proposed Action. The only added de minimis source is the 8-14 kHz WHOI micromodem as employed during the leave-behind testing, as it pings very intermittently and is only used for the navigation safety of the vehicle.

2.2.4 Drifting Oceanographic Sensors

Drifting oceanographic sensors are described in the 2018 OEA and there are no changes associated with the Proposed Action. The UpTempO project would deploy two surface buoys. There is a conductivity-temperature sensor pair attached to the hull to measure sea surface temperature and sea surface salinity. This is the only new addition to drifting oceanographic sensors for the Proposed Action.

2.2.5 Moored Oceanographic Sensors

Moored oceanographic sensors are described in the 2018 OEA and there are no changes associated with the Proposed Action.

2.2.6 Fixed and Towed Receiving Arrays

Horizontal and vertical arrays may be used to receive acoustic signals, if they are available. Examples are the Single Hydrophone Recording Units and Autonomous Multichannel Acoustic Recorder. Such arrays would be moored to the seafloor and remain in place throughout the activity.

2.2.7 Activities Involving Aircraft and Unmanned Air Vehicles

The deployment of the NRL sources in March 2022 would be accomplished by using aircraft that would land on the ice. Flights would be conducted with a Twin Otter aircraft or a single engine alternative that would be quieter. Flights would transit at 1,500 ft or 10,000 ft (457 or 3,048 m) above sea level. Twin Otters have flight speeds of 80 to 160 knots, a typical survey speed of 90 to 110 knots, 66 ft (20 m) wing span, and a total length of 26 ft (8 m) (U.S. Department of Commerce and National Oceanic and Atmospheric Administration 2015). At a distance of 2,152 ft (656 m) away, the received pressure levels of a Twin Otter range from 80 to 98.5 A-weighted decibels (expression of the relative loudness in the air as perceived by the human ear) and frequency levels ranging from 20 Hz to 10 kHz, though they are more typically in the 500 Hz range (Metzger 1995). Once on the floating ice, the team would drill holes with up to a 10 inch (in; 25.4 centimeter [cm]) diameter to deploy scientific equipment (e.g. source, hydrophone array, EMATT) into the water column.

The Proposed Action includes the use of an Unmanned Aerial System (UAS). The UAS would be utilized for aid of navigation and to confirm and study ice cover. The UAS would be deployed ahead of the ship to ensure a clear passage for the vessel and would have a maximum flight time of 20 minutes. The UAS would not be used for marine mammal observations or hover close to the ice near marine mammals. There would be no videotaping or picture taking of marine mammals as part of the Proposed Action. The UAS that would be used during the Proposed Action is a small commercially available system that generates low sound levels and is smaller than military grade systems. The dimensions of the proposed UAS are 11.4 in, (29 cm) by 11.4 in (29 cm) by 7.1 in (18 cm) and weighs only 2.5 pounds (1.13 kilograms [kg]). The UAS can operate up to 984 ft (300 m) away, which would keep the device in close proximity to the ship. The planned operation of the UAS is to fly it vertically above the ship to examine
the ice conditions in the path of the ship and around the area (i.e., not flown at low altitudes around the vessel). Currently acoustic parameters are not available for the proposed models of UASs to be utilized in the Proposed Action. As stated above these systems are very small and are similar to a remote control helicopter. It is likely marine mammals would not hear the device since the noise generated would likely not be audible from greater than 5 ft (1.5 m) away (Christiansen et al. 2016).

2.2.8 On-Ice Measurement Systems

On-ice measurement systems are described in the 2018 OEA, and there is no change associated with the Proposed Action.

2.2.9 Bottom Interaction Systems

Bottom interaction systems are described in the 2018 OEA, and there are no changes associated with the Proposed Action.

2.2.10 Weather Balloons

Weather balloons are described in the 2018 OEA, and there are no changes associated with the Proposed Action.

2.3 Screening Factors

The screening of alternatives is described in the 2018 OEA. The Proposed Action in the 2019 Supplement resulted from the availability of new VLF source technology for more comprehensive assessment and results from the first year of navigation source deployment. The Proposed Action in this document resulted from new density information and the addition of the limited use of a VLF source closer to shore. To meet the main scientific objectives, the use of year-round source transmissions in the Beaufort Sea was a necessary component of both the ONR and NRL projects, and some preliminary testing of new components needed to be done on-site for the ONR project. The navigation system must have a sufficiently long range and operate in deep water in an under-ice environment.

2.4 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors addressed in the 2018 OEA and in order to meet the purpose and need for the ARA, two action alternatives will be analyzed and compared to the No Action Alternative.

2.4.1 No Action Alternative

Under the No Action Alternative, scientific activity would be limited to the retrieval of active sources that have previously been deployed and covered under previous documentation.

2.4.2 Alternative 1 – The Preferred Alternative - Very Low frequency Source Use

Under Alternative 1 - the preferred alternative, the Proposed Action would incorporate all changes to the scientific plan and include a VLF source as part of the navigation system. A VLF source has the potential to increase the geographical coverage of the navigation system and also mitigate against effects on marine mammals, since the frequency of the source is outside the hearing range of marine mammals. Successful employment of VLF technology would also aid in future climate change studies in the area.
2.4.3 Alternative 2 – Excluding the use of the Very Low Frequency Source

Under Alternative 2, the Proposed Action would incorporate all changes in the scientific plan but not include a VLF source as part of the navigation system. Although it is considered more benign from an environmental perspective to introduce a VLF source (and possibly supplant LF sources depending on results), the motivation for looking at this alternative was to see if the larger range of VLF vice LF would result in exposures of species closer to the coast – in particular bowhead whales.

2.5 Alternatives Considered but not Carried Forward for Detailed Analysis

Alternatives that were considered but did not meet screening criteria, and therefore were not carried forward, are discussed in the 2018 OEA. A No Action Alternative of continuing with current experiments was considered. It would not be a matter of simply repeating previous analysis, as the input marine mammal density information has changed. Ultimately, it was decided that a continuation of existing work would not meet major scientific objectives.
This chapter presents a description of the environmental resources which may be affected from the changes in the Proposed Action or where best available science, laws or regulations differ from the 2018 OEA.

All potentially relevant environmental resource areas were initially considered for analysis in the 2018 OEA. In compliance with E.O. 12114, the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to “harm” from the changes associated with the new Proposed Action presented in this SOEA. “Harm” as defined by E.O. 12114, does not equate to take under the MMPA; “harm” in relation to marine mammals under E.O. 12114 extends to relatively minor environmental effects, such as minor behavioral responses to an active acoustic transmission. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental harm. The following resources were analyzed in the 2018 OEA and are not further analyzed herein: Physical resources (atmospheric temperature, bathymetry, current, circulation and water masses), water quality, sea ice, biological resources (invertebrates, marine birds, fish, and essential fish habitat.

The potential harm to the following resource areas are considered to be negligible or non-existent so they were not analyzed in the 2018 OEA and will not be analyzed herein: air quality, cultural resources, land use, visual resources, airspace, water quality, deep sea corals and coral reefs, marine vegetation, and sea turtles.

### 3.1 Biological Resources

Biological resources include living, native, or naturalized plant and animal species and the habitats within which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal.

Biological resources were divided into five major categories in the 2018 OEA: (1) invertebrates, (2) marine birds, (3) fish, (4) Essential Fish Habitat, and (5) marine mammals. Only marine mammals are anticipated to potentially be harmed by the Proposed Action based on revised acoustic effects criteria and, therefore, only impacts to marine mammals are assessed in this SOEA.

### 3.1.1 Regulatory Setting

For the purposes of this SOEA, species with special regulatory status are those listed as threatened or endangered under the ESA, and species afforded federal protection under the MMPA. Regulations implementing these federal statues are described in the 2018 OEA, and have not been changed.

### 3.1.2 Affected Environment

The following discussion provides a description of the marine mammals that could be harmed by the Proposed Action in the Study Area.

#### 3.1.2.1 Marine Mammals

Nine marine mammal species, which include three cetaceans, five pinnipeds, and the polar bear, are likely to occur in the Study Area during the Proposed Action. Marine mammals are found throughout the Study Area, including on the sea ice and within the water column. All marine mammals are protected under the MMPA. Table 3-1 lists the potential marine mammals within the Study Area, their stock, and
ESA status. Descriptions of the geographic range, habitat and distribution, and predator/prey interactions of each marine mammal species are included in the 2018 OEA.

### Table 3-1. Mammals Likely Present in the Study Area during the Proposed Action

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
<th>Stock(s) within the Study Area</th>
<th>ESA-Listing</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ESA-Listed Species</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bearded seal</td>
<td><em>Erignathus barbatus</em></td>
<td>Berengia2</td>
<td>Threatened</td>
</tr>
<tr>
<td></td>
<td><em>nauticus</em></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bowhead whale</td>
<td><em>Balaena mysticetus</em></td>
<td>Bering-Chukchi-Beaufort Seas</td>
<td>Endangered</td>
</tr>
<tr>
<td>Polar bear</td>
<td><em>Ursus maritimus</em></td>
<td>Southern Beaufort Sea, Chukchi/Bering Sea</td>
<td>Threatened</td>
</tr>
<tr>
<td>Ringed seal</td>
<td><em>Phoca hispida</em></td>
<td>Arctic2</td>
<td>Threatened</td>
</tr>
<tr>
<td><strong>Non-ESA Listed Species</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beluga whale</td>
<td><em>Delphinapterus leucas</em></td>
<td>Beaufort Sea</td>
<td>n/a</td>
</tr>
<tr>
<td>Gray whale</td>
<td><em>Eschrichtius robustus</em></td>
<td>Eastern North Pacific</td>
<td>n/a</td>
</tr>
<tr>
<td>Ribbon seal</td>
<td><em>Histriophoca fasciata</em></td>
<td>Alaska</td>
<td>n/a</td>
</tr>
<tr>
<td>Pacific walrus</td>
<td><em>Odobenus rosmarus</em></td>
<td>n/a</td>
<td>De-listed (previous candidate for listing)</td>
</tr>
<tr>
<td>Spotted seal</td>
<td><em>Phoca largha</em></td>
<td>Alaska</td>
<td>n/a</td>
</tr>
</tbody>
</table>

1 Scientific name of subspecies within the Study Area
2 Stock is designated by the MMPA.

#### 3.1.2.2 ESA-listed Marine Mammals

There are no other changes associated with the life histories of the ESA-listed marine mammal species within the Study Area.
Environmental Consequences

This chapter discusses the potential environmental consequences of the Proposed Action to the natural and physical environments described in Chapter 3. Stressors resulting from either of the Proposed Action Alternatives that may potentially harm the biological environment only include changes to non-impulsive acoustic sources; all other environmental consequences remain the same as the 2018 OEA. Therefore, only non-impulsive acoustic sources are analyzed for impacts to the biological resources affected. ESA species and conclusions for all stressors related to the Proposed Action are included in Table 4-3. The remaining environmental consequences are fully analyzed in the 2018 OEA for all biological resources:

- Acoustic: aircraft noise and vessel noise
- Physical: aircraft strike, vessel and in-water device strike, icebreaking (acoustic and physical impacts), and bottom disturbance
- Expended Material: entanglement and ingestion

In assessing the potential for environmental harm to biological resources from non-impulsive acoustic sources, a variety of factors must be considered, including source characteristics, animal presence and associated density, duration of exposure, and thresholds for harm and harassment for the species that may occur in the Study Area. The severity of the potential consequences such as physiological stress and behavioral response depends on the received sound level at the animal, the details of the sound-producing activity, the animal’s life history stage (e.g., juvenile or adult, breeding or feeding season), and past experience with the stimuli. An animal’s life history stage is an important factor to consider when predicting whether a stress response is likely. An animal’s life history stage includes its level of physical maturity (i.e., larva, infant, juvenile, sexually mature adult) and the primary activity in which it is engaged such as mating, feeding, or rearing/caring for young. Prior experience with a stressor may be of particular importance because repeated exposure to a stressor may dull the stress response via acclimation or increase the response via sensitization (St Aubin and Dierauf 2001). The types of potential consequences to marine species from acoustic sources can be described by the following categories:

- **Non-auditory injury**: Non-auditory injury can occur to lungs and organs and can cause tissue damage. Resonance occurs when the frequency of the sound waves matches the frequency of vibration of the air filled organ or cavity, causing it to resonate. This can, in certain circumstances, lead to damage to the tissue making up the organ or air filled cavity. Tissue damage can also be inflicted directly by sound waves in cases of sound waves with high amplitude and rapid rise time.

- **Hearing Loss**: Also called a noise-induced threshold shift, hearing loss manifests itself as a loss in hearing sensitivity across part of an animal’s hearing range, which is dependent upon the specifics of the noise exposure. Hearing loss may be either a Permanent Threshold Shift (PTS) or a Temporary Threshold Shift (TTS). If the threshold shift does not return to zero but leaves some finite amount of threshold shift, then that remaining threshold shift is a PTS. The intensity and duration of a sound that will cause PTS varies across species and even between individual animals. PTS is a consequence of the death of sensory hair cells of the auditory epithelia of the ear and a resultant loss of hearing ability in the general vicinity of the frequencies of stimulation (Myrberg 1990; Richardson et al. 1995).

- **Physiological stress**: Marine animals naturally experience physiological stress as part of their normal life histories. The physiological response to a stressor, often termed the stress response, is an adaptive process that helps an animal cope with changing external and internal environmental conditions. Sound-producing activities have the potential to cause additional stress. However, too much of a stress response can be harmful to an animal, resulting in physiological dysfunction.
If a sound is detected (i.e., heard or sensed) by an animal, a stress response can occur. Additionally, if an animal suffers injury or hearing loss, a physiological stress response will occur. The generalized stress response is characterized by a release of hormones (Reeder and Kramer 2005) and other chemicals (e.g., stress markers) such as reactive oxidative compounds associated with noise-induced hearing loss (Henderson et al. 2006). An acute stress response is traditionally considered part of the startle response and is hormonally characterized by the release of the catecholamines. Annoyance type reactions may be characterized by the release of either or both catecholamines and glucocorticoid hormones. Regardless of the physiological changes that make up the stress response, the stress response may contribute to an animal’s decision to alter its behavior.

**Behavioral response:** Marine animals may exhibit short-term behavioral reactions such as cessation of feeding, resting, or social interaction, and may also exhibit alertness or avoidance behavior (Richardson et al. 1995).

**Masking:** The presence of intense sounds or sounds within a mammal’s hearing range in the environment potentially can interfere with an animal’s ability to hear relevant sounds. This effect, known as “auditory masking,” could interfere with the animal’s ability to detect biologically relevant sounds such as those produced by predators or prey, thus increasing the likelihood of the animal not finding food or being preyed upon (Myrberg 1981; Popper et al. 2004). Masking only occurs in the frequency band of the sound that causes the masking condition. Other relevant sounds with frequencies outside of this band would not be masked.

### 4.1 Non-Impulsive Acoustic Analysis

The following marine mammals are susceptible to harm from the non-impulsive acoustic sources during the Proposed Action Alternatives: beluga whales, bowhead whales, gray whales, bearded seals, ribbon seals, ringed seals, spotted seals, and Pacific walrus. Polar bears are anticipated to remain on the ice surface and not be exposed to non-impulsive acoustic sources in the water column. In assessing the potential effects on marine mammals from the Proposed Action Alternatives, a variety of factors must be considered, including source characteristics, animal presence, animal hearing range, duration of exposure, and impact thresholds for species that may be present. Potential acoustic impacts could include PTS, TTS, or behavioral effects. To make these assessments, a model was used to quantitatively estimate the potential number of exposures that could occur, followed by a qualitative analysis to account for other factors not reflected by the model.

The Navy Acoustic Effects Model (NAEMO) was used to produce a quantitative estimate of PTS, TTS, and behavioral exposures for marine mammals. The Navy then further analyzed the data and conducted an in-depth qualitative analysis of the species distribution and likely responses to the non-impulsive acoustic sources based on available scientific literature. The determination of the effects to marine mammals was based on this combination of quantitative and qualitative analyses. Additional details on the acoustic modeling can be found in Appendix C in the 2018 OEA.

### 4.1.1 Quantitative Analysis

A quantitative analysis of the potential effects to marine mammals from the proposed non-impulsive acoustic sources was conducted using a method that calculates the total sound exposure level (SEL) and maximum sound pressure level (SPL) that a marine mammal may receive from the non-impulsive acoustic sources. NAEMO was used for all modeling analysis (U.S. Department of the Navy 2017b). Environmental characteristics (e.g., bathymetry, wind speed, and sound speed profiles) and source characteristics (i.e., source level, source frequency, transmit pulse length and interval, horizontal and vertical beam width and source depth) were used to determine the propagation loss of the acoustic
energy, which was calculated using the Comprehensive Acoustic System Simulation/Gaussian Ray
Bundle (CASS/GRAB) propagation model. Additionally, an under-ice model (Oceanographic and
Atmospheric Master Library ICE) for surface interaction was implemented in NAEMO. The propagation
loss then was used in NAEMO to create acoustic footprints. The NAEMO model then simulated source
movement through the Study Area and calculated sound energy levels around the source. Animats, or
representative animals, were distributed based on density data obtained from the Navy Marine Species
Density Database (U.S. Department of the Navy 2017c) and from recent data and information collected
and compiled by the Updated Marine Species Density Models for the Arctic Study Area (2020). The Navy
also used a Seasonal Relative Environmental Suitability model (Kaschner et al. 2006), based on seasonal
habitat preferences and requirements of known occurrences, such as temperature, bathymetry, and
distance to land data and literature review, because occurrence information for marine mammals in the
Study Area is not well known. Empirical data is coupled with Relative Environmental Suitability modeling
data to generate predictions of density data for locations where no survey data exist. The energy
received by each animat distributed within the model was summed into a total SEL. Additionally, the
maximum SPL received by each animat was also recorded.

NAEMO calculates the predicted number of exposures that could result in effects as determined by the
application of acoustic threshold criteria. Criteria and thresholds for measuring these effects induced
from underwater acoustic energy have been established for marine mammals. Marine mammal criteria
were established based on the following hearing groups: low-, mid-, and high-frequency cetaceans, and
phocid pinnipeds. A summary of physiological and behavioral criteria for both non-impulsive acoustic
and icebreaking sources are provided in Table 4-1 for groups of marine mammals that are found within
the Study Area. The thresholds established for physiological effects (SEls for PTS and TTS) for groups of
marine mammals that are found in the Study Area are described in detail in National Marine Fisheries
Service (2018). Behavioral criteria were developed by the U.S. Navy in coordination with NMFS to
support Phase III environmental analyses and MMPA Letter of Authorization renewals, and are
described in detail in U.S. Department of the Navy (2017a).

Table 4.1. Acoustic In-Water Criteria and Thresholds for Predicting Physiological and
Behavioral Effects on Marine Mammals Potentially Occurring in the Study Area

<table>
<thead>
<tr>
<th>Group</th>
<th>Species</th>
<th>Behavioral Criteria</th>
<th>Physiological Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non-Impulsive Acoustic Sources</td>
<td>Onset TTS</td>
</tr>
<tr>
<td>Low Frequency Cetaceans</td>
<td>Gray whale, bowhead whale</td>
<td>Low-Frequency BRF dose response function*</td>
<td>179 dB SEL cumulative</td>
</tr>
<tr>
<td>Mid Frequency Cetaceans</td>
<td>Beluga whale</td>
<td>Mid-Frequency BRF dose response function*</td>
<td>178 dB SEL cumulative</td>
</tr>
<tr>
<td>Phocidae (in water)</td>
<td>Bearded seal/Ringed seal</td>
<td>Pinniped Dose Response Function*</td>
<td>181 dB SEL cumulative</td>
</tr>
</tbody>
</table>

BRF = Behavioral Response Function
*See Figure 4-1
The results from the NAEMO acoustic analysis indicates that only two species, the beluga whales and ringed seal, have estimated exposures (Table 4-2). The modeling results indicate that any effects on animals are confined to behavioral responses; the modeling shows no occurrence of TTS or PTS. The number of exposures was the same for both alternatives, and no bowhead whale exposures were introduced by the inclusion of a VLF source in Alternative 1. Note that these exposures are for the October 2021 – October 2022, so sources will either be turned off in October 2022 or new environmental documentation will be prepared.

Figure 4-1. A) The Bayesian biphasic dose-response BRF for Odontocetes. B) The Bayesian biphasic dose-response BRF for Pinnipeds. C) The Bayesian biphasic dose-response BRF for Mysticetes. The blue solid line represents the Bayesian Posterior median values, the green dashed line represents the biphasic fit, and the grey represents the variance. [X-Axis: Received Level (dB re 1 μPa), Y-Axis: Probability of Response]
Table 4-2. NAEMO-Calculated Marine Mammal Estimated Yearly (October 2021 – October 2022) Non–Impulsive Acoustic Exposures

<table>
<thead>
<tr>
<th>Species</th>
<th>No Action Alternative</th>
<th>Alternative 1</th>
<th>Alternative 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Behavioral</td>
<td>TTS</td>
<td>PTS</td>
</tr>
<tr>
<td>Beluga whale</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bowhead whale</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Bearded seal</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Ringed seal</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Notes:
1. ESA-listed species

Results from the quantitative analysis should be regarded as conservative estimates that are influenced by limited marine mammal population data. While the numbers generated from the quantitative analysis provide overestimates of marine mammal exposures, mitigation measures would further limit actual exposures.

4.1.2 Qualitative Analysis

These quantitative calculations were then analyzed qualitatively, taking into account the best available data on the species itself, and how the species has been observed to respond to similar types of influences. No research has been conducted on the potential behavioral responses of ice associated seals and other marine mammals occurring in the Study Area to the type of non-impulsive acoustic sources used during the Proposed Action. However, data are available on effects of non-impulsive acoustic sources (e.g., sonar transmissions) on other phocids and marine mammals which was assessed and incorporated into the findings of this analysis.

Effects of Non-Impulsive Acoustic Sources on Phocids in Water

For non-impulsive sounds (i.e., similar to the sources used during the Proposed Action), data suggest that exposures of pinnipeds to sources between 90 and 140 dB re 1 \( \mu \text{Pa} \) do not elicit strong behavioral responses; no data were available for exposures at higher received levels for Southall et al., (2007) to include in their severity scale analysis. Reactions of harbor seals (Phoca vitulina) were the only available data for which the responses could be ranked on the severity scale. For reactions that were recorded, the majority (17 of 18 individuals/groups) were ranked on the severity scale as a 4 (moderate change in movement, brief shift in group distribution, or moderate change in vocal behavior) or lower; the remaining response was ranked as a 6 (minor or moderate avoidance of the sound source). Additional data on hooded seals (Cystophora cristata) indicate avoidance responses to signals above 160–170 dB re 1 \( \mu \text{Pa} \) (Kvadsheim et al. 2010), and data on gray (Halichoerus grypus) and harbor seals indicate avoidance response at received levels of 135–144 dB re 1 \( \mu \text{Pa} \) (Götz et al. 2010). In each instance where food was available, which provided the seals motivation to remain near the source, habituation to the signals occurred rapidly. In the same study, it was noted that habituation was not apparent in wild seals where no food source was available (Götz et al. 2010). This implies that the motivation of the animal is necessary to consider in determining the potential for a reaction. In one study aimed to investigate the under-ice movements and sensory cues associated with under-ice navigation of ice seals, acoustic transmitters (60–69 kHz at 159 dB re 1 \( \mu \text{Pa} \) at 1 m) were attached to ringed seals (Wartzok et al. 1992a; Wartzok et al. 1992b). An acoustic tracking system then was installed in the ice to receive the acoustic signals and provide real-time tracking of ice seal movements. Although the frequencies used in this study are at the upper limit of ringed seal hearing, the ringed seals appeared unaffected by the non-impulsive acoustic sources, as they were able to maintain normal behaviors (e.g., finding breathing holes).
Seals exposed to non-impulsive acoustic sources with a received SPL within the range of calculated exposures, $(142–193 \text{ dB re 1 \text{ \mu Pa}})$, have been shown to change their behavior by modifying diving activity and avoidance of the sound source (Götz et al. 2010; Kvadsheim et al. 2010). Although a minor change to a behavior may occur as a result of exposure to the sources in the Proposed Action, these changes would be within the normal range of behaviors for the animal (e.g., the use of a breathing hole further from the source, rather than one closer to the source, would be within the normal range of behavior) (Kelly et al. 1988).

Effects of Non-Impulsive Acoustic Sources on Other Marine Mammals Within the Study Area

Many of the contextual factors resulting from the behavioral response studies (e.g., close approaches by multiple vessels or tagging) would not occur during the Proposed Action. Research shows that if odontocetes do respond to acoustic transmissions, they may react in a number of ways depending on the characteristics of the sound source, their experience with the sound source, and whether they are migrating or on seasonal grounds (i.e., breeding or feeding grounds). Behavioral reactions may include alerting; breaking off feeding dives and surfacing; or diving or swimming away. Animals disturbed while engaged in other activities, such as feeding or reproductive behaviors, may be more likely to ignore or tolerate the disturbance and continue their natural behavior patterns. Therefore, most behavioral reactions from odontocetes are likely to be short-term, with low to moderate severity.

4.2 No Action Alternative

Under the No Action Alternative, the Navy would be limited to the retrieval of sources that were previously deployed.

The No Action Alternative is not expected to cause significant disruptions such as mass haul outs, or abandonment of breeding, that would result in significantly altered or abandoned behavior patterns. Given this, in accordance with the ESA the No Action Alternative would have no effect on bowhead whale, bearded seal, ringed seal, and polar bear from non-impulsive acoustic sources. In accordance with E.O. 12114, non-impulsive acoustic sources from the No Action Alternative would not significantly harm marine mammals.

4.3 Alternative 1 - the Preferred Alternative

As described above, the acoustic sources under the Preferred Alternative would include the use of the very low frequency source and other sources deployed in the Study Area. Although behavioral responses would typically be minor as described above, the lack of in-situ observation of the navigation sources does not allow for the standard mitigation, which would minimize interactions between an animal and any active sources. In contrast with most Navy testing, the acoustic transmissions would take place unsupervised over a yearlong basis, increasing the possibility that an exposure could occur, thus requiring a more conservative approach. Non-impulsive active acoustic sources are expected to result in, at most, minor to moderate avoidance responses of animals, over short and intermittent periods of time. Given this, in accordance with the ESA, the non-impulsive acoustic sources under the Preferred Alternative are likely to adversely affect, ringed seal; non-impulsive acoustic sources under the Preferred Alternative would have no effect on polar bear, bearded seal, or bowhead whale. Since the non-impulsive acoustic transmissions associated with the Preferred Alternative may cause a behavioral effect, ONR has applied for an Incidental Harassment Authorization from NMFS for level B take of ringed seals and beluga whales in accordance with MMPA. The Preferred Alternative is not expected to cause significant disruptions such as mass haul outs, or abandonment of breeding, that would result in significantly altered or abandoned behavior patterns. In accordance with E.O. 12114, non-impulsive
acoustic sources associated with the Proposed Action are not likely to significantly harm marine
mammals.

4.4 Alternative 2

As described above, all the sound sources except for the VLF sound source would be deployed under
Alternative 2, in the Study Area. Although behavioral responses would typically be minor as described
above, the lack of in-situ observation of the navigation sources does not allow for the standard mitigation,
which would minimize interactions between an animal and any active sources. In contrast with most Navy
testing, the acoustic transmissions would take place unsupervised over a yearlong basis, increasing the
possibility that an exposure could occur, thus requiring a more conservative approach. Non-impulsive
active acoustic sources are expected to result in, at most, minor to moderate avoidance responses of
animals, over short and intermittent periods of time. Given this, in accordance with the ESA, the non-
impulsive acoustic sources under Alternative 2, may affect, and are likely to adversely affect, ringed seal;
non-impulsive acoustic sources under Alternative 2 would have no effect on polar bear, bearded seal, or
bowhead whale. Alternative 2 is not expected to cause significant disruptions such as mass haul outs, or
abandonment of breeding, that would result in significantly altered or abandoned behavior patterns. In
accordance with E.O. 12114, non-impulsive acoustic sources associated with Alternative 2, are not likely
to significantly harm marine mammals.

4.5 Summary of Potential Impacts to Resources

Under either the No Action Alternative or the Proposed Action Alternatives, potential harm to physical
and most biological resources (i.e., invertebrates, birds, fish, and Essential Fish Habitat) would remain
the same as that described in the 2018 OEA. The modeling of the Proposed Action used an overestimate
of the population of ringed seals based on updated density numbers, therefore the estimated behavioral
effects are conservative compared to the NMFS predicted ringed seal population. The Proposed Action
Alternatives are not expected to result in population-level impacts to marine mammals. ESA listed
marine mammals conclusions for both Alternatives are included in Table 4-3. The table includes all
stressor information for the Proposed Action including stressors fully analyzed in previous
documentation still applicable.

Table 4-3. ESA Marine Mammal Conclusions for all Stressors

<table>
<thead>
<tr>
<th>Species</th>
<th>Stressor</th>
<th>ESA Conclusion under the Preferred Alternative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bearded Seal</td>
<td>Non-Impulsive acoustic sources</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td>Vessel/Aircraft noise</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td></td>
<td>Vessel/In-water device strike</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td></td>
<td>Entanglement</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td></td>
<td>Ingestion</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td>Bowhead Whale</td>
<td>Non-Impulsive acoustic sources</td>
<td>No effect</td>
</tr>
<tr>
<td></td>
<td>Vessel/Aircraft noise</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td></td>
<td>Vessel/In-water device strike</td>
<td>Entanglement</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------</td>
<td>--------------</td>
</tr>
<tr>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Polar Bear</th>
<th>Non-Impulsive acoustic sources</th>
<th>No effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel/Aircraft noise</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td>Vessel/In-water device strike</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td>Entanglement</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td>Ingestion</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ringed Seals</th>
<th>Non-Impulsive acoustic sources</th>
<th>May affect, likely to adversely affect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel/Aircraft noise</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td>Vessel/In-water device strike</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td>Entanglement</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
<tr>
<td>Ingestion</td>
<td>May affect, not likely to adversely affect</td>
<td>May affect, not likely to adversely affect</td>
</tr>
</tbody>
</table>
Mitigation Measures

Mitigation measures would be implemented during the Proposed Action. Mitigation measures are used to avoid and reduce potential impacts and standard operating procedures are implemented and provide additional safety and mission success, and are implemented regardless of their secondary benefits (e.g., to a resource).

Ships operated by or for the United States (U.S.) Department of the Navy (Navy) have personnel assigned to stand watch at all times, day and night, when moving through the water (underway). Watch personnel undertake extensive training in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent, including on-the-job instruction and a formal Personal Qualification Standard program (or equivalent program for supporting contractors or civilians), to certify that they have demonstrated all necessary skills (such as detection and reporting of floating or partially submerged objects). Their duties may be performed in conjunction with other job responsibilities, such as navigating the ship or supervising other personnel. While on watch, personnel employ visual search techniques, including the use of binoculars, using a scanning method in accordance with the U.S. Navy Lookout Training Handbook or civilian equivalent. A primary duty of watch personnel is to detect and report all objects and disturbances sighted in the water that may be indicative of a threat to the ship and its crew, such as debris, or surface disturbance. Per safety requirements, watch personnel also report any marine mammals sighted that have the potential to be in the direct path of the ship as a standard collision avoidance procedure.

While underway ships (including non-Navy ships operating on behalf of the Navy) utilizing active acoustics and towed in-water devices will have at least one watch personnel during activities. While underway, watch personnel are alert at all times and have access to binoculars.

5.1 Mitigation Measures

While in transit, ships shall be alert at all times, use extreme caution, and proceed at a "safe speed" so that the ship can take proper and effective action to avoid a collision with any marine mammal and can be stopped within a distance appropriate to the prevailing circumstances and conditions.

Drifting sources are left in place and cannot be turned off until the following year during ice free months. Once they are programmed they will operate at the specified pulse lengths and duty cycles until they are either turned off the following year or there is failure of the battery and they are not able to operate. Due to the ice covered nature of the Arctic, it is not possible to recover the sources or interfere with their transmit operations in the middle of the permit year.

Mitigation zones for low frequency active acoustics involve turning off a source when a marine mammal is sighted within 200 yards (yd; 183 m) from the source when the source is being tested during initial deployment. Active transmission will re-commence if any one of the following conditions are met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed and relative motion between the animal and the source, (3) the mitigation zone has been clear from any additional sightings for a period of 30 minutes, (4) the vessel has transited more than 400 yd (366 m) beyond the location of the last sighting.

During AMOS and UUV deployment visual observation would start 15 minutes prior to and continue throughout the deployment within a mitigation zone of 180 ft (55 m) around the deployed object. Deployment will stop if a marine mammal is visually detected within the mitigation zone. Deployment will re-commence if any one of the following conditions are met: (1) the animal is observed exiting the mitigation zone, (2) the animal is thought to have exited the mitigation zone based on its course and speed, or (3) the mitigation zone has been clear from any additional sightings for a period of 15 minutes.
Ships would avoid approaching marine mammals head on and would maneuver to maintain a mitigation zone of 500 yd (457 m) around observed whales, and 200 yd (183 m) around all other marine mammals, providing it is safe to do so during ice-free waters.

These requirements do not apply if a vessel's safety is at risk, such as when a change of course would create an imminent and serious threat to safety, person, vessel, or aircraft, and to the extent vessels are restricted in their ability to maneuver. No further action is necessary if a marine mammal other than a whale continues to close on the vessel after there has already been one maneuver and/or speed change to avoid the animal. Avoidance measures should continue for any observed whale in order to maintain a mitigation zone of 500 yd (457 m).

5.2 Monitoring and Reporting

There are no specific monitoring plans outside of lookouts aboard the Research Vessel (R/V) Sikuliaq and research vessel to be used in 2022. Due to the scientific objectives for data collection, acoustic sources would be deployed for an entire year without the ability to be turned off until a subsequent cruise the following year. Due to the harsh conditions in the Arctic Study Area, it is not feasible to tag and monitor marine mammals as it would require additional personnel and equipment.

While there is not monitoring specific to the Proposed Action, the Office of Naval Research (ONR) Marine Mammal Biology Program has funded research in Alaska on ice seals and whales. Currently ONR has funded a study to work with Native subsistence hunters and government agencies in Alaska (North Slope Borough Department of Wildlife Management) and Canada (Department of Fisheries and Oceans) to deploy satellite tags on ringed seals, spotted seals, bearded seals, bowhead whales, and beluga whales. The research is aimed to document year-round movements of each species and document habitat use relative to oceanographic conditions, ice cover, and human disturbance. New density data was used for this project, from a Navy-funded density modeling project through a Cooperative Agreement with Duke University. The Arctic density data products produced from this Cooperative Agreement have broad applications for conservation in the marine environment beyond the Navy’s uses, and as such, the project contributes to the maintenance and improvement of marine species resources as well as assisting the Navy in meeting its regulatory requirements for testing and training activities. Data from 10 receiving arrays in the Beaufort Sea basin are available for marine mammal analysis. ONR has also funded a project which is looking at the habitat based use of ice seals in Alaska and the Bering Sea. Though not directly overlapping with the Study Area, the research gives insight to ice seal movements and habitat use in the changing Arctic environment. The results of these efforts would be published in the future and used as best available science for modeling and prediction of animal use and movement.

The Navy is committed to documenting and reporting relevant aspects of training and research activities to verify implementation of mitigation, comply with current permits, and improve future environmental assessments. If any injury or death of a marine mammal is observed during the 2021-2022 Arctic Research Activities, the Navy will immediately halt the activity and report the incident consistent with the stranding and reporting protocol in other Navy documents such as the Atlantic Fleet Training and Testing Environmental Impact Statement/Overseas Environmental Impact Statement.
6 Consistency with Laws, Plans, Policies, and Regulations

The following laws are applicable to the Proposed Action.

Table 6-1. Principal Federal Laws Applicable to the Proposed Action

<table>
<thead>
<tr>
<th>Federal, State, Local, and Regional Land Use Plans, Policies, and Controls</th>
<th>Status of Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arctic Research and Policy Act (15 U.S.C. section 4101 et seq.)</td>
<td>This SOEA has been prepared in compliance with the goals of the Arctic Research and Policy Act.</td>
</tr>
<tr>
<td>Endangered Species Act (ESA) (16 U.S.C. section 1531 et seq.)</td>
<td>This SOEA considers impacts on species listed as threatened or endangered pursuant to this act. In accordance with the ESA, consultation with NMFS was re-initiated based on the determination that the Proposed Action may affect, and is likely to adversely affect ringed seals (<em>Phoca hispida</em>) and may affect, not likely to adversely affect bearded seals (<em>Erignathus barbatus nauticus</em>) and bowhead whales (<em>Balaena mysticetus</em>). These determinations have been modified due to changes in the Proposed Action described in this supplemental OEA. The most recent Biological Opinion was received on XX, 2021</td>
</tr>
<tr>
<td>Marine Mammal Protection Act (MMPA) (16 U.S.C. section 1361 et seq.)</td>
<td>This SOEA considers impacts on protected marine mammal species pursuant to this act. Based on the analysis contained within this SOEA, the Navy submitted an application for an IHA with NMFS for the taking of beluga whales and ringed seals and received the IHA on (XX, 2021)</td>
</tr>
<tr>
<td>Executive Order (E.O.) 12114, Environmental Effects Abroad of Major Federal Actions</td>
<td>This SOEA has been prepared in accordance with Navy E.O. 12114 procedures.</td>
</tr>
</tbody>
</table>
7 References


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