Appendices

Draft Programmatic Environmental Impact Statement for Surveying and Mapping Projects in U.S. Waters for Coastal and Marine Data Acquisition

National Oceanic and Atmospheric Administration

National Ocean Service

June 2021

APPENDIX A: SUMMARY OF NOS PROGRAM OFFICES AND THEIR USE OF ACTIVE ACOUSTIC DATA COLLECTION TECHNOLOGY

Center for Operational Oceanographic Products and Services

The Center for Operational Oceanographic Products and Services (CO-OPS) and its predecessors have gathered oceanographic data along our nation's coasts for over 200 years. CO-OPS is the authoritative source for accurate, reliable, and timely measurements that support safe and efficient maritime commerce, sound coastal management, and recreation. CO-OPS maintains over 200 continuously operating water level stations throughout the U.S. and its territories, data from which support water level forecasts and real time observations, determination of water level based datums, and monitoring long term trends in mean sea level (msl). The National Water Level Observation Network (NWLON) provides historical and present-day water level information to understand the patterns of water level trends or even high tide events. The entire collection of water level data forms the basis of many NOAA products and services that have evolved to support both national and local needs. CO-OPS also developed and maintains the Physical Oceanographic Real-Time System (PORTS®), a tool that integrates real-time environmental observations, forecasts and other geospatial information from measurements of water levels, currents, salinity, and meteorological parameters (e.g., winds, atmospheric pressure, air and water temperatures). CO-OPS disseminates observations and predictions derived from these data to improve the safety and efficiency of maritime commerce and coastal resource management. The Ocean Systems Test and Evaluation Program (OSTEP) lab explores, develops, and transitions emerging technologies and techniques for collecting tidal and current data, and oceanographic systems to support safe and efficient marine navigation and a healthy and sustainable coastal environment.

CO-OPS' water level stations and PORTS Program use hydroacoustic tools associated with their tidal gauges and water level stations. A number of water level stations and current survey applications require implementation of an Acoustic Doppler Current Profiler (ADCP) along with an acoustic water level sensor that operates above the water.

For maritime navigation in harbors and coastal waterways, real-time water level information reduces risks to life, property, and the coastal environment. Real-time water level data from a nearby gauge provides mariners with the tide levels to inform decision-making to avoid groundings. This information is collected through ADCPs in the form of side-lookers, bottom-lookers, or bottom mounted devices, depending on the specific PORTS station requirements.

National Centers for Coastal Ocean Science

The National Centers for Coastal Ocean Science (NCCOS) conducts and funds research in support of NOS core priorities. In addition, NCCOS research focusses on four thematic priority areas: 1) coastal change: vulnerability, mitigation, and restoration; 2) marine spatial ecology; 3) stressor impacts and mitigation (e.g. harmful algal blooms) and 4) social science. NCCOS conducts work nationally through its facilities located in Silver Spring MD, Charleston SC, Beaufort NC, Oxford MD, and Kasitsna Bay AK, and funds external grant recipients nationwide through the Competitive Research Program. The majority of the NCCOS hydroacoustics survey work is conducted through the Biogeography Branch, which develops detailed benthic habitat and fish distribution maps via hydroacoustic or visual methods (e.g., self-contained underwater breathing apparatus (SCUBA) diving, remotely operated vehicle (ROV) surveys, video cameras, etc.). The results of these data are used, among other things, to: (1) identify areas that may be high priorities for management or protection; (2) inform renewable energy infrastructure or aquaculture; and (3) understand the mechanisms that influence the distribution and connectivity of fishery resources.

NCCOS hydroacoustic activities currently involve developing innovative ecosystem maps, models, and assessments to guide communities in managing coastal ecosystems. Multibeam, single/splitbeam and side-scan sonar data are used to develop benthic seafloor habitat or cultural resource maps, as well as maps on the distribution and biomass of fishery resources. NCCOS also uses remotely operated vehicles (ROVs), AUVs, drop cameras, and divers to ground truth the benthic habitat maps for accuracy. NCCOS conducts mapping and other survey work nationwide in estuaries, and in marine ecosystems – especially in marine protected areas (MPAs), National Marine Sanctuaries, and in coral reefs. Habitat maps enhance the ability of coastal managers and policy makers to assess, protect, and preserve the condition of marine ecosystems and are essential tools for ocean planning and ecosystem management. By providing the baseline data on the ecological condition of reefs and other natural resources these data can show conservation efficacy over time. They are most often used by federal and state planners to identify areas in need of enhanced management (e.g., protection of fish spawning areas and deep coral habitats) and facilitate informed decisions and proper placement of offshore energy development and aquaculture, as well as the examination of proposed changes in national marine sanctuary boundaries. Through acoustic sonar technologies, NCCOS has advanced understanding of the connectivity, distribution, abundance, ecology, and ecological condition of marine ecosystems. These ecosystems are often difficult to survey due to their remoteness (i.e., deep-sea habitats).

Office of National Geodetic Survey

The National Geodetic Survey (NGS) has, for more than 200 years, provided the Nation with geodetic and geographic positioning services. NGS provides a common reference framework, the National Spatial Reference System (NSRS), for establishing the coordinate positions of all geographic and geospatial data. The foundational elements – latitude, longitude, elevation, shoreline information and their changes over time – contribute to informed decision making and impact a wide range of important activities including mapping and charting, navigation, flood risk determination, transportation, land use, and ecosystem management.

NGS delineates the shoreline through various photogrammetric sources, including tide-coordinated stereo aerial photographs, commercial satellite imagery, Light Detection and Ranging (lidar), and related remote sensing technologies. The data-gathering process results in a vector database of the national shoreline and products such as high-resolution aerial frame photographs, orthoimagery, and coastal lidar data sets.

Office of Coast Survey

The Office of Coast Survey carries out NOAA's surveying and charting responsibility pursuant to the Coast and Geodetic Survey Act of 1947 and the Ocean and Coastal Mapping Integration Act of 2009. The Office of Coast Survey's area of responsibility includes U.S. waters extending seaward to the limits of the U.S. Exclusive Economic Zone (U.S. EEZ) – well over 3 million square nautical miles (nm^2) of U.S. waters. The program collects hydrographic data and creates and maintains marine charts and other products to support safe navigation for commercial shipping, the fishing industry, recreational boaters, and state and local governments. Hydrographic data are collected with Office of Coast Survey vessels, NOAA Office of Marine and Aviation Operations (OMAO) vessels, chartered (contracted) vessels, and opportunistically from other government, academic, and industry mapping efforts. The data and data products also support military and government operations. NOAA has identified 500,000 nm^2 within the U.S. EEZ as "navigationally significant waters," which are areas in greater need of modern hydrographic surveying. The Coast Survey Development Laboratory (CSDL) explores, develops, and transitions emerging technologies and techniques for charting, hydrographic, and oceanographic systems to support safe and efficient marine navigation and a healthy and sustainable coastal environment. The Joint Hydrographic Center, with its University of New Hampshire academic partner, conducts applied research and development on hydrographic and ocean mapping topics.

The Office of Coast Survey acquires hydrographic data to update the nation's nautical charts with the accuracy essential to maintain the public trust in navigational products. The public may access survey data at NOAA's National Centers for Environmental Information (NCEI), formerly the National Geophysical Data Center, and nautical charts are available from a variety of sources, including Coast Survey's website. Office of Coast Survey activities include surveying navigationally significant areas annually, using four OMAO ships (all of which are equipped with survey boats ("launches")), six navigation response team (NRT) survey boats, a 54-foot research vessel, and chartered vessels operated by private contractors.

The Office of Coast Survey contracts approximately half of its hydrographic survey projects. Contractors often use the same vessels from year to year, regardless of whether the vessels are chartered ("vessels of opportunity") or owned by the contract firm. During transits, contractors operate under all of the normal regulations for vessels in the area, using shipping lanes, recommended routes, and natural channels as appropriate. Currently, the Coast Survey Development Laboratory is evaluating the use of autonomous underwater vehicles (AUVs) and surface vessels (ASVs) as tools for hydrographic surveying. The use of AUVs and ASVs could greatly increase survey efficiency. Additionally, AUVs could be used for marine incident response and port security surveys due to their small size and flexible deployment options. The Office of Coast Survey funds hydrographic and ocean mapping research at the Joint Hydrographic Center via cooperative agreement.

Office for Coastal Management

OCM is composed of four principal programs: Coastal Zone Management Program, National Estuarine Research Reserve System, Coral Reef Conservation Program, and the Digital Coast Program. Major components of the Coastal Zone Management Program include federal consistency; nonpoint pollution control; and coastal zone enhancements. Thirty-four states and territories currently participate in the voluntary partnership. OCM provides annual cooperative agreements to these states for diverse projects that manage and enhance coastal areas. There are 29 National Estuarine Research Reserves to which NOAA provides annual funding and technical guidance. Much of the day-to-day management is conducted by states or universities, in coordination with state and local partners. These reserves aim to protect and study important estuaries that, collectively, encompass more than 1.3 million acres. Program goals are purposefully broad and could include use of a wide array of hydroacoustic methods, such as tracking fish habitat utilization. The Coral Reef Conservation Act of 2000 established the Coral Reef Conservation Program to protect, conserve, and restore the nation's coral reefs. The Program brings together expertise from across NOAA to address impacts from climate change and related ocean acidification; land-based sources of pollution; and unsustainable fishing practices. It partners with state and territorial governments, academic institutions, non-governmental organizations (NGOs), and community groups. The Program provides annual funds to support coral conservation projects and scientific studies to address the three primary threats. Finally, NOAA developed Digital Coast to provide coastal data and the tools, training, and other information necessary to make those data useful. Data sets range from economic data to satellite imagery and are designed to be most useful to the coastal management community.

OCM provides funds to coastal states and National Estuarine Research Reserves to conduct site-specific sonar benthic mapping exercises, though this occurs infrequently. OCM also provides funds to other levels of government (state, local, foreign), as well as to academia and non-profits, via grants, cooperative agreements or contracts.

The Coral Reef Conservation Program (CRCP) provides funds to other parts of NOAA (e.g., NCCOS, Office of National Marine Sanctuaries [ONMS], and NMFS), which may engage in hydroacoustic work. These "action offices" conduct any necessary NEPA analyses of those activities. In addition, CRCP develops and implements contracts and MOUs and grants to federal, foreign, state and local governments, academia, and NGOs.

Some of the projects that have been funded through OCM include:

- Side scan sonar in the Hudson River;
- Acoustic backscatter imagery; and
- Benthic habitat mapping in the Tortugas area of south Florida and other areas as part of the Marine Cadastre for ocean use planning.

Office of National Marine Sanctuaries

ONMS is the federal agency that oversees the thirteen sites in the National Marine Sanctuary System and two Marine National Monuments. Together, these protected areas encompass more than 600,000 square miles of ocean and Great Lake waters. National Marine Sanctuaries have been established via acts of Congress or an administrative process for focused, long-term management. The two Marine National Monuments (Papahānaumokuākea and Rose Atoll) were designated by Presidential proclamation under the Antiquities Act.

Sanctuaries and monuments contain unique resources including some of the following: deep ocean habitats; kelp forests; coral and temperate reefs; whale migration corridors; deep-sea canyons; and historically significant shipwrecks and other underwater archaeological sites. Organizationally, the Sanctuary System is divided into four regions: Northeast and Great Lakes; Southeast Atlantic, Gulf of Mexico and Caribbean; West Coast; and Pacific Islands. The mission of ONMS is to identify, protect, conserve, and enhance the natural and maritime heritage resources, values, and qualities of the National Marine Sanctuary System for present and future generations. The National Marine Sanctuaries Act (NMSA) is the governing statute for all designated sanctuaries. The act authorizes the U.S. Secretary of Commerce to designate as national marine sanctuaries areas of the marine environment or Great Lakes with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational, or aesthetic qualities.

Each sanctuary and marine national monument conducts a number of field operations that support management, research and education objectives. Sanctuary vessel operations include all activities conducted on the water from an ONMS small boat or via an ONMS-sponsored mission. These include, but are not limited to, research, education, outreach, marine or cultural resource and habitat assessments, restoration activities, marine mammal disentanglement, and law enforcement. All ONMS vessels must comply with the operational protocols and procedures in the NOAA Small Boats Policy (NAO 209-125).

Hydroacoustic operations may include AUVs, ROVs, and towed gliders, bathymetric and seafloor habitat mapping, as well as remote sensing. Underwater sampling platforms such as AUVs, ROVs and ocean gliders may feature acoustic sensors that can be deployed to monitor whales and their habitat, survey the seafloor for entanglement threats, and to monitor water quality and ocean conditions (i.e., detecting hypoxia and ocean acidification).

ONMS vessels may be used to deploy passive acoustic monitoring equipment that is anchored to the seafloor and may also tow or deploy drifting passive acoustic monitoring equipment. Passive acoustic devices are used to study biological and anthropogenic sound and behavior of marine animals, and emit sound from vessels to map the seafloor. Some equipment and instruments, such as ROVs, hydrophones and towed camera systems, may be tethered to the ship and towed behind a vessel, or are otherwise operated from a vessel. AUVs are remotely operated vehicles that are usually launched from the ship with a pre-programmed navigation route and then recovered once the AUV track has been completed. All of the technologies are operated pursuant to valid permits and regulations.

Other acoustic equipment may be deployed using snorkelers or SCUBA divers, or from vessels. Towing missions normally occur monthly to quarterly. Equipment, such as hydrophones or other acoustic receivers, is often deployed within a sanctuary by anchoring it with cable ties, brackets, or clamps to existing infrastructure (e.g., buoys, channel markers), weights, or lengths of rebar that have been installed by SCUBA divers using hammers or pneumatic drills. In some cases, acoustic tags may be attached to fish to monitor movement and to marine mammals for tracking and research pursuant to NMFS, ESA, and MMPA permits. OMAO vessels are used to deploy AUVs, ROVs, towed magnetometers, multibeam echo sounders, and side scan sonars in order to inventory resources and document new maritime heritage sites. Aircraft use lidar in nearshore areas for long-term monitoring and to characterize shallow-water benthic and intertidal habitats.

Diver surveys are sometimes used to supplement normal remote sensing surveys and are particularly helpful in shallow areas of high topographical complexity. Divers working to ground-truth remotely sensed information may be stationary at a single site or towed behind a boat at approximately 3 knots/hour when surveying larger areas of the marine environment. For example, the NOAA Ship *Hiʻialakai* is a 224-foot research vessel that is outfitted with Kongsberg EM300 and EM3002 multibeam systems that are used to map the seafloor. In addition to the seafloor maps that are produced, data collected by the ship's multibeam systems are also used to identify appropriate dive sites for ONMS related research activities. In areas that are too shallow for the *Hiʻialakai* to safely access, the ship regularly uses launches/tender vessels and towed divers to support ground truthing efforts.

Office of Response and Restoration

The Office of Response and Restoration (ORR) is a center of expertise in preparing for, evaluating, and responding to threats to coastal environments, including oil and chemical spills, releases from hazardous waste sites, and marine debris. Within ORR, the Emergency Response Division provides scientific expertise for responses to oil and chemical spills in U.S. marine and coastal waters. Its efforts facilitate spill prevention, preparedness, response, and restoration at national and local levels. The Assessment and Restoration Division conducts natural resource damage assessments, with the objective of restoring natural resources injured by releases of oil and hazardous substances in marine and coastal waters. The Marine Debris Division undertakes national and international efforts focused on researching, reducing, and preventing debris in the marine environment.

ORR hydroacoustic data collection may include the use of various devices such as the acoustic Doppler current profilers (ADCPs) and echo sounders to track and map oil plumes and to characterize fish and plankton presence. ORR's Marine Debris Division (MDD) funds marine debris research, prevention and removal activities. Since 2006, the MDD has supported more than 135 removal projects across the country and removed more than 12 million pounds of debris from our oceans. To accomplish this, the MDD may perform and fund activities that use sensing technologies for the detection and subsequent removal of submerged marine debris. These technologies include: multibeam and side-scan sonar; side-imaging sonar; ROVs and AUVs with cameras or other sensors attached; diver towed video; and propeller cameras. The sonar systems typically used by the MDD-funded projects are commercially-available, low powered, high frequency systems, not fundamentally different from those used by most recreational boats and fishing vessels.

Integrated Ocean Observing System

The Integrated Ocean Observing System (IOOS) is a national-regional partnership that provides observational coastal data, forecasts, and new tools to improve safety, enhance the economy, and protect the environment. Integrated ocean information is available in near real time, as well as retrospectively, and improves NOAA's ability to understand and predict coastal storms, wave heights, and sea level change. The IOOS Program Office is organized into two divisions that implement policies, protocols, and standards to implement IOOS and oversee the daily operations and coordination of the System: (1) Operations Division (Ops) and (2) Regions, Budget, and Policy (RB&P). The Operations Division coordinates the contributions of federally-owned observing and modeling systems and develops and integrates non-federal observing and modeling capacity into the system in partnership with IOOS regions. Ops serves as the system architect for data processing, management and communications, in accordance with standards and protocols established by the National Ocean Council, and leads nationwide program integration for modeling development, undersea glider operations, high frequency radar, and animal telemetry. RB&P oversees functions such as management, budgeting, execution, policy, and regional and external affairs. Additionally, RB&P initiates and maintains relationships to encourage participation in U.S. IOOS by federal agencies, non-federal groups and industries.

Technologies deployed and observational activities under the IOOS Program can be categorized into the following groups: 1) passive sensors and instrumentation; 2) vessels and sampling; 3) autonomous underwater vehicles (AUVs), gliders, and drifters; 4) moorings, marine stations, buoys, and fixed arrays; 5) high frequency radar; 6) sonar; and 7) lidar.

Marine vessels, including personal watercraft, may be used to implement, operate, and maintain aspects of the IOOS Program. Activities may range in size and involve small vessels to larger research vessels. Sampling may be performed from aboard a vessel or on-land along shorelines and can include activities such as conductivity, temperature, and depth surveys; beach monitoring; bathymetric surveys; monitoring of algae, zooplankton, and ocean conditions; invertebrate and fish sampling; and monitoring of fixed arrays.

APPENDIX B: NOTICE OF INTENT TO PREPARE A PROGRAMMATIC ENVIIRONMENTAL ASSESSMENT (PEA)

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taking, importing, and exporting of endangered and threatened species (50 CFR parts 222–226), as applicable.

Permit No. 19225: The requested permit (81 FR 5990, November 1, 2016) authorizes Dr. Darling to use passive acoustic monitoring, active playbacks, suction cup and dart tagging, biopsy sampling, underwater photography/videography, photo ID and photogrammetry during aerial and vessel surveys to address a variety of questions regarding social organization, behavior, and communication of humpback whales (*Megaptera novaeangliae*). Research may occur off Hawaii (primarily off west Maui), and Alaska. Incidental harassment is authorized for the following non-target species: North Pacific right whales (*Eubalaena japonica*); false killer whales (*Pseudorca crassidens*); Dall's porpoises (*Phocoenoides dalli*); spinner (*Stenella longirostris*), pantropical spotted (*S. attenuata*), and bottlenose dolphins (*Turisiops truncatus*); killer whales (*Orcinus orca*); Hawaiian monk seals (*Neomonachus schauinslandi*); harbor seals (*Phoca vitulina*); and Steller sea lions (*Eumetopias jubatus*). The permit is valid until October 31, 2021.

Permit No. 19257: The requested permit (80 FR 59736, November 1, 2016) authorizes Ms. Zoidis to use passive acoustic monitoring, suction cup tagging, biopsy sampling, underwater photography/videography, and photo ID during vessel surveys in Hawaii and the Mariana Islands (Guam and the Commonwealth of the Northern Mariana Islands) to address a variety of questions regarding population size, habitat use, and behavior of baleen and odontocete species. The research would target humpback whales and 25 other species of whales and dolphins. Species may undergo all methodologies (except right whales, which will not be tagged). Incidental harassment for all species is also authorized. Research would take place throughout the year. The permit is valid until October 31, 2021.

Permit No. 19315: The requested permit (81 FR 59192, August 29, 2016) authorizes researchers to conduct vessel and aerial surveys of North Atlantic right whales (*Eubalaena glacialis*) and bowhead whales (*Balaena mysticetus*) opportunistically in Atlantic waters from Maine to New Jersey to gain a better understanding of right whale population status, relationship to habitat conditions, distribution and abundance, movement patterns, and interactions with human activities. Surveys may involve approach for observation, photo-identification, and prey mapping. Up to 16 other species of cetaceans and four species of pinnipeds may be incidentally harassed during surveys. The request to suction cup tag a subset of right whales was denied. The permit is valid for five years from the date of issuance.

Permit No. 19674: The requested permit (81 FR 59192, August 29, 2016) authorizes Dr. Kraus to conduct vessel and aerial surveys of North Atlantic right whales in U.S. and international waters of the North Atlantic from Florida to Iceland to assess, quantify, and track trends in the demographic characteristics of right whales; and to identify, quantify and monitor the long term trends in anthropogenic impacts on the species. Surveys may involve approach for observation, photo-identification, and biopsy and blow sampling, thermal imaging, passive acoustic recording, collection of sloughed skin and feces, photogrammetry, and/or incidental harassment of right whales. Right whale parts may be received, imported or exported. Humpback whales, harbor porpoises (*Phocoena phocoena*), and Atlantic white-sided dolphins (*Lagenorhynchus acutus*) may be incidentally harassed during vessel surveys. The permit is valid for five years from the date of issuance.

Permit No. 20599: The requested permit (81 FR 66928, September 29, 2016) authorizes researchers to take Antarctic fur seals (*Arctocephalus gazella*), southern elephant seals (*Mirounga leonina*), crabeater seals (*Lobodon carcinophagus*), leopard seals (*Hydrurga leptonyx*), Ross seals (*Ommatophoca rossii*), and Weddell seals (*Leptonychotes weddellii*) for life history studies and census surveys for abundance and distribution of pinnipeds in the South Shetland Islands, Antarctica, as part of a long-term ecosystem monitoring program established in 1986. The applicant also requests permission to import tissue samples collected from any animals captured and from salvaged carcasses of any species of pinniped or cetacean found in the study area. The permit is valid for five years from the date of issuance.

In compliance with the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*), a final determination has been made that the activities proposed are categorically excluded from the requirement to prepare an environmental assessment or environmental impact statement.

As required by the ESA, as applicable, issuance of these permit was based on a finding that such permits: (1) Were applied for in good faith; (2) will not operate to the disadvantage of such endangered species; and (3) are consistent with the purposes and policies set forth in section 2 of the ESA.

Dated: December 13, 2016.

Julia Harrison,

Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service.

[FR Doc. 2016–30414 Filed 12–16–16; 8:45 am]

BILLING CODE 3510–22–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

Programmatic Environmental Assessment

AGENCY: National Ocean Service (NOS), NOAA, Department of Commerce.

ACTION: Notice of intent to prepare a programmatic environmental assessment; request for Comments.

SUMMARY: NOAA is issuing this notice to advise the public that NOS is preparing a programmatic environmental assessment (PEA) in accordance with the National Environmental Policy Act (NEPA) to evaluate the environmental impacts of NOS hydroacoustic surveys, mapping, and other related data gathering activities. NOS offices that conduct hydroacoustic surveys, mapping, and other related data-gathering activities which may be covered under this PEA include: Center for Operational Oceanographic Products and Services, National Centers for Coastal Ocean Science, Office of Coast Survey, Office for Coastal Management, Office of National Marine Sanctuaries, Office of Response and Restoration, Office of National Geodetic Survey, and the U.S. Integrated Ocean Observing System Program Office. The PEA will encompass the environment of all geographic areas where NOS conducts these activities, to include terrestrial areas, but primarily focusing on U.S. waters from the coastline to the limits of the U.S. Exclusive Economic Zone, which extends no more than 200 nautical miles from the territorial sea baseline.

NOAA provides this notice to advise other Federal and State agencies, Territories, Tribal Governments, local governments, private parties, and the public of our intent to prepare a PEA, to provide information on the nature of the analysis, and to invite input.

DATES: Comments must be received by January 18, 2017.

ADDRESSES: Comments may be submitted by mail, email, or FAX. Mail:

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DOC/NOAA/NOS, Environmental Compliance Coordinator, SSMC4-Station 13612, 1305 East West Highway, Silver Spring, MD 20910. Email: *nosaa.ec@noaa.gov*. FAX: 301–713–4269. Comments may also be submitted through the NOS Environmental Compliance Web site: *http://oceanservice.noaa.gov/about/environmental-compliance.html*.

FOR FURTHER INFORMATION CONTACT: Giannina DiMaio, Environmental Compliance Coordinator for NOS, at *nosaa.ec@noaa.gov* or 240–533–0918.

SUPPLEMENTARY INFORMATION: NEPA requires that NOAA consider all reasonably foreseeable environmental effects of our proposed actions, and to involve and inform the public in our decision making process. The main goal of this scoping process is to help NOS focus the analysis of the PEA on the relevant environmental and socioeconomic issues.

NOS uses hydroacoustic surveys to map the ocean floor to provide reliable nautical charts, benthic habitat condition and distribution maps, fishery distribution maps, current and tide charts, and other products necessary for safe navigation, economic security, environmental sustainability, and sound marine resource decision-making in U.S. ocean and coastal waters. These charts and maps are needed to provide reliable navigation, ecosystem distribution and condition information to the public, private users, and decision makers. Up-to-date navigation charts are used to ensure safety, efficiency of transit, and economic well-being.

NOS will take other environmental compliance steps concurrently with the preparation of this PEA to include: application for a 5-year Letter of Authorization pursuant to Section 101 of the Marine Mammal Protection Act; completion of a section 7 consultation under the Endangered Species Act; consultation on the Essential Fish Habitat provisions of the Magnuson-Stevens Fishery Conservation and Management Act; consultations in compliance with Section 106 of the National Historic Preservation Act; and completion of federal consistency determinations for compliance with the Coastal Zone Management Act. Analysis conducted in support of consultations, including quantitative analysis for estimating acoustic impacts on marine species, will be included in the PEA as appropriate.

NOS has not yet identified action alternatives to be analyzed in the PEA. NOS recommends that programmatic NEPA documents examine at least three alternatives, including the no-action alternative.

NOS will use input provided by Federal and State agencies, Territories, Tribal Governments, local governments, private parties, and the public during this scoping process in the preparation of the PEA. Publication of this notice initiates the public scoping process to solicit public and agency comment regarding the full spectrum of environmental issues and concerns relating to the scope and content of the PEA including:

- Analyses of the human and marine resources that could be affected;
- the nature and extent of the potential impacts on those resources;
- a reasonable range of alternatives to the proposed action; and
- mitigation and monitoring measures.

Comments and questions concerning this PEA should be directed to the NOS contact at the address provided above.

Authority: 42 U.S.C. 4321–4347; 40 CFR 1500 *et seq.;* NOAA Administrative Order 216–6A.

Dated: December 9, 2016.

W. Russell Callender,

Assistant Administrator for Ocean Services and Coastal Management.

[FR Doc. 2016–30439 Filed 12–16–16; 8:45 am]

BILLING CODE 3510–JE–P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

RIN 0649–XF088

Gulf of Mexico Fishery Management Council; Public Meeting

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

ACTION: Notice of a public meeting.

SUMMARY: The Gulf of Mexico Fishery Management Council will hold a one and a half day meeting of its Standing, Reef Fish, Coastal Migratory Pelagics (CMP) and Socioeconomics Scientific and Statistical Committees (SSC).

DATES: The meeting will convene on Tuesday, January 10, 2017, from 1 p.m. to 5 p.m. and Wednesday, January 11, 2017, from 8:30 a.m. to 5 p.m., EDT.

ADDRESSES: The meeting will be held at the Mayfair Hotel, located at 3000 Florida Avenue, Coconut Grove, Miami, FL 33133; telephone: (305) 441–0000.

Council address: Gulf of Mexico Fishery Management Council, 2203 N. Lois Avenue, Suite 1100, Tampa, FL 33607; telephone: (813) 348–1630.

FOR FURTHER INFORMATION CONTACT: Steven Atran, Senior Fishery Biologist, Gulf of Mexico Fishery Management Council; *steven.atran@gulfcouncil.org*, telephone: (813) 348–1630.

SUPPLEMENTARY INFORMATION:

Tuesday, January 10, 2017; 1 p.m. to 5 p.m. and Wednesday, January 11, 2017; 8:30 a.m. to 5 p.m.

I. Introductions and Adoption of Agenda

II. Approval Minutes
  a. Sept. 20–21, 2016 Standing, Reef Fish, Mackerel and Shrimp meeting summary
  b. Sept. 20–21, 2016 Standing, Reef Fish, Mackerel and Shrimp verbatim minutes
  c. Nov. 22, 2016 Standing and Reef Fish webinar summary

III. Selection of SSC representative at January 30-February 2 Council meeting

IV. Review of Updated National Standard Guidelines (webinar)

Mackerel SSC Session

V. Gulf migratory group king mackerel updated OFL and ABC yield streams for 2017/18 to 2019/20

Reef Fish SSC Session

VI. SEDAR 49 Data-limited Species Assessment, Part 1
  a. Introduction and discussion of management framework (no final results until March)

VII. Gag Update Assessment

VIII. Mechanism for Allowing Carryover of Quota Underharvest
  a. SEFSC analysis of carryover levels

IX. Analysis of time for stocks to recover from MSST under different life history characteristics

Socioeconomic SSC Session

X. Discussion on economic and social implications of catch limits
  a. Discussion of catch limits with respect to National Standard 5
  b. Discussion of catch limits with respect to National Standard 8

Other Items

XI. Dates for future SSC meetings

— Meeting Adjourns —

The meeting will be broadcast via webinar. You may register for SSC Meeting: Standing, Reef Fish, Mackerel and Socioeconomic on January 10–11, 2017 at: *https://attendee.gotowebinar.com/register/3383291116212545537*

The Agenda is subject to change, and the latest version along with other meeting materials will be posted on the Council's file server. To access the file server, the URL is *https://public.gulfcouncil.org:5001/webman/index.cgi*, or go to the Council's Web

APPENDIX C: TECHNICAL ACOUSTIC ANALYSIS OF OCEANOGRAPHIC SURVEYS

Technical Acoustic Analysis of Oceanographic Surveys for the National Ocean Service

Underwater Acoustic Modeling Oceanographic Survey Sounds and Animal Exposure Modeling

Submitted to:

Solv, LLC

Authors:
Samuel Denes
David Zeddies
Katy Limpert
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7 April 2021

P001444-001
Document 002082

Version 1.0

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Denes, S., Zeddies, D., Limpert, K., and K. Lucke 2021. Technical Acoustic Analysis of Oceanographic Surveys for the National Ocean Service: Underwater Acoustic Modeling Oceanographic Survey Sounds and Animal Exposure Modeling, Document 02082, Version 1.0. Technical Report by JASCO Applied Sciences for Solv, LLC

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APPENDIX TABLES

Introduction

The National Ocean Service (NOS) uses many different sound-producing sources when conducting oceanographic surveys. As a practical approach in evaluating the potential impacts of the sounds on marine species near the survey, a series of acoustic modeling steps ranging from simple to sophisticated were performed to support the NOS Programmatic Environment Impact Statement (PEIS) for Surveying and Mapping Projects in U.S. Waters for Coastal and Marine Data Acquisition. An escalating approach was taken because the potential impacts from many of the sources were expected to be negligible, which could be shown using simple models. After evaluating all the sources using the simple modeling approach, sources with the potential for greater impacts were then evaluated with a more sophisticated acoustic model and by considering the behavior of the marine species.

Criteria must be established to gauge the potential for sound to affect marine species. The National Oceanic and Atmospheric Administration (NOAA) has published technical guidance for received sound levels that may result in injury (Level A, NMFS 2018) and received levels that may results in behavioral disruption (Level B, NOAA 2019) (see Appendix B). Based on the acoustic frequency of the signal, each source was categorized as belonging to one of four frequency categories: 1) less than 30 kHz, 2) between 30 and 70 kHz, 3) between 70 and 200 kHz, and 4) above 200 kHz. Sources operating above 200 kHz were not analyzed in this work as they are unlikely to cause behavioral or physiological impacts if animals are unlikely to perceive them. For each source, the distance at which injury could occur was first estimated using the far-field source level and a simple geometric spreading model. If the distance for potential injury was <10 m, then the source was categorized as having a low (negligible) potential for impact and was not considered in additional modeling. The 10 m criteria, roughly approximated from the survey platform vessel sizes, was chosen as encounters at shorter ranges are precluded by the physical presence of the vessel hull. Furthermore, the source level calculated from far-field measurements over estimates the received levels at short ranges (in the near field) before beams from the array have fully formed. If the predicted range to injury was >10 m, then a more accurate propagation model was used to refine the injury range estimate (3D Cumulative Acoustic Modeling). If the refined range was <10 m then the source was again categorized as low impact and not considered in additional modeling. If the refined range was still >10 m, then the sound field of a conservatively-chosen representative sound source in each frequency band (<30 kHz, 30-70 kHz, and 70-200 kHz) was used in simulations that considered species-specific behaviors controlling the movement of simulated animals (Animal Movement Modelling). These simulations estimated the number of animals that could exceed injury threshold during the representative surveys. Annual injury and behavioral disruption estimates for species were then calculated using the survey level of effort in each region (Annual Exposure Estimates).

Methods

Source Characteristics

The sound a source produces is characterized in time, spectral content, and space. As sound travels away from a source, it is shaped by interactions with the environment in which it propagates. For this reason, the sound field produced by a source is specific to the source and the location. Understanding the potential for sound exposure to impact animals requires an understanding of the sound field to which they could be exposed.

The sound sources of potential concern during active acoustic surveys are the moving Sound Navigation and Ranging (SONAR) sources. The equipment used during any individual survey depends on the final survey design, vessel availability, site conditions, and data needs. A selection of equipment was used in this assessment to estimate potential horizontal impact distances to regulatory defined injury and behavioral harassment thresholds (described in Appendix B):

- For equipment not measured in Crocker and Fratantonio (2016) manufacturer specifications, personal communications with manufacturers were used. Manufacturer specifications typically represent the maximum output of a source and do not always represent the most likely operational settings. Use of the manufacture’s specifications generally overestimates the potential impact for that equipment and is therefore conservative.
- For equipment that was not measured in Crocker and Fratantonio (2016) and where manufacturer specifications were not available or did not contain the required information, a similar source measured in Crocker and Fratantonio (2016) was used as a proxy.

Table 1 identifies the proposed survey equipment expected to operate at, or below, 200 kHz, and lists the relevant acoustic parameters of each of these sources. Equipment that will be operated at frequencies higher than 200 kHz (e.g., some multibeam echosounders and side scan sonars) are not included in this analysis as they operate at frequencies above the hearing range of marine mammals. A full list of the active acoustic equipment that NOS expects to utilize can be found in Appendix D.

Table 1. Active acoustic equipment source and operational parameters as provided by NOS supplemented with manufacturer data and field measurements (Crocker and Fratantonio 2016), when necessary.

Type*	Manufacturer	Model	Source Level (SPLrms, dB re 1 µPa m)	Pulse length (ms)	Minimum frequency (kHz)	Maximum frequency (kHz)	Predominant beam width (deg)	Repitition rate (Hz)
ADCP	Teledyne	RDI Ocean Surveyor	213	22	75	75	180	0.75
ADCP	TRDI	Workhorse/Sentinel	213	22	75	75	20	0.75
ADCP	Teledyne	Ocean Surveyor	220	22	150	150	180	1.5
ADCP	TRDI	Workhorse/Sentinel	233	11.5	150	150	20	0.75
ALT		1007- 200 m altimeter	204	0.45	120	120	180	20
Comm	Nortek	AWAC	184	1	26	26	180	0.5
Comm	Nortek	AWAC	180	1.8	25	25	180	1
Comm	Edgetech	Offshore 4410C Trackpoint II	193	15	4.5	4.5	180	1
Comm	LinkQuest	TN1505b transponder	185	15	31	31	180	1
Comm	Teledyne	ORE Trackpoint III	190	15	8	8	180	0.5
Comm	Tracklink	5000 USBL	190	0.1	14.2	14.2	120	0.5
Comm	Tracklink	1500 HA System	190	15	31	31	180	1
Comm	Tracklink	5000 MA	190	0.1	14.2	14.2	180	1

Type*	Manufacturer	Model	Source Level (SPLrms, dB re 1 µPa m)	Pulse length (ms)	Minimum frequency (kHz)	Maximum frequency (kHz)	Predominant beam width (deg)	Repitition rate (Hz)
Comm	ORE	Offshore 4377A transponder with depth telemetry	197	1.3	23	23	180	0.01
Comm	Benthos	UAT-376 transponders	180	5	25	25	180	4
MBES	Kongsberg	EM710 Mk1 0.5x1	229	2	70	70	140	20
MBES	Kongsberg	EM710 Mk2 0.5x1	231	2	40	40	140	20
MBES	Kongsberg	EM710	231	2	70	70	140	20
MBES	Seabeam	3012 Phase 1 hybrid 12 kHz multibeam sonar bathymetric mapping system	247	20	12	12	180	4
MBES	Simrad	EM302	214	5	30	30	180	10
MBES	Reson	7125	220	0.3	40	40	180	50
MBES	Simrad	ME70	225	5	70	70	180	10
MBES	Simrad	EM710	231	2	100	100	180	20
MBES	Teledyne Odom	MB1	234	0.01	170	170	120	60
MBES	Kongsberg	EM124	242	0.015	12.5	12.5	150	0.17
SAS	Kongsberg	HISAS 1032	234	0.01	60	60	180	20

Type*	Manufacturer	Model	Source Level (SPLrms, dB re 1 µPa m)	Pulse length (ms)	Minimum frequency (kHz)	Maximum frequency (kHz)	Predominant beam width (deg)	Repitition rate (Hz)
SBES	Teledyne Odom	CV100	229	0.04	100	100	20	20
SBES	Teledyne Odom	CV200	229	2	24	24	20	20
SBES	Teledyne Odom	CV200	229	2	50	50	20	20
SBES	Kongsberg	EA 60	234	1	12	12	16	20
SBES	Simrad	ES60	234	1	12	12	180	20
SBES	Kongsberg	EA 60	234	1	38	38	7	20
SBP	EdgeTech	3200-XS w/ SB-0512i	212	5	0.5	0.5	41	10
SBP	Knudsen	320 B/R	222	0.01	3.5	3.5	28	5
SBP	Edgetech	CHIRP	234	1	4	4	180	5
SES	Simrad	EK60	234	2	38	38	180	20
Source	Teledyne	Benthos	177	4	25	25	180	2
Source	Datasonics	DPL-275	180	5	25	25	180	50
Source	Applied Acoustics Engineering	1300A Series Micro Beacon	183	15	21.5	21.5	180	0.5
SSS	Klein	3000	234	0.4	120	120	180	10

*ADCP = Acoustic Doppler Current Profiler; ALT = Altimeter; Comm = Acoustic Communication System; MBES = Multibeam Echosounder; SAS = Synthetic Aperture Sonar; SBES = Single Beam Echosounder; SBP = Sub Bottom Profiler; SES = Scientific Echosounder; Source = Beacon/pinger; SSS = Side Scan Sonar

Propagation

Geometric Spreading Model

A geometric spreading loss model based on guidance from National Marine Fisheries Service (NMFS) was used to estimate horizontal distances to the NMFS injury criteria for each of the NOS sources and each of the marine mammal hearing groups (Appendix B). Detailed methods used to implement this simplified model are presented in Appendix C. This analysis revealed many sources which had a less than 10 m range to injury impact, making the likelihood of quantifiable exposures highly unlikely and the potential impacts negligible. NMFS provides a spreadsheet to calculate these distances, but it is not designed for high-resolution geophysical survey sources and does not consider seawater absorption or beam patterns, both of which can substantially influence received sound levels, and as such, the remaining sources (Table 3) not eliminated as negligible were carried forward for more detailed, 3D Acoustic Modelling.

3D Acoustic Modelling with Fixed Source/Receiver Accumulation

Using JASCO's Marine Operations Noise Model (MONM, described in Appendix C), sound fields were predicted by combining models of main- and side-lobe fields. Sources were modeled according to the parameterized beam patterns in Table 1. Sources were divided into three categories based on their beam patterns: omni-directional, conical, and fan. Omnidirectional sources only have a main lobe with equal energy produced in all directions. Conical sources have azimuthally symmetric main lobes, generally pointing downwards from platforms, and lower energy at elevation angles outside of the main cone. Fan-type sources are defined by a large difference between along- and across-track beampatterns. Fan-type sources generally have an across-track beamwidth on the order of 90° and an along-track beamwidth on the order of 1° (Figure 1). Propagation loss was modeled separately for the main- and side-lobe portions of the different beam patterns. The source levels were defined independently for the main- and side-lobes, with the beamwidth correction being applied to the side lobe according to the equations provided in Appendix C.

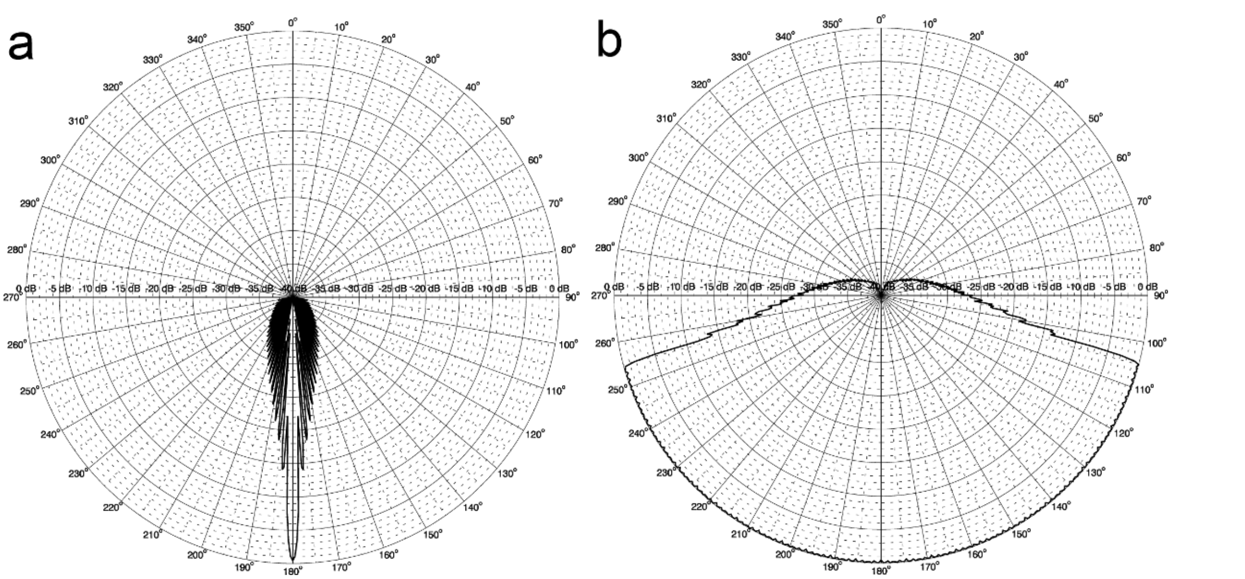

Figure 1. Vertical slice for the Modelled beam pattern for a multibeam system with 191 individual 2ºx2º beams, making a 150º swath perpendicular to the vessel track; (a) along- and (b) across-track direction.

Acoustic propagation was modeled for these sources at 57 locations throughout United States (U.S.) waters (Figure 2). Locations were selected within the operational regions to represent different depth regimes defined in Table 2. For regions where manatees are present, a limit of 10 m was set for the limit between shallow and mid-depth regimes. As manatees are more likely to remain exclusively in very shallow waters, where ranges to impact are short relative to deeper water, assessing impacts only at these depths was necessary for this species, while the impacts for other coastal species could be assessed in the mid-depth regime as well.

As indicated above, a subset of the operational sources within the NOS fleet was modeled (Table 3). These sources were selected as those with the largest ranges to injurious exposures of similar source types (beam pattern, frequency, type). Table 3 describes most acoustic characteristics of the sources used in 3D models.

Table 2. Depth ranges for numerical acoustic propagation models.

Depth Class	Depth Range (m)
Shallow	< 40 < 10*
Mid-depth	40 – 200 10 – 200*
Deep	200 – 1000
Very deep	> 1000

* A 10 m limit for the shallow and mid-depth classes was used in regions where manatees are present.

Table 3. Acoustic parameters for detailed range dependent, 3D propagation modeling.

Manufacturer	Model	SL (dB re 1 µPa)	Frequency (kHz)	Signal duration (ms)	Ping rate (Hz)
Knudsen	320 B/R	222	3.5	10	5
Simrad	ES60	225	12	1	20
Kongsberg	EM124	242	12.5	15	0.17
Teledyne Odom	CV200	229	24	2	20
Simrad	EM302	214	30	5	10
Kongsberg	EM710	231	40	2	20
Teledyne Odom	CV200	229	50	2	20
Kongsberg	EM710	231	70	2	20
Klein	3000	234	100	0.4	10

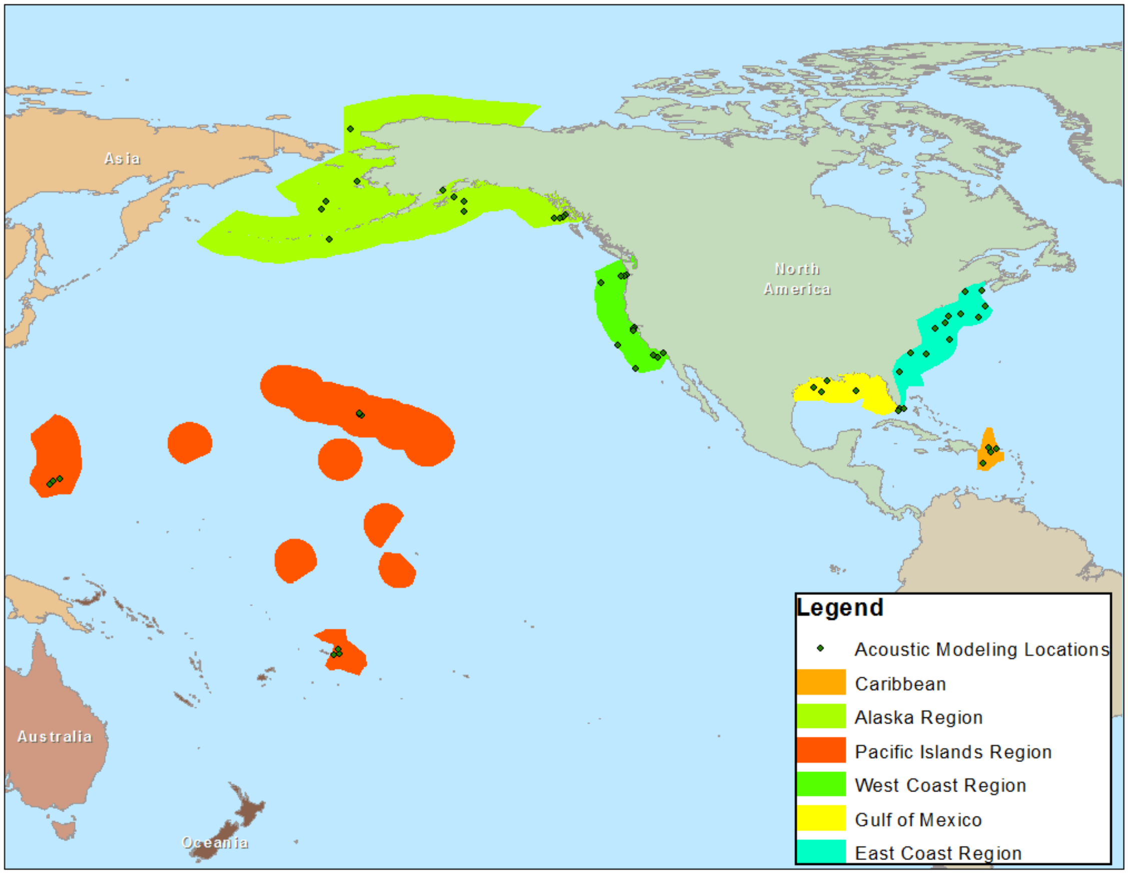

Figure 2. Overview of acoustic modeling locations throughout U.S. waters.

Cumulative Grid

The 3D sound fields generated using MONM with beampatterns represent point-in-time sound fields. The sound sources are most often moving. However, to represent the sound field over the course of a 24-hour period of surveying, a cumulative sound field was calculated by adding the sound field to itself, with an offset of the source position determined by general vessel speeds as provided by operators in Appendix D. These sound fields represent the exposure estimates from a survey assuming that a receiver (e.g., marine mammal) is fixed in place for the duration of the survey and located at the depth with greatest acoustic energy. (The movement and distribution of animal receivers is addressed in the next step in the exposure modelling process, described in the next section). Most of the biotic receivers with which we are concerned will not be in the same location for a 24-hour period, nor would it be at the same – loudest – depth for that duration. Ranges to cumulative threshold criteria isopleths – regions within which a metric is above threshold - were calculated as the normal distance (right angle) from the track.

Animal Movement Modelling

Simulations of active acoustic survey activities and animal movement modeling were run within five different regions (Figure 2). Regions were selected to represent larger geographic areas for proposed activity and provide realistic bathymetric approximations and presence of species groups. Conservative representatives of active acoustic sources in different frequency bands were used as proxy sources for all active acoustic sources within the frequency bands (<30 kHz, 30-70 kHz, 70-200 kHz). Simulations duration was four days, with three days of active acoustic surveys within the simulation.

Simulation results were analyzed for both injury and behavioral exposures (Appendix B) and average exposures per 24 hours of survey activity for each simulation. Results were then scaled by the expected linear nautical miles in each region, depth regime, and frequency band for each of the alternatives and species modeled. A detailed description of the modeling can be found in Appendix C.

Exposure Range Estimation

Animal movement and exposure modeling can be used to estimate radial distances to cumulative sound exposure level (SEL) impact thresholds as an alternative to single pulse acoustic propagation ranges. The range to the closest point of approach (CPA) for each of the species-specific animats (simulated animals) is recorded. The $ER_{95\%}$ (95% Exposure Range) is the horizontal range that includes 95% of animat CPAs that exceed a given impact threshold (Figure 3). $ER_{95\%}$ is reported for marine mammals for SEL injury threshold.

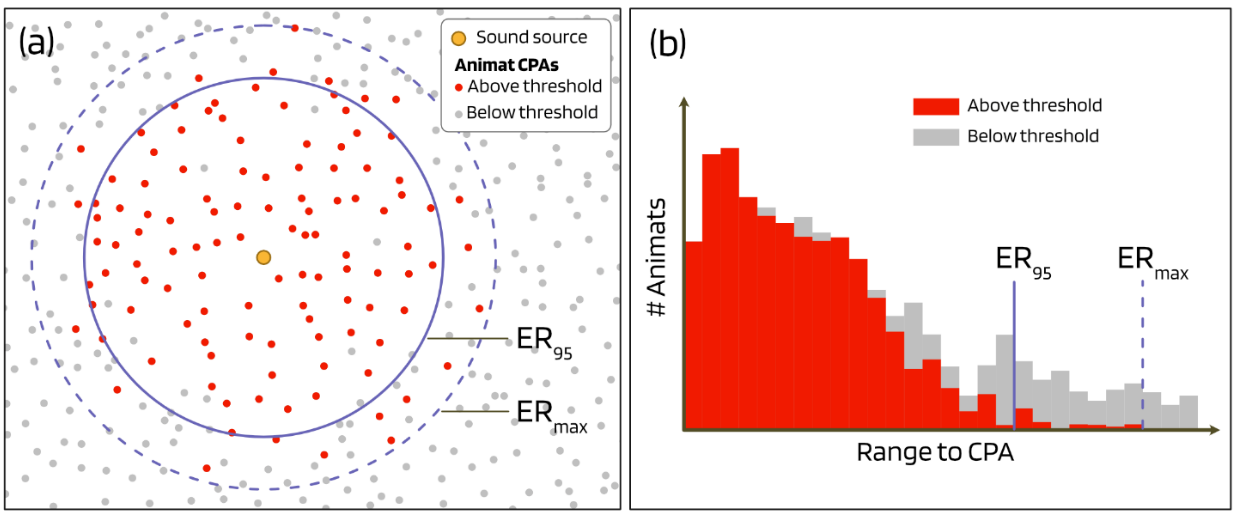

Figure 3. Example distribution of animat closest points of approach (CPAs). Panel (a) shows the horizontal distribution of animats near a sound source. Panel (b) shows the distribution of ranges to animat CPAs. The 95% and maximum Exposure Ranges ($ER_{95\%}$ and ER_{max}) are indicated in both panels.

Density Estimation

Species abundance and distribution were obtained from NOAA and USFWS Stock Assessment Reports (SAR) (USFWS 2014f, 2014a, 2014b, 2014c, 2014d, 2014e, 2017, 2018, NOAA 2019) (Table 4). Species densities within the NOS operational areas were estimated by distributing their abundance over the operational area that fell within the species' habitat preference and associated depth category. If a species occupies an area larger than the action area (e.g., pelagic species outside the Exclusive Economic Zone [EEZ]) the conservative assumption was made that the abundance of the species occurred wholly within the operational areas under assessment. Densities derived from SAR were compared with habitat based models when available (e.g., Roberts et al. 2018). Densities calculated as part of this work were neither consistently higher nor lower than those from habitat based models. Habitat based model species densities were not available for the entire EEZ for all species evaluated. Therefore, for consistency within this analysis, the densities were calculated from the SAR abundance estimates and depth ranges within operational regions.

Table 4. Estimated density of marine mammal species populations grouped by NOS operational region.

Species	Regions	Density (animals/km^2)
Atlantic spotted dolphin	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.0543
	Gulf of Mexico	0.0533
	Southeast Continental Shelf, Southeast OCS	1.274E-05
Atlantic white-sided dolphin	Gulf of Maine, Georges Bank, New England	0.2625
Baird's beaked whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0131
Bearded seal	Bering	0.1918
Beluga whale	Beaufort	0.3312
	Chukchi	0.0852
	Bering	0.0113
	Gulf of Alaska (Cooke inlet)	0.0041
Blainville beaked whale	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.0211
	Hawaiian Archipelago	0.0008
	Gulf of Mexico	0.0004
	Southeast Continental Shelf, Southeast OCS	3.263E-05
Blue whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0019
	Hawaiian Archipelago	4.683E-05
Bowhead whale	Bering, Chukchi, Beaufort	0.0474
Bryde's whale	Hawaiian Archipelago	0.0007
	Gulf of Mexico	4.682E-05
California sea lion	Southern California Bight	3.9014

Species	Regions	Density (animals/km^2)
Clymene's dolphin	Gulf of Mexico	0.0003
	Mid-Atlantic Bight, Southeast Continental Shelf	4.329E-06
Common bottlenose dolphin	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.3889
	Gulf of Mexico	0.0516
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0328
	Hawaiian Archipelago	0.0072
	Southeast Continental Shelf, Southeast OCS	2.225E-05
Common Minke whale	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.0098
	Gulf of Alaska, Aleutians	0.0059
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0049
	Bering	0.0026
Cuvier's beaked whale	Gulf of Maine, Georges Bank	2.0836
	New England, Northeast OCS, Mid-Atlantic Bight	0.0216
	Southeast Continental Shelf, Southeast OCS	0.0069
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0061
	Hawaiian Archipelago	0.0003
	Gulf of Mexico	0.0003
Dall's porpoise	SE Alaska, Gulf of Alaska, Aleutians, Bering	0.0216
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0042
Dwarf sperm whale	Hawaiian Archipelago	0.0073

Species	Regions	Density (animals/km^2)
	Gulf of Mexico	0.0005
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	7.717E-05
False killer whale	Hawaiian Archipelago	0.04092
	American Samoa	0.00369
	Gulf of Mexico	0.0018
	Central/Western Pacific	0.0006
	Southeast Continental Shelf	3.144E-07
Fin whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0034
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.0033
	Gulf of Alaska	0.0014
	Bering	0.0012
	Hawaiian Archipelago	6.329E-05
Fraser's dolphin	Hawaiian Archipelago	1.4112
	Gulf of Mexico	0.0074
Gervais beaked whale	Gulf of Maine, Georges Bank	0.0520
	New England, Northeast OCS, Mid-Atlantic Bight	0.0227
	Southeast Continental Shelf, Southeast OCS	3.263E-05
Gray whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf, SE Alaska, Gulf of Alaska, Aleutians, Bering, Chukchi, Beaufort	0.0035
Grey seal	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.0514

Species	Regions	Density (animals/km^2)
Guadalupe fur seal	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0104
Harbor porpoise	Gulf of Maine	0.0917
	Southwest Continental Shelf	0.0221
	Gulf of Alaska	0.0138
	Northwest Continental Shelf	0.0101
	SE Alaska	0.0028
	Aleutians, Bering	0.0015
Harbor seal	SE Alaska	0.7074
	Gulf of Alaska	0.5270
	Southern California Bight, Southwest Continental Shelf	0.2158
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.1439
	Northwest Continental Shelf	0.1420
	Aleutians	0.0249
	Bering	0.0207
Harp seal	Gulf of Maine	1.0800
Hawaiian monk seal	Hawaiian Archipelago	0.1245
Hooded seal	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	0.0002
Humpback whale	Gulf of Maine, Georges Bank	0.0048
	SE Alaska, Gulf of Alaska, Bering, Aleutians, Hawaiian Archipelago (Central North Pacific)	0.0015
	SE Alaska, Gulf of Alaska, Bering, Aleutians, American Samoa, (Western North Pacific)	0.00021

Species	Regions	Density (animals/km^2)
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf (CA/OR/WA)	0.0011
	New England, Northeast OCS, Mid-Atlantic Bight	0.0009
Long-beaked common dolphin	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.7875
Longman's (Indo-Pacific) beaked whale	Hawaiian Archipelago	0.0032
Manatee	Gulf of Mexico, Atlantic	0.0318
	Caribbean	0.0008
Melon-headed whale	Gulf of Mexico	0.0084
	Hawaiian Archipelago	0.0038
Mesoplodont beaked whales (all)	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0050
North Atlantic right whale	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf	3.432E-06
North Pacific right whale	Aleutians	0.0005
	Bering	5.075E-05
Northern elephant seal	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf, SE Alaska, Gulf of Alaska, Aleutians	0.2262
Northern fur seal	Northwest Continental Shelf, SE Alaska, Gulf of Alaska, Aleutians, Bering	1.8217
Northern fur seal	Southern California Bight, Southwest Continental Shelf	1.6530
Northern right whale dolphin	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.4532
Killer Whale, Offshore	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0005

Species	Regions	Density (animals/km^2)
Pacific white-sided dolphin	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.2084
	SE Alaska, Gulf of Alaska, Aleutians	0.1007
Pantropical spotted dolphin	Hawaiian Archipelago	1.5292
	Gulf of Mexico	0.5192
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	6.859E-05
Pilot whales, long finned	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS, Atlantic, Caribbean	3.120E-05
Pilot whales, short finned	Hawaiian Archipelago	0.0080
	Gulf of Mexico	0.0044
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0017
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS, Atlantic, Caribbean	0.0002
Polar Bear	Bering, Chukchi	0.0039
Pygmy killer whale	Hawaiian Archipelago	0.1873
	Gulf of Mexico	0.0003
Pygmy sperm whale	Hawaiian Archipelago	0.1257
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0320
	Gulf of Mexico	0.0004

Species	Regions	Density (animals/km^2)
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS, Atlantic, Caribbean	2.692E-06
Killer Whale, Resident	SE Alaska	0.0029
	Gulf of Alaska	0.0027
	Bering	0.0021
	Aleutians	0.0008
	Northwest Continental Shelf (Southern Resident)	0.0003
	Hawaiian Archipelago	6.015E-05
Ribbon seal	Gulf of Alaska, Aleutians, Bering, Chukchi, Beaufort	0.0797
Ringed seals	Bering, Chukchi	0.0852
Risso's dolphin	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.0308
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0095
	Hawaiian Archipelago	0.0048
	Gulf of Mexico	0.0035
	Southeast Continental Shelf, Southeast OCS, Atlantic	2.172E-06
Rough-toothed dolphin	Hawaiian Archipelago	1.2771
	Gulf of Mexico	0.0014
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	1.928E-07
Sea otter	Northwest Continental Shelf (WA/OR)	0.0534
	Southwest Continental Shelf (CA)	0.0877
	SE Alaska	0.0746

Species	Regions	Density (animals/km^2)
	Aleutians (SW Alaska)	0.0425
	Gulf of Alaska (SC Alaska)	0.0326
Sei whale	Gulf of Maine, Georges Bank, New England	0.0022
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0008
	Hawaiian Archipelago	0.0002
Short-beaked common dolphin	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	8.0993
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.3378
	Southeast Continental Shelf, Southeast OCS, Atlantic	1.664E-05
Sowerby's Beaked Whale	Gulf of Maine, Georges Bank	0.0520
	New England, Northeast OCS, Mid-Atlantic Bight	0.0227
	Southeast Continental Shelf, Southeast OCS	3.263E-05
Sperm whale	Central/Western Pacific	0.0444
	SE Alaska, Gulf of Alaska, Aleutians, Bering, Chukchi, Beaufort	0.0151
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.0033
	Gulf of Mexico	0.0021
	Hawaiian Archipelago	0.0019
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	4.665E-05
Spinner dolphin	American Samoa	0.1244
	Gulf of Mexico	0.1167
	Hawaiian Archipelago	0.0182

Species	Regions	Density (animals/km^2)
Spotted seal	Aleutians, Bering, Chukchi, Beaufort	1.0466
Steller sea lion	Northwest Continental Shelf, SE Alaska	0.3129
	Gulf of Alaska, Aleutians, Bering	0.0272
Striped dolphin	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	1.7813
	Hawaiian Archipelago	1.6725
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.4170
	Gulf of Mexico	0.0189
Killer Whale, Transient	Northwest Continental Shelf, SE Alaska	0.0007
	Aleutians	0.0004
	Gulf of Alaska	0.0002
	Hawaiian Archipelago	6.014E-05
	Gulf of Mexico	5.134E-05
True's Beaked Whale	Gulf of Maine, Georges Bank	0.0520
	New England, Northeast OCS, Mid-Atlantic Bight	0.0227
	Southeast Continental Shelf, Southeast OCS	3.263E-05
Walrus	Aleutians, Bering, Chukchi	0.0612
White-beaked dolphin	Gulf of Maine	0.0292

Proposed Alternative Exposure Calculations

The different levels of survey effort for the three alternatives evaluated in the PEIS (described in Sections 2.4, 2.5, and 2.6 of the PEIS) affect the numbers of estimated exposures for each alternative. While NOS did not provide region specific differences in the nautical miles that would be surveyed between the different alternatives, they did provide the total number of nautical miles surveyed under each of the alternatives for each NOS program office by region and depth. It was assumed that the change in survey effort between alternatives would be distributed uniformly across the geographic regions. Only three offices estimated that levels of effort for active acoustic equipment use would be different beteween the alternatives: Office of Coast Survey (OCS), National Centers for Coastal Ocean Science (NCCOS), and Office of Response and Restoration (ORR). ORR only uses active acoustic equipment operating at frequencies above 200 kHz, so the variation in their survey effort was not included in this analysis. The estimated nautical miles surveyed for OCS and NCCOS in each region for Alternatives B and C were scaled by the percent change in survey effort miles relative to Alternative A for each equipment type used (Table 5).

Table 5. Proposed linear nautical miles of survey effort by alternative for the NOS program offices that reported different levels of effort for active acoustic equipment use between the alternatives. Percentages of miles relative to Alternative A are provided in parentheses.

Category	Alternative A	Alternative B	Alternative C
< 30 kHz	391,623	489,462	587,300
30 – 200 kHz	734,920	885,692	1,036,464

The changes in OCS and NCCOS single beam and multibeam echosounder effort were used to scale the effects of all NOS program office hydroacoustic surveying due to their use of active acoustic sources with operational frequencies between 30 and 200 kHz. The increased nautical miles for the sub-bottom profiler effort in the different alternatives was applied to the acoustic equipment operating below 30 kHz. As can be seen in Table 5, OCS single beam and multibeam effort accounts for the greatest overall effort compared to other equipment or offices. The changes in effort between the alternatives, and therefore exposures, is most heavily influenced by the OCS single beam and multibeam estimates.

Results

Geometric Spreading Loss Model

Ranges to threshold for injurious exposure for each of the marine mammal hearing groups were calculated for each of the sources using the simplified acoustic propagation model of geometric spreading loss (described in Appendix C) (Table 6). Many of the ranges to threshold are negligible (<1 m), and it was determined that further modelling was unnecessary. Sources were considered de minimis if the largest range to impact was less than 10 m. The impact of any source with such short ranges to acoustic criteria thresholds would be related to its presence as either a stationary object or the platform from which it operates, both of which are outside the scope of this analysis. A subset of sources, with operational characteristics representing the full range of frequencies, with ranges >10 m were further analyzed using more sophisticated modeling approaches; see next sections.

Table 6. Range to NMFS 2018 technical guidance inury thresholds based on a geometric spreading loss model.

Type**	Manufacturer	Model	LFC*	MFC*	HFC*	PPW*	OPW*	SI*	de minimus Impact
ADCP	Teledyne	RDI Ocean Surveyor	<1 m	<1 m	92	<1 m	<1 m	<1 m	NO
ADCP	TRDI	Ocean Surveyor	<1 m	1	136	<1 m	<1 m	<1 m	NO
ADCP	Teledyne	Workhorse/Sentinel	<1 m	<1 m	5	<1 m	<1 m	<1 m	YES
ALT		1007- 200m altimeter	<1 m	<1 m	8	<1 m	<1 m	<1 m	YES
Comm	Nortek	AWAC	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Comm	Edgetech	Offshore 4410C Trackpoint II	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Comm	LinkQuest	TN1505b transponder	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Comm	Teledyne	Ore Trackpoint III	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Comm	Tracklink	5000 USBL	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Comm	Tracklink	TrackLink 1500 HA System	<1 m	<1 m	1	<1 m	<1 m	<1 m	YES
Comm	Tracklink	5000 MA	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Comm	ORE	ORE Offshore 4377A	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Comm	Benthos	UAT-376 transponders	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
MBES	Kongsberg	EM124	43	70	3039	45	<1 m	17	NO
MBES	Kongsberg	EM710 Mk1 0.5x1	<1 m	38	549	1	<1 m	<1 m	NO
MBES	Kongsberg	EM710 Mk2 0.5x1	4	85	1131	10	<1 m	3	NO
MBES	Kongsberg	EM710	<1 m	53	610	2	<1 m	<1 m	NO
MBES	Simrad	EM302	<1 m	3	383	<1 m	<1 m	<1 m	NO
MBES	Reson	7125	<1 m	4	341	<1 m	<1 m	<1 m	NO

Type**	Manufacturer	Model	LFC*	MFC*	HFC*	PPW*	OPW*	SI*	de minimus Impact
MBES	Simrad	ME70	<1 m	22	460	<1 m	<1 m	<1 m	NO
MBES	Simrad	EM710	<1 m	33	440	<1 m	<1 m	<1 m	NO
MBES	Teledyne Odom	MB1	<1 m	<1 m	82	<1 m	<1 m	<1 m	NO
SAS	Kongsberg	HISAS 1032	<1 m	1	141	<1 m	<1 m	<1 m	NO
SBES	Teledyne Odom	CV100	<1 m	<1 m	6	<1 m	<1 m	<1 m	NO
SBES	Teledyne Odom	CV200	<1 m	2	169	<1 m	<1 m	<1 m	NO
SBES	Kongsberg	EA 60	1	2	174	1	<1 m	<1 m	NO
SBES	Simrad	ES60	55	83	3301	57	<1 m	21	NO
SBES	Kongsberg	EA 60	<1 m	<1 m	52	<1 m	<1 m	<1 m	NO
SBP	EdgeTech	3200-XS w/ SB-0512i	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
SBP	Edgetech	Chirp	<1 m	<1 m	5	<1 m	<1 m	6	YES
SBP	Knudsen	320 B/R	<1 m	<1 m	6	<1 m	<1 m	<1 m	NO
SES	Simrad	EK60	9	143	1411	21	<1 m	7	NO
Source	Teledyne	Benthos	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
Source	Datasonics	DPL-275	<1 m	<1 m	2	<1 m	<1 m	<1 m	YES
Source	Applied Acoustics Engineering	1300A Series Micro Beacon	<1 m	<1 m	<1 m	<1 m	<1 m	<1 m	YES
SSS	Klein	3000	<1 m	9	292	<1 m	<1 m	<1 m	NO

*LFC = Low Frequency Cetaceans; MFC = Mid Frequency Cetaceans; HFC = High Frequency Cetaceans; PPW = Phocid Pinnipeds in Water; OPW = National Centers for Coastal Ocean Science Otariid Pinnipeds in Water; SI = Sirenians

**ADCP = Acoustic Doppler Current Profiler; ALT = Altimeter; Comm = Acoustic Communication System; MBES = Multibeam Echosounder; SAS = Synthetic Aperture Sonar; SBES = Single Beam Echosounder; SBP = Sub Bottom Profiler; SES = Scientific Echosounder; Source = Beacon/pinger; SSS = Side Scan Sonar

3D Cumulative Acoustic Modeling

After eliminating the de minimis sources from further evaluation, eight sources, representing the different frequency bands of the sources for which the geometric spreading loss calculations resulted in the greatest ranges under the source and operational conditions provided by NOS offices (Table 3), were modeled using JASCO's Bellhop raytracing implementation (Appendix C). These models were run at 57 locations within the geographic region NOS proposes active acoustic survey operations. In each of the regions, up to four source locations were selected representing a depth regime of shallow, mid-depth, deep, and very deep (Table 2). At each of the 57 locations, acoustic propagation models were run for the corresponding to the different source frequencies of the representative sources (Table 3). Seasonal sound velocity profiles were selected to represent a variety of conditions with one to four profiles based on variability of the sound velocity profile (Teague et al. 1990, Carnes 2009) at a location. Examples of the range dependent one-second, sound exposure levels for four sources along their major axes are provided in Figures 4 through 7 for the different hearing group weightings. The variation in the received level as a function of range and depth is represented by color. The directionality of the source, frequency content of the signal, depth of the water, and weighting function applied all play a role in the propagation loss predicted. These plots represent point in time models and do not indicate ranges to criteria thresholds. These model results were used as inputs to the animal movement modeling.

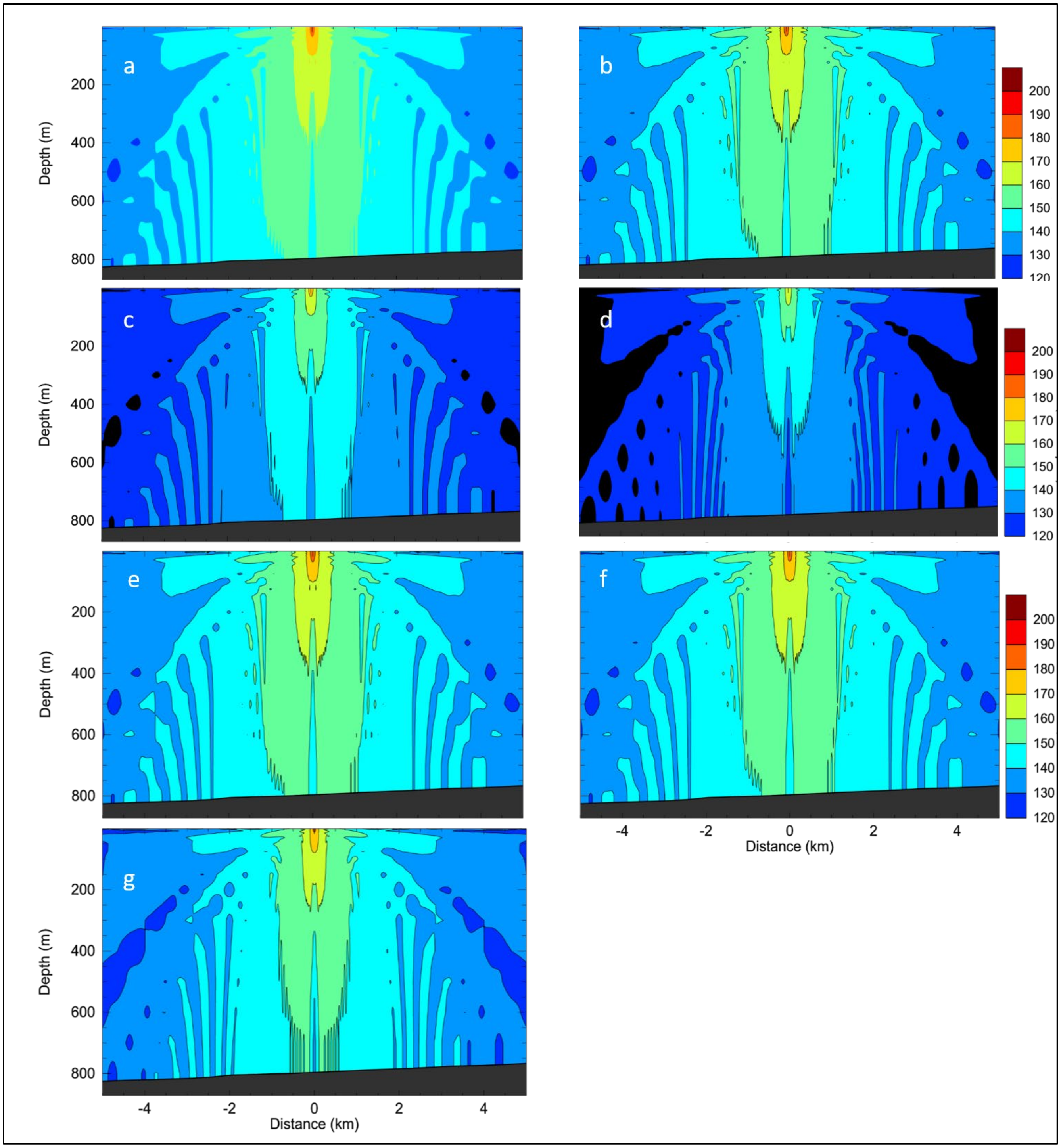

Figure 4. Knudsen 320 B/R 3.5 kHz sound exposure level at the Atlantic (24.821°N, -79.9265°E) modeling site in deep water. a) Unweighted b) LF weighted c) MF weighted d) HF weighted e) OPW weighted f) PPW weighted g) SI weighted.

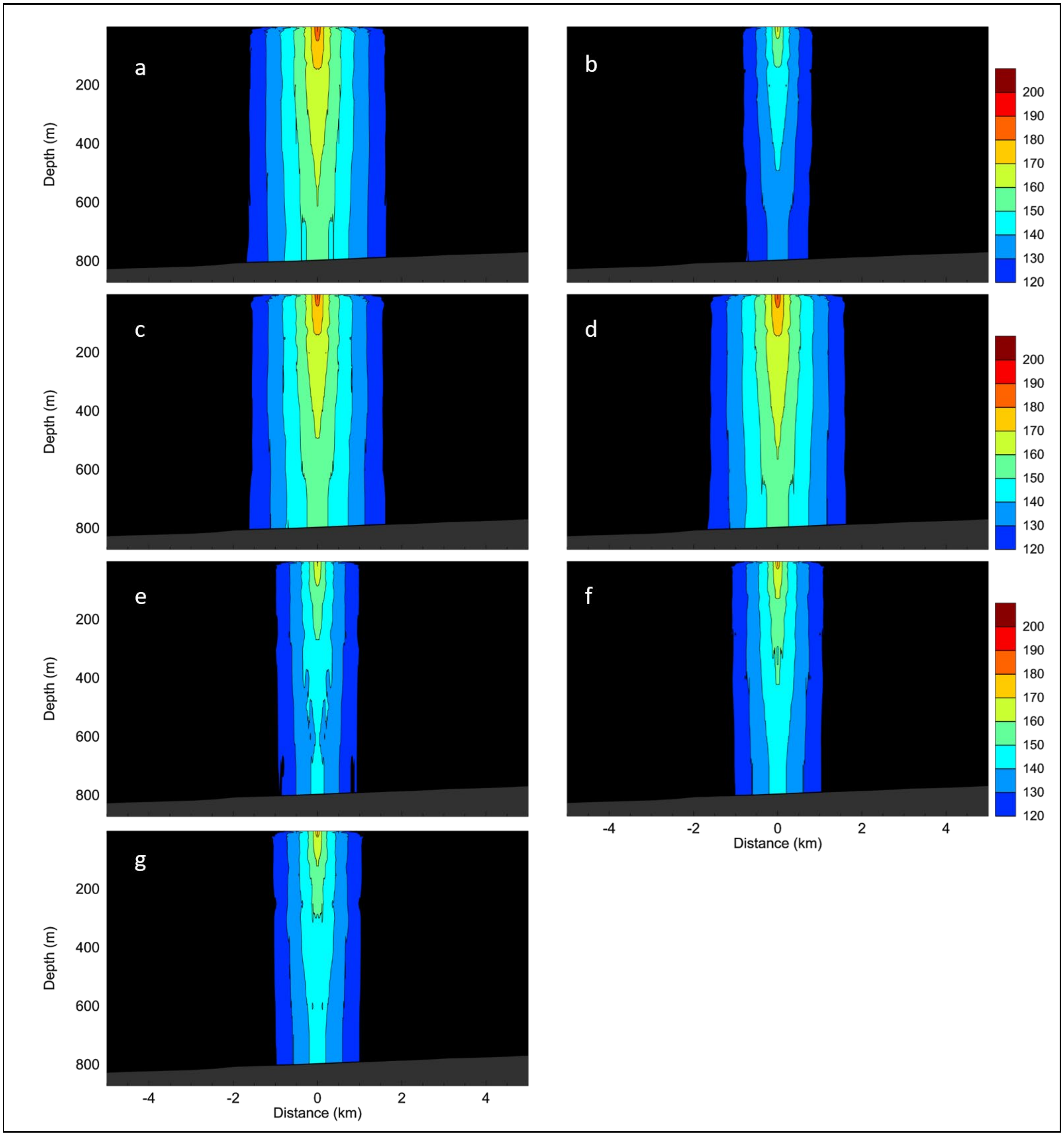

Figure 5. Kongsberg EM710 at 70 kHz sound exposure level at the Atlantic (24.821°N, -79.9265°E) modeling site in deep water. a) Unweighted b) LF weighted c) MF weighted d) HF weighted e) OPW weighted f) PPW weighted g) SI weighted.

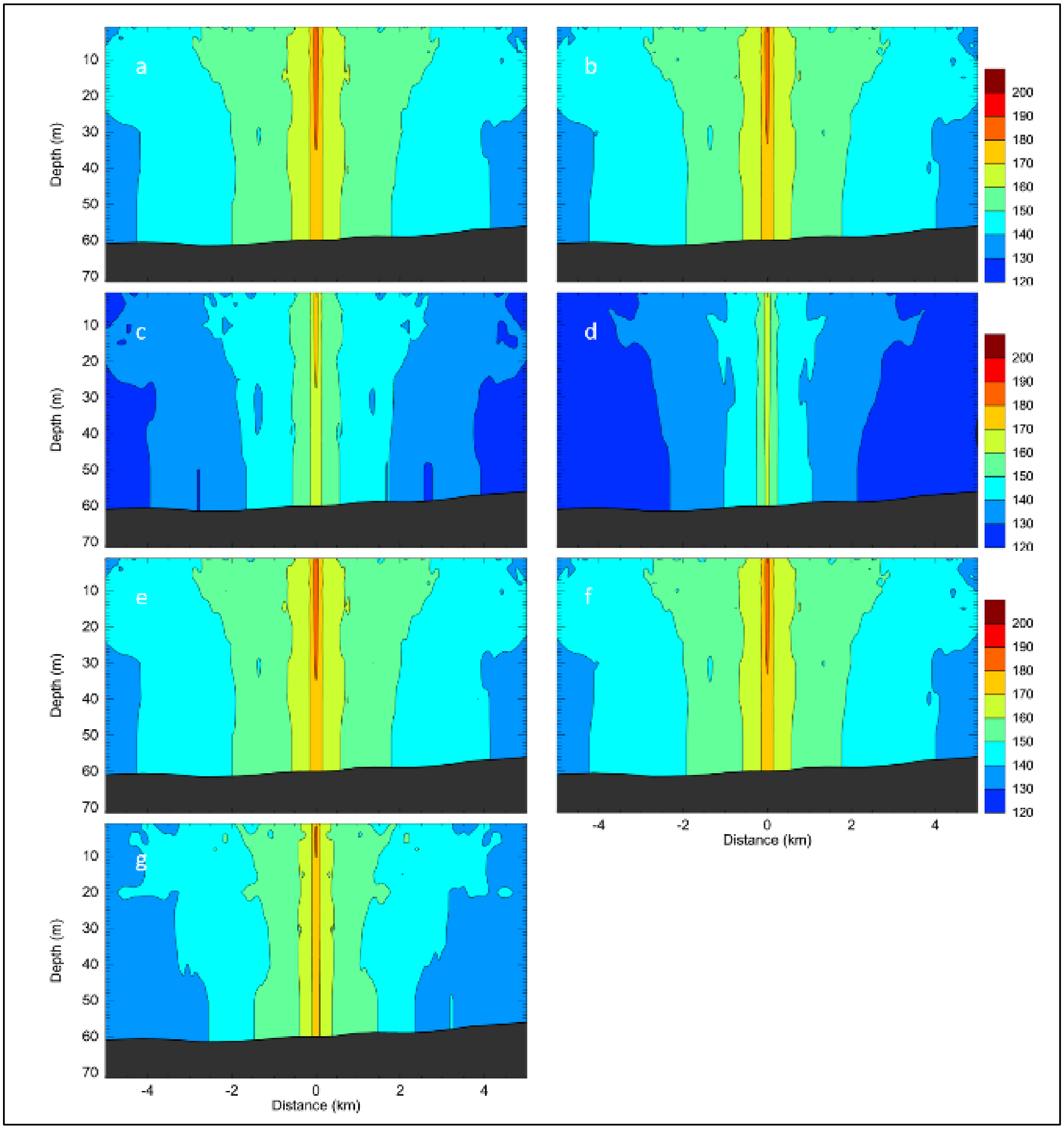

Figure 6. Knudsen 320 B/R 3.5 kHz sound exposure level at the Atlantic (24.5390°N, -80.7623°E) modeling site in mid-depth water. a) Unweighted b) LF weighted c) MF weighted d) HF weighted e) OPW weighted f) PPW weighted g) SI weighted.

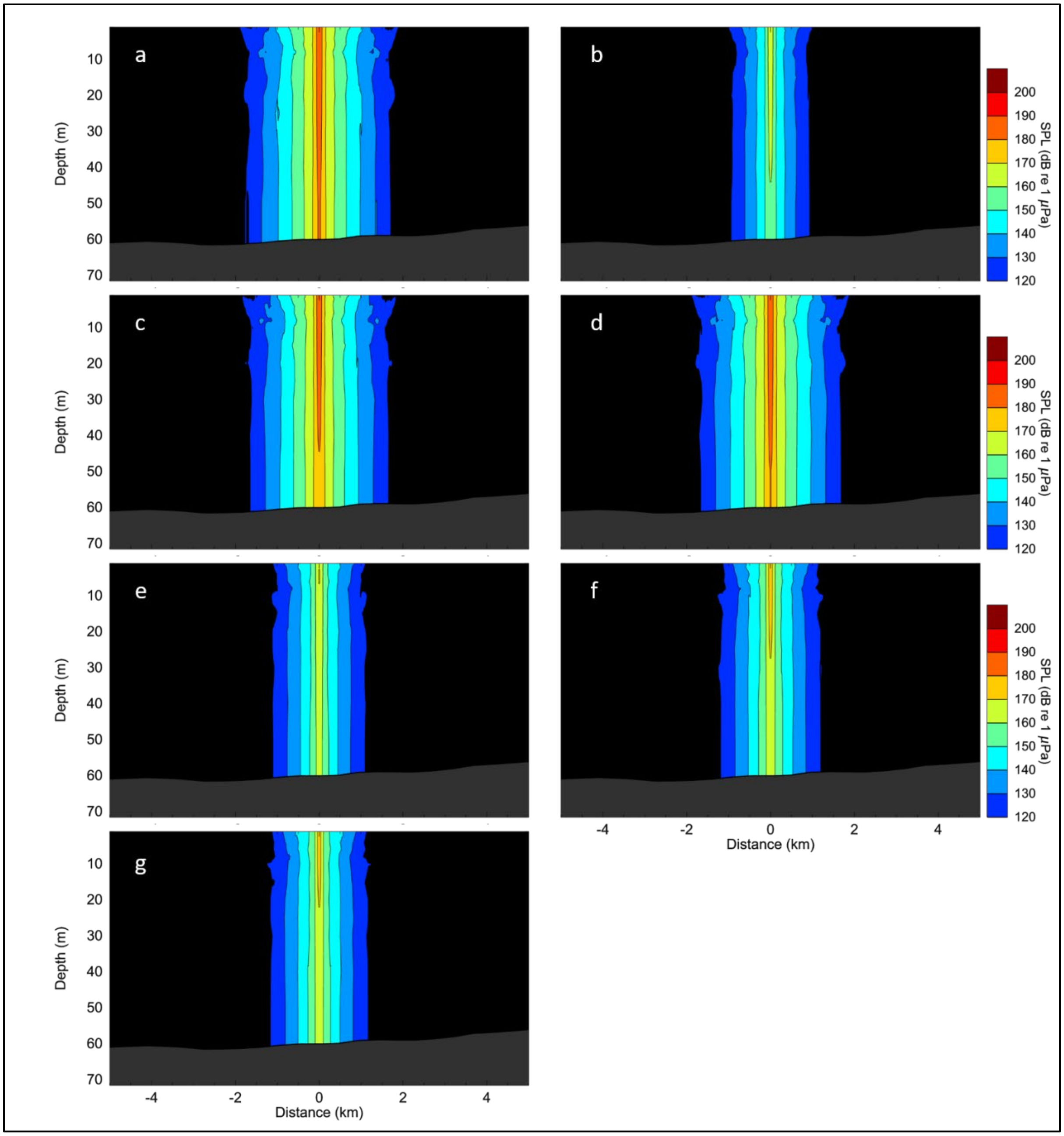

Figure 7. Kongsberg EM710 at 70 kHz sound exposure level at the Atlantic (24.5390°N, -80.7623°E) modeling site in mid-depth water. a) Unweighted b) LF weighted c) MF weighted d) HF weighted e) OPW weighted f) PPW weighted g) SI weighted.

Cumulative exposure ranges were calculated by adding the propagation results from a point source along a track. The sound fields were weighted according to the hearing group weighting functions and evaluated against non-impulsive threshold criteria (NMFS 2018). Ranges to cumulative exposure thresholds for non-impulsive criteria for low-frequency cetaceans, mid-frequency cetaceans, phocid pinnipeds, and other carnivores were less than 10 m for all sources even under the most conservative use cases.

Animal Movement Modelling

Simulations representing 72 hours of continuous NOS survey activities were conducted using sound fields generated from the 3-D acoustic propagation modeling. Simulations were conducted in five regions, Alaska, the East Coast, the Gulf of Mexico, the West Coast, and Hawaii for representative acoustic sources.

For most species, no injurious exposures were estimated at any range. In Tables 7 through 11, results for most species that can possibly be exposed above Injury criteria suggest that zero percent of the individuals within a simulation are exposed above the Injury threshold once scaled by the real world population densities. For many of the species with exposures above the Injury threshold, criteria were exceeded but only if the animats were within 12 m of the source. Of the exposures above the Injury threshold at greater ranges, all were for high-frequency cetaceans (harbor and Dalls' porpoises, and pygmy and dwarf sperm whales). The exposure ranges for these species was up to 154 m.

Exposures exceeding the behavioral disruption threshold were estimated for many more species. Ranges to these thresholds were limited to <300 m for most species. Some deep diving species, sperm whales and beaked whales, had exposure ranges up to 675 m including depth. This occurred when animats were within the main beam directly below the source but at limited horizontal range.

Table 7. Distance (Range) to Injury and Behavioral Exposure results for animal movement simulations in Alaskan waters. Percent of the simulated individuals and ranges to exposure for each species and source type for injury and behavioral criteria are presented.

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Blue whale	Knudsen 320 B/R	0.00%	0	0.18%	135
Blue whale	Kongsberg EM710	0.00%	0	0.11%	195
Blue whale	Simard ES60	0.00%	0	0.34%	199
Fin whale	Knudsen 320 B/R	0.00%	0	0.48%	131
Fin whale	Kongsberg EM710	0.00%	0	0.19%	70
Fin whale	Simard ES60	0.00%	0	0.64%	170
Humpback whale	Knudsen 320 B/R	0.00%	0	3.65%	194
Humpback whale	Kongsberg EM710	0.00%	0	1.76%	124
Humpback whale	Simard ES60	0.00%	0	4.91%	267
Minke whale	Knudsen 320 B/R	0.00%	0	0.23%	155
Minke whale	Kongsberg EM710	0.00%	0	0.25%	229
Minke whale	Simard ES60	0.00%	0	0.32%	191
North Pacific right whale	Knudsen 320 B/R	0.00%	0	0.46%	126
North Pacific right whale	Kongsberg EM710	0.00%	0	0.54%	212
North Pacific right whale	Simard ES60	0.00%	0	0.74%	178

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Sei whale	Knudsen 320 B/R	0.00%	0	0.39%	125
Sei whale	Kongsberg EM710	0.00%	0	0.45%	233
Sei whale	Simard ES60	0.00%	0	0.49%	172
Baird's beaked whale	Knudsen 320 B/R	0.00%	0	0.53%	135
Baird's beaked whale	Kongsberg EM710	0.00%	0	0.31%	195
Baird's beaked whale	Simard ES60	0.00%	0	0.96%	199
Beaked whales (guild)	Knudsen 320 B/R	0.00%	0	0.53%	135
Beaked whales (guild)	Kongsberg EM710	0.00%	0	0.31%	195
Beaked whales (guild)	Simard ES60	0.00%	0	0.96%	199
Beluga whale	Knudsen 320 B/R	0.00%	0	0.67%	135
Beluga whale	Kongsberg EM710	0.00%	0	0.71%	211
Beluga whale	Simard ES60	0.00%	0	0.97%	186
Blainville's beaked whale	Knudsen 320 B/R	0.00%	0	0.98%	140
Blainville's beaked whale	Kongsberg EM710	0.00%	0	0.55%	199
Blainville's beaked whale	Simard ES60	0.00%	0	1.44%	181
Common bottlenose dolphin	Knudsen 320 B/R	0.00%	0	0.49%	147
Common bottlenose dolphin	Kongsberg EM710	0.00%	0	0.54%	223
Common bottlenose dolphin	Simard ES60	0.00%	0	0.62%	197
Killer whale	Knudsen 320 B/R	0.00%	0	0.67%	149
Killer whale	Kongsberg EM710	0.00%	0	0.52%	216
Killer whale	Simard ES60	0.00%	0	0.73%	171
Mesoplodont whales	Knudsen 320 B/R	0.00%	0	0.29%	143
Mesoplodont whales	Kongsberg EM710	0.00%	0	0.18%	142
Mesoplodont whales	Simard ES60	0.00%	0	0.44%	181
Pacific white-sided dolphin	Knudsen 320 B/R	0.00%	0	0.49%	147

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Pacific white-sided dolphin	Kongsberg EM710	0.00%	0	0.54%	223
Pacific white-sided dolphin	Simard ES60	0.00%	0	0.62%	197
Sperm whale	Knudsen 320 B/R	0.00%	0	0.22%	153
Sperm whale	Kongsberg EM710	0.00%	0	0.12%	966
Sperm whale	Simard ES60	0.00%	0	0.35%	198
Stejneger's beaked whale	Knudsen 320 B/R	0.00%	0	0.53%	135
Stejneger's beaked whale	Kongsberg EM710	0.00%	0	0.31%	195
Stejneger's beaked whale	Simard ES60	0.00%	0	0.96%	199
Dalls porpoise	Knudsen 320 B/R	0.08%	19	1.12%	126
Dalls porpoise	Kongsberg EM710	0.02%	18	0.66%	168
Dalls porpoise	Simard ES60	0.02%	12	1.53%	177
Harbor porpoise	Knudsen 320 B/R	0.07%	27	0.11%	148
Harbor porpoise	Kongsberg EM710	0.05%	26	0.36%	86
Harbor porpoise	Simard ES60	0.01%	18	0.12%	146
Harbor seal	Knudsen 320 B/R	0.00%	0	2.67%	188
Harbor seal	Kongsberg EM710	0.00%	0	0.98%	60
Harbor seal	Simard ES60	0.00%	0	2.95%	255
Northern fur seal	Knudsen 320 B/R	0.00%	0	2.99%	203
Northern fur seal	Kongsberg EM710	0.00%	0	1.09%	66
Northern fur seal	Simard ES60	0.00%	0	3.52%	240
Ribbon seal	Knudsen 320 B/R	0.00%	0	2.91%	209
Ribbon seal	Kongsberg EM710	0.00%	0	0.97%	61
Ribbon seal	Simard ES60	0.00%	0	3.22%	240
Sea otter	Knudsen 320 B/R	0.00%	0	10.29%	180
Sea otter	Kongsberg EM710	0.00%	0	4.10%	54
Sea otter	Simard ES60	0.00%	0	12.01%	249
Spotted seal	Knudsen 320 B/R	0.00%	0	2.91%	209

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Spotted seal	Kongsberg EM710	0.00%	0	0.97%	61
Spotted seal	Simard ES60	0.00%	0	3.22%	240
Walrus	Knudsen 320 B/R	0.00%	0	1.47%	179
Walrus	Kongsberg EM710	0.00%	0	0.48%	69
Walrus	Simard ES60	0.00%	0	1.87%	268

Table 8. Distance (Range) to Injury and Behavioral Exposure results for animal movement simulations off the East Coast of the U.S.Percent of the simulated individuals and ranges to exposure for each species and source type for injury and behavioral criteria are presented.

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Blue whale	Knudsen 320 B/R	0.00%	0	2.04%	136
Blue whale	Kongsberg EM710	0.00%	0	1.78%	201
Blue whale	Simard ES60	0.00%	0	2.90%	188
Brydes whale	Knudsen 320 B/R	0.00%	0	1.28%	199
Brydes whale	Kongsberg EM710	0.00%	0	1.30%	201
Brydes whale	Simard ES60	0.00%	0	1.42%	249
Fin whale	Knudsen 320 B/R	0.00%	0	3.62%	217
Fin whale	Kongsberg EM710	0.00%	0	1.18%	83
Fin whale	Simard ES60	0.00%	0	4.88%	283
Humpback whale	Knudsen 320 B/R	0.00%	0	3.60%	214
Humpback whale	Kongsberg EM710	0.00%	0	2.90%	271
Humpback whale	Simard ES60	0.00%	0	4.94%	278
Minke whale	Knudsen 320 B/R	0.00%	0	4.45%	196

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Minke whale	Kongsberg EM710	0.00%	0	3.41%	202
Minke whale	Simard ES60	0.00%	0	6.10%	274
North Atlantic right whale	Knudsen 320 B/R	0.00%	0	4.65%	219
North Atlantic right whale	Kongsberg EM710	0.00%	0	3.50%	261
North Atlantic right whale	Simard ES60	0.00%	0	5.79%	280
Sei whale	Knudsen 320 B/R	0.00%	0	4.70%	225
Sei whale	Kongsberg EM710	0.00%	0	3.54%	263
Sei whale	Simard ES60	0.00%	0	6.43%	272
Atl spotted dolphin	Knudsen 320 B/R	0.00%	0	3.62%	211
Atl spotted dolphin	Kongsberg EM710	0.00%	0	2.90%	253
Atl spotted dolphin	Simard ES60	0.00%	0	5.14%	274
Atlantic white sided dolphin	Knudsen 320 B/R	0.00%	0	3.42%	206
Atlantic white sided dolphin	Kongsberg EM710	0.00%	0	3.10%	254
Atlantic white sided dolphin	Simard ES60	0.00%	0	4.65%	267
Blainville's Beaked whale	Knudsen 320 B/R	0.00%	0	2.10%	154
Blainville's Beaked whale	Kongsberg EM710	0.00%	0	2.18%	232
Blainville's Beaked whale	Simard ES60	0.00%	0	3.17%	193
Clymene dolphin	Knudsen 320 B/R	0.00%	0	1.29%	143
Clymene dolphin	Kongsberg EM710	0.00%	0	1.35%	246
Clymene dolphin	Simard ES60	0.00%	0	1.80%	186

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Common bottlenose dolphin	Knudsen 320 B/R	0.00%	0	4.68%	221
Common bottlenose dolphin	Kongsberg EM710	0.00%	0	3.21%	229
Common bottlenose dolphin	Simard ES60	0.00%	0	6.21%	279
False killer whale	Knudsen 320 B/R	0.00%	0	1.68%	152
False killer whale	Kongsberg EM710	0.00%	0	1.33%	240
False killer whale	Simard ES60	0.00%	0	2.27%	194
Frasers dolphin	Knudsen 320 B/R	0.00%	0	2.15%	141
Frasers dolphin	Kongsberg EM710	0.00%	0	1.57%	208
Frasers dolphin	Simard ES60	0.00%	0	2.66%	186
Killer whale	Knudsen 320 B/R	0.00%	0	1.32%	145
Killer whale	Kongsberg EM710	0.00%	0	1.39%	272
Killer whale	Simard ES60	0.00%	0	1.90%	200
Melon-headed whale	Knudsen 320 B/R	0.00%	0	1.43%	146
Melon-headed whale	Kongsberg EM710	0.00%	0	1.45%	225
Melon-headed whale	Simard ES60	0.00%	0	2.00%	194
Mesoplodont whales	Knudsen 320 B/R	0.00%	0	1.89%	125
Mesoplodont whales	Kongsberg EM710	0.00%	0	1.71%	220
Mesoplodont whales	Simard ES60	0.00%	0	2.43%	192
Northern bottlenose dolphin	Knudsen 320 B/R	0.00%	0	2.36%	136
Northern bottlenose dolphin	Kongsberg EM710	0.00%	0	2.06%	201
Northern bottlenose dolphin	Simard ES60	0.00%	0	3.36%	188

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Pantropical spotted dolphin	Knudsen 320 B/R	0.00%	0	1.62%	134
Pantropical spotted dolphin	Kongsberg EM710	0.00%	0	1.42%	214
Pantropical spotted dolphin	Simard ES60	0.00%	0	2.10%	185
Pilot whales	Knudsen 320 B/R	0.00%	0	1.55%	143
Pilot whales	Kongsberg EM710	0.00%	0	1.63%	246
Pilot whales	Simard ES60	0.00%	0	2.17%	186
Rissos dolphin	Knudsen 320 B/R	0.00%	0	3.21%	187
Rissos dolphin	Kongsberg EM710	0.00%	0	3.01%	252
Rissos dolphin	Simard ES60	0.00%	0	4.92%	272
Rough-toothed dolphin	Knudsen 320 B/R	0.00%	0	4.56%	221
Rough-toothed dolphin	Kongsberg EM710	0.00%	0	3.13%	229
Rough-toothed dolphin	Simard ES60	0.00%	0	6.06%	279
Short-beaked common dolphin	Knudsen 320 B/R	0.00%	0	1.51%	163
Short-beaked common dolphin	Kongsberg EM710	0.00%	0	1.41%	196
Short-beaked common dolphin	Simard ES60	0.00%	0	1.74%	213
Short-finned pilot whale	Knudsen 320 B/R	0.00%	0	2.52%	229
Short-finned pilot whale	Kongsberg EM710	0.00%	0	2.48%	273
Short-finned pilot whale	Simard ES60	0.00%	0	2.81%	254
Sperm whale	Knudsen 320 B/R	0.00%	0	2.52%	135
Sperm whale	Kongsberg EM710	0.00%	0	2.10%	205
Sperm whale	Simard ES60	0.00%	0	3.15%	185

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Spinner dolphin	Knudsen 320 B/R	0.00%	0	2.09%	138
Spinner dolphin	Kongsberg EM710	0.00%	0	1.99%	220
Spinner dolphin	Simard ES60	0.00%	0	3.24%	190
Striped dolphin	Knudsen 320 B/R	0.00%	0	3.60%	209
Striped dolphin	Kongsberg EM710	0.00%	0	2.39%	227
Striped dolphin	Simard ES60	0.00%	0	5.01%	270
Dwarf sperm whale	Knudsen 320 B/R	0.11%	2	2.44%	131
Dwarf sperm whale	Kongsberg EM710	0.07%	17	1.91%	204
Dwarf sperm whale	Simard ES60	0.07%	32	3.33%	169
Harbor porpoise	Knudsen 320 B/R	0.49%	39	0.59%	223
Harbor porpoise	Kongsberg EM710	0.18%	28	1.47%	77
Harbor porpoise	Simard ES60	0.00%	0	0.61%	281
Pygmy sperm whale	Knudsen 320 B/R	0.11%	2	0.73%	151
Pygmy sperm whale	Kongsberg EM710	0.07%	17	0.84%	250
Pygmy sperm whale	Simard ES60	0.07%	32	1.14%	199
Grey seal	Knudsen 320 B/R	0.00%	0	1.54%	211
Grey seal	Kongsberg EM710	0.00%	0	1.52%	282
Grey seal	Simard ES60	0.00%	0	1.68%	280
Harbor seal	Knudsen 320 B/R	0.00%	0	3.10%	210
Harbor seal	Kongsberg EM710	0.00%	0	2.81%	288
Harbor seal	Simard ES60	0.00%	0	3.44%	270
Harp seal	Knudsen 320 B/R	0.00%	0	3.03%	210
Harp seal	Kongsberg EM710	0.00%	0	2.75%	288

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Harp seal	Simard ES60	0.00%	0	3.37%	270
Hooded seal	Knudsen 320 B/R	0.00%	0	4.48%	225
Hooded seal	Kongsberg EM710	0.00%	0	4.48%	276
Hooded seal	Simard ES60	0.00%	0	4.88%	266
Manatee	Knudsen 320 B/R	0.00%	0	2.87%	225
Manatee	Kongsberg EM710	0.00%	0	2.41%	276
Manatee	Simard ES60	0.00%	0	3.06%	266

Table 9. Distance (Range) to Injury and Behavioral Exposure results for animal movement simulations in the Gulf of Mexico. Percent of the simulated individuals and ranges to exposure for each species and source type for injury and behavioral criteria are presented.

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Brydes whale	Knudsen 320 B/R	0.00%	0	2.05%	137
Brydes whale	Kongsberg EM710	0.00%	0	2.12%	219
Brydes whale	Simard ES60	0.00%	0	3.31%	215
Atl Spotted dolphin	Knudsen 320 B/R	0.00%	0	1.46%	112
Atl Spotted dolphin	Kongsberg EM710	0.00%	0	1.50%	201
Atl Spotted dolphin	Simard ES60	0.00%	0	1.70%	197
Blainville's Beaked whale	Knudsen 320 B/R	0.00%	0	1.93%	140
Blainville's Beaked whale	Kongsberg EM710	0.00%	0	1.70%	207
Blainville's Beaked whale	Kongsberg EM710	0.00%	0	1.33%	180
Blainville's Beaked whale	Simard ES60	0.00%	0	2.71%	172

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Blainville's Beaked whale	Simard ES60	0.00%	0	2.77%	178
Clymene dolphin	Knudsen 320 B/R	0.00%	0	2.05%	198
Clymene dolphin	Kongsberg EM710	0.00%	0	1.95%	131
Clymene dolphin	Simard ES60	0.00%	0	1.75%	227
Common bottlenose dolphin	Knudsen 320 B/R	0.00%	0	2.46%	142
Common bottlenose dolphin	Kongsberg EM710	0.00%	0	2.57%	215
Common bottlenose dolphin	Simard ES60	0.00%	0	3.76%	205
Cuviers beaked whale	Knudsen 320 B/R	0.00%	0	1.51%	128
Cuviers beaked whale	Kongsberg EM710	0.00%	0	0.47%	126
Cuviers beaked whale	Simard ES60	0.00%	0	2.28%	180
False killer whale	Knudsen 320 B/R	0.00%	0	2.47%	180
False killer whale	Kongsberg EM710	0.00%	0	1.95%	117
False killer whale	Simard ES60	0.00%	0	1.59%	204
Frasers dolphin	Knudsen 320 B/R	0.00%	0	0.35%	131
Frasers dolphin	Kongsberg EM710	0.00%	0	0.46%	215
Frasers dolphin	Simard ES60	0.00%	0	0.68%	205
Killer whale	Knudsen 320 B/R	0.00%	0	1.70%	207
Killer whale	Kongsberg EM710	0.00%	0	2.23%	199
Killer whale	Simard ES60	0.00%	0	1.44%	154
Melon-headed whale	Knudsen 320 B/R	0.00%	0	1.62%	260
Melon-headed whale	Kongsberg EM710	0.00%	0	2.71%	172
Melon-headed whale	Simard ES60	0.00%	0	1.95%	131
Pantropical spotted dolphin	Knudsen 320 B/R	0.00%	0	1.64%	229
Pantropical spotted dolphin	Kongsberg EM710	0.00%	0	1.92%	185

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Pantropical spotted dolphin	Simard ES60	0.00%	0	1.38%	118
Pilot whales	Knudsen 320 B/R	0.00%	0	1.75%	227
Pilot whales	Kongsberg EM710	0.00%	0	1.92%	185
Pilot whales	Simard ES60	0.00%	0	1.16%	117
Pygmy killer whale	Knudsen 320 B/R	0.00%	0	2.08%	208
Pygmy killer whale	Kongsberg EM710	0.00%	0	2.05%	198
Pygmy killer whale	Simard ES60	0.00%	0	1.25%	138
Rissos dolphin	Knudsen 320 B/R	0.00%	0	1.35%	114
Rissos dolphin	Kongsberg EM710	0.00%	0	1.53%	229
Rissos dolphin	Simard ES60	0.00%	0	1.88%	210
Rough-toothed dolphin	Knudsen 320 B/R	0.00%	0	2.42%	226
Rough-toothed dolphin	Kongsberg EM710	0.00%	0	2.03%	232
Rough-toothed dolphin	Simard ES60	0.00%	0	2.58%	252
Short-finned pilot whale	Knudsen 320 B/R	0.00%	0	1.72%	167
Short-finned pilot whale	Kongsberg EM710	0.00%	0	1.20%	144
Short-finned pilot whale	Simard ES60	0.00%	0	0.54%	178
Sperm whale	Knudsen 320 B/R	0.00%	0	0.74%	132
Sperm whale	Kongsberg EM710	0.00%	0	1.08%	230
Sperm whale	Simard ES60	0.00%	0	1.47%	212
Spinner dolphin	Knudsen 320 B/R	0.00%	0	2.42%	140
Spinner dolphin	Kongsberg EM710	0.00%	0	2.08%	218
Spinner dolphin	Simard ES60	0.00%	0	4.04%	212
Striped dolphin	Knudsen 320 B/R	0.00%	0	2.12%	132
Striped dolphin	Kongsberg EM710	0.00%	0	2.21%	224

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Striped dolphin	Simard ES60	0.00%	0	3.23%	209
Dwarf sperm whale	Knudsen 320 B/R	0.05%	5	2.77%	173
Dwarf sperm whale	Kongsberg EM710	0.00%	0	1.25%	138
Dwarf sperm whale	Simard ES60	0.03%	35	1.42%	192
Pygmy sperm whale	Knudsen 320 B/R	0.03%	7	2.80%	223
Pygmy sperm whale	Kongsberg EM710	0.00%	0	2.84%	181
Pygmy sperm whale	Simard ES60	0.03%	35	1.83%	129
Manatee	Knudsen 320 B/R	0.00%	0	1.58%	131
Manatee	Kongsberg EM710	0.00%	0	0.94%	161
Manatee	Simard ES60	0.00%	0	2.37%	187

Table 10. Exposure results for animal movement simulations off Hawaii. Percent of the simulated individuals and ranges to exposure for each species and source type for injury and behavioral criteria are presented.

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Blue whale	Knudsen 320 B/R	0.00%	0	0.17%	137
Blue whale	Kongsberg EM710	0.00%	0	0.18%	231
Blue whale	Simard ES60	0.00%	0	0.28%	205
Brydes whale	Knudsen 320 B/R	0.00%	0	0.45%	116
Brydes whale	Kongsberg EM710	0.00%	0	0.79%	231
Brydes whale	Simard ES60	0.00%	0	1.10%	197
Fin whale	Knudsen 320 B/R	0.00%	0	1.51%	141
Fin whale	Kongsberg EM710	0.00%	0	1.56%	204
Fin whale	Simard ES60	0.00%	0	2.11%	202

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Humpback whale	Knudsen 320 B/R	0.00%	0	7.66%	138
Humpback whale	Kongsberg EM710	0.00%	0	5.01%	211
Humpback whale	Simard ES60	0.00%	0	8.63%	179
Minke whale	Knudsen 320 B/R	0.00%	0	2.75%	124
Minke whale	Kongsberg EM710	0.00%	0	3.35%	224
Minke whale	Simard ES60	0.00%	0	4.87%	204
Sei whale	Knudsen 320 B/R	0.00%	0	0.44%	126
Sei whale	Kongsberg EM710	0.00%	0	0.53%	221
Sei whale	Simard ES60	0.00%	0	0.63%	200
Blainville's beaked whale	Knudsen 320 B/R	0.00%	0	0.56%	205
Blainville's beaked whale	Kongsberg EM710	0.00%	0	0.37%	215
Blainville's beaked whale	Simard ES60	0.00%	0	0.29%	131
Common bottlenose dolphin	Knudsen 320 B/R	0.00%	0	1.11%	137
Common bottlenose dolphin	Kongsberg EM710	0.00%	0	1.09%	197
Common bottlenose dolphin	Simard ES60	0.00%	0	1.97%	210
False killer whale	Knudsen 320 B/R	0.00%	0	0.16%	142
False killer whale	Kongsberg EM710	0.00%	0	0.15%	214
False killer whale	Simard ES60	0.00%	0	0.29%	197
Frasers dolphin	Knudsen 320 B/R	0.00%	0	0.20%	134
Frasers dolphin	Kongsberg EM710	0.00%	0	0.13%	208
Frasers dolphin	Simard ES60	0.00%	0	0.21%	161

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Killer whale	Knudsen 320 B/R	0.00%	0	0.24%	134
Killer whale	Kongsberg EM710	0.00%	0	0.24%	208
Killer whale	Simard ES60	0.00%	0	0.41%	197
Longman's (Indo-Pacific) beaked whale	Knudsen 320 B/R	0.00%	0	0.23%	144
Longman's (Indo-Pacific) beaked whale	Kongsberg EM710	0.00%	0	0.21%	242
Longman's (Indo-Pacific) beaked whale	Simard ES60	0.00%	0	0.31%	185
Melon-headed whale	Knudsen 320 B/R	0.00%	0	0.55%	120
Melon-headed whale	Kongsberg EM710	0.00%	0	0.70%	214
Melon-headed whale	Simard ES60	0.00%	0	0.94%	203
Pantropical spotted dolphin	Knudsen 320 B/R	0.00%	0	0.13%	126
Pantropical spotted dolphin	Kongsberg EM710	0.00%	0	0.19%	227
Pantropical spotted dolphin	Simard ES60	0.00%	0	0.29%	209
Pilot whales (guild)	Knudsen 320 B/R	0.00%	0	1.38%	120
Pilot whales (guild)	Kongsberg EM710	0.00%	0	1.49%	209
Pilot whales (guild)	Simard ES60	0.00%	0	2.30%	201
Pygmy killer whale	Knudsen 320 B/R	0.00%	0	1.18%	130
Pygmy killer whale	Kongsberg EM710	0.00%	0	0.98%	206
Pygmy killer whale	Simard ES60	0.00%	0	1.57%	201
Rissos dolphin	Knudsen 320 B/R	0.00%	0	3.26%	141

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Rissos dolphin	Kongsberg EM710	0.00%	0	2.85%	228
Rissos dolphin	Simard ES60	0.00%	0	3.88%	185
Rough-toothed dolphin	Knudsen 320 B/R	0.00%	0	1.72%	140
Rough-toothed dolphin	Kongsberg EM710	0.00%	0	1.47%	213
Rough-toothed dolphin	Simard ES60	0.00%	0	2.53%	199
Short-beaked common dolphin	Knudsen 320 B/R	0.00%	0	1.75%	129
Short-beaked common dolphin	Kongsberg EM710	0.00%	0	1.70%	213
Short-beaked common dolphin	Simard ES60	0.00%	0	2.34%	191
Short-finned pilot whale	Knudsen 320 B/R	0.00%	0	1.16%	128
Short-finned pilot whale	Kongsberg EM710	0.00%	0	1.02%	210
Short-finned pilot whale	Simard ES60	0.00%	0	1.81%	199
Sperm whale	Knudsen 320 B/R	0.00%	0	0.88%	114
Sperm whale	Kongsberg EM710	0.00%	0	1.03%	196
Sperm whale	Simard ES60	0.00%	0	1.34%	182
Spinner dolphin	Knudsen 320 B/R	0.00%	0	0.05%	145
Spinner dolphin	Kongsberg EM710	0.00%	0	0.05%	228
Spinner dolphin	Simard ES60	0.00%	0	0.07%	198
Striped dolphin	Knudsen 320 B/R	0.00%	0	0.41%	146
Striped dolphin	Kongsberg EM710	0.00%	0	0.42%	225
Striped dolphin	Simard ES60	0.00%	0	0.58%	194

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Dwarf sperm whale	Knudsen 320 B/R	0.00%	0	0.69%	141
Dwarf sperm whale	Kongsberg EM710	0.00%	0	0.62%	228
Dwarf sperm whale	Simard ES60	0.00%	0	0.85%	185
Pygmy sperm whale	Knudsen 320 B/R	0.00%	0	0.79%	118
Pygmy sperm whale	Kongsberg EM710	0.00%	0	1.08%	201
Pygmy sperm whale	Simard ES60	0.00%	0	1.60%	202
Hawaiian monk seal	Knudsen 320 B/R	0.00%	0	2.59%	138
Hawaiian monk seal	Kongsberg EM710	0.00%	0	2.21%	211
Hawaiian monk seal	Simard ES60	0.00%	0	3.63%	202

Table 11. Exposure results for animal movement simulations off the West Coast of the US. Percent of the simulated individuals and ranges to exposure for each species and source type for injury and behavioral criteria are presented.

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Blue whale	Knudsen 320 B/R	0.00%	0	0.28%	478
Blue whale	Kongsberg EM710	0.00%	0	0.04%	413
Blue whale	Simard ES60	0.00%	0	0.39%	477
Brydes whale	Knudsen 320 B/R	0.00%	0	1.06%	121
Brydes whale	Kongsberg EM710	0.00%	0	1.02%	199
Brydes whale	Simard ES60	0.00%	0	1.74%	197

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Fin whale	Knudsen 320 B/R	0.00%	0	1.38%	133
Fin whale	Kongsberg EM710	0.00%	0	1.18%	203
Fin whale	Simard ES60	0.00%	0	1.75%	193
Humpback whale	Knudsen 320 B/R	0.00%	0	14.39%	206
Humpback whale	Kongsberg EM710	0.00%	0	6.32%	147
Humpback whale	Simard ES60	0.00%	0	20.03%	301
Minke whale	Knudsen 320 B/R	0.00%	0	2.02%	137
Minke whale	Kongsberg EM710	0.00%	0	1.36%	195
Minke whale	Simard ES60	0.00%	0	2.42%	172
North Pacific right whale	Knudsen 320 B/R	0.00%	0	2.76%	146
North Pacific right whale	Kongsberg EM710	0.00%	0	2.63%	214
North Pacific right whale	Simard ES60	0.00%	0	3.66%	191
Sei whale	Knudsen 320 B/R	0.00%	0	1.38%	133
Sei whale	Kongsberg EM710	0.00%	0	1.18%	203
Sei whale	Simard ES60	0.00%	0	1.75%	193
Beaked whale	Knudsen 320 B/R	0.00%	0	0.43%	589
Beaked whale	Kongsberg EM710	0.00%	0	0.07%	611
Beaked whale	Simard ES60	0.00%	0	0.55%	530
Blainville's beaked whale	Knudsen 320 B/R	0.00%	0	1.77%	493
Blainville's beaked whale	Kongsberg EM710	0.00%	0	0.10%	392
Blainville's beaked whale	Simard ES60	0.00%	0	0.87%	496

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Common bottlenose dolphin	Knudsen 320 B/R	0.00%	0	1.14%	126
Common bottlenose dolphin	Kongsberg EM710	0.00%	0	0.99%	194
Common bottlenose dolphin	Simard ES60	0.00%	0	1.46%	193
Killer whale	Knudsen 320 B/R	0.00%	0	1.28%	143
Killer whale	Kongsberg EM710	0.00%	0	1.01%	197
Killer whale	Simard ES60	0.00%	0	1.84%	191
Long-beaked common dolphin	Knudsen 320 B/R	0.00%	0	1.39%	125
Long-beaked common dolphin	Kongsberg EM710	0.00%	0	1.18%	197
Long-beaked common dolphin	Simard ES60	0.00%	0	2.13%	197
Mesoplodont whales	Knudsen 320 B/R	0.00%	0	0.43%	589
Mesoplodont whales	Kongsberg EM710	0.00%	0	0.07%	611
Mesoplodont whales	Simard ES60	0.00%	0	0.55%	530
Northern right whale dolphin	Knudsen 320 B/R	0.00%	0	0.43%	589
Northern right whale dolphin	Kongsberg EM710	0.00%	0	0.07%	611
Northern right whale dolphin	Simard ES60	0.00%	0	0.55%	530
Pacific white-sided dolphin	Knudsen 320 B/R	0.00%	0	1.53%	132
Pacific white-sided dolphin	Kongsberg EM710	0.00%	0	1.51%	202
Pacific white-sided dolphin	Simard ES60	0.00%	0	2.46%	202

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Pilot whale	Knudsen 320 B/R	0.00%	0	1.39%	125
Pilot whale	Kongsberg EM710	0.00%	0	1.18%	197
Pilot whale	Simard ES60	0.00%	0	2.13%	197
Rissos dolphin	Knudsen 320 B/R	0.00%	0	1.38%	143
Rissos dolphin	Kongsberg EM710	0.00%	0	1.13%	191
Rissos dolphin	Simard ES60	0.00%	0	1.85%	185
Short-beaked common dolphin	Knudsen 320 B/R	0.00%	0	1.91%	140
Short-beaked common dolphin	Kongsberg EM710	0.00%	0	1.27%	191
Short-beaked common dolphin	Simard ES60	0.00%	0	2.82%	192
Short-finned pilot whale	Knudsen 320 B/R	0.00%	0	0.75%	115
Short-finned pilot whale	Kongsberg EM710	0.00%	0	0.80%	208
Short-finned pilot whale	Simard ES60	0.00%	0	1.11%	201
Sperm whale	Knudsen 320 B/R	0.00%	0	0.42%	506
Sperm whale	Kongsberg EM710	0.00%	0	0.15%	675
Sperm whale	Simard ES60	0.00%	0	0.67%	477
Stejneger's beaked whale	Knudsen 320 B/R	0.00%	0	0.75%	478
Stejneger's beaked whale	Kongsberg EM710	0.00%	0	0.11%	413
Stejneger's beaked whale	Simard ES60	0.00%	0	1.02%	477
Striped dolphin	Knudsen 320 B/R	0.00%	0	0.93%	526
Striped dolphin	Kongsberg EM710	0.00%	0	0.14%	253

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Striped dolphin	Simard ES60	0.00%	0	1.22%	522
Dalls porpoise	Knudsen 320 B/R	0.07%	20	1.07%	136
Dalls porpoise	Kongsberg EM710	0.06%	24	0.62%	128
Dalls porpoise	Simard ES60	0.01%	15	1.58%	191
Dwarf sperm whale	Knudsen 320 B/R	0.00%	0	0.19%	460
Dwarf sperm whale	Kongsberg EM710	0.00%	0	0.04%	248
Dwarf sperm whale	Simard ES60	0.00%	0	0.29%	470
Harbor porpoise	Knudsen 320 B/R	0.20%	26	2.69%	140
Harbor porpoise	Kongsberg EM710	0.13%	28	1.12%	78
Harbor porpoise	Simard ES60	0.00%	0	3.80%	189
Pygmy sperm whale	Knudsen 320 B/R	0.00%	0	0.00%	0
Pygmy sperm whale	Kongsberg EM710	0.00%	0	0.00%	0
Pygmy sperm whale	Simard ES60	0.00%	0	0.00%	0
California sea lion	Knudsen 320 B/R	0.00%	0	3.21%	203
California sea lion	Kongsberg EM710	0.00%	0	1.22%	69
California sea lion	Simard ES60	0.00%	0	3.91%	275
Guadalupe fur seal	Knudsen 320 B/R	0.00%	0	3.12%	211
Guadalupe fur seal	Kongsberg EM710	0.00%	0	1.10%	69
Guadalupe fur seal	Simard ES60	0.00%	0	3.68%	280
Harbor seal	Knudsen 320 B/R	0.00%	0	3.21%	203
Harbor seal	Kongsberg EM710	0.00%	0	1.22%	69
Harbor seal	Simard ES60	0.00%	0	3.91%	275
Northern fur seal	Knudsen 320 B/R	0.00%	0	3.12%	211

Simulated Species	Source	Injury Percent	Injury Exposure ($ER_{95\%}$) Range (m)	Behavior Percent	Behavior Exposure ($ER_{95\%}$) Range (m)
Northern fur seal	Kongsberg EM710	0.00%	0	1.10%	69
Northern fur seal	Simard ES60	0.00%	0	3.68%	280
Sea otter	Knudsen 320 B/R	0.00%	0	12.92%	212
Sea otter	Kongsberg EM710	0.00%	0	4.86%	66
Sea otter	Simard ES60	0.00%	0	14.84%	266

Annual Exposure Estimates

Annual injury exposure estimates were calculated by determining the proportion of animats that were exposed above threshold for a given survey type (less than 30 kHz or between 30 and 200 kHz) in each of the regions (Tables 7 through 11), scaling by the density of that species within the activity regions (Table 4), and multiplying by the number of days required to complete the proposed efforts. Estimated exposures summed over all regions are presented in Tables 12, 13, and 14, respectively for proposed Alternatives A, B, and C. Except for high-frequency cetaceans, no faunal group would be exposed to sound levels exceeding injury criteria for non-impulsive sounds. For high-frequency cetaceans, Dall's and harbor porpoise and pygmy and dwarf sperm whales, simulation results suggest that few animals would be exposed above non-impulsive injury criteria threshold. After incorporating survey effort and species' regional densities, injurious exposures would be expected within a maximum of 50 m. However, for these high resolution sources, this range is well within the near-field. The actual received levels of sound within the near-field are well below the modeled far field approximations.

Annual behavioral exposure estimates were similarly calculated. The proportion of simulated animats exposed above threshold for a survey was calculated (Tables 7 through 11). That number was then scaled by the estimated density (Table 4) and level of effort for that region. Results, presented in Table 15, are grouped by species and region (stock). Table 15 provides estimated daily exposures above behavioral criteria thresholds and the average time, in seconds, that animats above criteria threshold were exposed above that criteria. Tables 16, 17, and 18 contain annual and total exposures by proposed alternative A, B, and C, respectively.

Table 12. Injury exposures for each year of active acoustic surveys for activities associated with proposed Alternative A summed over all simulated regions.

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Blue whale	0	0	0	0	0	0	0
Bowhead whale	0	0	0	0	0	0	0
Bryde's whale	0	0	0	0	0	0	0
Common Minke whale	0	0	0	0	0	0	0
Fin whale	0	0	0	0	0	0	0
Gray whale	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0
North Atlantic right whale	0	0	0	0	0	0	0
North Pacific right whale	0	0	0	0	0	0	0
Sei whale	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0
Atlantic white-sided dolphin	0	0	0	0	0	0	0
Baird's beaked whale	0	0	0	0	0	0	0
Beluga whale	0	0	0	0	0	0	0
Gervais beaked whale	0	0	0	0	0	0	0
Blainville beaked whale	0	0	0	0	0	0	0
Mesoplodont beaked whales (all)	0	0	0	0	0	0	0
Clymene's dolphin	0	0	0	0	0	0	0
Common bottlenose dolphin	0	0	0	0	0	0	0
Cuvier's beaked whale	0	0	0	0	0	0	0

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
False killer whale	0	0	0	0	0	0	0
Fraser's dolphin	0	0	0	0	0	0	0
Resident Killer Whale	0	0	0	0	0	0	0
Transient Killer Whale	0	0	0	0	0	0	0
Offshore Killer Whale	0	0	0	0	0	0	0
Long-beaked common dolphin	0	0	0	0	0	0	0
Longman's (Indo-Pacific) beaked whale	0	0	0	0	0	0	0
Melon-headed whale	0	0	0	0	0	0	0
Northern right whale dolphin	0	0	0	0	0	0	0
Pacific white-sided dolphin	0	0	0	0	0	0	0
Pantropical spotted dolphin	0	0	0	0	0	0	0
Pilot whales, long finned	0	0	0	0	0	0	0
Pilot whales, short finned	0	0	0	0	0	0	0
Pygmy killer whale	0	0	0	0	0	0	0
Risso's dolphin	0	0	0	0	0	0	0
Rough-toothed dolphin	0	0	0	0	0	0	0
Short-beaked common dolphin	0	0	0	0	0	0	0
Sperm whale	0	0	0	0	0	0	0
Sowerby's Beaked Whale	0	0	0	0	0	0	0
Spinner dolphin	0	0	0	0	0	0	0

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Striped dolphin	0	0	0	0	0	0	0
White-beaked dolphin	0	0	0	0	0	0	0
True's Beaked Whale	0	0	0	0	0	0	0
Dwarf sperm whale	0.57	0.45	0.57	0.45	0.57	0.57	3.18
Pygmy sperm whale	0.4	0.23	0.38	0.21	0.37	0.37	1.96
Dall's porpoise	7.93	8.08	7.89	7.89	7.89	7.89	47.57
Harbor porpoise	11.59	12.1	13.96	12.84	10.91	10.91	72.31
Bearded seal	0	0	0	0	0	0	0
Grey seal	0	0	0	0	0	0	0
Guadalupe fur seal	0	0	0	0	0	0	0
Hawaiian monk seal	0	0	0	0	0	0	0
Harbor seal	0	0	0	0	0	0	0
Harp seal	0	0	0	0	0	0	0
Hooded seal	0	0	0	0	0	0	0
Northern fur seal	0	0	0	0	0	0	0
Ribbon seal	0	0	0	0	0	0	0
Ringed seals	0	0	0	0	0	0	0
Spotted seal	0	0	0	0	0	0	0
Manatee	0	0	0	0	0	0	0
Sea otter	0	0	0	0	0	0	0
Walrus	0	0	0	0	0	0	0
Northern elephant seal	0	0	0	0	0	0	0
Polar Bear	0	0	0	0	0	0	0
California sea lion	0	0	0	0	0	0	0
Steller sea lion	0	0	0	0	0	0	0

Table 13. Injury exposures for each year of active acoustic surveys for activities associated with proposed Alternative B summed over all simulated regions.

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Blue whale	0	0	0	0	0	0	0
Bowhead whale	0	0	0	0	0	0	0
Bryde's whale	0	0	0	0	0	0	0
Common Minke whale	0	0	0	0	0	0	0
Fin whale	0	0	0	0	0	0	0
Gray whale	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0
North Atlantic right whale	0	0	0	0	0	0	0
North Pacific right whale	0	0	0	0	0	0	0
Sei whale	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0
Atlantic white-sided dolphin	0	0	0	0	0	0	0
Baird's beaked whale	0	0	0	0	0	0	0
Beluga whale	0	0	0	0	0	0	0
Gervais beaked whale	0	0	0	0	0	0	0
Blainville beaked whale	0	0	0	0	0	0	0
Mesoplodont beaked whales (all)	0	0	0	0	0	0	0
Clymene's dolphin	0	0	0	0	0	0	0
Common bottlenose dolphin	0	0	0	0	0	0	0
Cuvier's beaked whale	0	0	0	0	0	0	0

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
False killer whale	0	0	0	0	0	0	0
Fraser's dolphin	0	0	0	0	0	0	0
Resident Killer Whale	0	0	0	0	0	0	0
Transient Killer Whale	0	0	0	0	0	0	0
Offshore Killer Whale	0	0	0	0	0	0	0
Long-beaked common dolphin	0	0	0	0	0	0	0
Longman's (Indo-Pacific) beaked whale	0	0	0	0	0	0	0
Melon-headed whale	0	0	0	0	0	0	0
Northern right whale dolphin	0	0	0	0	0	0	0
Pacific white-sided dolphin	0	0	0	0	0	0	0
Pantropical spotted dolphin	0	0	0	0	0	0	0
Pilot whales, long finned	0	0	0	0	0	0	0
Pilot whales, short finned	0	0	0	0	0	0	0
Pygmy killer whale	0	0	0	0	0	0	0
Risso's dolphin	0	0	0	0	0	0	0
Rough-toothed dolphin	0	0	0	0	0	0	0
Short-beaked common dolphin	0	0	0	0	0	0	0
Sperm whale	0	0	0	0	0	0	0
Sowerby's Beaked Whale	0	0	0	0	0	0	0
Spinner dolphin	0	0	0	0	0	0	0

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Striped dolphin	0	0	0	0	0	0	0
White-beaked dolphin	0	0	0	0	0	0	0
True's Beaked Whale	0	0	0	0	0	0	0
Dwarf sperm whale	0.7	0.57	0.71	0.57	0.7	0.7	3.95
Pygmy sperm whale	0.48	0.28	0.46	0.26	0.45	0.45	2.38
Dall's porpoise	9.84	10.02	9.82	9.82	9.38	9.82	58.7
Harbor porpoise	13.52	14.09	16.13	14.88	7.97	12.77	79.36
Bearded seal	0	0	0	0	0	0	0
Grey seal	0	0	0	0	0	0	0
Guadalupe fur seal	0	0	0	0	0	0	0
Hawaiian monk seal	0	0	0	0	0	0	0
Harbor seal	0	0	0	0	0	0	0
Harp seal	0	0	0	0	0	0	0
Hooded seal	0	0	0	0	0	0	0
Northern fur seal	0	0	0	0	0	0	0
Ribbon seal	0	0	0	0	0	0	0
Ringed seals	0	0	0	0	0	0	0
Spotted seal	0	0	0	0	0	0	0
Manatee	0	0	0	0	0	0	0
Sea otter	0	0	0	0	0	0	0
Walrus	0	0	0	0	0	0	0
Northern elephant seal	0	0	0	0	0	0	0
Polar Bear	0	0	0	0	0	0	0
California sea lion	0	0	0	0	0	0	0
Steller sea lion	0	0	0	0	0	0	0

Table 14. Injury exposures for each year of active acoustic surveys for activities associated with proposed Alternative C summed over all simulated regions.

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Blue whale	0	0	0	0	0	0	0
Bryde's whale	0	0	0	0	0	0	0
Common Minke whale	0	0	0	0	0	0	0
Fin whale	0	0	0	0	0	0	0
Gray whale	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0
North Atlantic right whale	0	0	0	0	0	0	0
North Pacific right whale	0	0	0	0	0	0	0
Sei whale	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0
Atlantic white-sided dolphin	0	0	0	0	0	0	0
Baird's beaked whale	0	0	0	0	0	0	0
Beluga whale	0	0	0	0	0	0	0
Bowhead whale	0	0	0	0	0	0	0
Gervais beaked whale	0	0	0	0	0	0	0
Blainville beaked whale	0	0	0	0	0	0	0
Mesoplodont beaked whales (all)	0	0	0	0	0	0	0
Clymene's dolphin	0	0	0	0	0	0	0
Common bottlenose dolphin	0	0	0	0	0	0	0
Cuvier's beaked whale	0	0	0	0	0	0	0

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
False killer whale	0	0	0	0	0	0	0
Fraser's dolphin	0	0	0	0	0	0	0
Resident Killer Whale	0	0	0	0	0	0	0
Transient Killer Whale	0	0	0	0	0	0	0
Offshore Killer Whale	0	0	0	0	0	0	0
Long-beaked common dolphin	0	0	0	0	0	0	0
Longman's (Indo-Pacific) beaked whale	0	0	0	0	0	0	0
Melon-headed whale	0	0	0	0	0	0	0
Northern right whale dolphin	0	0	0	0	0	0	0
Pacific white-sided dolphin	0	0	0	0	0	0	0
Pantropical spotted dolphin	0	0	0	0	0	0	0
Pilot whales, long finned	0	0	0	0	0	0	0
Pilot whales, short finned	0	0	0	0	0	0	0
Pygmy killer whale	0	0	0	0	0	0	0
Risso's dolphin	0	0	0	0	0	0	0
Rough-toothed dolphin	0	0	0	0	0	0	0
Short-beaked common dolphin	0	0	0	0	0	0	0
Sperm whale	0	0	0	0	0	0	0
Sowerby's Beaked Whale	0	0	0	0	0	0	0
Spinner dolphin	0	0	0	0	0	0	0

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Striped dolphin	0	0	0	0	0	0	0
White-beaked dolphin	0	0	0	0	0	0	0
True's Beaked Whale	0	0	0	0	0	0	0
Dwarf sperm whale	0.86	0.68	0.86	0.68	0.86	0.86	4.8
Pygmy sperm whale	0.58	0.33	0.56	0.32	0.55	0.55	2.89
Dall's porpoise	11.76	11.69	11.73	11.74	11.3	11.73	69.95
Harbor porpoise	15.47	12.22	18.31	16.95	9.71	14.65	87.31
Bearded seal	0	0	0	0	0	0	0
Grey seal	0	0	0	0	0	0	0
Guadalupe fur seal	0	0	0	0	0	0	0
Hawaiian monk seal	0	0	0	0	0	0	0
Harbor seal	0	0	0	0	0	0	0
Harp seal	0	0	0	0	0	0	0
Hooded seal	0	0	0	0	0	0	0
Northern fur seal	0	0	0	0	0	0	0
Ribbon seal	0	0	0	0	0	0	0
Ringed seals	0	0	0	0	0	0	0
Spotted seal	0	0	0	0	0	0	0
Manatee	0	0	0	0	0	0	0
Sea otter	0	0	0	0	0	0	0
Walrus	0	0	0	0	0	0	0
Northern elephant seal	0	0	0	0	0	0	0
Polar Bear	0	0	0	0	0	0	0
California sea lion	0	0	0	0	0	0	0
Steller sea lion	0	0	0	0	0	0	0

Table 15. Daily behavioral disruption exposures for active acoustic sources below 30 kHz and from 30 kHz to 200 kHz. Thresholds for these exposures are 160 dB unweighted sound pressure level (SPL). The time above the behavioral criteria threshold, in seconds, indicates the duration for which an animat was exposed above threshold.

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
Blue whale	Hawaiian Archipelago	0	28	0	45
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.29	6	0.21	37
Bryde's whale	Gulf of Mexico	0.01	55	0	109
	Hawaiian Archipelago	0.14	48	0.08	91
Common Minke whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.91	34	0.75	35
	Gulf of Alaska, Aleutians	0.7	38	0.64	32
	Bering	0.3	38	0.28	32
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	2.17	67	1.61	79
Fin whale	Hawaiian Archipelago	0.01	39	0.01	70
	Gulf of Alaska	0.15	45	0.12	46
	Bering	0.13	45	0.1	46
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.66	96	0.49	119
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.57	42	0.45	45
Gray whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf, SE Alaska, Gulf of Alaska, Aleutians, Bering, Chukchi, Beaufort	0.73	119	0.54	128

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
Humpback whale	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	0.88	77	0.72	82
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf (CA/OR/WA)	0.68	119	0.49	128
	SE Alaska, Gulf of Alaska, Bering, Aleutians, Hawaiian Archipelago (Central North Pacific)	0.12	39	0.11	68
	SE Alaska, Gulf of Alaska, Bering, Aleutians, American Samoa (Western North Pacific)	0.18	39	0.16	68
North Atlantic right whale	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf	0	92	0	114
North Pacific right whale	Aleutians	0.05	42	0.04	51
	Bering	0.01	42	0	51
Sei whale	Gulf of Maine, Georges Bank, New England	0.44	96	0.33	119
	Hawaiian Archipelago	0.03	39	0.03	70
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.13	42	0.11	45
Atlantic spotted dolphin	Southeast Continental Shelf, Southeast OCS	0	58	0	75
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	10.18	58	7.32	75
	Gulf of Mexico	7.79	43	4.66	71
Atlantic white-sided dolphin	Gulf of Maine, Georges Bank, New England	49.01	68	34.48	88
Baird's beaked whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	1.32	52	1	62
Beluga whale	Gulf of Alaska	0.29	85	0.2	120

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
	Bering	0.82	85	0.57	120
	Beaufort	23.84	85	16.56	120
	Chukchi	6.14	85	4.26	120
Bowhead whale	Bering, Chukchi, Beaufort	4.71	42	3.35	51
Gervais beaked whale	Gulf of Maine, Georges Bank	3.75	31	2.67	37
	Southeast Continental Shelf, Southeast OCS	0	31	0	37
	New England, Northeast OCS, Mid-Atlantic Bight	1.63	31	1.16	37
Blainville beaked whale	Gulf of Mexico	0.03	50	0	87
	Southeast Continental Shelf, Southeast OCS	0	31	0	37
	Hawaiian Archipelago	0.05	24	0.03	39
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	1.52	31	1.08	37
Mesoplodont beaked whales (all)	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.5	38	0.38	41
Clymene's dolphin	Gulf of Mexico	0.03	33	0.02	46
	Mid-Atlantic Bight, Southeast Continental Shelf	0	42	0	50
Common bottlenose dolphin	Hawaiian Archipelago	1.16	102	0.76	212
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	2.93	73	2.3	104
	Gulf of Mexico	3.16	212	2.72	451
	Southeast Continental Shelf, Southeast OCS	0	444	0	588
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	18.15	444	16.34	588
	Gulf of Mexico	0.02	56	0	83

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
Cuvier's beaked whale	Hawaiian Archipelago	0.02	24	0.01	41
	Gulf of Maine, Georges Bank	0.37	31	0.27	37
	Southeast Continental Shelf, Southeast OCS	0.5	31	0.35	37
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.61	54	0.47	57
	New England, Northeast OCS (grey area below georges), Mid-Atlantic Bight	1.56	31	1.11	37
False killer whale	Southeast Continental Shelf	0	42	0	47
	Gulf of Mexico	0.18	31	0.12	51
	Central/Western Pacific	0.09	32	0.05	56
	American Samoa	0.59	32	0.34	56
	Hawaiian Archipelago	6.55	32	3.82	56
Fraser's dolphin	Gulf of Mexico	0.84	30	0.59	42
	Hawaiian Archipelago	16.09	28	8.84	46
Resident Killer Whale	Northwest Continental Shelf	0.03	36	0.02	44
	Hawaiian Archipelago	0.01	34	0.01	49
	SE Alaska	0.78	37	0.54	43
	Aleutians	0.13	37	0.09	43
	Bering	0.33	37	0.24	43
	Gulf of Alaska	0.41	37	0.3	43
Transient Killer Whale	Gulf of Mexico	0	34	0	45
	Gulf of Alaska	0.03	37	0.02	43
	Hawaiian Archipelago	0.01	34	0.01	49
	Northwest Continental Shelf, SE Alaska	0.18	36	0.12	44

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
	Aleutians	0.06	37	0.04	43
Offshore Killer Whale	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.12	36	0.08	44
Long-beaked common dolphin	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	153.31	43	99.75	52
Longman's (Indo-Pacific) beaked whale	Hawaiian Archipelago	0.16	24	0.08	41
Melon-headed whale	Gulf of Mexico	0.68	29	0.44	44
	Hawaiian Archipelago	0.3	31	0.19	48
Northern right whale dolphin	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	47.74	38	37.17	41
Pacific white-sided dolphin	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	33.77	36	20.98	40
	SE Alaska, Gulf of Alaska, Aleutians	10.74	36	6.65	39
Pantropical spotted dolphin	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	0.01	42	0.01	50
	Gulf of Mexico	50.88	33	36.69	46
	Hawaiian Archipelago	205.94	31	122.34	59
Pilot whales, long finned	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS, Atlantic, Caribbean	0	35	0	39
Pilot whales, short finned	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.1	43	0.07	52

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
	Gulf of Mexico	0.31	33	0.22	52
	Hawaiian Archipelago	0.52	39	0.36	79
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS, Atlantic, Caribbean	0.01	35	0.01	39
Pygmy killer whale	Gulf of Mexico	0.02	46	0.01	31
	Hawaiian Archipelago	17.99	37	7.99	69
Risso's dolphin	Gulf of Mexico	0.47	70	0.31	89
	Southeast Continental Shelf, Southeast OCS, Atlantic	0	125	0	107
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	1.45	33	1.08	40
	Hawaiian Archipelago	1.58	45	1.2	70
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	5.75	125	4.62	107
Rough-toothed dolphin	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	0	71	0	100
	Gulf of Mexico	0.18	49	0.1	118
	Hawaiian Archipelago	16.94	35	8.34	88
Short-beaked common dolphin	Southeast Continental Shelf, Southeast OCS, Atlantic	0	74	0	91
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	70.05	74	51.13	91

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	177.11	32	119.87	38
Sperm whale	Gulf of Mexico	0.2	44	0.13	86
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.27	45	0.17	46
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	0	28	0	28
	Hawaiian Archipelago	0.06	26	0.04	36
	SE Alaska, Gulf of Alaska, Aleutians, Bering, Chukchi, Beaufort	0.57	44	0.36	51
	Central/Western Pacific	1.36	26	1.01	36
Sowerby's Beaked Whale	Gulf of Maine, Georges Bank	3.75	36	2.67	40
	Southeast Continental Shelf, Southeast OCS	0	36	0	40
	New England, Northeast OCS, Mid-Atlantic Bight	1.63	36	1.16	40
Spinner dolphin	Hawaiian Archipelago	1.73	62	1.29	124
	Gulf of Mexico	11.99	29	7.71	47
	American Samoa	11.78	62	8.79	124
Striped dolphin	Gulf of Mexico	3.06	33	1.92	50
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	42.54	35	32.53	36
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	191.2	32	123.51	39
	Hawaiian Archipelago	51.29	32	36.57	56

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
White-beaked dolphin	Gulf of Maine	5.46	68	3.84	88
True's Beaked Whale	Gulf of Maine, Georges Bank	3.75	36	2.67	40
	Southeast Continental Shelf, Southeast OCS	0	36	0	40
	New England, Northeast OCS, Mid-Atlantic Bight	1.63	36	1.16	40
Dwarf sperm whale	Gulf of Mexico	0.04	32	0.02	53
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	0.01	33	0	38
	Hawaiian Archipelago	0.67	36	0.28	66
Pygmy sperm whale	Gulf of Mexico	0.03	32	0.02	53
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS, Atlantic, Caribbean	0	33	0	38
	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0	35	0	46
	Hawaiian Archipelago	28.57	41	16.84	77
Dall's porpoise	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	0.53	38	0.36	48
	SE Alaska, Gulf of Alaska, Aleutians, Bering	3.55	47	2.59	47
Harbor porpoise	SE Alaska	0.5	52	0.36	66
	Southwest Continental Shelf	3.94	46	2.79	54
	Gulf of Alaska	1.45	52	1.07	66
	Aleutians, Bering	0.15	52	0.11	66

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
	Northwest Continental Shelf	1.8	46	1.28	54
	Gulf of Maine	14.43	106	10.7	134
Bearded seal	Bering	20.33	131	18.41	170
Grey seal	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	4.67	185	4.19	200
Guadalupe fur seal	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf	1.22	125	1.04	132
Hawaiian monk seal	Hawaiian Archipelago	27.22	61	19.25	114
Harbor seal	Aleutians	2.51	135	2.28	190
	Northwest Continental Shelf	17.9	156	14.68	172
	Southern California Bight, Southwest Continental Shelf	27.2	156	22.3	172
	Bering	2.08	153	1.89	190
	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight	7.96	209	7.29	221
	SE Alaska	89.14	135	73.1	190
	Gulf of Alaska	53.05	135	48.13	190
Harp seal	Gulf of Maine	120.96	196	108.72	207
Hooded seal	Gulf of Maine, Georges Bank, New England, Northeast OCS, Mid-Atlantic Bight, Southeast Continental Shelf, Southeast OCS	0.03	196	0.02	207
Northern fur seal	Southern California Bight, Southwest Continental Shelf	196.16	125	166.41	132
	Northwest Continental Shelf, SE Alaska, Gulf of Alaska, Aleutians, Bering	211.32	131	179.74	178

Species	Regions	Exposures <30kHz	Time (s) above 160 dB	Exposures <200kHz	Time (s) above 160 dB
Ribbon seal	Gulf of Alaska, Aleutians, Bering, Chukchi, Beaufort	8.45	131	7.65	170
Ringed seal	Bering, Chukchi	9.03	131	8.18	170
Spotted seal	Aleutians, Bering, Chukchi, Beaufort	110.94	131	100.48	170
Manatee	Gulf of Mexico, Atlantic	5.15	175	4.73	178
	Caribbean	0.14	267	0.12	265
Sea otter	Northwest Continental Shelf (WA/OR)		233		248
	Southwest Continental Shelf (CA)	25.72	233	22.39	248
	Gulf of Alaska	7.77	173	6.66	212
	SE Alaska	21.9	173	19.06	212
	Aleutians	10.1	173	8.66	212
Walrus	Aleutians, Bering, Chukchi	4.9	80	3.92	102
Northern elephant seal	Southern California Bight, Southwest Continental Shelf, Northwest Continental Shelf, SE Alaska, Gulf of Alaska, Aleutians	23.98	131	21.72	170
Polar Bear	Bering, Chukchi	0.31	80	0.25	102
California sea lion	Southern California Bight	491.58	156	403.15	172
Steller sea lion	Gulf of Alaska, Aleutians, Bering	3.16	131	2.69	170
	Northwest Continental Shelf, SE Alaska	37.13	131	31.5	170

Table 16. Behavioral disruption exposures for each year of active acoustic surveys for activities associated with proposed Alternative A summed over all simulated regions.

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Blue whale	44.8	44.89	44.62	44.75	44.62	44.62	268.3
Bowhead whale	76.83	36.71	2.36	577.83	0.43	0.43	694.59
Bryde's whale	10.78	18.9	10.53	18.7	10.44	10.44	79.79
Common Minke whale	496.24	574.15	685.39	569.77	520.69	520.69	3366.93
Fin whale	238.36	262.78	293.29	260.04	243.78	243.78	1542.03
Gray whale	204.8	198.69	199.64	283.76	189.46	189.46	1265.81
Humpback whale, Gulf of Maine	136.52	155.07	162.46	151.93	177.24	177.24	960.46
Humpback whale, Central North Pacific	27.45	44.05	40.99	49.26	25.46	25.46	212.67
Humpback whale, Western North Pacific	3.84	6.17	5.74	6.9	3.57	3.57	29.79
Humpback whale, CA/OR/WA	144.69	142.8	140.54	139.83	140.36	140.36	848.58
North Atlantic right whale	0.08	0.08	0.09	0.08	0.09	0.09	0.51
North Pacific right whale	0.02	0.04	0	0.08	0	0	0.14
Sei whale	45.9	65.76	56.75	63.44	50.37	50.37	332.59
Atlantic spotted dolphin	2612.02	2451.25	2955.56	2108.46	2329.13	2329.12	14785.54
Atlantic white-sided dolphin	3210.91	6176.29	5460.1	5781.63	4145.3	4145.3	28919.53
Baird's beaked whale	206.85	206.64	205.98	205.97	205.97	205.97	1237.38
Beluga whale	166.34	53.36	73.35	1350.88	18.47	18.47	1680.87
Beludga whale, Cooke Inlet	11.35	12.65	18.5	14.7	10.98	10.98	79.16
Gervais beaked whale	50.38	50.32	50.42	50.32	50.36	50.36	302.16

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Blainville beaked whale	46.92	48.44	46.97	48.44	46.91	46.91	284.59
Mesoplodont beaked whales (all)	79.11	79.02	78.77	78.77	78.77	78.77	473.21
Clymene's dolphin	4.2	2.49	2.75	1.36	2.25	2.25	15.3
Common bottlenose dolphin	3132.31	3681.91	4427.81	3324.51	3213.32	3213.32	20993.18
Cuvier's beaked whale	64.86	77.28	76.69	76.99	64.57	64.57	424.96
False killer whale	367.77	628.54	359.19	621.71	356.25	356.25	2689.71
Fraser's dolphin	2783.68	5583.23	2784	5583.23	2783.43	2783.43	22301
Resident Killer Whale	42.97	43.7	44.13	45	38.67	38.67	253.14
Transient Killer Whale	19.17	19.4	18.78	18.53	18.27	18.27	112.42
Offshore Killer Whale	24.28	24.59	24.28	24.26	24.25	24.25	145.91
Long-beaked common dolphin	22879.75	22494.99	22103.57	21961.11	22067.37	22067.37	133574.16
Longman's (Indo-Pacific) beaked whale	5.46	11.03	5.46	11.03	5.46	5.46	43.9
Melon-headed whale	21.19	21.89	21.26	21.89	21.2	21.2	128.63
Northern right whale dolphin	2959.13	2824.4	2677.73	2624.86	2664.45	2664.45	16415.02
Pacific white-sided dolphin	5744.57	5725.67	5767.03	5612.64	5513.35	5513.35	33876.61
Pantropical spotted dolphin	6038.47	8198.27	5955.59	8198.27	5920.23	5920.23	40231.06
Pilot whales, long finned	0.94	0.89	1.08	0.91	0.98	0.98	5.78
Pilot whales, short finned	103.62	109.22	88.43	96.76	82.72	82.71	563.46
Pygmy killer whale	855.35	1534.89	854.9	1534.1	854.56	854.56	6488.36

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Risso's dolphin	1425.15	1674.65	1818.08	1595.75	1484.44	1484.44	9482.51
Rough-toothed dolphin	8343.47	14953.29	8341.45	14947.59	8339	8339	63263.8
Short-beaked common dolphin	257551.72	262977.57	260747.64	258774.81	258490.4	258490.4	1557032.54
Sperm whale	66.42	61.97	65.98	61.35	65.8	65.8	387.32
Sowerby's Beaked Whale	50.38	50.32	50.42	50.32	50.36	50.36	302.16
Spinner dolphin	565.86	258.17	548.01	258.17	540.58	540.58	2711.37
Striped dolphin	17366.17	27603.65	17357.78	27602.57	17355.74	17355.74	124641.65
White-beaked dolphin	339.52	380.66	380.66	376.09	376.09	376.09	2229.11
True's Beaked Whale	50.38	50.32	50.42	50.32	50.36	50.36	302.16
Dwarf sperm whale	23.9	43.22	24.01	43.22	23.83	23.83	182.01
Pygmy sperm whale	1507.05	2691.76	1506.6	2690.71	1506.13	1506.13	11408.38
Dall's porpoise	159.57	162.7	158.97	159	158.93	158.93	958.1
Harbor porpoise	245.71	256.05	285.81	266.81	234.97	234.97	1524.32
Bearded seal	748.29	1733.47	2382.69	2568.91	599.9	599.9	8633.16
Grey seal	752.73	913.19	1136.48	862.8	841.17	841.17	5347.54
Guadalupe fur seal	267.13	271	267.25	266.99	266.86	266.86	1606.09
Hawaiian monk seal	515.68	848.35	515.96	848.35	515.96	515.96	3760.26
Harbor seal	11742.63	12611.86	13624.94	12247.39	11135.04	11135.04	72496.9
Harp seal	9599.5	10764.37	10764.37	10634.94	10634.94	10634.94	63033.06
Hooded seal	2.26	2.37	3.37	2.23	2.51	2.51	15.25
Northern fur seal	14336.76	23990.38	32476.43	29592.14	11729.22	11729.22	123854.15
Ribbon seal	880.64	1082.1	1572.23	3790.23	547.87	547.87	8420.94
Ringed seals	607.52	770.24	1058.71	3582.31	266.56	266.56	6551.9
Spotted seal	5157.13	8359.64	12933.61	26665.19	3261.25	3261.25	59638.07
Manatee	42.23	80.95	88.25	126.97	88.25	88.25	514.9
Sea otter, Southeast AK	327.46	346.01	258.69	258.69	258.69	258.69	1708.23

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Sea otter, Southcentral AK	138.05	159.47	255.26	193	132.08	132.08	1009.94
Sea otter, Southwest AK	0	0	0	0	0	0	0
Sea otter, WA/OR	398.56	303.65	288.88	266.17	293.64	293.64	1844.54
Sea otter, CA	692.33	690.76	686.36	707.62	686.36	686.36	4149.79
Walrus	291	368.94	507.12	1715.92	127.68	127.68	3138.34
Northern elephant seal	6436.07	6555.35	6871.5	6433.87	6059.49	6059.49	38415.77
Polar Bear	12.79	20.73	32.08	66.13	8.09	8.09	147.91
California sea lion	6580.28	7955.04	6869.73	6584.95	6584.95	6584.95	41159.9
Steller sea lion	4121.87	4155.65	3971.58	3896	3622.93	3622.93	23390.96

Table 17. Behavioral disruption exposures for each year of active acoustic surveys for activities associated with proposed Alternative B summed over all simulated regions.

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Blue whale	55.31	55.42	55.11	55.26	50.2	55.1	326.4
Bowhead whale	84.51	40.38	2.6	635.61	0.47	0.47	764.04
Bryde's whale	13.41	23.59	13.15	23.37	13.05	13.05	99.62
Common Minke whale	581.82	667.54	789.89	662.69	369.71	608.73	3680.38
Fin whale	284.12	311.1	344.55	308.09	205.25	290.07	1743.18
Gray whale	248.74	242.02	243.08	335.61	203.59	231.88	1504.92
Humpback whale, Gulf of Maine	151.83	172.21	180.34	168.77	50.03	196.61	919.79
Humpback whale, Central North Pacific	33.24	52.89	48.14	58.62	31.06	31.06	255.01
Humpback whale, Western North Pacific	4.65	7.41	6.74	8.21	4.35	4.35	35.71

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Humpback whale, CA/OR/WA	176.27	174.21	171.73	170.95	145.74	171.53	1010.43
North Atlantic right whale	0.1	0.1	0.11	0.1	0.07	0.11	0.59
North Pacific right whale	0.02	0.04	0	0.09	0	0	0.15
Sei whale	54.22	78.53	66.15	75.99	36.3	59.14	370.33
Atlantic spotted dolphin	3063.08	2841.63	3440.95	2464.58	1841.76	2751.87	16403.87
Atlantic white-sided dolphin	3532	7148.41	6006.11	6714.28	947.79	4559.83	28908.42
Baird's beaked whale	255.26	255.04	254.32	254.31	231.19	254.31	1504.43
Beluga whale	182.97	58.7	80.68	1485.96	20.31	20.31	1848.93
Beluga whale, Cooke inlet	13.79	15.23	21.67	17.48	13.39	13.39	94.95
Gervais beaked whale	62.25	62.17	62.29	62.17	62.22	62.22	373.32
Blainville beaked whale	58.36	60.26	58.42	60.26	58.35	58.35	354
Mesoplodont beaked whales (all)	97.62	97.53	97.26	97.26	88.41	97.26	575.34
Clymene's dolphin	4.94	2.89	3.33	1.64	2.78	2.79	18.37
Common bottlenose dolphin	3574.46	4180.01	4999.46	3786.85	1565.33	3663.52	21769.63
Cuvier's beaked whale	81.02	96.57	95.87	96.25	80.71	80.71	531.13
False killer whale	457.81	784.33	448.4	776.82	445.16	445.16	3357.68
Fraser's dolphin	3479.31	6979.05	3479.91	6979.05	3479.28	3479.28	27875.88
Resident Killer Whale	52.44	53.28	53.68	54.7	46.52	47.67	308.29
Transient Killer Whale	23.62	23.91	23.2	22.96	21.91	22.64	138.24
Offshore Killer Whale	29.68	30.03	29.69	29.66	25.17	29.65	173.88

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Long-beaked common dolphin	27660.66	27239.1	26808.55	26651.83	21397.11	26768.73	156525.98
Longman's (Indo-Pacific) beaked whale	6.82	13.79	6.82	13.79	6.82	6.82	54.86
Melon-headed whale	26.48	27.35	26.56	27.35	26.49	26.49	160.72
Northern right whale dolphin	3478.06	3330.04	3168.7	3110.55	2086.76	3154.1	18328.21
Pacific white-sided dolphin	6960.72	6940.35	6985.83	6816	5563.68	6706.79	39973.37
Pantropical spotted dolphin	7530.13	10247.85	7439.17	10247.85	7400.28	7400.28	50265.56
Pilot whales, long finned	1.14	1.08	1.31	1.09	1.02	1.19	6.83
Pilot whales, short finned	125.48	133.49	108.8	119.76	98.4	102.45	688.38
Pygmy killer whale	1068.98	1918.46	1068.55	1917.58	1068.18	1068.18	8109.93
Risso's dolphin	1684.29	1971.66	2116.53	1884.84	1118.22	1749.51	10525.05
Rough-toothed dolphin	10427.75	18690.5	10426.31	18684.23	10423.6	10423.61	79076
Short-beaked common dolphin	312230.46	318217.85	315764.94	313594.8	246169.37	313281.98	1819259.4
Sperm whale	82.38	76.79	81.89	76.11	77.62	81.67	476.46
Sowerby's Beaked Whale	62.25	62.17	62.29	62.17	62.22	62.22	373.32
Spinner dolphin	703.56	322.7	683.9	322.7	675.73	675.73	3384.32
Striped dolphin	21568.11	34367.29	21559.81	34366.11	20807.74	21557.56	154226.62
White-beaked dolphin	373.47	418.72	418.72	413.69	11.48	413.69	2049.77
True's Beaked Whale	62.25	62.17	62.29	62.17	62.22	62.22	373.32
Dwarf sperm whale	29.87	54.03	30.01	54.03	29.81	29.81	227.56
Pygmy sperm whale	1883.52	3364.47	1883.15	3363.31	1882.61	1882.64	14259.7
Dall's porpoise	198.18	201.66	197.55	197.58	188.97	197.5	1181.44

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Harbor porpoise	284.52	295.84	328.6	307.71	144	272.67	1633.34
Bearded seal	823.12	1906.82	2620.96	2825.8	659.89	659.89	9496.48
Grey seal	866.31	1042.79	1288.4	987.36	442.79	963.56	5591.21
Guadalupe fur seal	326.19	330.46	326.33	326.05	273.28	325.9	1908.21
Hawaiian monk seal	644.59	1060.43	644.94	1060.43	644.94	644.94	4700.27
Harbor seal	14176.55	15133.19	16247.58	14732.3	11507.17	13508.7	85305.49
Harp seal	10559.45	11840.81	11840.81	11698.44	308.55	11698.44	57946.5
Hooded seal	2.61	2.68	3.83	2.52	1.37	2.88	15.89
Northern fur seal	16553.25	27172.19	36506.84	33334.12	13684.92	13684.92	140936.24
Ribbon seal	1000.98	1222.6	1761.74	4201.54	634.94	634.94	9456.74
Ringed seals	668.27	847.27	1164.58	3940.54	293.21	293.21	7207.08
Spotted seal	5672.84	9195.61	14226.98	29331.71	3587.37	3587.37	65601.88
Manatee	46.45	94.86	97.07	145.48	0	97.07	480.93
Sea otter, Southeast AK	397.98	418.38	322.33	322.33	322.33	322.33	2105.68
Sea otter, Southcentral AK	166.23	189.79	295.16	226.67	159.66	159.66	1197.17
Sea otter, Southwest AK	0	0	0	0	0	0	0
Sea otter, OR/WA	460.13	355.76	339.5	314.53	264.39	344.74	2079.05
Sea otter, CA	796.51	794.81	789.96	813.34	291.41	789.96	4275.99
Walrus	320.1	405.84	557.83	1887.51	140.45	140.45	3452.18
Northern elephant seal	7784.01	7915.58	8263.34	7781.95	6281.82	7370.13	45396.83
Polar Bear	14.07	22.81	35.28	72.74	8.9	8.9	162.7
California sea lion	8225.36	9738.29	8544.44	8231.19	8231.19	8231.19	51201.66
Steller sea lion	5004.86	5042.24	4839.76	4756.62	4270.62	4456.25	28370.35

Table 18. Behavioral disruption exposures for each year of active acoustic surveys for activities associated with proposed Alternative C summed over all simulated regions.

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Blue whale	65.82	63.23	65.59	65.78	60.87	65.59	386.88
Bowhead whale	92.19	44.05	2.83	693.4	0.52	0.52	833.51
Bryde's whale	16.06	28.27	15.77	28.04	15.76	15.66	119.56
Common Minke whale	667.39	512.66	894.37	755.63	447.16	696.74	3973.95
Fin whale	329.89	275.63	395.8	356.14	248.52	336.37	1942.35
Gray whale	292.67	266.17	286.51	387.45	246.01	274.29	1753.1
Humpback whale, Gulf of Maine	167.13	27.5	198.24	185.61	61.18	215.98	855.64
Humpback whale, Central North Pacific	39.03	61.73	55.28	67.99	36.76	36.65	297.44
Humpback whale, Western North Pacific	5.47	8.64	7.74	9.52	5.15	5.13	41.65
Humpback whale, CA/OR/WA	207.87	188.25	202.91	202.07	176.92	202.69	1180.71
North Atlantic right whale	0.1	0.07	0.12	0.11	0.08	0.11	0.59
North Pacific right whale	0.03	0.05	0	0.1	0	0	0.18
Sei whale	62.53	68.35	75.55	88.54	44.08	67.89	406.94
Atlantic spotted dolphin	3514.16	2226.75	3926.33	2820.69	2220.3	3174.6	17882.83
Atlantic white-sided dolphin	3853.09	4130.85	6552.11	7646.92	1162.7	4974.35	28320.02
Baird's beaked whale	303.67	290.29	302.66	302.65	280.3	302.65	1782.22
Beluga whale	199.6	64.04	88.02	1621.05	22.16	22.16	2017.03
Beluga whale, Cooke inlet	16.24	17.82	24.84	20.27	15.81	15.81	110.79
Gervais beaked whale	74.13	74.04	74.19	74.04	74.11	74.11	444.62
Blainville beaked whale	69.82	72.07	69.87	72.07	69.79	69.79	423.41

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Mesoplodont beaked whales (all)	116.13	111.01	115.74	115.74	107.19	115.74	681.55
Clymene's dolphin	5.66	3.26	3.92	1.92	3.32	3.33	21.41
Common bottlenose dolphin	4016.61	2385.35	5571.11	4249.15	1909.89	4113.71	22245.82
Cuvier's beaked whale	97.21	116.1	115.05	115.49	97.3	96.87	638.02
False killer whale	547.84	940.08	537.6	931.94	538.38	534.07	4029.91
Fraser's dolphin	4174.96	8374.85	4175.82	8374.85	4175.14	4175.14	33450.76
Resident Killer Whale	61.87	62.08	63.24	64.4	55.54	56.69	363.82
Transient Killer Whale	28.06	27.52	27.6	27.36	26.37	27	163.91
Offshore Killer Whale	35.1	32.48	35.11	35.08	30.58	35.07	203.42
Long-beaked common dolphin	32441.58	28395.95	31513.51	31342.55	26001.56	31470.07	181165.22
Longman's (Indo-Pacific) beaked whale	8.19	16.55	8.19	16.55	8.19	8.19	65.86
Melon-headed whale	31.77	32.82	31.86	32.82	31.78	31.78	192.83
Northern right whale dolphin	3996.99	3008.29	3659.67	3596.22	2546.45	3643.74	20451.36
Pacific white-sided dolphin	8176.88	7400.43	8204.64	8019.37	6736.74	7900.23	46438.29
Pantropical spotted dolphin	9021.79	12297.42	8922.78	12297.42	8880.34	8880.34	60300.09
Pilot whales, long finned	1.35	1.1	1.55	1.28	1.22	1.39	7.89
Pilot whales, short finned	147.31	154.69	129.17	142.76	118.32	122.21	814.46
Pygmy killer whale	1282.58	2302.03	1282.19	2301.09	1292.61	1281.78	9742.28
Risso's dolphin	1943.42	1596.5	2414.97	2173.97	1355.64	2014.57	11499.07

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Rough-toothed dolphin	12512.02	22427.66	12511.17	22420.88	12613.56	12508.23	94993.52
Short-beaked common dolphin	366909.17	326845.44	370782.23	368414.8	299641.45	368073.55	2100666.64
Sperm whale	98.31	89.46	97.84	90.91	93.68	97.58	567.78
Sowerby's Beaked Whale	74.13	74.04	74.19	74.04	74.11	74.11	444.62
Spinner dolphin	841.25	387.23	819.79	387.23	810.88	810.88	4057.26
Striped dolphin	25770.06	40685.29	25761.84	41129.63	25004.15	25759.39	184110.36
White-beaked dolphin	407.42	12.52	456.78	451.3	26.86	451.3	1806.18
True's Beaked Whale	74.13	74.04	74.19	74.04	74.11	74.11	444.62
Dwarf sperm whale	35.84	64.83	36.01	64.83	35.77	35.77	273.05
Pygmy sperm whale	2259.99	4037.17	2259.72	4035.95	2278.05	2259.16	17130.04
Dall's porpoise	236.81	235.89	236.11	236.15	227.85	236.07	1408.88
Harbor porpoise	323.29	222.5	371.41	348.62	176.24	310.4	1752.46
Bearded seal	897.95	2080.17	2859.22	3082.69	719.88	719.88	10359.79
Grey seal	979.89	598.29	1440.33	1111.92	538.41	1085.96	5754.8
Guadalupe fur seal	385.24	353.22	385.42	385.1	332.2	384.95	2226.13
Hawaiian monk seal	773.51	1272.52	773.94	1272.52	783.62	773.94	5650.05
Harbor seal	16610.48	15907.3	18870.21	17217.18	13806.42	15882.34	98293.93
Harp seal	11519.4	336.6	12917.25	12761.93	710.67	12761.93	51007.78
Hooded seal	2.96	1.32	4.3	2.82	1.67	3.26	16.33
Northern fur seal	18769.74	30353.99	40537.24	37076.1	15640.6	15640.6	158018.27
Ribbon seal	1121.32	1363.1	1951.25	4612.85	722.01	722.01	10492.54
Ringed seals	729.03	924.29	1270.45	4298.77	319.87	319.87	7862.28
Spotted seal	6188.55	10031.57	15520.34	31998.22	3913.5	3913.5	71565.68
Manatee	50.68	58.08	105.9	163.99	7.94	105.9	492.49
Sea otter, Southeast AK	468.5	490.77	385.99	385.99	385.99	385.99	2503.23

Species	Year1	Year2	Year3	Year4	Year5	Year6	Total Exposures
Sea otter, Southcentral AK	194.42	220.11	335.06	260.35	187.24	187.24	1384.42
Sea otter, Southwest AK	0	0	0	0	0	0	0
Sea otter, OR/WA	521.72	310.48	390.14	362.89	316.2	395.86	2297.29
Sea otter, CA	900.67	560.35	893.57	919.08	375.61	893.57	4542.85
Walrus	349.2	442.73	608.54	2059.1	153.22	153.22	3766.01
Northern elephant seal	9131.95	8494.64	9655.17	9130.03	7571.36	8680.76	52663.91
Polar Bear	15.35	24.88	38.49	79.36	9.71	9.71	177.5
California sea lion	9870.42	11521.55	10219.17	9877.43	9877.43	9877.43	61243.43
Steller sea lion	5887.86	5703.84	5707.95	5617.27	5128.18	5289.58	33334.68

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Appendix A. Acoustics

Basic Acoustics

Sound travels as a mechanical wave through media by oscillation of the media's particles, including liquids (water), solids (e.g., seabed sediments), or gas (air). Without a medium, sound cannot exist. Sound in water and air:

- travels as longitudinal P-waves, where the direction of particle motion is parallel to the direction of propagation, and
- consists of alternating compressions and rarefactions.

Sound in rock and sediments:

- travels as both longitudinal P-waves and transverse S-waves, where the direction of particle motion is perpendicular to the direction of propagation.
- P waves travel faster than S waves and arrive at receivers first.

Sounds Properties

Wavelength: spatial distance between two successive 'peaks' in a propagating wave: λ [m]. It is related to sound speed c and frequency f by $\lambda = c/f$ (Figure A-1).

Frequency: rate of oscillation as the number of cycles per second: f [Hz: Hertz]; $1\ Hz = 1/s$

Period: duration of 1 cycle: $T = 1/f$ [s]. It is related to wavelength by $T = \lambda/c$

Amplitude: magnitude of the largest departure from its equilibrium value of an acoustic variable (ANSI, S1.1-2013). High amplitude corresponds to high intensity.

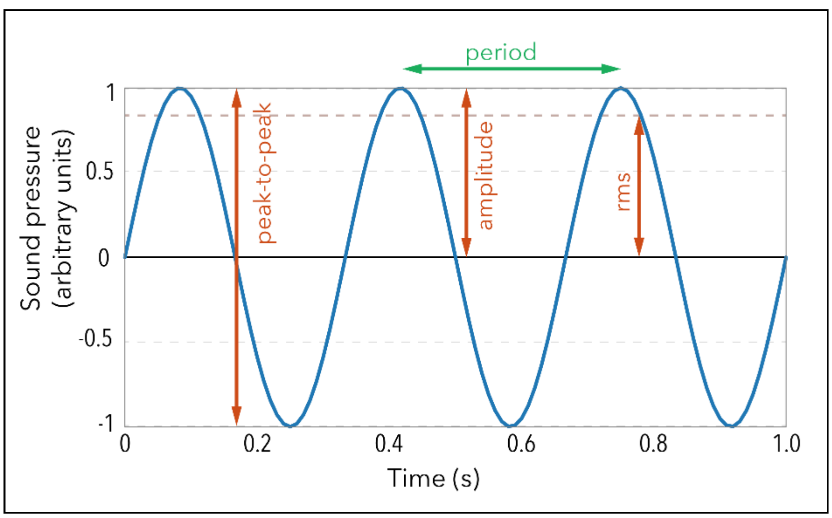

Figure A-1. A cosine wave with a peak value (i.e., amplitude) of 1, peak-to-peak value of 2, rms value of 0.71, period of 0.33 s, and frequency of 3 Hz.

Speed: the distance travelled per unit time $c = \lambda/T = \lambda \times f$ where c = the speed of sound [m/s], f = frequency (Hz), and λ = wavelength (m).

Pulse Length: For impulsive (pulsed) sound (e.g., airguns, pile driving), the pulse length is often taken as the 90 % pulse energy duration $T_{90\%}$, which is the time between the 5 % and 95 % points on the cumulative energy curve. $SPL_{rms90\%}$ is computed by averaging p2 from $T_{5\%}$ to $T_{95\%}$ (Figure A-2).

Duty Cycle: The fraction of time that a source is 'on'. e.g., a source transmitting for 2 hours per day has a duty cycle of 2/24 = 0.08 = 8 %.

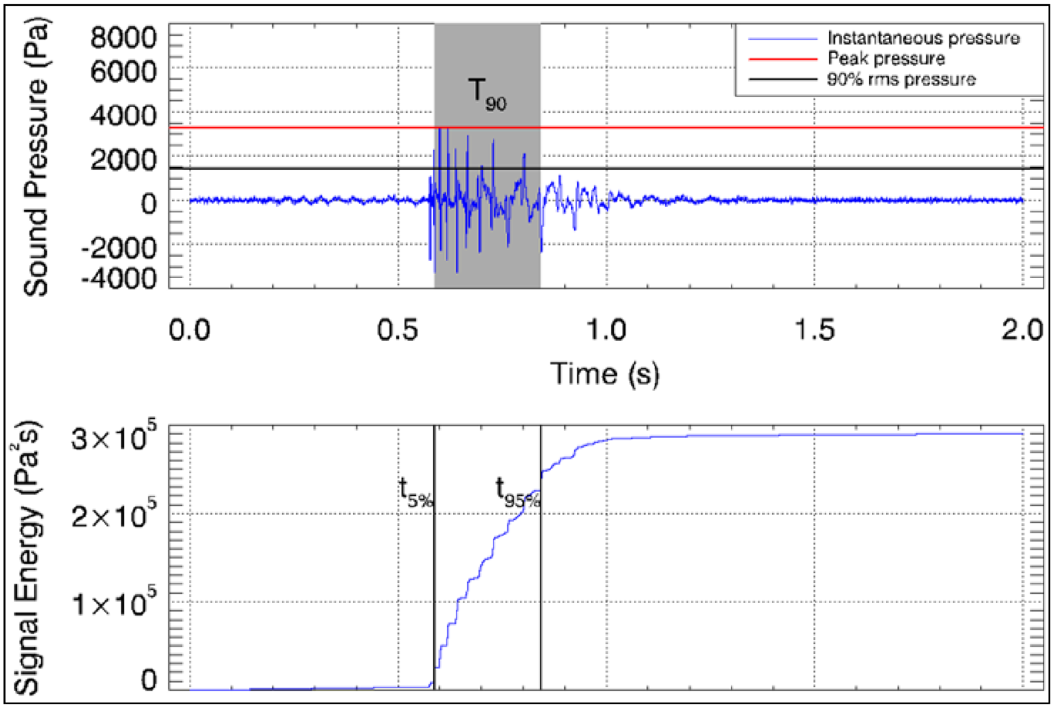

Figure A-2. The rms90 value is computed using the rms square pressure over T90, the period between the time of 5% and 95% of the cumulative square pressure

Signal components: time domain and frequency domain

The Fourier Transform: Signals in time (time domain) can be expressed in terms of their frequency components (frequency domain). The Fourier Transform computes the spectral (frequency) content of a signal *h(t)*:

$$H(f) = \int_{-\infty}^{+\infty} h(t)\, \mathrm{e}^{-2\pi i f t} \mathrm{d}t$$

And, the Inverse Fourier transform computes the time-domain signal, *h(t)*, from the spectral components *H(t)*:

$$h(t) = \int_{-\infty}^{+\infty} H(t)\, \mathrm{e}^{2\pi i f t} \mathrm{d}t$$

Transmission Loss

The propagation of sound through the environment was modelled by predicting the acoustic transmission loss—a measure, in decibels, of the decrease in sound level between a source and a receiver some distance away. Geometric spreading of acoustic waves is the predominant way by which transmission loss occurs. Transmission loss also happens when the sound is absorbed and scattered by the seawater, and absorbed scattered, and reflected at the water surface and within the seabed. Transmission loss depends on the acoustic properties of the ocean and seabed; its value changes with frequency.

If the acoustic source level (SL), expressed in dB re 1 µPa @ 1 m, and transmission loss (TL), in dB, at a given frequency are known, then the received level (RL) at a receiver location can be calculated in dB by:

$$\mathrm{RL} = \mathrm{SL} - \mathrm{TL}$$

Pulsed Versus Non-Pulsed Sounds

Anthropogenic sounds can affect marine life in a variety of ways. Numerous scientific reviews and workshops over the past 40 years have investigated these effects (Payne and Webb, 1971; Fletcher and Busnel; 1978; Richardson et al., 1995; MMC, 2007; Nowacek et al., 2007; Southall et al., 2007; Weilgart, 2007; Tyack, 2008). Anthropogenic sounds that could affect marine life are generally divided into two main categories when they are investigated: pulsed divided into single and multiple, and non-pulsed sounds (Southall et al., 2007). Pulsed or impulsive sounds include pile driving and airgun shots as well as some sonar; non-pulsed, continuous-types of sounds include certain sonar and vessel propulsion sounds and machinery sounds. Numerous definitions and mathematical distinctions distinguish pulsed from non-pulsed sounds (Burdic, 2003). Southall et al. (2007) adopted a measurement-based distinction originally proposed by Harris (1998) that if measurements between the continuous and impulse sound level meter settings differ by ≥ 3 dB, a sound is pulsed, whereas if the difference is < 3 dB the sound is non-pulsed. The distinction between these two sound types, however, is not always obvious. Certain signals, for example those from acoustic deterrent or harassment devices, share properties of both pulsed and non-pulsed sounds. A signal near a source could be categorized as a pulse, but due to propagation effects as it moves farther from the source, it could be categorized as non-pulsed (e.g., Greene and Richardson, 1988).

Following guidance from the NMFS, high-resolution geophysical sources can be either impulsive or non-impulsive. NMFS has performed qualitative classification of the impulsiveness of these sources. NMFS has determined that sparkers and boomers are classified as impulsive sources, while sub-bottom profilers and multi-beam echosounders are non-impulsive. This classification is based on NMFS' qualitative assessment of the generated waveforms (pers comm, Benjamin Laws [NMFS] 2020).

Acoustics Metrics

Underwater sound pressure amplitude is measured in decibels (dB) relative to a fixed reference pressure of p_0 = 1 µPa. Because the perceived loudness of sound, especially pulsed sound such as from seismic airguns, pile driving, and sonar, is not generally proportional to the instantaneous acoustic pressure, several sound level metrics are commonly used to evaluate sound and its effects on marine life. Here we provide specific definitions of relevant metrics used in the accompanying report. Where possible, we follow the American National Standard Institute and International Organization for Standardization definitions and symbols for sound metrics (e.g., ISO, 2017; ANSI, R2013), but these standards are not always consistent.

The zero-to-peak sound pressure, or peak sound pressure (PK or $L_{p,pk}$; dB re 1 µPa), is the decibel level of the maximum instantaneous acoustic pressure in a stated frequency band attained by an acoustic pressure signal, $p(t)$:

$$L_{\text{p,pk}} = 10\log_{10}\frac{\max|p^2(t)|}{p_0^2} = 20\log_{10}\frac{\max|p(t)|}{p_0} \tag{1}$$

PK is often included as a criterion for assessing whether a sound is potentially injurious; however, because it does not account for the duration of an acoustic event, it is generally a poor indicator of perceived loudness.

The peak-to-peak sound pressure (PK-PK or $L_{p,pk\text{-}pk}$; dB re 1 µPa) is the difference between the maximum and minimum instantaneous sound pressure, possibly filtered in a stated frequency band, attained by an impulsive sound, *p(t)*:

$$L_{\text{p,pk-pk}} = 10\log_{10}\frac{[\max(p(t)) - \min(p(t))]^2}{p_0^2} \tag{2}$$

The sound pressure level (SPL or L_p; dB re 1 µPa) is the root-mean-square (rms) pressure level in a stated frequency band over a specified time window (*T*; s). It is important to note that SPL always refers to an rms pressure level and therefore not instantaneous pressure:

$$L_{\text{p}} = 10\log_{10}\left(\frac{1}{T}\int_T g(t)\,p^2(t)\,dt \Big/ p_0^2\right) \tag{3}$$

where *g(t)* is an optional time weighting function. In many cases, the start time of the integration is marched forward in small time steps to produce a time-varying SPL function. For short acoustic events, such as sonar pulses and marine mammal vocalizations, it is important to choose an appropriate time window that matches the duration of the signal. For in-air studies, when evaluating the perceived loudness of sounds with rapid amplitude variations in time, the time weighting function *g(t)* is often set to a decaying exponential function that emphasizes more recent pressure signals. This function mimics the leaky integration nature of mammalian hearing. For example, human-based fast time-weighted SPL ($L_{p,fast}$) applies an exponential function with time constant 125 ms. A related simpler approach used in underwater acoustics sets *g(t)* to a boxcar (unity amplitude) function of width 125 ms; the results can be referred to as $L_{p,boxcar\ 125ms}$. Another approach, historically used to evaluate SPL of impulsive signals underwater, defines *g(t)* as a boxcar function with edges set to the times corresponding to 5% and 95% of the cumulative square pressure function encompassing the duration of an impulsive acoustic event. This calculation is applied individually to each impulse signal, and the results have been referred to as 90% SPL ($L_{p,90\%}$).

The sound exposure level (SEL or L_E; dB re 1 µPa2·s) is the time-integral of the squared acoustic pressure over a duration (*T*):

$$L_{\text{E}} = 10\log_{10}\left(\int_T p^2(t)\,dt \Big/ T_0 p_0^2\right) \tag{4}$$

where T_0 is a reference time interval of 1 s. SEL continues to increase with time when non-zero pressure signals are present. It is a dose-type measurement, so the integration time applied must be carefully considered for its relevance to impact to the exposed recipients.

SEL can be calculated over a fixed duration, such as the time of a single event or a period with multiple acoustic events. When applied to pulsed sounds, SEL can be calculated by summing the SEL of the *N* individual pulses. For a fixed duration, the square pressure is integrated over the duration of interest. For multiple events, the SEL can be computed by summing (in linear units) the SEL of the *N* individual events:

$$L_{\mathrm{E,N}} = 10\log_{10}\sum_{i=1}^{N} 10^{\frac{L_{E,i}}{10}} \tag{5}$$

Because the SPL(T_{90}) and SEL are both computed from the integral of square pressure, these metrics are related numerically by the following expression, which depends only on the duration of the time window *T*:

$$L_{\mathrm{p}} = L_{\mathrm{E}} - 10\log_{10}(T) \tag{6}$$

$$L_{\mathrm{p90}} = L_{\mathrm{E}} - 10\log_{10}(T_{90}) - 0.458 \tag{7}$$

where the 0.458 dB factor accounts for the 10% of pulse SEL missing from the SPL(T_{90}) integration time window.

Energy equivalent SPL (L_{eq}; dB re 1 µPa) denotes the SPL of a stationary (constant amplitude) sound that generates the same SEL as the signal being examined, *p(t)*, over the same time period, *T*:

$$L_{\mathrm{eq}} = 10\log_{10}\left(\frac{1}{T}\int_{T} p^2(t)\,dt \Big/ p_0^2\right) \tag{8}$$

The equations for SPL and the energy-equivalent SPL are numerically identical. Conceptually, the difference between the two metrics is that the SPL is typically computed over short periods (typically of one second or less) and tracks the fluctuations of a non-steady acoustic signal, whereas the L_{eq} reflects the average SPL of an acoustic signal over time periods typically of one minute to several hours.

If applied, the frequency weighting of an acoustic event should be specified, as in the case of M-weighted SEL (e.g., L_E, $L_{FC,24h}$) or auditory-weighted SPL ($L_{p,ht}$). The use of fast, slow, or impulse exponential-time-averaging or other time-related characteristics should also be specified.

In the present report, audiogram-weighted, fast-averaged SPL ($L_{p,ht,F}$) is defined by the exponential function from Plomp and Bouman (1959):

$$L_{\mathrm{p,ht}} = L_{E,\mathrm{ht,per\text{-}pulse}} - 10\log_{10}(d/0.9)\,,$$
$$L_{\mathrm{p,ht,F}} = L_{p,\mathrm{ht}} + 10\log_{10}\frac{1-e^{-d/\tau}}{1-e^{-T/\tau}} \tag{9}$$

where *d* is the duration in seconds, τ is the time constant of 0.125 s representing marine mammal auditory integration time, $L_{p,ht}$ is the audiogram-weighted SPL over pulse duration, and *T* is the pulse repetition period. This metric accounts for the hearing sensitivity of specific species through frequency weighting, and results in reduced perceived loudness (i.e., sensation level) for pulses shorter than auditory integration time (τ).

Decidecade Band Analysis

The distribution of a sound's power with frequency is described by the sound's spectrum. The sound spectrum can be split into a series of adjacent frequency bands. Splitting a spectrum into 1 Hz wide bands, called passbands, yields the power spectral density of the sound. This splitting of the spectrum into passbands of a constant width of 1 Hz, however, does not represent how animals perceive sound.

Because animals perceive exponential increases in frequency rather than linear increases, analyzing a sound spectrum with passbands that increase exponentially in size better approximates real-world scenarios. In underwater acoustics, a spectrum is commonly split into decidecade bands, which are approximately one-third of an octave (base 2) wide and often referred to as 1/3-octave-bands. Each octave represents a doubling in sound frequency. The center frequency of the *i*th band, $f_c(i)$, is defined as:

$$f_{\mathrm{c}}(i) = 10^{\frac{i}{10}} \tag{1}$$

and the low (f_{lo}) and high (f_{hi}) frequency limits of the *i*th band are defined as:

$$f_{\mathrm{lo},i} = 10^{\frac{-1}{20}} f_{\mathrm{c}}(i) \quad \text{and} \quad f_{\mathrm{hi},i} = 10^{\frac{1}{20}} f_{\mathrm{c}}(i) \tag{2}$$

The decidecade bands become wider with increasing frequency, and on a logarithmic scale the bands appear equally spaced (Figure A-3).

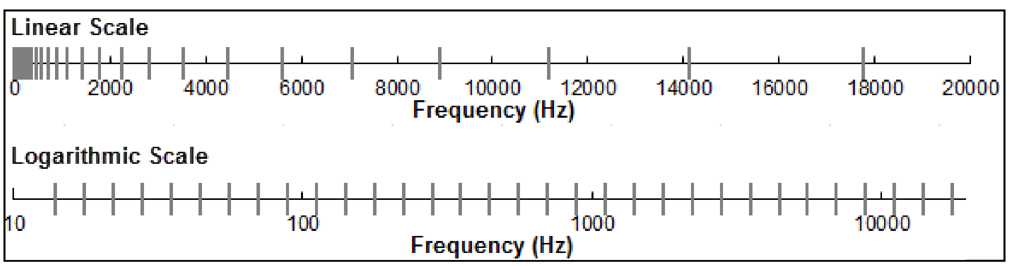

Figure A-3. Decidecade frequency bands (vertical lines) shown on a linear frequency scale and a logarithmic scale

The sound pressure level in the *i*th band ($L_{p,i}$) is computed from the spectrum *S(f)* between $f_{lo,i}$ and $f_{hi,i}$:

$$L_{\mathrm{p},i} = 10 \log_{10} \int_{f_{\mathrm{lo},i}}^{f_{\mathrm{hi},i}} S(f)\, df \tag{3}$$

Summing the sound pressure level of all the bands yields the broadband sound pressure level:

$$\text{Broadband SPL} = 10 \log_{10} \sum_{i} 10^{\frac{L_{p,i}}{10}} \tag{4}$$

Figure A-4 shows an example of how the decidecade band sound pressure levels compare to the sound pressure spectral density levels of an ambient noise signal. Because the decidecade bands are wider with increasing frequency, the decidecade band SPL is higher than the spectral levels, especially at higher frequencies. Acoustic modelling of decidecade bands requires less computation time than 1 Hz bands and still resolves the frequency-dependence of the sound source and the propagation environment.

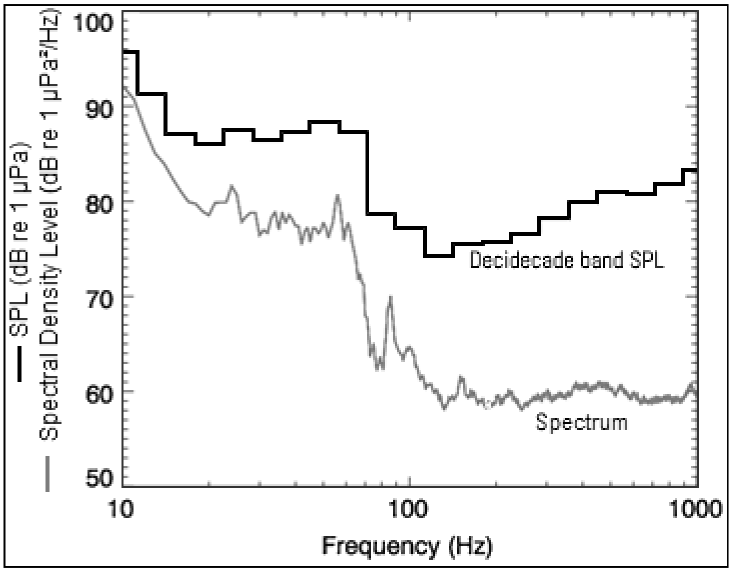

Figure A-4. Sound pressure spectral density levels and the corresponding decidecade band sound pressure levels of example ambient noise shown on a logarithmic frequency scale

Appendix B. Marine Mammal Impact Criteria

The Marine Mammal Protection Act (MMPA) (16 U.S.C. 1362) prohibits the take of marine mammals. The MMPA defines the term "take" as: to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal. The MMPA defines harassment in two categories relevant to anthropogenic activity. These are:

- (Level A) Any act of pursuit, torment, or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild, and
- (Level B) Any act of pursuit, torment or annoyance which has the potential to disturb a marine mammal or marine mammal stock in the wild by causing a disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering but which does not have the potential to injure a marine mammal or marine mammal stock in the wild.

To assess the potential impacts of the active underwater acoustic sound sources, it is necessary to first establish acoustic exposure criteria for which takes could result. In 2016, NMFS issued a Technical Guidance document that provides acoustic thresholds for onset of permanent threshold shift (PTS) in marine mammal hearing for most sound sources, that was then updated in 2018 (NMFS 2016, NMFS 2018). NMFS also provided guidance on the use of weighting functions when applying injury (Level A) criteria. NMFS Guidance recommends the use of a dual criterion for assessing exposures, including a peak (unweighted/flat) sound level metric (PK) and a cumulative sound exposure level (SEL) metric with frequency weighting (Table B-1). Both acoustic criteria and weighting function application are divided into functional hearing groups within the Technical Guidance and Navy effects criteria (low-, mid-, and high-frequency cetatceans, phocid pinnipeds, other carnivores, and sirenia) that species are assigned to, based on their respective hearing ranges (Finneran et al. 2017, [NMFS] National Marine Fisheries Service (US) 2018).

The publication of ISO 18405 Underwater Acoustics–Terminology (ISO, 2017) provided a dictionary of underwater bioacoustics standards (ANSI S1.1-2013 R2013). The definitions and conventions discussed here follow ISO (2017) except where stated otherwise (Table B-1).

Table B-1. Summary of relevant acoustic terminology used by US regulators

Metric	NOAA (NMFS, 2018)	This report (ISO, 2017)	
		Main Text/Tables	**Equations**
Sound pressure level	n/a	SPL	L_{p}
Peak pressure level	PK	PK	L_{pk}
Cumulative sound exposure level	$\mathrm{SEL_{cum}}$	SEL	L_{E}

The $\mathrm{SEL_{cum}}$ metric as used by the NMFS describes the sound energy received by a receptor over a period of 24 hours. Accordingly, following the ISO standard, this will be denoted as SEL in this report, except for in tables and equations where L_E will be used alongside SEL to account for its use in mathematical equations.

Marine Mammal Hearing Groups

Current data and predictions show that marine mammal species differ in their hearing capabilities, in absolute hearing sensitivity as well as frequency band of hearing (Richardson et al. 1995, Wartzok and Ketten 1999, Southall et al. 2007, Au and Hastings 2008). While hearing measurements are available for a small number of species based on captive animal studies, direct measurements of many odontocetes and all mysticetes do not exist. As a result, hearing ranges for many odontocetes are grouped with similar species, and 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), vocalizations (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 et al. 2007) In 2007, Southall et al. proposed that marine mammals be divided into hearing groups. This division was updated in 2016 and 2018 by NMFS using more recent best available science (Table B-2).

Table B-2. Marine mammal hearing groups

Hearing Group	Generalized hearing range*
Low-frequency (LF) cetaceans: (mysticetes or baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans: (odontocetes: delphinids, beaked whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans: (other odontocetes)	275 Hz to 160 kHz
Phocid pinnipeds in water (PW)	50 Hz to 86 kHz
Other carnivores in water (OW)	60 Hz to 39 kHz
Sirenia (SI)	150 Hz to 40 kHz

Sources: NMFS 2018; Sills et al., 2014; Blackstock et al. 2017

* The generalized hearing range for all species within a group. Individual hearing will vary.

Marine Mammal Auditory Weighting Functions

The potential for anthropogenic sounds to impact marine mammals is largely dependent on whether the sound occurs at frequencies that an animal can hear well, unless the sound pressure level is so high that it can cause physical tissue damage regardless of frequency. Weighting functions are applied to the sound spectra under consideration to weight the importance of received sound levels at particular frequencies in a manner reflective of an animal's sensitivity to those frequencies (Nedwell and Turnpenny 1998, Nedwell et al. 2007). In this study, multiple weighting functions were used. Southall et al. (2007) were first to suggest weighting functions and functional hearing groups for marine mammals. The weighting functions from Southall et al. (2007) were referred to as m-weighting. For this analysis, the Technical Guidance issued by NOAA (NMFS 2018), which included weighting functions and associated thresholds, was used for determining the ranges for potential injury to marine mammals.

Southall et al. (2007) Frequency Weighting Functions

Auditory weighting functions for marine mammals, called M-weighting functions, were proposed by Southall et al. (2007). These M-weighting functions are applied in a similar way as A-weighting for noise level assessments for humans. Functions were defined for five hearing groups of marine mammals:

- Low-frequency (LF) cetaceans—mysticetes (baleen whales)
- Mid-frequency (MF) cetaceans—some odontocetes (toothed whales)
- High-frequency (HF) cetaceans—odontocetes specialized for using high-frequencies
- Pinnipeds in water (Pw)—seals, sea lions, and walrus
- Pinnipeds in air (not addressed here)

The M-weighting functions have unity gain (0 dB) through the passband and their high and low frequency roll-offs are approximately –12 dB per octave. The amplitude response in the frequency domain of each M-weighting function is defined by:

$$G(f) = -20\log_{10}\left[\left(1+\frac{a^2}{f^2}\right)\left(1+\frac{f^2}{b^2}\right)\right] \tag{1}$$

where *G(f)* is the weighting function amplitude (in dB) at the frequency *f* (in Hz), and *a* and *b* are the estimated lower and upper hearing limits, respectively, which control the roll-off and passband of the weighting function. The parameters *a* and *b* are defined uniquely for each hearing group (Table B-3). Figures Figure B-1and Figure B-2 show the auditory weighting functions recommended by Southall et al. (2007).

Table B-3. Parameters for the auditory weighting functions recommended by Southall et al. (2007).

Functional Hearing Group	*a* (Hz)	*b* (Hz)
Low-frequency cetaceans	7	22,000
Mid-frequency cetaceans	150	160,000
High-frequency cetaceans	200	180,000
Pinnipeds in water	75	75,000

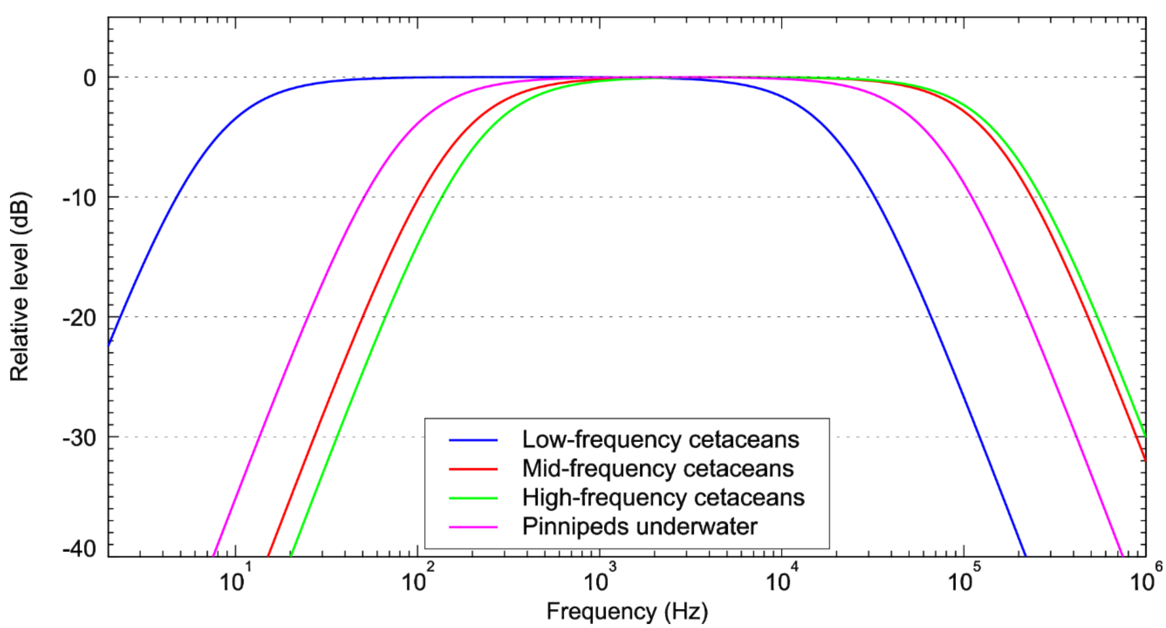

Figure B-1. Auditory weighting functions for the functional marine mammal hearing groups as recommended by Southall et al. (2007)

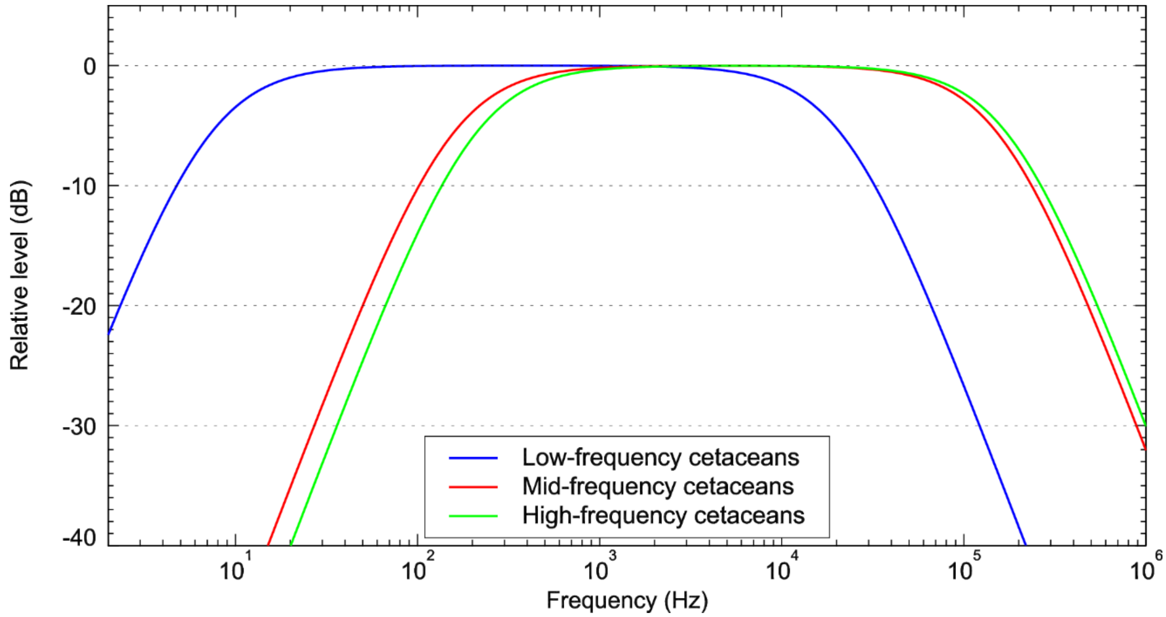

Figure B-2. Auditory weighting functions for the low-, mid-, and high-frequency cetacean hearing groups as recommended by Southall et al. (2007).

NMFS (2018) Frequency Weighting Functions

In 2015, a U.S. Navy technical report by Finneran (2015) recommended new auditory weighting functions. The auditory weighting functions for marine mammals are applied in a similar way as A-weighting for noise level assessments for humans. The new frequency-weighting functions are expressed as:

$$G(f) = K + 10\log_{10}\left\{\frac{(f/f_1)^{2a}}{[1+(f/f_1)^2]^a[1+(f/f_2)^2]^b}\right\} \qquad (1)$$

Finneran (2015) proposed five functional hearing groups for marine mammals in water: low-, mid- and high-frequency cetaceans (LF, MF, and HF cetaceans, respectively), phocid pinnipeds, and otariid pinnipeds. The parameters for these frequency-weighting functions were further modified the following year (Finneran 2016) and were adopted in NOAA's technical guidance that assesses acoustic impacts on marine mammals (NMFS 2018). The updates did not affect the content related to either the definitions of M-weighting functions or the threshold values. Table B-4 lists the frequency-weighting parameters for each hearing group. Figure B-3 shows the resulting frequency-weighting curves.

Table B-4. Parameters for the auditory weighting functions recommended by NMFS (2018).

Functional Hearing Group	*a*	*b*	f_1 (Hz)	f_2 (Hz)	*K* (dB)
Low-frequency cetaceans	1.0	2	200	19,000	0.13
Mid-frequency cetaceans	1.6	2	8,800	110,000	1.20
High-frequency cetaceans	1.8	2	12,000	140,000	1.36
Phocid pinnipeds in water	1.0	2	1,900	30,000	0.75
Other carnivores in water	2.0	2	940	25,000	0.64
Sirenia	1.8	2	4,300	25,000	2.62

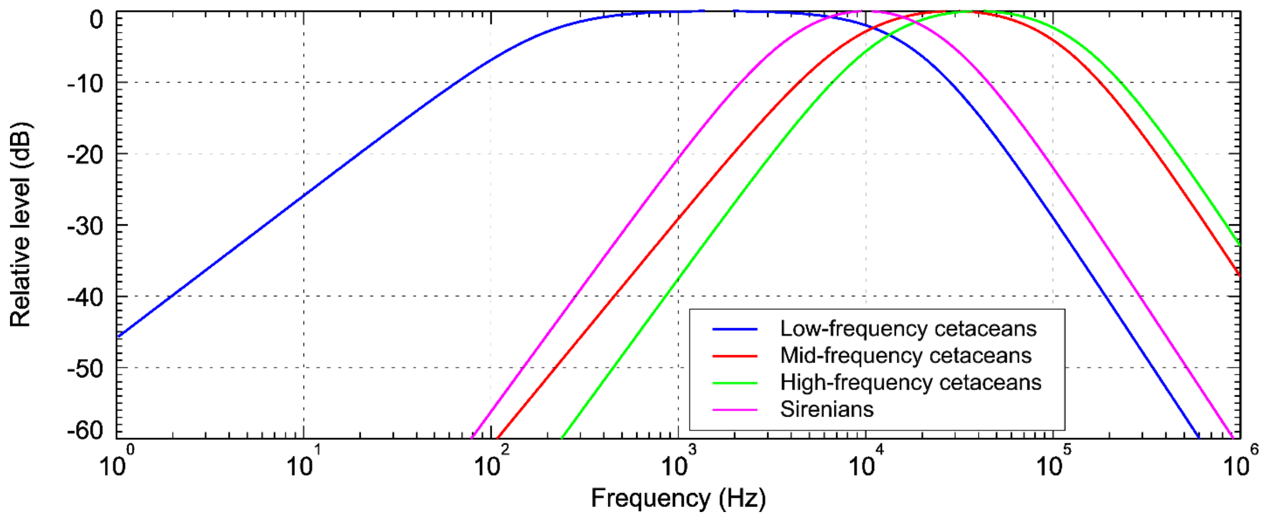

Figure B-3. Auditory weighting functions for the low-, mid-, and high-frequency cetacean and sirenian hearing groups as recommended by NMFS (2018). Sirenian weighting function is from Blackstock et al. (2017)

Injury Exposure Criteria

Injury to the hearing apparatus of a marine mammal may result from a fatiguing stimulus measured in terms of SEL, which considers the sound level and duration of the exposure signal. Intense sounds may also damage hearing independent of duration, so an additional metric of peak pressure (PK) is also used to assess acoustic exposure injury risk. A permanent threshold shift (PTS) in hearing may be considered injurious but there are no published data on the sound levels that cause PTS in marine mammals. There are data that indicate the received sound levels at which temporary threshold shift (TTS) occurs, and PTS onset may be extrapolated from TTS onset level and an assumed growth function (Southall et al. 2007). The NMFS (2018) criteria incorporate the best available science to estimate PTS onset in marine mammals from sound energy accumulated over 24 hours (SEL), or very loud, instantaneous peak sound pressure levels. These dual threshold criteria of SEL and PK are used to calculate marine mammal exposures (Table B-5).

Table B-5. Summary of relevant injury onset acoustic thresholds (NMFS 2018).

	PTS onset thresholds* (received level)	
Hearing Group	**Non-impulsive**	**Impulsive**
Low-frequency (LF) cetaceans	$L_{E,\,LF,\,24h}$: 199 dB	$L_{pk,\,flat}$: 219 dB $L_{E,\,LF,\,24h}$: 183 dB
Mid-frequency (MF) cetaceans	$L_{E,\,MF,\,24h}$: 198 dB	$L_{pk,\,flat}$: 230 dB $L_{E,\,MF,\,24h}$: 185 dB
High-frequency (HF) cetaceans	$L_{E,\,HF,\,24h}$: 173 dB	$L_{pk,\,flat}$: 202 dB $L_{E,\,HF,\,24h}$: 155 dB
Phocid seals in water (PW)	$L_{E,\,PW,\,24h}$: 201 dB	$L_{pk,\,flat}$: 218 dB $L_{E,\,PW,\,24h}$: 185 dB

Hearing Group	PTS onset thresholds* (received level)	
	Non-impulsive	Impulsive
Other carnivores in water (OW)	$L_{E,\,OW}$, 24h: 219 dB	L_{pk}, flat: 232 dB $L_{E,\,OW}$, 24h: 203 dB
Sirenia (SI)	$L_{E,\,SI}$, 24h: 206 dB	L_{pk}, flat: 226 dB $L_{E,\,SI}$, 24h: 190 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.

L_{pk}, flat–peak sound pressure is flat weighted or unweighted and has a reference value of 1 µPa

L_E - denotes cumulative sound exposure over a 24-hour period and has a reference value of 1 μPa^2s

The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting.

Behavioral Disruption Exposure Criteria

Numerous studies on marine mammal behavioral responses to sound exposure have not resulted in consensus in the scientific community regarding the appropriate metric for assessing behavioral reactions. It is recognized that the context in which the sound is received affects the nature and extent of responses to a stimulus (Southall et al. 2007, Ellison and Frankel 2012), and because of the complexity and variability of marine mammal behavioral responses to acoustic exposure, NMFS has not yet released technical guidance on behavioral thresholds for use in calculating animal exposures (NMFS 2018). NMFS currently uses a step function to assess behavioral impact (NOAA, 2005). A 50 percent probability of inducing behavioral responses at an SPL of 160 dB re 1 µPa was derived from the HESS (1999) report, which was based on the responses of migrating mysticete whales to airgun sounds (Malme et al. 1983, Malme et al. 1984). The HESS team recognized that behavioral responses to sound may occur at lower levels, but significant responses were only likely to occur above a SPL of 140 dB re 1 µPa.

Appendix C. Acoustic Models

Geometric Models

Spherical Spreading Loss: Near the source, where sound can propagate uniformly in all directions:

$$\mathrm{PL} = 20 \log_{10}(R/1\ \mathrm{m})\ \mathrm{dB}$$

Cylindrical Spreading Loss: In very shallow water, sound cannot propagate as a spherical wave in all directions, but only as a cylindrical wave bound by the sea floor and the sea surface.

$$\mathrm{PL} = \mathit{constant} + 10 \log_{10}(\mathrm{R}/1\ \mathrm{m})\ \mathrm{dB}$$

Combined Spreading Loss: In general, sound propagates spherically near the source, whereas at long range, after a few bottom reflections, the propagation becomes cylindrical. If the transition range is Rc the propagation loss can be approximate by

$$= 20 \log_{10}(Rc/1\ \mathrm{m})\ \mathrm{dB} + 10 \log_{10}(R/1\ \mathrm{m})\ \mathrm{dB}$$

Geometric models are the simplest and are taken as to be the most conservative. If the range to injury and behavior thresholds are short (i.e., on the scale of the vessel) when calculated using a geometric model, then the sources are unlikely to cause any more impacts than the vessels themselves.

Ranges found to be larger than 10 m, roughly approximate to the survey platform vessel sizes, were recalculated using a more accurate (and less conservative) model to calculate the ranges. If the ranges are on the order of the vessel, then the sources are considered to be no more impactful than the vessels themselves.

If the ranges for a source remain larger than the vessel when using models that consider the environment, then the sound fields were sampled using agent-based simulations (see animal movement modeling below). This approach gives the best estimate of the exposure level for marine species because it takes into account the 3D sound field and the behavior of the animals.

Cumulative Exposure from Survey Track

This section describes the methods used to estimate the horizontal distances to the National Marine Fisheries Service (NMFS) injury criteria (Appendix B). All sources were assessed with the non-impulsive source criteria.

NMFS provides a spreadsheet to calculate these distances, but it is not designed for high-resolution geophysical survey sources and does not consider seawater absorption or beam patterns, both of which can substantially influence received sound levels. To account for these effects, we model sound levels using Equations C-1 to C-9, as follows.

The sonar equation is used to calculate the sound pressure level:

$$\mathrm{SPL}(r) = SL - PL(r)\,, \tag{C-1}$$

where *SPL* is the sound pressure level (dB re 1 μPa), *r* is the distance from the source (m), *SL* is the source level (dB re 1 μPa m), and *PL* is the propagation loss as a function of distance. Propagation loss is calculated using:

$$PL(r) = 20\log_{10}\left(\frac{r}{1\,m}\right)\ \mathrm{dB} + \alpha(f)\cdot r/1000\,, \tag{C-2}$$

where $\alpha(f)$ is the absorption coefficient (dB/km) and f is frequency (kHz). The absorption coefficient is approximated by discarding the boric acid term from Ainslie (2010, p 29 equation 2.2):

$$\alpha(f) \approx 0.000339f^2 + 48.5f^2/(75.6^2 + f^2)\,. \tag{C-3}$$

When a range of frequencies is produced by a source, we use the lowest frequency for determining the absorption coefficient.

The source level is either its in-beam value (for angles within the −3 dB beamwidth) or a single representative out-of-beam value. This representative value is estimated by first calculating upper and lower bounds and then taking the average of these. We assume the beam pattern $b(u)$ is that of an unshaded circular transducer:

$$b(u) = (2\ J_1(u)/u)^2, \tag{C-4}$$

where $J_1(u)$ is a first order Bessel function of the first kind, whose argument is a function of off-axis angle θ and beamwidth (full width at half maximum) $\delta\theta$

$$u = u_0\frac{\sin\theta}{\sin\frac{\delta\theta}{2}}, \tag{C-5}$$

where $u_0 = 1.614$.

For the upper limit we choose the highest sidelobe level of the beam pattern, given by Ainslie (2010 p 265 Table 6.2):

$$B_{\max} = -17.6\ dB. \tag{C-6}$$

For the lower limit we consider the asymptotic behavior of the beam pattern in the horizontal direction

$$J_1(u) \sim \sqrt{\frac{2}{\pi u}}\cos\left(u - \frac{3\pi}{4}\right), \tag{C-7}$$

where

$$u = \frac{u_0}{\sin\frac{\delta\theta}{2}}\,. \tag{C-8}$$

In this way we obtain the lower limit as

$$B_{\min} = 10\log_{10}\left(\frac{8}{\pi\, u_0^3}\sin^3\frac{\delta\theta}{2}\right)\mathrm{dB}\,. \qquad \text{(C-9)}$$

The out-of-beam source level is found by adding the arithmetic mean of $B_{\min}$ and $B_{\max}$ to the in-beam source level.

For broad beam sources (beamwidths larger than 90°), we assumed the source was omnidirectional. For intermediate beam sources (beamwidths between 36° and 90°), we interpolated the correction between the two methods. The resulting correction as a function of beamwidth is shown in Figure C-1.

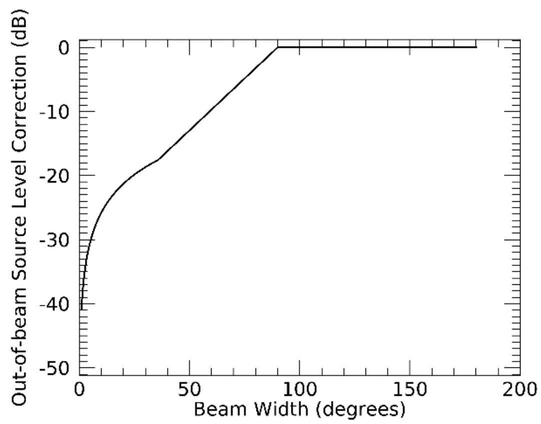

Figure C-1. Correction for calculating out-of-beam source level (i.e., in the horizontal direction) from in-beam source level, as a function of source beamwidth.

Separate impact ranges are calculated using the in-beam source level at the angle corresponding to the −3 dB half-width and the out-of-beam source level in the horizontal direction. The higher of the two sound levels was then selected for assessing impact distance.

Distances to peak thresholds were calculated using the peak source level and applying propagation loss from Equation (C-2. Peak levels were assessed for both in-beam and out-of-beam levels (the latter was assessed using the out-of-beam source level correction described previously).

For the weighted SEL thresholds, we performed the following steps:

Calculated weighted broadband source levels by assuming a flat spectrum between the source minimum and maximum frequency, weighted the spectrum according to the marine mammal hearing group weighting function

1. (NMFS 2018) , and summing across frequency. A 0.5 dB correction is added to the energy source level (ESL) because the 90 % energy pulse duration usually used to evaluate SL contains only 90 % of the pulse energy. The 0.5 dB correction ensures that all of the energy in the pulse is included.
2. Modeled propagation loss as a function of oblique range using Equation (C-2.
3. Modeled per-pulse SEL for a stationary receiver at a fixed distance off a straight survey line, using a vessel transit speed of 3.5 knots and source-specific pulse length and repetition rate. The off-line distance is referred to as the closest point of approach (CPA) and was performed for CPA distances between 1 m and 10 km. The survey line length was modeled as 10 km long (analysis showed longer survey lines increased SEL by a negligible amount). SEL is calculated as $SPL + 10\log_{10}\frac{T}{1\,\mathrm{s}}$ dB, where T is the pulse duration.

4. Calculated the SEL for each survey line to produce curves of weighted SEL as a function of CPA distance.
5. Used the curves from Step 4 to estimate the CPA distance to the impact criteria.

This method accounts for the hearing sensitivity of the marine mammal group, seawater absorption, and beamwidth for downwards-facing transducers.

3-D Propagation Model Bellhop

JASCO's Marine Operations Noise Model (MONM) computes received SEL for directional impulsive sources at a specified source depth. Underwater sound propagation (i.e., transmission loss) was predicted with JASCO's Marine Operations Noise Model (MONM). This model computes sound propagation from highly-directional, high-frequency acoustic sources via the BELLHOP Gaussian beam acoustic ray-trace model (Porter and Liu 1994). This version of MONM accounts for sound attenuation due to energy absorption through ion relaxation and viscosity of water in addition to acoustic attenuation due to reflection at the medium boundaries and internal layers (Fisher and Simmons 1977). The former type of sound attenuation is important for frequencies higher than 5 kHz and cannot be neglected without noticeably affecting the model results. MONM incorporates the following site-specific environmental properties: a bathymetric grid of the modelled area, underwater sound speed as a function of depth, and a geoacoustic profile based on the overall stratified composition of the seafloor.

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 modelled to include the majority of acoustic energy emitted by the source. At each center frequency, the transmission loss is modelled within each of the N vertical planes as a function of depth and range from the source. The 1/3-octave-band received per-pulse SELs are computed by subtracting the band transmission loss values 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. The step sizes are chosen to provide increased coverage near the depth of the source and at depths of interest in terms of the sound speed profile. For areas with deep water, sampling is not performed at depths beyond those reachable by marine mammals. The received per-pulse SEL at a surface sampling location is taken as the maximum value that occurs over all samples within the water column, i.e., the maximum-over-depth received per-pulse SEL. These maximum-over-depth per-pulse SELs are presented as color contours around the source.

Three-dimensional Sound Field

Acoustic fields in three dimensions are generated from propagation loss calculated in 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 (Figure C-2). These vertical radial planes are separated by an angular step size of $\Delta\theta$, yielding N = 360°/$\Delta\theta$ planes. The three-dimensional sound fields are used for estimating acoustic exposure using animal movement modeling. Ranges to thresholds and example maximum-over-depth plan-view maps are generated for estimating exposure for some species and for illustrative purposes.

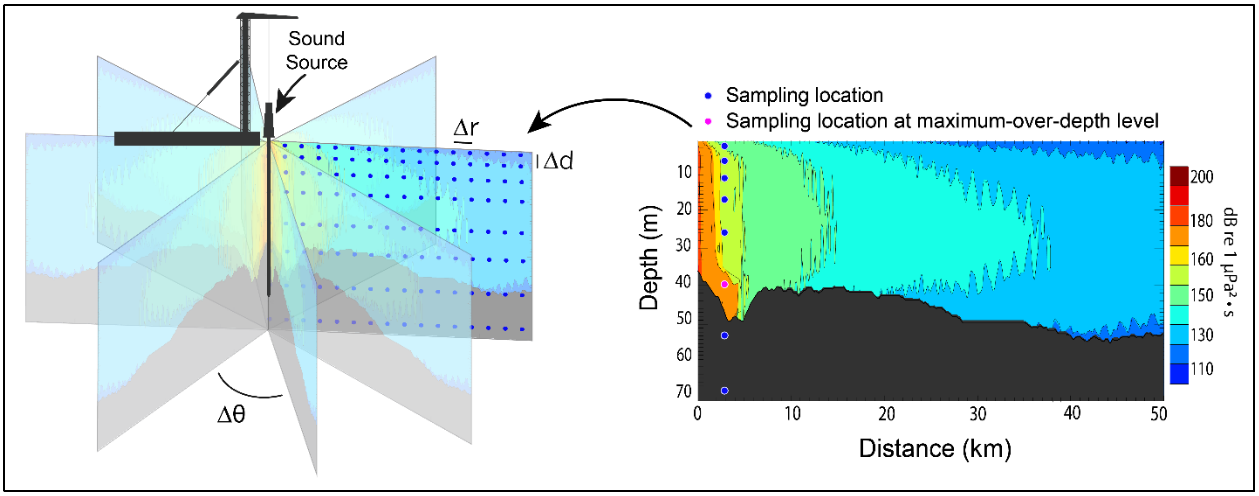

Figure C-2. Modeled three-dimensional sound field (N×2-D method) and maximum-over-depth modeling approach. Sampling locations are shown as blue dots on both figures. On the right panel, the pink dot represents the sampling location where the sound level is maximum over the water column. This maximum-over-depth level is used in calculating distances to sound level thresholds for some marine animals.

ACOUSTIC ENVIRONMENT

Bathymetry

Water depths throughout the modeled areas (Figure 2) were extracted from the SRTM15+ (v7.0) global bathymetry grid, a 30 arc-second grid rendered for the entire globe (Rodríguez et al. 2005). Bathymetry for each modeled location were extracted and re-gridded, by minimum curvature gridding, onto a Universal Transverse Mercator (UTM) Zone coordinate projection with a regular grid spacing of 250 × 250 m.

Geoacoustics

In a shallow environment, interactions between the acoustic field and the seabed are important and accurate geoacoustic profiles are needed for proper acoustic modeling. The interactions between the acoustic field and seabed become negligible in much deeper water. The generic geoacoustic profiles are therefore considered valid for the entire modeled areas around the study sites. The layers as deep as several hundreds of meters can affect the propagation of the low frequency waves. With the increase in frequency of the waves, the importance of deeper layers decreases and for frequencies well above 1 kHz, only the properties of the surficial layer are relevant.

With the absence of the detailed data on the physical properties of the bottom for the modeling area a simplified geoacoustic model is created consisting of one or more layers with constant thickness. The layer interfaces are parallel to the bottom surface. The geoacoustic properties for the modelled sites (Table C-1) were estimated from the average parameters based on the sediment model presented by (Buckingham 2005). The qualitative description of the modeled sediment is provided in Table C-1.

Sound Velocity Profile

The sound speed profiles for the modeled sites were derived from temperature and salinity profiles from the US Naval Oceanographic Office's Generalized Digital Environmental Model V 3.0 (GDEM; Teague et al. 1990, Carnes 2009). 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 US 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 Coppens (1981). Monthly sound velocity profiles for each modeling location in Table C-1 were compared and grouped based on general characteristics of uniform, upward refracting, downward refracting, and the presence of a surface duct. Representative sound velocity profiles were selected for each site and profile group and presented in Table C-1.

Table C-1. Parameters for the modeled environments and source locations for each of the operational regions.

Region	Depth class	Mean water depth in region (m)	Time of Year	Source latitude	Source longitude	Source easting	Source northing	UTM Zone	Water depth at source (m)	Sediment type
Mid-Atlantic Bight	Mid-depth (<200 m)	32	Feb, May, Aug, Nov	37.5947	-74.8532	512958	4160854	18	34.8	Fine sand
Mid-Atlantic Bight	Deep (200-1000 m)	581.3	Feb, May, Aug, Nov	38.4818	-73.2590	651859	4260712	18	746.6	Silty clay
Southern New England	Mid-depth (<200 m)	55.4	Feb, May, Aug, Nov	39.5678	-72.8461	685019	4382000	18	60.4	Silty sand-sand-silty sand
Southern New England	Deep (200-1000 m)	507.6	Feb, May, Aug, Nov	39.9133	-70.8000	346154	4419689	19	529.6	Sand-silt-silty sand
Georges Bank	Mid-depth (<200 m)	71.8	Feb, Jul, Oct	41.1250	-67.0463	664006	4554473	19	63.6	Sand-silt-clay
Gulf of Maine	Mid-depth (<200 m)	123.3	Feb, May, Aug, Nov	43.3500	-70.1333	408150	4800307	19	101.4	Fine sand
Gulf of Maine	Deep (200-1000 m)	224.8	Feb, May, Aug, Nov	43.6166	-67.5783	614713	4830276	19	231.0	Sand-silt-clay
Offshore of NE Continental Shelf	Very deep (>1000 m)	3006.1	Jan, Apr, Aug	39.4128	-68.0757	579568	4362994	19	3128.3	Silty clay
SE Continental Shelf	Shallow (<10 m)	4.9	Jan, May, Sep	33.6193	-78.8529	699178	3722007	17	9.3	Coarse sand
SE Continental Shelf	Mid-depth (10-200 m)	40.2	Jan, May, Sep	30.7268	-80.5979	538496	3399397	17	32.7	Coarse sand
SE Continental Shelf	Deep (200-1000 m)	673.9	Jan, May, Sep	33.5673	-76.2855	380686	3714923	18	588.8	Coarse sand
Offshore of SE Continental Shelf	Very deep (>1000 m)	3613.5	Feb, Aug	35.7508	-72.6680	710859	3958812	18	3993.4	Coarse sand
Gulf of Mexico	Shallow (<10 m)	4.3	Mar, Sep	29.2090	-92.1296	584611	3231451	15	4.6	Coarse sand

Region	Depth class	Mean water depth in region (m)	Time of Year	Source latitude	Source longitude	Source easting	Source northing	UTM Zone	Water depth at source (m)	Sediment type
Gulf of Mexico	Mid-depth (10-200 m)	55.1	Mar, Sep	28.1456	-94.2046	381711	3113921	15	59.8	Silty sand
Gulf of Mexico	Deep (200-1000 m)	562.2	Mar, Sep	27.5753	-92.9326	506650	3050156	15	573.1	Silty clay
Gulf of Mexico	Very deep (>1000 m)	2368.6	Mar, Sep	27.6348	-87.5219	448517	3056858	16	2841.8	Silty clay
Atlantic	Shallow (<10 m)	6.3	Feb, Aug	24.8352	-80.6599	534366	2746748	17	7.1	Coarse sand-limestone
Atlantic	Mid-depth (10-200 m)	145.3	Feb, Aug	24.5390	-80.7623	524079	2713927	17	186.5	Silty sand-limestone
Atlantic	Deep (200-1000 m)	484.8	Feb, Aug	24.8217	-79.9265	608491	2745628	17	793.8	Silty clay-limestone
Caribbean	Shallow waters (<10 m)	5.7	Apr	17.9417	-66.0833	808975	1986156	19	8.2	Coarse sand
Caribbean	Mid-depth waters (10-200 m)	47.7	Apr	18.4151	-65.1397	273983	2037446	20	53.6	Fine sand
Caribbean	Deep (200-1000 m)	634.2	Apr	18.5665	-66.4132	773034	2054821	19	833.0	Sand-silt-clay
Caribbean	Very deep (>1000 m)	4672.3	Apr	16.1882	-67.3597	675354	1790450	19	4741.2	Clay-chalk-limestone
NW Continental Shelf	Shallow (<40 m)	34.9271	Jan, Aug	46.1202	-124.0281	420170	5108081	10	27.3	Silty sand
NW Continental Shelf	Mid-depth (40-200 m)	146.371	Jan, Aug	45.8811	-124.3948	391455	5081936	10	142.4	Clayey silt
NW Continental Shelf	Deep (200-1000 m)	522.757	Jan, Aug	45.8289	-124.7628	362782	5076680	10	468.1	Clay

Region	Depth class	Mean water depth in region (m)	Time of Year	Source latitude	Source longitude	Source easting	Source northing	UTM Zone	Water depth at source (m)	Sediment type
Offshore of NW Continental Shelf	Very deep (>1000 m)	2873.11	Jan, Aug	44.8730	-127.9698	581042	4969444	9	2873.4	Clay
SW Continental Shelf	Shallow (<40 m)	25.4811	Jan, Aug	37.7584	-122.6386	531506	4179148	10	17.8	Silt
SW Continental Shelf	Mid-depth (40-200 m)	81.6679	Jan, Aug	37.6034	-122.8711	511122	4161904	10	80.9	Clayey silt
SW Continental Shelf	Deep (200-1000 m)	599.619	Jan, Aug	37.1791	-122.9640	502942	4114880	10	559.7	Clay
Offshore of SW Continental Shelf	Very deep (>1000 m)	4562.61	Jan, Aug	34.9436	-125.2905	290516	3869276	10	4565.7	Clay
Southern California Bight	Shallow (<40 m)	43.2099	Jan, Aug	33.6692	-118.1843	389948	3726208	11	24.3	Clayey silt
Southern California Bight	Mid-depth (40-200 m)	103.829	Jan, Aug	33.3537	-119.6642	251868	3693800	11	88.8	Sandy silt
Southern California Bight	Deep (200-1000 m)	1641.28	Jan, Aug	32.8963	-118.9432	317999	3641588	11	1706.5	Silty clay
Southern California Bight	Very deep (>1000 m)	4162.58	Mar, Aug	31.1572	-122.4600	551230	3447213	10	4203.7	Clay
Gulf of Alaska	Shallow (<40 m)	29.7873	Apr	59.5724	-153.1316	492188	6603884	5	29.7	Sandy silt
Gulf of Alaska	Mid-depth (40-200 m)	149.487	Feb, May, Jul, Oct	58.5103	-151.3493	595799	6486829	5	159.0	Silt
Gulf of Alaska	Deep (200-1000 m)	412.386	Feb, May, Jul, Oct	57.7399	-149.7447	336207	6403149	6	496.0	Clay
Gulf of Alaska	Very deep (>1000 m)	4754.57	Feb, May, Aug, Nov	56.0760	-149.8199	352916	6219932	6	4756.7	Sand
SE Alaska	Shallow (<40 m)	68.7436	Feb, May, Jul, Dec	55.7083	-133.7089	580743	6174452	8	17.8	Sand

Region	Depth class	Mean water depth in region (m)	Time of Year	Source latitude	Source longitude	Source easting	Source northing	UTM Zone	Water depth at source (m)	Sediment type
SE Alaska	Mid-depth (40-200 m)	144.935	Feb, May, Jul, Dec	55.3571	-134.1236	555167	6134956	8	142.1	Sand-silt-clay
SE Alaska	Deep (200-1000 m)	842.99	Feb, May, Aug, Nov	55.1856	-134.5288	529645	6115704	8	535.9	Clay
SE Alaska	Very deep (>1000 m)	2558.31	Feb, May, Aug, Nov	55.0412	-135.4916	468147	6099589	8	2560.4	Clay
Eastern Bering Sea	Shallow (<40 m)	20.4209	Apr	60.8590	-166.8350	399890	6748568	3	20.6	Sand
Eastern Bering Sea	Mid-depth (40-200 m)	96.4274	Jan, Aug	57.8367	-171.6659	460017	6410868	2	97.1	Silt
Eastern Bering Sea	Deep (200-1000 m)	577.871	Jan, Aug	56.5601	-172.4380	411226	6269460	2	687.3	Clayey silt
Aleutian Islands	Very deep (>1000 m)	4054.28	Jan, Aug	51.7074	-171.1949	486155	5728616	2	4057.5	Clay
Chukchi Sea	Mid-depth (<200 m)	49.77	Aug	69.2817	-167.9131	384499	7688498	3	43.4	Clay-silt
Hawaiian Islands	Mid-depth (<200 m)	77.8535	Jun	23.8290	-166.1610	381572	2635816	3	3.0	Silt-clay
Hawaiian Islands	Deep (200-1000 m)	804.206	Jun	23.8945	-166.5071	346387	2643420	3	717.4	Silt-cla
Hawaiian Islands	Very deep (>1000 m)	3313.23	Jun	24.1842	-166.3916	358413	2675448	3	3264.7	Silt-cla
Marianna Islands	Mid-depth (<200 m)	621.351	Jun	12.7690	144.3530	212510	1413101	55	51.6	Silt-cla
Marianna Islands	Deep (200-1000 m)	727.148	Jun	13.3771	144.8568	267732	1479927	55	780.2	Sand-silt-clay
Marianna Islands	Very deep (>1000 m)	5189.39	Jun	13.5941	146.0131	393104	1503113	55	5314.2	Silt-clay

Region	Depth class	Mean water depth in region (m)	Time of Year	Source latitude	Source longitude	Source easting	Source northing	UTM Zone	Water depth at source (m)	Sediment type
Samoa	Mid-depth (<200 m)	1001.65	Jun	-14.2312	-170.5529	548306	8426605	2	83.9	Silt-clay
Samoa	Deep (200-1000 m)	1301.54	Jun	-14.1282	-169.6637	644362	8437628	2	558.7	Silt-clay
Samoa	Very deep (>1000 m)	4912.22	Jun	-13.4724	-169.7600	634325	8510196	2	5001.4	Sand-silt-clay

Animal Movement Modeling

The JASCO Animal Simulation Model Including Noise Exposure (JASMINE) was used to predict the probability of exposure of animals to sound arising from proposed project activities. Sound exposure models such as JASMINE use simulated animals (animats) to sample the predicted 3-D sound fields with movement rules derived from animal observations (see below). The parameters used for forecasting realistic behaviors (e.g., diving, foraging, aversion, and surface times) are determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species. With animats programmed to behave like marine species that may be present near a project area, the predicted sound fields are sampled in a way that real animals are expected to experience (Figure C-4). The output of the simulation is the exposure history for each animat within the simulation. An individual animat's sound exposure levels are summed over a specified duration, i.e., 24 hours, to determine its total received acoustic energy (SEL) and maximum received PK and SPL. These received levels are then compared to the threshold criteria (see Appendix B). The number of animats predicted to receive sound levels exceeding the thresholds indicates the probability of such exposures and can be interpreted as the percentage of the population expected to exceed threshold or scaled by the real-world density estimates for each species to obtain the mean number of real-world animals expected to receive above-threshold sound levels. A fuller description of animal movement modeling and the parameters used in the JASMINE simulations is provided below.

Animal Movement and Exposure Modeling

To assess the risk of impacts from exposure, an estimate of received sound levels for the animals in the area during operation of the project is required. Animals move and sound fields may be complex. The sound received by an animal is a function of where the animal is at any given time. To a reasonable approximation, the location of the sound source(s) is known, and acoustic modeling can be used to predict the 3D sound field. The location and movement of animals within the sound field, however, is unknown. Realistic animal movement within sound fields can be simulated. Repeated random sampling (Monte Carlo method simulating many animals within the operations area) is used to estimate the sound exposure history of the population of simulated animals (animats) during operations.

Monte Carlo methods provide a heuristic approach for determining the probability distribution function (PDF) of complex situations, such as animals moving in a sound field. The probability of an event's occurrence is determined by the frequency with which it occurs in the simulation. The greater the number of samples, in this case the more animats, the better the approximation of the PDF. Animats are randomly placed, or seeded, within the simulation boundary at a specified density (animats/km^2). Higher densities provide a finer PDF estimate resolution but require more computational resources. To ensure good representation of the PDF, the animat density is set as high as practical allowing for computation time (1 animat/km^2 in this study). The animat density is generally much higher than the real-world density to ensure good representation of the PDF. Typically, the resulting PDF is scaled using the real-world density to determine the number of real-world animals expected to exceed a threshold.

Several models for marine mammal movement have been developed (Ellison et al. 1987, Frankel et al. 2002, Houser 2006). These models use an underlying Markov chain to transition from one state to another based on probabilities determined from measured swimming behavior. The parameters may represent simple states, such as the speed or heading of the animal, or complex states, such as likelihood of participating in foraging, play, rest, or travel. Attractions and aversions to variables like anthropogenic sounds and different depth ranges can be included in the models.

JASMINE was based on the open-source marine mammal movement and behavior model (3 MB; Houser 2006) and used to predict the exposure of animats (virtual marine mammals) to sound arising from sound sources in simulated representative surveys. Inside JASMINE, the sound source location mimics the movement of the source vessel through the proposed survey pattern. Animats are programmed to behave like the marine animals likely to be present in the survey area. The parameters used for forecasting realistic behaviors (e.g., diving, foraging, aversion, and surface times.) are determined and interpreted from marine species studies (e.g., tagging studies) where available, or reasonably extrapolated from related species. An individual animat's modeled sound exposure levels are summed over the total simulation duration, such as 24 hours or the entire simulation, to determine its total received energy and then compared to the assumed threshold criteria.

Animal Movement Parameters

JASMINE uses previously measured behavior to forecast behavior in new situations and locations. The parameters used for forecasting realistic behavior are determined (and interpreted) from marine species studies (e.g., tagging studies). Each parameter in the model is described as a probability distribution. When limited or no information is available for a species parameter, a Gaussian or uniform distribution may be chosen for that parameter. For the Gaussian distribution, the user determines the mean and standard deviation of the distribution from which parameter values are drawn. For the uniform distribution, the user determines the maximum and minimum distribution from which parameter values are drawn. When detailed information about the movement and behavior of a species are available, a user-created distribution vector, including cumulative transition probabilities, may be used (referred to here as a vector model; Houser, 2006). Different sets of parameters can be defined for different behavior states. The probability of an animat starting out in or transitioning into a given behavior state can in turn be defined in terms of the animat's current behavioral state, depth, and the time of day. In addition, each travel parameter and behavioral state has a termination function that governs how long the parameter value or overall behavioral state persists in simulation.

The parameters used in JASMINE describe animal movement in both the vertical and horizontal planes. The parameters relating to travel in these two planes are briefly described below. (The species-specific parameters used in this study are listed below).

Travel sub-models

- **Direction**: determines an animat's choice of direction in the horizontal plane. Sub-models are available for determining the heading of animats, allowing for movement to range from strongly biased to undirected. A random walk model can be used for behaviors with no directional preference, such as feeding and playing. In a random walk, all bearings are equally likely at each parameter transition time step. A correlated random walk can be used to smooth the changes in bearing by using the current heading as the mean of the distribution from which to draw the next heading. An additional variant of the correlated random walk is available that includes a directional bias for use in situations where animals have a preferred absolute direction, such as migration. A user-defined vector of directional probabilities can also be input to control animat heading. For more detailed discussion of these parameters, see Houser (2006) and Houser and Cross (1999).
- **Travel rate**: defines an animat's rate of travel in the horizontal plane. When combined with vertical speed and dive depth, the dive profile of the animat is produced.

Dive sub-models

- **Ascent rate**: defines an animat's rate of travel in the vertical plane during the ascent portion of a dive.
- **Descent rate**: defines an animat's rate of travel in the vertical plane during the descent portion of a dive.
- **Depth**: defines an animat's maximum dive depth.
- **Bottom following**: determines whether an animat returns to the surface once reaching the ocean floor, or whether it follows the contours of the bathymetry.
- **Reversals**: determines whether multiple vertical excursions occur once an animat reaches the maximum dive depth. This behavior is used to emulate the foraging behavior of some marine mammal species at depth. Reversal-specific ascent and descent rates may be specified.
- **Surface interval**: determines the duration an animat spends at, or near, the surface before diving again.

Exposure Integration Time

The interval over which acoustic exposure (SEL) should be integrated and maximal exposure (SPL) determined is not well defined. Both Southall et al. (2007)and the NMFS (2018) recommend a 24-hour accumulation period but state that there may be situations where this is not appropriate (e.g., a high-level source and confined population). Resetting the integration after 24 hours can lead to overestimating the number of individual animals exposed because individuals can be counted multiple times during an operation. The type of animal movement engine used in this study simulates realistic movement using swimming behavior collected over relatively short periods (hours to days) and does not include large-scale movement such as migratory circulation patterns. Therefore, the simulation time is limited to a few weeks, the approximate scale of the collected data (Houser 2006). For this study, three-day simulations (i.e., 72 hours) were modeled for each scenario. The average number of animats exposed above each threshold considered was calculated for each 24 hour period of the three day simulation.

Ideally, a simulation area is large enough to encompass the entire range of a population so that any animal that could approach the survey area during an operation is included. However, there are limits to the simulation area, and computational overhead increases with area. For practical reasons, the simulation area is limited in this analysis to a maximum distance of 30 km (18.6 miles) from the simulated survey. To represent the most impactful scenarios, simulations were designed so that survey activities overlapped species range (Figure C-3). In the simulation, every animat that reaches a border is replaced by another animat entering at the opposing border, e.g., an animat crossing the northern border of the simulation is replaced by one entering the southern border at the same longitude. When this action places the animat in an inappropriate water depth, the animat is randomly re-seeded in a location suited to its species definition. The exposures of all animats (including those leaving the simulation and those entering) are kept for analysis. This approach maintains a consistent animat density and allows for longer integration periods in simulation areas smaller than the population's range.

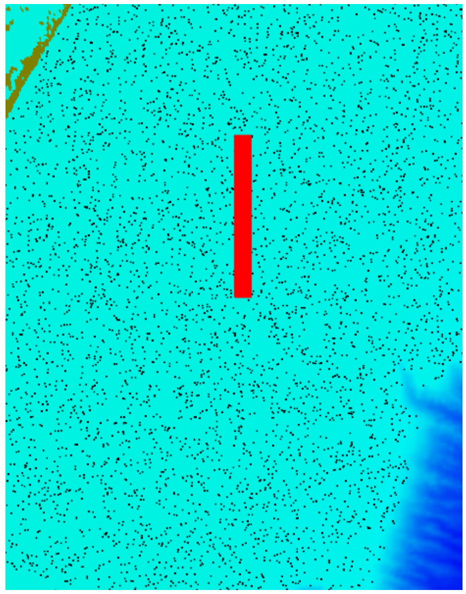

Figure C-3. Example animat seeding and source tracks for the Mid-Atlantic region. Atlantic spotted dolphin.

Marine Mammal Species-Specific Details

The parameters used to create marine mammal animat movement in JASMINE for each species are listed below. Table C-2 through Table C-38 show the behavioral state, variable within the behavioral state, the value/distribution/range of the variable, and the source for determining the variable. Note that different species may have different behavioral states.

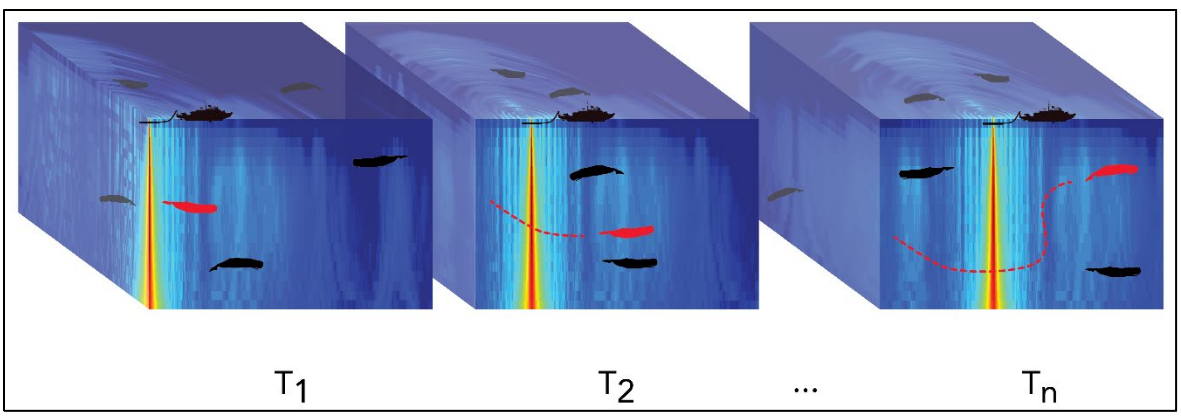

Figure C-4. Graphic of animats in a moving sound field. Example animat (red) shown moving with each time step. The acoustic exposure of each animat is determined by where it is in the sound field, and its exposure history is accumulated as the simulation steps through time.

There are several species of marine mammals that may be present in the vicinity of the proposed survey locations, including several endangered species (sperm whales and several mysticetes), and the critically endangered North Atlantic right whales. Details for each of the marine mammal species evaluated in this study are listed below.

Table C-2. *Atlantic spotted dolphins*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Behavior1	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Random 0.08 - 5.69	Davis et al. (1996)
	Ascent rate (m/s)	Gaussian 1.15 (0.8)	Davis et al. (1996)
	Descent rate (m/s)	Gaussian 1.23 (0.48)	Davis et al. (1996)
	Dive depth (m)	Random 0.0 - 60.0	Davis et al. (1996)
	Bottom following	Yes	Griffin et al. (2005)
	Reversals	Gaussian 2.0 (2.0)	Griffin et al. (2005)
	Probability of reversal	0.5	Approximated (Davis et al. 1996)
	Reversal ascent dive rate (m/s)	Gaussian 1.15 (0.8)	Davis et al. (1996)
	Reversal descent dive rate (m/s)	Gaussian 1.23 (0.48)	Davis et al. (1996)
	Time in reversal (s)	Gaussian 20.81 (21.5)	Griffin et al. (2005)
	Surface interval (s)	Gaussian 63.59 (52.66)	Griffin et al. (2005)
General	Shore following (m)	4	Davis et al. (1996)
	Depth limit on seeding (m)	4.0 (minimum), 250.0 (maximum)	Davis et al. (1996)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-3. *Atlantic white-sided dolphin*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10.0	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.58 (1.02)	Mate et al. (1994)
	Ascent rate (m/s)	Gaussian 0.42 (0.24)	Spotted dolphin value (Scott and Chivers 2009)
	Descent rate (m/s)	Gaussian 0.58 (0.34)	Spotted dolphin value (Scott and Chivers 2009)
	Average depth (m)	Gaussian 22.1 (15.71)	Spotted dolphin value (Scott and Chivers 2009)
	Bottom following	Yes	Approximated spotted dolphin value (Scott and Chivers 2009)
	Reversals	Not implemented	Approximated spotted dolphin value (Scott and Chivers 2009)
	Surface interval (s)	Gaussian 68.4 (304.8)	Spotted dolphin value–(Scott and Chivers 2009)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated spotted dolphin value (Scott and Chivers 2009)
Night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10.0	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.58 (1.02)	Mate et al. (1994)
	Ascent rate (m/s)	Gaussian 0.74 (0.41)	Spotted dolphin value (Scott and Chivers 2009)
	Descent rate (m/s)	Gaussian 0.93 (0.54)	Spotted dolphin value (Scott and Chivers 2009)

Behavior	Variable	Value	Reference
	Average depth (m)	Gaussian 24.0 (27.1)	Spotted dolphin value (Scott and Chivers 2009)
	Bottom following	Not implemented	Approximated spotted dolphin value (Scott and Chivers 2009)
	Reversals	Gaussian 3.0 (1.0)	Approximated spotted dolphin value (Scott and Chivers 2009)
	Probability of reversal	0.5	Approximated spotted dolphin value (Scott and Chivers 2009)
	Reversal ascent dive rate (m/s)	Gaussian 0.74 (0.41)	Spotted dolphin value (Scott and Chivers 2009)
	Reversal descent dive rate (m/s)	Gaussian 0.93 (0.54)	Spotted dolphin value (Scott and Chivers 2009)
	Time in reversal (s)	Gaussian 39.0 (55.2)	Spotted dolphin value (Scott and Chivers 2009)
	Surface interval (s)	Gaussian 49.8 (108.6)	Spotted dolphin value (Scott and Chivers 2009)
	Bout duration (s)	Sigmoidal $T_{50} = 3600$, k = 7	Approximated spotted dolphin value (Scott and Chivers 2009)
General	Shore following (m)	2	Approximated spotted dolphin value (Scott and Chivers 2009)
	Depth limit on seeding (m)	2 (minimum), 300 (maximum)	Approximated spotted dolphin value (Scott and Chivers 2009)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-4. *Beluga whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Foraging	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser (2006)
	Termination coefficient	0.2	Houser (2006)
	Travel rate (m/s)	Random 0.4 - 0.6	Martin et al. (1998)
	Ascent rate (m/s)	Gaussian 1.7 (0.02)	Martin et al. (1998)
	Descent rate (m/s)	Gaussian 1.68 (0.04)	Martin et al. (1998)
	Dive depth (m)	Random 40.0 – 956.0	Hauser et al. (2015)
	Bottom following	Not implemented	Not implemented
	Reversals	Not implemented	Martin et al. (1998)
	Surface interval (s)	Gaussian 43.8 (2.0)	Frost et al. (1985)
	Bout duration (s)	Gaussian 21600.0 (1800.0)	Approximated
Travel	Travel direction	Vector model	Proxy: Bottlenose dolphin
	Travel rate (m/s)	Vector model	Proxy: Bottlenose dolphin
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Proxy: Bottlenose dolphin
	Descent rate (m/s)	Gaussian 1.6 (0.2)	Proxy: Bottlenose dolphin
	Dive depth (m)	Gaussian 7.0 (3.0)	Proxy: Bottlenose dolphin
	Bottom following	Not implemented	Not implemented
	Reversals	Not implemented	Averaged over dive profiles (Martin et al. 1998)
	Surface interval (s)	Gaussian 3.0 (2.0)	Frost et al. (1985)
	Bout duration (s)	Gaussian 21600.0 (1800.0)	Approximated
General	Shore following (m)	2	Approximated
	Depth limit on seeding (m)	2.0 (minimum), 11000.0 (maximum)	Approximated

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-5. *Blainville's beaked whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep Foraging Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.34 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.7 (0.1)	Tyack et al. (2006)
	Descent rate (m/s)	Gaussian 1.6 (0.2)	Baird et al. (2006b)
	Dive depth (m)	Gaussian 1408.0 (210.0)	Tyack et al. (2006)
	Bottom following	Yes	Baird et al. (2006b)
	Reversals	Gaussian 6.0 (2.0)	Tyack et al. (2006)
	Probability of reversal	0.9	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.7 (0.2)	Tyack et al. (2006)
	Reversal descent dive rate (m/s)	Gaussian 1.5 (0.1)	Approximated
	Time in reversal (s)	Gaussian 40.0 (20.0)	Madsen et al. (2005)
	Surface interval (s)	Gaussian 1200.0 (996.0)	Madsen et al. (2005)
	Bout duration (s)	Sigmoidal T_{50} = 3534, k = 10	Tyack et al. (2006)
Shallow Dive - day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.37 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.3 (0.2)	Tyack et al. (2006) Baird et al. (2006b)
	Descent rate (m/s)	Gaussian 0.3 (0.2)	Baird et al. (2006b)
	Dive depth (m)	Gaussian 304.0 (61.0)	Tyack et al. (2006) Baird et al. (2006b)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 126.0 (500.0)	Tyack et al. (2006)
	Bout duration (s)	Gaussian 3780 (1860)	Tyack et al. (2006)
	Travel direction	Correlated random walk	Approximated

Behavior	Variable	Value	Reference
Shallow Dive – night	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.32 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.3 (0.2)	Tyack et al. (2006) Baird et al. (2006b)
	Descent rate (m/s)	Gaussian 0.3 (0.2)	Tyack et al. (2006) Baird et al. (2006b)
	Dive depth (m)	Gaussian 241.0 (61.0)	Tyack et al. (2006)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 144.0 (2000.0)	Tyack et al. (2006)
	Bout duration (s)	Gaussian 3780 (1860)	Tyack et al. (2006)
General	Shore following (m)	10	10
	Depth limit on seeding (m)	633.0 (minimum), 80000.0 (maximum)	Baird et al. (2006) Waring et al. (2001)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-6. *Blue whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Non-foraging (deep)	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 2.78 (1.39)	Sears and Perrin (2009)
	Ascent rate (m/s)	Gaussian 2.1 (0.52)	Croll et al. (2001)
	Descent rate (m/s)	Gaussian 2.2 (0.38)	Croll et al. (2001)
	Dive depth (m)	Gaussian 154.3 (38.8)	Croll et al. (2001)
	Bottom following	Not implemented	Approximated Watwood and Buonantony (2012)
	Reversals	Gaussian 1.5 (0.5)	Acevedo-Gutierrez et al. (2002)
	Probability of reversal	0.7	Approximated Watwood and Buonantony (2012)
	Reversal ascent dive rate (m/s)	Gaussian 0.7 (0.2)	Watwood and Buonantony (2012)
	Reversal descent dive rate (m/s)	Gaussian 0.7 (0.2)	Watwood and Buonantony (2012)
	Time in reversal (s)	Gaussian 90.0 (30.0)	Acevedo-Gutierrez et al. (2002)
	Surface interval (s)	Gaussian 78.0 (30.2)	Acevedo-Gutierrez et al. (2002)
	Bout duration (s)	Gaussian 600 (120): 1900 - 0600 hr Gaussian 3600 (420): 0600 - 1900 hr	Approximated Watwood and Buonantony (2012)
Non-foraging (shallow)	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 2.78 (1.39)	Sears and Perrin (2009)
	Ascent rate (m/s)	Gaussian 2.1 (0.52)	Croll et al. (2001)
	Descent rate (m/s)	Gaussian 2.2 (0.38)	Croll et al. (2001)
	Dive depth (m)	Gaussian 154.3 (38.8)	Croll et al. (2001)

Behavior	Variable	Value	Reference
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 1.5 (0.5)	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 78.0 (30.2)	Acevedo-Gutierrez et al. (2002)
	Bout duration (s)	Gaussian 600 (120): 1900 - 0600 hr Gaussian 3600 (420): 0600 - 1900 hr	Approximated (Watwood and Buonantony 2012)
Foraging	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.25 (0.42)	Sears and Perrin (2009)
	Ascent rate (m/s)	Gaussian 1.6 (0.5)	Goldbogen et al. (2011)
	Descent rate (m/s)	Gaussian 2.6 (0.5)	Goldbogen et al. (2011)
	Dive depth (m)	Gaussian 201.0 (52.0)	Goldbogen et al. (2011)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 3.5 (1.1)	Goldbogen et al. (2011)
	Probability of reversal	0.7	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	Gaussian 2.4 (0.9)	Croll et al. (2001)
	Reversal descent dive rate (m/s)	Gaussian 1.5 (0.4)	Croll et al. (2001)
	Time in reversal (s)	Gaussian 300.0 (60.0)	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 162.0 (66.0)	Goldbogen et al. (2011)
	Bout duration (s)	Gaussian 3600.0 (1800.0)	Approximated (Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
General	Shore following (m)	200	Approximated (Branch et al. 2007)
	Depth limit on seeding (m)	200.0 (minimum), 8000.0 (maximum)	Approximated (Branch et al. 2007)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-7. *Bottlenose dolphin*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Foraging	Travel direction	Vector model	Ward (1999)
	Travel rate (m/s)	Vector model	Ward (1999)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Houser et al. (2010)
	Descent rate (m/s)	Gaussian 1.6 (0.2)	Houser et al. (2010)
	Dive depth (m)	Gaussian 25 (5)	Hastie et al. (2006)
	Bottom following	Yes	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 2.0 (2.0)	Approximated
	Probability of reversal	0.5	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 1.15 (0.8)	(Houser 2006)
	Reversal descent dive rate (m/s)	Gaussian 1.23 (0.48)	(Houser 2006)
	Time in reversal (s)	Gaussian 20.81 (21.5)	(Houser 2006)
	Surface interval (s)	Gaussian 63.59 (52.66)	(Houser 2006)
	Bout duration (s)	Gaussian 252 (210)	Ward (1999)
Playing	Travel direction	Vector model	Ward (1999)
	Travel rate (m/s)	Vector model	Ward (1999)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Houser et al. (2010)
	Descent rate (m/s)	Gaussian 1.6 (0.2)	Houser et al. (2010)
	Average depth (m)	Gaussian 7 (3)	Würsig and Würsig (1979), Hastie et al. (2006)
	Bottom following	Yes	Approximated (Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 3 (2)	Approximated (Watwood and Buonantony 2012)
	Bout duration (s)	Gaussian 138 (54)	Ward (1999)
Resting	Travel direction	Vector model	Ward (1999)
	Travel rate (m/s)	Vector model	Ward (1999)
	Ascent rate (m/s)	Gaussian 0.5 (0.1)	Approximated (Watwood and Buonantony 2012)
	Descent rate (m/s)	Gaussian 0.5 (0.1)	Approximated (Watwood and Buonantony 2012)
	Dive depth (m)	Random, max = 2	Approximated (Watwood and Buonantony 2012)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 3 (2)	Approximated (Watwood and Buonantony 2012)
	Bout duration (s)	Gaussian 174 (96)	Ward (1999)
Socializing	Travel direction	Vector model	Ward (1999)
	Travel rate (m/s)	Vector model	Ward (1999)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Houser et al. (2010)
	Descent rate (m/s)	Gaussian 1.6 (0.2)	Houser et al. (2010)

Behavior	Variable	Value	Reference
	Dive depth (m)	Random, max = 10	Hastie et al. (2006) Würsig and Würsig (1979)
	Bottom following	Yes	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 3 (2)	Approximated (Watwood and Buonantony 2012)
	Bout duration (s)	Gaussian 204 (174)	Ward (1999)
Travel	Travel direction	Vector model	Ward (1999)
	Travel rate (m/s)	Vector model	Ward (1999)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Houser et al. (2010)
	Descent rate (m/s)	Gaussian 1.6 (0.2)	Houser et al. (2010)
	Average depth (m)	Gaussian 7 (3)	Hastie et al. (2006) Würsig and Würsig (1979)
	Bottom following	Yes	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 3 (2)	Approximated (Watwood and Buonantony 2012)
	Bout duration	Gaussian 306 (276)	Ward (1999)

Behavior	Variable	Value	Reference
General	Shore following (m)	2.1	Approximated (Watwood and Buonantony 2012)
	Depth limit on seeding (m)	2.1 (minimum), 1000 (maximum)	Approximated (Watwood and Buonantony 2012)

Approximated: Value based on the best fit for diving profile. Those values were not available from literature but were estimated producing a diving profile similar to D-tag results for example.

Table C-8. *Bryde's whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Random 0.8 - 1.53	Murase et al. (2015)
	Ascent rate (m/s)	Gaussian 0.95 (0.55)	Alves et al. (2010)
	Descent rate (m/s)	Gaussian 1.25 (0.4)	Alves et al. (2010)
	Dive depth (m)	Gaussian 134.0 (61.5)	Alves et al. (2010)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 1.5 (1.5)	Alves et al. (2010)
	Probability of reversal	0.7	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.95 (0.55)	Alves et al. (2010)
	Reversal descent dive rate (m/s)	Gaussian 1.25 (0.4)	Alves et al. (2010)
	Time in reversal (s)	Gaussian 50.1 (45.3)	Alves et al. (2010)
	Surface interval (s)	Random 120.0 - 300.0	Alves et al. (2010)
	Bout duration (s)	Gaussian 600 (120): 1900 - 0600 h Gaussian 3600 (420): 0600 - 1900 h	Approximated
Shallow	Travel direction	Correlated random walk	Ward (1999)
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Random 0.8 - 1.53	Murase et al. (2015)
	Ascent rate (m/s)	Gaussian 0.95 (0.55)	Alves et al. (2010)
	Descent rate (m/s)	Gaussian 1.25 (0.4)	Alves et al. (2010)
	Dive depth (m)	Random 1.0 - 40.0	Alves et al. (2010)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated

Behavior	Variable	Value	Reference
	Surface interval (s)	Random 141.0 - 236.0	Di Sciara (1983)
	Bout duration (s)	Gaussian 0 (0): 1900 - 0600 h Gaussian 3600 (420): 0600 - 1900 h	Approximated
General	Shore following (m)	20	Gonçalves et al. (2016)
	Depth limit on seeding (m)	20.0 (minimum), 3000.0 (maximum)	Gonçalves et al. (2016)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-9. *Cuvier's beaked whale*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep Foraging Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.5 (0.5)	Approximated (Schorr et al. 2009)
	Ascent rate (m/s)	Gaussian 0.69 (0.19)	Baird et al. (2006b), Tyack et al. (2006)
	Descent rate (m/s)	Gaussian 1.47 (0.13)	Baird et al. (2006b), Tyack et al. (2006)
	Dive depth (m)	Gaussian 1070.0 (317.0)	Tyack et al. (2006)
	Bottom following	Not implemented	(Baird et al. 2006b)
	Reversals	Gaussian 20.0 (2.0)	Approximated (Baird et al. 2006b)
	Probability of reversal	0.95	Approximated (Baird et al. 2006b)
	Reversal ascent dive rate (m/s)	Gaussian 0.8 (0.2)	Approximated (Baird et al. 2006b)
	Reversal descent dive rate (m/s)	Gaussian 0.8 (0.2)	Approximated (Baird et al. 2006b)
	Time in reversal (s)	Gaussian 40.0 (20.0)	Tyack et al. (2006)
	Surface interval (s)	Gaussian 474.0 (996.0)	Baird et al. (2006b)
	Bout duration (s)	Sigmoidal T50 = 1200.0, k = 10.0	MacLeod and D'Amico (2006)
Shallow Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.5 (0.5)	Approximated (Schorr et al. 2009)
	Ascent rate (m/s)	Gaussian 0.61 (0.2)	Baird et al. (2006b), Tyack et al. (2006)
	Descent rate (m/s)	Gaussian 0.53 (0.24)	Baird et al. (2006b), Tyack et al. (2006)

Behavior	Variable	Value	Reference
	Dive depth (m)	Gaussian 221.0 (100.0)	Tyack et al. (2006)
	Bottom following	Not implemented	(Baird et al. 2006b)
	Reversals	Not implemented	Tyack et al. (2006)
	Surface interval (s)	Gaussian 474.0 (996.0)	(Baird et al. 2006b)
	Bout duration (s)	Gaussian 3780.0 (1860.0)	Tyack et al. (2006)
General	Shore following (m)	1000	(Baird et al. 2006b)
	Depth limit on seeding (m)	1381 (minimum), 80000.0 (maximum)	(Baird et al. 2006b)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-10. ***Manatee*****: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).**

Behavior	Variable	Value	Reference
Feeding	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser (2006)
	Termination coefficient	0.2	Houser (2006)
	Travel rate (m/s)	Gaussian 0.42 (0.12)	Approximated, based on Deutsch (2003)
	Ascent rate (m/s)	Gaussian 0.28 (0.1)	**Chilvers et al. (2004)** (s.d.: best guess)
	Descent rate (m/s)	Gaussian 0.57 (0.1)	**Chilvers et al. (2004)** (s.d.: best guess)
	Dive depth (m)	Gaussian 3.0 (5.0)	**Chilvers et al. (2004)** (s.d.: best guess)
	Bottom following	Not implemented	Not implemented
	Reversals	Random 3.0 - 5.0	Approximated
	Probability of reversal	0.3	Approximated
	Reversal ascent dive rate (m/s)	Random 0.01 - 0.02	Approximated
	Reversal descent dive rate (m/s)	Random 0.01 - 0.02	Approximated
	Time in reversal (s)	Random 10.0 - 66.0	Whiting (2002)
	Surface interval (s)	Gaussian 13.0 (1.0)	Whiting (2002)
	Bout duration (s)	Sigmoidal T_{50} = 1200, k = 10	Approximated
Travelling-Migrating	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.32 (0.12)	Deutsch et al. 2003
	Ascent rate (m/s)	Gaussian 0.24 (0.1)	**Chilvers et al. (2004)** (s.d.: best guess)
	Descent rate (m/s)	Gaussian 0.24 (0.1)	**Chilvers et al. (2004)** (s.d.: best guess)
	Dive depth (m)	Gaussian 5.0 (3.0)	**Chilvers et al. (2004)** (s.d.: best guess)

Behavior	Variable	Value	Reference
	Bottom following	Not implemented	Not implemented
	Reversals	Random 3.0 - 5.0	Approximated
	Probability of reversal	0.3	Approximated
	Reversal ascent dive rate (m/s)	Random 0.01 - 0.02	Approximated
	Reversal descent dive rate (m/s)	Random 0.01 - 0.02	Approximated
	Time in reversal (s)	Random 10.0 - 66.0	Whiting (2002)
	Surface interval (s)	Gaussian 13.0 (1.0)	Whiting (2002)
	Bout duration (s)	Gaussian 3780 (1860)	Approximated
General	Shore following (m)	1	Hodgson (2004)
	Depth limit on seeding (m)	1.0 (minimum), 40.0 (maximum)	Marsh et al. (2012)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-11. *Dwarf sperm whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep Foraging Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser et al. (2006)
	Termination coefficient	0.2	Houser et al. (2006)
	Travel rate (m/s)	Gaussian 1.5 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.69 (0.19)	(weighted from Baird et al. 2006b, Tyack et al. 2006)
	Descent rate (m/s)	Gaussian 1.47 (0.13)	(weighted from Baird et al. 2006b, Tyack et al. 2006)
	Dive depth (m)	Gaussian 1070.0 (317.0)	(Tyack et al. 2006)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 10.0 (2.0)	**(Best estimate from Tyack et al. 2006)**
	Probability of reversal	0.95	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.8 (0.2)	(Approximated based on Blainville' s beaked whale data in Madsen et al. 2005)
	Reversal descent dive rate (m/s)	Gaussian 0.8 (0.2)	Not implemented
	Time in reversal (s)	Gaussian 40.0 (20.0)	**(Best estimate from Tyack et al. 2006)**
	Surface interval (s)	Gaussian 474.0 (996.0)	**(Tyack et al. 2006)**
	Bout duration (s)	Sigmoidal T_{50} = 1200.0, k = 10.0	Approximated
Shallow Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser et al. (2006)
	Termination coefficient	0.2	Houser et al. (2006)
	Travel rate (m/s)	Gaussian 1.5 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.61 (0.2)	(weighted from Baird et al. 2006b, Tyack et al. 2006)
	Descent rate (m/s)	Gaussian 0.53 (0.24)	(weighted from Baird et al. 2006b, Tyack et al. 2006)
	Dive depth (m)	Gaussian 221.0 (100.0)	**(Tyack et al. 2006)**

Behavior	Variable	Value	Reference
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 474.0 (996.0)	**(Tyack et al. 2006)**
	Bout duration (s)	Gaussian 3780.0 (1860.0)	**(Tyack et al. 2006)**
General	Shore following (m)	200	Kaschner et al. (2006)
	Depth limit on seeding (m)	200.0 (minimum), 11000.0 (maximum)	Kaschner et al. (2006)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-12. *False Killer whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Behavior 1	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser et al. (2006)
	Termination coefficient	0.2	Houser et al. (2006)
	Travel rate (m/s)	Random 0.08 - 5.69	Approximated from Atlantic spotted dolphin (Davis et al. 1996)
	Ascent rate (m/s)	Gaussian 1.15 (0.8)	Approximated from Atlantic spotted dolphin (Griffin et al. 2005)
	Descent rate (m/s)	Gaussian 1.23 (0.48)	Approximated from Atlantic spotted dolphin (Griffin et al. 2005)
	Dive depth (m)	Random 1.0 - 60.0	Approximated from Atlantic spotted dolphin (Davis et al. 1996)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 2.0 (2.0)	Approximated
	Probability of reversal	0.5	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 1.15 (0.8)	Approximated from Atlantic spotted dolphin (Griffin et al. 2005)
	Reversal descent dive rate (m/s)	Gaussian 1.23 (0.48)	Approximated from Atlantic spotted dolphin (Griffin et al. 2005)
	Time in reversal (s)	Gaussian 20.81 (21.5)	Approximated from Atlantic spotted dolphin (Griffin et al. 2005)
	Surface interval (s)	Gaussian 63.59 (52.66)	Approximated from Atlantic spotted dolphin (Griffin et al. 2005)
General	Shore following (m)	100	(Baird 2018)
	Depth limit on seeding (m)	100.0 (minimum), 8000.0 (maximum)	(Baird 2018); approximated

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-13. *Fin whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Non-foraging shallow	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.6 (0.6)	Lafortuna et al. (2003)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Croll et al. (2001)
	Descent rate (m/s)	Gaussian 3.0 (0.2)	Croll et al. (2001)
	Dive depth (m)	Gaussian 46.0 (4.8)	Croll et al. (2001)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 3.1 (1.1)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	0.95	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	Gaussian 1.7 (0.4)	Approximated (Croll et al. 2001)
	Reversal descent dive rate (m/s)	Gaussian 1.4 (0.5)	Approximated (Croll et al. 2001)
	Time in reversal (s)	Gaussian 13.7 (2.8)	Approximated (Croll et al. 2001)
	Surface interval (s)	Gaussian 123.8 (42.3)	Acevedo-Gutierrez et al. (2002)
	Bout duration (s)	Sigmoidal $T_{50} = 10$, k = 10	Approximated (Watwood and Buonantony 2012)
Non-foraging Deep	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.7 (0.5)	Lafortuna et al. (2003)
	Ascent rate (m/s)	Gaussian 1.7 (0.4)	Croll et al. (2001)

Behavior	Variable	Value	Reference
	Descent rate (m/s)	Gaussian 2.0 (0.2)	Croll et al. (2001)
	Dive depth (m)	Gaussian 120 (33.5)	Croll et al. (2001)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 80 (19.2)	Acevedo-Gutiérrez et al. (2002)
	Bout duration (s)	Sigmoidal T_{50} = 15, k = 15	Approximated (Watwood and Buonantony 2012)
Foraging Shallow	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.6 (0.6)	Goldbogen et al. (2006)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Goldbogen et al. (2006)
	Descent rate (m/s)	Gaussian 3.0 (0.2)	Goldbogen et al. (2006)
	Dive depth (m)	Gaussian 46.0 (4.8)	Croll et al. (2001)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 3.1 (1.1)	Croll et al. (2001) Goldbogen et al. (2006)
	Probability of reversal	0.95	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	Gaussian 1.7 (0.4)	Croll et al. (2001)
	Reversal descent dive rate (m/s)	Gaussian 1.4 (0.5)	Croll et al. (2001)
	Time in reversal (s)	Gaussian 13.7 (2.8)	Croll et al. (2001)

Behavior	Variable	Value	Reference
	Surface interval (s)	Gaussian 123.8 (42.3)	Acevedo-Gutiérrez et al. (2002)
	Bout duration (s)	Sigmoidal T_{50} = 30, k = 15	Approximated (Watwood and Buonantony 2012)
Foraging Deep	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.6 (0.6)	Goldbogen et al. (2006)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Goldbogen et al. (2006)
	Descent rate (m/s)	Gaussian 3.0 (0.2)	Goldbogen et al. (2006)
	Dive depth (m)	Gaussian 248.0 (18.0)	Goldbogen et al. (2006)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 3.1 (1.1)	Croll et al. (2001) Goldbogen et al. (2006)
	Probability of reversal	0.95	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	Gaussian 1.7 (0.4)	Croll et al. (2001)
	Reversal descent dive rate (m/s)	Gaussian 1.4 (0.5)	Croll et al. (2001)
	Time in reversal (s)	Gaussian 13.7 (2.8)	Croll et al. (2001)
	Surface interval (s)	Gaussian 123.8 (42.3)	Acevedo-Gutiérrez et al. (2002)
	Bout duration (s)	Sigmoidal T_{50} = 50, k = 15	Approximated (Watwood and Buonantony 2012)
General	Shore following (m)	400	Approximated (Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
	Depth limit on seeding (m)	400.0 (minimum), 2000.0 (maximum)	Approximated (Watwood and Buonantony 2012)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-14. *Fraser's dolphin*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser et al. (2006)
	Termination coefficient	0.2	Houser et al. (2006)
	Travel rate (m/s)	Gaussian 3.035 (1.22)	(Au and Perryman 1982)
	Ascent rate (m/s)	Gaussian 0.6 (0.368)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Descent rate (m/s)	Gaussian 0.538 (0.343)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Dive depth (m)	Gaussian 22.6 (17.5)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 55.7 (32.1)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated
Night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser et al. (2006)
	Termination coefficient	0.2	Houser et al. (2006)
	Travel rate (m/s)	Gaussian 3.035 (1.22)	(Au and Perryman 1982)
	Ascent rate (m/s)	Gaussian 0.6 (0.368)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Descent rate (m/s)	Gaussian 0.538 (0.343)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Dive depth (m)	Gaussian 22.6 (17.5)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Bottom following	Not implemented	Approximated

Behavior	Variable	Value	Reference
	Reversals	Not implemented	Approximated
	Probability of reversal	0.5	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 1.542 (0.709)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Reversal descent dive rate (m/s)	Gaussian 1.463 (0.668)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Time in reversal (s)	Gaussian 39.0 (55.2)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Surface interval (s)	Gaussian 65.8 (32.0)	Approximated from striped dolphin (Minamikawa et al. 2003)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated
General	Shore following (m)	1000	(Kaschner et al. 2016)
	Depth limit on seeding (m)	1000.0 (minimum), 8000.0 (maximum)	(Kaschner et al. 2016)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-15. *Gervais' beaked whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep Foraging Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.34 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.7 (0.1)	Tyack et al. (2006)
	Descent rate (m/s)	Gaussian 1.6 (0.2)	Baird et al. (2006b)
	Dive depth (m)	Gaussian 1408.0 (210.0)	Tyack et al. (2006)
	Bottom following	Yes	Baird et al. (2006b)
	Reversals	Gaussian 6.0 (2.0)	Tyack et al. (2006)
	Probability of reversal	0.9	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.7 (0.2)	Tyack et al. (2006)
	Reversal descent dive rate (m/s)	Gaussian 1.5 (0.1)	Approximated
	Time in reversal (s)	Gaussian 40.0 (20.0)	Madsen et al. (2005)
	Surface interval (s)	Gaussian 1200.0 (996.0)	Madsen et al. (2005)
	Bout duration (s)	Sigmoidal T_{50} = 3534, k = 10	Tyack et al. (2006)
Shallow Dive - day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.37 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.3 (0.2)	Tyack et al. (2006) Baird et al. (2006b)
	Descent rate (m/s)	Gaussian 0.3 (0.2)	Tyack et al. (2006) Baird et al. (2006b)
	Dive depth (m)	Gaussian 304.0 (61.0)	Tyack et al. (2006)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 126.0 (500.0)	Tyack et al. (2006)

Behavior	Variable	Value	Reference
	Bout duration (s)	Gaussian 3780 (1860)	Tyack et al. (2006)
Shallow Dive - night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.32 (0.5)	Approximated
	Ascent rate (m/s)	Gaussian 0.3 (0.2)	Tyack et al. (2006) Baird et al. (2006b)
	Descent rate (m/s)	Gaussian 0.3 (0.2)	Tyack et al. (2006) Baird et al. (2006b)
	Dive depth (m)	Gaussian 241.0 (61.0)	Tyack et al. (2006)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 144.0 (2000.0)	Tyack et al. (2006)
	Bout duration (s)	Gaussian 3780 (1860)	Tyack et al. (2006)
General	Shore following (m)	10	Approximated
	Depth limit on seeding (m)	633.0 (minimum), 80000.0 (maximum)	Baird et al. (2006) Waring et al. (2001)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-16. ***Gray seal:*** **Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).**

Behavior	Variable	Value	Reference
Square	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.111 (0.861)	Breed et al. (2009)
	Ascent rate (m/s)	Gaussian 0.9 (0.04)	Beck et al. (2003)
	Descent rate (m/s)	Gaussian 1.0 (0.03)	Beck et al. (2003)
	Average depth (m)	Gaussian 62 (3.5)	Beck et al. (2003)
	Bottom following	Not implemented	Approximated (Beck et al. 2003)
	Reversals	Not implemented	Approximated (Beck et al. 2003)
	Surface interval (s)	Gaussian 132 (7.2)	Approximated (Beck et al. 2003)
	Bout duration (s)	Gaussian 2700 (1800)	Approximated (Beck et al. 2003)
Right skewed square	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.111 (0.861)	Breed et al. (2009)
	Ascent rate (m/s)	Gaussian 0.6 (0.02)	Beck et al. (2003)
	Descent rate (m/s)	Gaussian 1.5 (0.05)	Beck et al. (2003)
	Average depth (m)	Gaussian 53.0 (3.9)	Beck et al. (2003)
	Bottom following	Yes	Approximated (Beck et al. 2003)
	Reversals	Not implemented	Approximated (Beck et al. 2003)
	Surface interval (s)	Gaussian 132 (7.2)	Approximated (Beck et al. 2003)

Behavior	Variable	Value	Reference
	Bout duration (s)	Gaussian 1200 (300)	Approximated (Beck et al. 2003)
Left skewed square	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.111 (0.861)	Breed et al. (2009)
	Ascent rate (m/s)	Gaussian 1.2 (0.12)	Beck et al. (2003)
	Descent rate (m/s)	Gaussian 0.4 (0.05)	Beck et al. (2003)
	Average depth (m)	Gaussian 32.0 (1.7)	Beck et al. (2003)
	Bottom following	Yes	Approximated (Beck et al. 2003)
	Reversals	Not implemented	Approximated (Beck et al. 2003)
	Surface interval (s)	Gaussian 132 (7.2)	Approximated (Beck et al. 2003)
	Bout duration (s)	Gaussian 1200 (300)	Approximated (Beck et al. 2003)
V-shaped	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.111 (0.861)	Breed et al. (2009)
	Ascent rate (m/s)	Gaussian 0.7 (0.11)	Beck et al. (2003)
	Descent rate (m/s)	Gaussian 0.5 (0.05)	Beck et al. (2003)
	Average depth (m)	Gaussian 26.0 (1.1)	Beck et al. (2003)
	Bottom following	Not implemented	Approximated (Beck et al. 2003)
	Reversals	Not implemented	Approximated (Beck et al. 2003)
	Surface interval (s)	Gaussian 132 (7.2)	Approximated (Beck et al. 2003)

Behavior	Variable	Value	Reference
	Bout duration (s)	Gaussian 600 (300)	Approximated (Beck et al. 2003)
Wiggle	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.111 (0.861)	Breed et al. (2009)
	Ascent rate (m/s)	Gaussian 0.9 (0.08)	Beck et al. (2003)
	Descent rate (m/s)	Gaussian 1.0 (0.04)	Beck et al. (2003)
	Average depth (m)	Gaussian 26.0 (1.1)	Beck et al. (2003)
	Bottom following	Not implemented	Approximated (Beck et al. 2003)
	Reversals	Random 2–4	Approximated (Beck et al. 2003)
	Probability of reversal	1.0	Approximated (Beck et al. 2003)
	Reversal ascent dive rate (m/s)	Gaussian 0.9 (0.08)	Beck et al. (2003)
	Reversal descent dive rate (m/s)	Gaussian 1.0 (0.04)	Beck et al. (2003)
	Time in reversal (s)	Random 30–90	Approximated (Beck et al. 2003)
	Surface interval (s)	Gaussian 132 (7.2)	Approximated (Beck et al. 2003)
	Bout duration	Gaussian 1800 (900)	Approximated (Beck et al. 2003)
General	Shore following (m)	0	Approximated (Jessopp et al. 2013)
	Depth limit on seeding (m)	0.0 (minimum), 1000.0 (maximum)	Approximated (Jessopp et al. 2013)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-17. *Harbor porpoise*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Daytime	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.9 (0.3)	Otani et al. (2000)
	Ascent rate (m/s)	Gaussian 0.87 (0.38)	Westgate et al. (1995)
	Descent rate (m/s)	Gaussian 0.99 (0.34)	Westgate et al. (1995)
	Average depth (m)	Gaussian 22.5 (11.6)	Westgate et al. (1995)
	Bottom following	Yes	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 1 (0)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	0.84	Westgate et al. (1995)
	Reversal ascent dive rate (m/s)	Gaussian 0.0 (0.0)	Approximated (Watwood and Buonantony 2012)
	Reversal descent dive rate (m/s)	Gaussian 0.0 (0.0)	Approximated (Watwood and Buonantony 2012)
	Time in reversal (s)	Gaussian 20.5 (2.8)	Westgate et al. (1995)
	Surface interval (s)	Gaussian 31.6 (73.8)	Otani et al. (1998) Otani et al. (2000)
	Bout duration (s)	$T_{50} = 600$ (s), k = 1	Approximated (Watwood and Buonantony 2012)
Nighttime	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated

Behavior	Variable	Value	Reference
	Travel rate (m/s)	Gaussian 0.9 (0.3)	Westgate et al. (1995)
	Ascent rate (m/s)	Gaussian 1.34 (0.53)	Westgate et al. (1995)
	Descent rate (m/s)	Gaussian 1.44 (0.51)	Westgate et al. (1995)
	Average depth (m)	Gaussian 37.5 (12.5)	Westgate et al. (1995)
	Bottom following	Yes	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 1 (0)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	0.84	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	Gaussian 0.0 (0.0)	Approximated (Watwood and Buonantony 2012)
	Reversal descent dive rate (m/s)	Gaussian 0.0 (0.0)	Approximated (Watwood and Buonantony 2012)
	Time in reversal (s)	Gaussian 10.3 (13.9)	Westgate et al. (1995)
	Surface interval (s)	Gaussian 31.6 (73.8)	Otani et al. (1998) Otani et al. (2000)
	Bout duration (s)	T_{50} = 600 (s), k = 1	Approximated (Watwood and Buonantony 2012)
General	Shore following (m)	10	Approximated (Watwood and Buonantony 2012)
	Depth limit on seeding (m)	10 (minimum), 200 (maximum)	Osmek et al. (1996)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-18. *Harbor seal*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Type 0 dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.37 (0.39)	Lesage et al. (1999)
	Ascent rate (m/s)	Gaussian 0.71 (0.46)	Lesage et al. (1999)
	Descent rate (m/s)	Gaussian 0.76 (0.47)	Lesage et al. (1999)
	Average depth (m)	Gaussian 2 (1)	Lesage et al. (1999)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 10 (2)	Lesage et al. (1999)
	Bout duration (s)	Gaussian 198 (1674)	Approximated (Watwood and Buonantony 2012)
Type 1 dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.48 (0.32)	Lesage et al. (1999)
	Ascent rate (m/s)	Gaussian 1.13 (0.16)	Lesage et al. (1999)
	Descent rate (m/s)	Gaussian 1.12 (0.19)	Lesage et al. (1999)
	Dive depth (m)	Gaussian 76.51 (21.14)	Approximated (Folkow et al. 2004, Nordøy et al. 2008)
	Bottom following	Yes	Approximated (Folkow et al. 2004, Nordøy et al. 2008)
	Reversals	Gaussian 5 (2)	Approximated (Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
	Probability of reversal	0.08	Lesage et al. (1999)
	Reversal ascent dive rate (m/s)	Gaussian 1.13 (0.16)	Approximated (Watwood and Buonantony 2012)
	Reversal descent dive rate (m/s)	Gaussian 1.12 (0.19)	Approximated (Watwood and Buonantony 2012)
	Time in reversal (s)	Gaussian 5 (2)	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 42.6 (23.5)	Lesage et al. (1999)
	Bout duration (s)	Gaussian 654 (1314)	Approximated (Watwood and Buonantony 2012)
Type 2 dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.37 (0.39)	Lesage et al. (1999)
	Ascent rate (m/s)	Gaussian 0.61 (0.25)	Lesage et al. (1999)
	Descent rate (m/s)	Gaussian 0.66 (0.27)	Lesage et al. (1999)
	Average depth (m)	Gaussian 12.2 (9.07)	Lesage et al. (1999)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 43.8 (60.7)	Lesage et al. (1999)
	Bout duration (s)	Gaussian 138 (180)	Approximated (Watwood and Buonantony 2012)
Type 3 dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated

Behavior	Variable	Value	Reference
	Travel rate (m/s)	Gaussian 0.89 (0.42)	Lesage et al. (1999)
	Ascent rate (m/s)	Gaussian 0.85 (0.23)	Lesage et al. (1999)
	Descent rate (m/s)	Gaussian 0.64 (0.25)	Lesage et al. (1999)
	Average depth (m)	Gaussian 51.85 (21.56)	Lesage et al. (1999)
	Bottom following	Yes	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 5 (2)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	0.08	Lesage et al. (1999)
	Reversal ascent dive rate (m/s)	Gaussian 0.85 (0.23)	Approximated (Watwood and Buonantony 2012)
	Reversal descent dive rate (m/s)	Gaussian 0.64 (0.25)	Approximated (Watwood and Buonantony 2012)
	Time in reversal (s)	Gaussian 5 (1)	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 40.2 (31.0)	Lesage et al. (1999)
	Bout duration (s)	Gaussian 252 (306)	Approximated (Watwood and Buonantony 2012)
Type 4 dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.5 (0.32)	Lesage et al. (1999)
	Ascent rate (m/s)	Gaussian 0.38 (0.18)	Lesage et al. (1999)
	Descent rate (m/s)	Gaussian 0.76 (0.19)	Lesage et al. (1999)
	Average depth (m)	Gaussian 27.27 (10.14)	Lesage et al. (1999)
	Bottom following	Yes	Lesage et al. (1999)

Behavior	Variable	Value	Reference
	Reversals	Gaussian 5 (2)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	0.08	Lesage et al. (1999)
	Reversal ascent dive rate (m/s)	Gaussian 0.38 (0.18)	Approximated (Watwood and Buonantony 2012)
	Reversal descent dive rate (m/s)	Gaussian 0.76 (0.19)	Approximated (Watwood and Buonantony 2012)
	Time in reversal (s)	Gaussian 5 (1)	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 38.6 (34.8)	Lesage et al. (1999)
	Bout duration	Gaussian 306 (498)	Approximated (Watwood and Buonantony 2012)
Type 5 dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.21 (0.31)	Lesage et al. (1999)
	Ascent rate (m/s)	Gaussian 0.80 (0.34)	Lesage et al. (1999)
	Descent rate (m/s)	Gaussian 0.70 (0.17)	Lesage et al. (1999)
	Average depth (m)	Gaussian 65.14 (31.07)	Lesage et al. (1999)
	Bottom following	Not implemented	Lesage et al. (1999)
	Reversals	Gaussian 5 (2)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	0.08	Lesage et al. (1999)
	Reversal ascent dive rate (m/s)	Gaussian 0.80 (0.34)	Lesage et al. (1999)
	Reversal descent dive rate (m/s)	Gaussian 0.70 (0.17)	Lesage et al. (1999)

Behavior	Variable	Value	Reference
	Time in reversal (s)	Gaussian 5 (1)	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 44.8 (31.9)	Lesage et al. (1999)
	Bout duration	Gaussian 414 (1122)	Approximated (Watwood and Buonantony 2012)
General	Shore following (m)	2.1	Approximated (Watwood and Buonantony 2012)
	Depth limit on seeding (m)	2.1 (minimum), 250 (maximum)	Lowry et al. (2001) Gjertz et al. (2001) Lander et al. (2002)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-19. *Harp seal*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.48 (0.32)	Harbor seal surrogate - Dive type 1 (Lesage et al. 1999)
	Ascent rate (m/s)	Gaussian 0.85 (0.1)	Folkow et al. (2004)
	Descent rate (m/s)	Gaussian 0.85 (0.1)	Folkow et al. (2004)
	Dive depth (m)	Gaussian 76.51 (21.14)	Approximated (Folkow et al. 2004, Nordøy et al. 2008)
	Bottom following	Yes	Approximated (Folkow et al. 2004, Nordøy et al. 2008)
	Reversals	Gaussian 5.0 (2.0)	Harbor seal surrogate - Dive type 1 (Lesage et al. 1999)
	Probability of reversal	0.88	Harbor seal surrogate - Dive type 1 (Lesage et al. 1999)
	Reversal ascent dive rate (m/s)	Gaussian 0.85 (0.1)	Folkow et al. (2004)
	Reversal descent dive rate (m/s)	Gaussian 0.85 (0.1)	Folkow et al. (2004)
	Time in reversal (s)	Gaussian 5.0 (1.0)	Harbor seal surrogate - Dive type 1 (Lesage et al. 1999)
	Surface interval (s)	Gaussian 42.6 (23.5)	Harbor seal surrogate - Dive type 1 (Lesage et al. 1999)
General	Shore following (m)	0	Approximated (harbor seal surrogate - Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
	Depth limit on seeding (m)	0.0 (minimum), 700.0 (maximum)	Harbor seal surrogate - Lowry et al. (2001) Gjertz et al. (2001) Lander et al. (2002)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-20. *Humpback whale*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Migrating	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.8 (0.25)	Meynecke et al. (2013) Murase et al. (2015)
	Ascent rate (m/s)	Gaussian 1.9 (0.25)	Dolphin (1987)
	Descent rate (m/s)	Gaussian 1.7 (0.7)	Dolphin (1987)
	Dive depth (m)	Gaussian 45 (10)	Smith et al. (2012)
	Bottom following	Not implemented	Approximated (based on figure in Dunlop et al. 2013)
	Reversals	Gaussian 7 (3)	Alves et al. (2010)
	Probability of reversal	1	Approximated (based on figure in Dunlop et al. 2013)
	Reversal ascent dive rate (m/s)	Gaussian 0.1 (0.1)	Approximated (based on figure in Dunlop et al. 2013)
	Reversal descent dive rate (m/s)	Gaussian 0.1 (0.1)	Approximated (based on figure in Dunlop et al. 2013)
	Time in reversal (s)	Gaussian 60 (15)	Approximated (based on figure in Dunlop et al. 2013)
	Surface interval (s)	Gaussian, 60 (27)	Dolphin (1987)
	Bout Duration	Sigmoidal T_{50} = 60, k = 7.0	Approximated based on (Goldbogen et al. 2008)
General	Shore following (m)	10	Approximated (based on Smith et al. 2012)
	Depth limit on seeding (m)	20 (minimum), 70 (maximum)	Approximated (based on Smith et al. 2012)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-21. *Killer whale*: Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Shallow	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 2.0 (1.61)	Dahlheim and White (2010)
	Ascent rate (m/s)	Gaussian 1.832 (1.448)	Baird (1994)
	Descent rate (m/s)	Gaussian 1.822 (1.51)	Baird (1994)
	Dive depth (m)	Gaussian 8.0 (2.0)	Miller et al. (2010)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated (Miller et al. 2010)
	Surface interval (s)	Gaussian 3.0 (2.0)	Approximated (Miller et al. 2010)
	Bout duration (s)	Sigmoidal T50 = 300, k = 7: 1900 - 0600 h Sigmoidal T50 = 600, k = 7: 0600 - 1900 h	Approximated (Miller et al. 2010)
Deep	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 2.0 (1.61)	Dahlheim and White (2010)
	Ascent rate (m/s)	Gaussian 1.832 (1.448)	Baird (1994)
	Descent rate (m/s)	Gaussian 1.822 (1.51)	Baird (1994)
	Dive depth (m)	Gaussian 40.0 (20.0)	Baird (1994)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 3.5 (1.5)	Approximated (Miller et al. 2010)
	Probability of reversal	1	Approximated (Miller et al. 2010)
	Reversal ascent dive rate (m/s)	Gaussian 1.832 (1.448)	Baird (1994)

Behavior	Variable	Value	Reference
	Reversal descent dive rate (m/s)	Gaussian 1.822 (1.51)	Baird (1994)
	Time in reversal (s)	Gaussian 10.0 (1.0)	Approximated (Miller et al. 2010)
	Surface interval (s)	Gaussian 3.0 (2.0)	Approximated (Miller et al. 2010)
	Bout duration (s)	Gaussian 300 (7): 1800 - 0600 hr Gaussian 600 (7): 0600 - 1800 h	Approximated (Miller et al. 2010)
General	Shore following (m)	100	Approximated
	Depth limit on seeding (m)	100.0 (minimum), 6000.0 (maximum)	Approximated

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-22. *Long-finned pilot whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep - Night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.3 (0.8)	Bloch et al. (2003)
	Ascent rate (m/s)	Gaussian 2.02 (0.68)	Baird et al. (2002)
	Descent rate (m/s)	Gaussian 1.75 (0.34)	Baird et al. (2002)
	Dive depth (m)	Random 50.0 - 828.0	Heide-Jørgensen et al. (2002)
	Bottom following	Not implemented	Approximated (figure in Baird et al. 2002)
	Reversals	Gaussian 3.0 (1.0)	Approximated (figure in Baird et al. 2002)
	Probability of reversal	0.8	Approximated (figure in Baird et al. 2002)
	Reversal ascent dive rate (m/s)	Gaussian 0.02 (0.02)	Approximated (figure in Baird et al. 2002)
	Reversal descent dive rate (m/s)	Gaussian 0.02 (0.02)	Approximated (figure in Baird et al. 2002)
	Time in reversal (s)	Gaussian 50.0 (30.0)	Approximated (figure in Baird et al. 2002)
	Surface interval (s)	Gaussian 480.0 (30.0)	Approximated (Baird et al. 2002)
	Bout duration (s)	Gaussian 600 (300)	Approximated (figure in Baird et al. 2002)
Shallow - Day	Travel direction	Random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.3 (0.8)	Bloch et al. (2003)
	Ascent rate (m/s)	Gaussian 2.02 (0.68)	Baird et al. (2002)
	Descent rate (m/s)	Gaussian 1.75 (0.34)	Baird et al. (2002)
	Dive depth (m)	Gaussian 15.0 (3.0)	Heide-Jørgensen et al. (2002)

Behavior	Variable	Value	Reference
	Bottom following	Not implemented	Approximated (figure in Baird et al. 2002)
	Reversals	Not implemented	Approximated (figure in Baird et al. 2002)
	Surface interval (s)	Gaussian 30.0 (30.0)	Approximated (figure in Baird et al. 2002)
	Bout duration (s)	Gaussian 3000 (600)	Approximated (figure in Baird et al. 2002)
General	Shore following (m)	100	Approximated (Mate et al. 2005)
	Depth limit on seeding (m)	100.0 (minimum), 3000.0 (maximum)	Approximated (Mate et al. 2005)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-23. *Melon-headed whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep - Night	Travel direction	Correlated random walk	Approximated Soury (1996)
	Perturbation value	10	Approximated Soury (1996)
	Termination coefficient	0.2	Approximated Soury (1996)
	Travel rate (m/s)	Gaussian 1.3 (0.8)	(Bloch et al. 2003)
	Ascent rate (m/s)	Gaussian 2.02 (0.68)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Descent rate (m/s)	Gaussian 1.75 (0.34)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Dive depth (m)	Random 150.0 - 400.0	(Joyce et al. 2016)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 3.0 (1.0)	Approximated
	Probability of reversal	0.8	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.02 (0.02)	Approximated
	Reversal descent dive rate (m/s)	Gaussian 0.02 (0.02)	Approximated
	Time in reversal (s)	Gaussian 50.0 (30.0)	Approximated
	Surface interval (s)	Gaussian 480.0 (30.0)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Bout duration (s)	Gaussian 600 (300)	Approximated
Shallow - Day	Travel direction	Correlated random walk	Approximated (Soury 1996)
	Perturbation value	10	Approximated (Soury 1996)
	Termination coefficient	0.2	Approximated (Soury 1996)

Behavior	Variable	Value	Reference
	Travel rate (m/s)	Gaussian 1.3 (0.8)	Approximated from long-finned pilot whales (Bloch et al. 2003)
	Ascent rate (m/s)	Gaussian 2.02 (0.68)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Descent rate (m/s)	Gaussian 1.75 (0.34)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Dive depth (m)	Gaussian 100.0 (15.0)	(Joyce et al. 2016)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 30.0 (30.0)	Approximated
	Bout duration (s)	Gaussian 3000 (600)	Approximated
General	Shore following (m)	200	(Kaschner et al. 2016)
	Depth limit on seeding (m)	200.0 (minimum), 11000.0 (maximum)	(Kaschner et al. 2016)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-24. *Mesoplodont beaked whales*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep foraging dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.5 (0.5)	(Baird et al. 2006b)
	Ascent rate (m/s)	Gaussian 0.79 (0.13)	Baird et al. (2006a), Tyack et al. (2006)
	Descent rate (m/s)	Gaussian 1.45 (0.2)	Baird et al. (2006a), Tyack et al. (2006)
	Dive depth (m)	Gaussian 835.0 (143.0)	Tyack et al. (2006)
	Bottom following	Not implemented	(Baird et al. 2006b)
	Reversals	Gaussian 20.0 (2.0)	Tyack et al. (2006)
	Probability of reversal	0.95	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.8 (0.2)	Madsen et al. (2005)
	Reversal descent dive rate (m/s)	Gaussian 0.8 (0.2)	Madsen et al. (2005)
	Time in reversal (s)	Gaussian 40.0 (20.0)	Tyack et al. (2006)
	Surface interval (s)	Gaussian 228.0 (276.0)	Tyack et al. (2006)
	Bout duration (s)	Sigmoidal T50 = 1200.0, k = 600.0	Tyack et al. (2006)
Shallow dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.5 (0.5)	(Baird et al. 2006b)
	Ascent rate (m/s)	Gaussian 0.35 (0.2)	Baird et al. (2006a), Tyack et al. (2006)
	Descent rate (m/s)	Gaussian 0.34 (0.2)	Baird et al. (2006a), Tyack et al. (2006)
	Dive depth (m)	Gaussian 71.0 (52.0)	Tyack et al. (2006)

Behavior	Variable	Value	Reference
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 228.0 (276.0)	Tyack et al. (2006)
	Bout duration (s)	Gaussian 3780.0 (1860.0)	Tyack et al. (2006)
General	Shore following (m)	633	Waring et al. (2001), Baird et al. (2006b)
	Depth limit on seeding (m)	633.0 (minimum), 100000.0 (maximum)	Waring et al. (2001), Baird et al. (2006b)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-25. ***Minke whale:*** **Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).**

Behavior	Variable	Value	Reference
Feeding dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.25 (0.3)	Approximated (Blix and Folkow 1995)
	Ascent rate (m/s)	Gaussian 2.1 (0.3)	Approximated (fin whale - Goldbogen et al. 2011)
	Descent rate (m/s)	Gaussian 3 (0.2)	Approximated (fin whale - Goldbogen et al. 2011)
	Dive depth (m)	Gaussian 35 (20)	Approximated (based on figure in Blix and Folkow 1995)
	Bottom following	Not implemented	Approximated (Blix and Folkow 1995)
	Reversals	Gaussian 3.1 (1.1)	Approximated (fin whale - Croll et al. 2001, Goldbogen et al. 2006)
	Probability of reversal	0.95	Approximated (Blix and Folkow 1995)
	Reversal ascent dive rate (m/s)	Gaussian 1.7 (0.4)	Fin whale–Croll et al. (2001)
	Reversal descent dive rate (m/s)	Gaussian 1.4 (0.5)	Fin whale–Croll et al. (2001)
	Time in reversal (s)	Gaussian 13.7 (2.8)	Fin whale–Croll et al. (2001)
	Surface interval (s)	Gaussian 66.1 (96.7)	Stockin et al. (2001)
	Bout duration (s)	Gaussian 1500 (500)	Approximated (based on figure in Blix and Folkow 1995)
Cruising dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated

Behavior	Variable	Value	Reference
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.25 (0.3)	Approximated (Blix and Folkow 1995)
	Ascent rate (m/s)	Gaussian 1.7 (0.4)	Approximated (fin whale - Goldbogen et al. 2011)
	Descent rate (m/s)	Gaussian 2.0 (0.2)	Approximated (fin whale - Goldbogen et al. 2011)
	Dive depth (m)	Gaussian 15 (10)	Approximated (based on figure in Blix and Folkow 1995)
	Bottom following	Not implemented	Approximated (based on figure in Blix and Folkow 1995)
	Reversals	Not implemented	Approximated (based on figure in Blix and Folkow 1995)
	Surface interval (s)	Gaussian 66.1 (96.7)	Stockin et al. (2001)
	Bout duration (s)	Gaussian 1000 (600)	Approximated (based on figure in Blix and Folkow 1995)
Sleeping	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.25 (0.3)	Approximated (Blix and Folkow 1995)
	Ascent rate (m/s)	Gaussian 1.7 (0.4)	Approximated (fin whale - Goldbogen et al. 2011)
	Descent rate (m/s)	Gaussian 2.0 (0.2)	Approximated (fin whale - Goldbogen et al. 2011)

Behavior	Variable	Value	Reference
	Dive depth (m)	Gaussian 10 (5)	Approximated (based on figure in Blix and Folkow 1995)
	Bottom following	Not implemented	Approximated (based on figure in Blix and Folkow 1995)
	Reversals	Not implemented	Approximated (based on figure in Blix and Folkow 1995)
	Surface interval (s)	Gaussian 66.1 (96.7)	Stockin et al. (2001)
	Bout duration (s)	Gaussian 2000 (400)	Approximated (based on figure in Blix and Folkow 1995)
Unknown	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.25 (0.3)	Approximated (Blix and Folkow 1995)
	Ascent rate (m/s)	Gaussian 1.7 (0.4)	Approximated (fin whale - Goldbogen et al. 2011)
	Descent rate (m/s)	Gaussian 2.0 (0.2)	Approximated (fin whale - Goldbogen et al. 2011)
	Dive depth (m)	Gaussian 20 (10)	Approximated (based on figure in Blix and Folkow 1995)
	Bottom following	Not implemented	Approximated (based on figure in Blix and Folkow 1995)
	Reversals	Not implemented	Approximated (based on figure in Blix and Folkow 1995)
	Surface interval (s)	Gaussian 66.1 (96.7)	Stockin et al. (2001)

Behavior	Variable	Value	Reference
	Bout duration (s)	Gaussian 1500 (500)	Approximated (based on figure in Blix and Folkow 1995)
General	Shore following (m)	80	Approximated (Hooker et al. 1999)
	Depth limit on seeding (m)	80 (minimum), 200 (maximum)	Hooker et al. (1999)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-26. *North Atlantic right whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Foraging dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.47 (0.26)	Baumgartner and Mate (2003)
	Ascent rate (m/s)	Gaussian 1.47 (0.26)	Baumgartner and Mate (2003)
	Descent rate (m/s)	Gaussian 1.4 (0.3)	Baumgartner and Mate (2003)
	Dive depth (m)	Gaussian 121.2 (24.2)	Baumgartner and Mate (2003)
	Bottom following	Not implemented	Approximated (based on figure in Baumgartner and Mate 2003)
	Reversals	Gaussian 1.0 (0)	Approximated (based on figure in Baumgartner and Mate 2003)
	Probability of reversal	1.0	Approximated (based on figure in Baumgartner and Mate 2003)
	Reversal ascent dive rate (m/s)	Gaussian 0.01 (0.01)	Approximated (based on figure in Baumgartner and Mate 2003)
	Reversal descent dive rate (m/s)	Gaussian 0.01 (0.01)	Approximated (based on figure in Baumgartner and Mate 2003)
	Time in reversal (s)	Gaussian 420.0 (60)	Approximated (based on figure in Baumgartner and Mate 2003)
	Surface interval (s)	Gaussian 187.8 (59.4)	Baumgartner and Mate (2003)
	Bout duration (s)	Gaussian 3600 (600)	Approximated (based on figure in Baumgartner and Mate 2003)

Behavior	Variable	Value	Reference
V-shape	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.47 (0.26)	Baumgartner and Mate (2003)
	Ascent rate (m/s)	Gaussian 1.47 (0.26)	Baumgartner and Mate (2003)
	Descent rate (m/s)	Gaussian 1.4 (0.3)	Baumgartner and Mate (2003)
	Dive depth (m)	Gaussian 121.2 (24.2)	Baumgartner and Mate (2003)
	Bottom following	Not implemented	Approximated (based on figure in Baumgartner and Mate 2003)
	Reversals	Not implemented	Approximated (based on figure in Baumgartner and Mate 2003)
	Surface interval (s)	Gaussian 440 (120)	Baumgartner and Mate (2003)
	Bout duration (s)	Gaussian 1800 (600)	Approximated (based on figure in Baumgartner and Mate 2003)
Other	Travel direction	Correlated random walk	Approximated (based on fin whale - Watwood and Buonantony 2012)
	Perturbation value	10	Approximated (based on fin whale - Watwood and Buonantony 2012)
	Termination coefficient	0.2	Approximated (based on fin whale - Watwood and Buonantony 2012)
	Travel rate (m/s)	Gaussian 1.47 (0.26)	Baumgartner and Mate (2003)

Behavior	Variable	Value	Reference
	Ascent rate (m/s)	Gaussian 1.47 (0.26)	Baumgartner and Mate (2003)
	Descent rate (m/s)	Gaussian 1.4 (0.3)	Baumgartner and Mate (2003)
	Average depth (m)	Gaussian 121.2 (24.2)	Baumgartner and Mate (2003)
	Bottom following	Not implemented	Approximated (based on figure in Baumgartner and Mate 2003)
	Reversals	Random 1.0–10	Approximated (based on figure in Baumgartner and Mate 2003)
	Probability of reversal	0.3	Approximated (based on figure in Baumgartner and Mate 2003)
	Reversal ascent dive rate (m/s)	Gaussian 0.08 (0.05)	Approximated (based on figure in Baumgartner and Mate 2003)
	Reversal descent dive rate (m/s)	Gaussian 0.01 (0.01)	Approximated (based on figure in Baumgartner and Mate 2003)
	Time in reversal (s)	Gaussian 200 (60)	Approximated (based on figure in Baumgartner and Mate 2003)
	Surface interval (s)	Gaussian 440 (120)	Approximated (based on figure in Baumgartner and Mate 2003)
	Bout duration (s)	Gaussian 1200 (600)	Approximated (based on figure in Baumgartner and Mate 2003)
General	Shore following (m)	30	Approximated (based on Baumgartner and Mate 2003)
	Depth limit on seeding (m)	30 (minimum), 200 (maximum)	Baumgartner and Mate (2005)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-27. *Pantropical spotted dolphin*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 2.39 (1.22)	Scott and Chivers (2009)
	Ascent rate (m/s)	Gaussian 0.42 (0.24)	Scott and Chivers (2009)
	Descent rate (m/s)	Gaussian 0.58 (0.34)	Scott and Chivers (2009)
	Dive depth (m)	Gaussian 22.1 (15.71)	Scott and Chivers (2009)
	Bottom following	Yes	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 68.4 (304.8)	Scott and Chivers (2009)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated
Night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.83 (1.54)	Scott and Chivers (2009)
	Ascent rate (m/s)	Gaussian 0.74 (0.41)	Scott and Chivers (2009)
	Descent rate (m/s)	Gaussian 0.93 (0.54)	Scott and Chivers (2009)
	Dive depth (m)	Gaussian 24.0 (27.1)	Scott and Chivers (2009)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 3.0 (1.0)	Approximated
	Probability of reversal	0.5	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.74 (0.41)	Scott and Chivers (2009)
	Reversal descent dive rate (m/s)	Gaussian 0.93 (0.54)	Scott and Chivers (2009)
	Time in reversal (s)	Gaussian 39.0 (55.2)	Approximated
	Surface interval (s)	Gaussian 49.8 (108.6)	Scott and Chivers (2009)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated

Behavior	Variable	Value	Reference
General	Shore following (m)	200	Herzing and Elliser (2016)
	Depth limit on seeding (m)	200.0 (minimum), 100000.0 (maximum)	Approximated

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-28. *Pygmy killer whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep - Night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.3 (0.8)	(Bloch et al. 2003)
	Ascent rate (m/s)	Gaussian 2.02 (0.68)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Descent rate (m/s)	Gaussian 1.75 (0.34)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Dive depth (m)	Random 150.0 - 400.0	(Joyce et al. 2016)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 3.0 (1.0)	Approximated
	Probability of reversal	0.8	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.02 (0.02)	Approximated
	Reversal descent dive rate (m/s)	Gaussian 0.02 (0.02)	Approximated
	Time in reversal (s)	Gaussian 50.0 (30.0)	Approximated
	Surface interval (s)	Gaussian 480.0 (30.0)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Bout duration (s)	Gaussian 600 (300)	Approximated
Shallow - Day	Travel direction	Correlated random walk	Approximated (Soury 1996)
	Perturbation value	10	Approximated (Soury 1996)
	Termination coefficient	0.2	Approximated (Soury 1996)
	Travel rate (m/s)	Gaussian 1.3 (0.8)	Approximated from long-finned pilot whales (Bloch et al. 2003)

Behavior	Variable	Value	Reference
	Ascent rate (m/s)	Gaussian 2.02 (0.68)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Descent rate (m/s)	Gaussian 1.75 (0.34)	Approximated from long-finned pilot whales (Baird et al. 2002)
	Dive depth (m)	Gaussian 100.0 (15.0)	(Joyce et al. 2016)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 30.0 (30.0)	Approximated
	Bout duration (s)	Gaussian 3000 (600)	Approximated
General	Shore following (m)	200	(Kaschner et al. 2016)
	Depth limit on seeding (m)	200.0 (minimum), 11000.0 (maximum)	(Kaschner et al. 2016)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-29. *Pygmy sperm whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Dive - Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.54 (0.607)	Scott et al. (2001)
	Ascent rate (m/s)	Gaussian 2.2 (0.2)	Aguilar Soto et al. (2009)
	Descent rate (m/s)	Gaussian 2.0 (0.2)	Aguilar Soto et al. (2009)
	Dive depth (m)	Gaussian 30.0 (20.0)	Wells et al. (2013)
	Bottom following	Yes	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 165.0 (69.0)	Sakai et al. (2011)
	Bout duration (s)	Gaussian 480 (60)	Approximated
General	Shore following (m)	10	Approximated
	Depth limit on seeding (m)	10.0 (minimum), 950.0 (maximum)	Approximated

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-30. *Risso's dolphin:* Data values and references input in JASMINE to create diving behavior(number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Shallow dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	2	Approximated
	Travel rate (m/s)	Gaussian 1.997 (1.058)	Wells et al. (2009)
	Ascent rate (m/s)	Gaussian 0.42 (0.24)	Spotted dolphin value (Scott and Chivers 2009)
	Descent rate (m/s)	Gaussian 0.58 (0.34)	Spotted dolphin value (Scott and Chivers 2009)
	Average depth (m)	Gaussian 8.0 (20.0)	Wells et al. (2009)
	Bottom following	Not implemented	Approximated spotted dolphin value (Scott and Chivers 2009)
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 11.0 (4.0)	Bearzi et al. (2011)
	Bout duration (s)	T_{50} = 3600 (s), k = 7	Approximated spotted dolphin value (Scott and Chivers 2009)
Deep dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	2	Approximated
	Travel rate (m/s)	Gaussian 1.997 (1.058)	Wells et al. (2009)
	Ascent rate (m/s)	Gaussian 0.74 (0.41)	Spotted dolphin value (Scott and Chivers 2009)
	Descent rate (m/s)	Gaussian 0.93 (0.54)	Spotted dolphin value (Scott and Chivers 2009)
	Average depth (m)	Random 20–500	Wells et al. (2009)

Behavior	Variable	Value	Reference
	Bottom following	Not implemented	Approximated spotted dolphin value (Scott and Chivers 2009)
	Reversals	Not implemented	Approximated spotted dolphin value (Scott and Chivers 2009)
	Surface interval (s)	Gaussian 11.0 (4.0)	Bearzi et al. (2011)
	Bout duration (s)	T_{50} = 3600 (s), k = 7	Approximated spotted dolphin value (Scott and Chivers 2009)
General	Shore following (m)	2	Approximated (Wells et al. 2009)
	Depth limit on seeding (m)	2 (minimum), 500 (maximum)	Approximated (Wells et al. 2009)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-31. *Rough-toothed dolphin*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Travel	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.25 (0.5)	Ritter (2002)
	Ascent rate (m/s)	Gaussian 0.42 (0.24)	Approximated (pantropical spotted dolphin)
	Descent rate (m/s)	Gaussian 0.58 (0.34)	Approximated (pantropical spotted dolphin)
	Dive depth (m)	Gaussian 6.0 (4.0)	Wells et al. (2008)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 68.4 (304.8)	Approximated (pantropical spotted dolphin)
	Bout duration (s)	Gaussian 30 (60)	Approximated
Shallow - Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 1.25 (0.5)	Ritter (2002)
	Ascent rate (m/s)	Gaussian 0.42 (0.24)	Approximated (pantropical spotted dolphin)
	Descent rate (m/s)	Gaussian 0.58 (0.34)	Approximated (pantropical spotted dolphin)
	Dive depth (m)	Gaussian 6.0 (4.0)	Wells et al. (2008)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 49.8 (108.6)	Wells and Gannon (2005)
	Bout duration (s)	Gaussian 60 (30): 1800 - 0600 h Gaussian 120 (30): 0600 - 1800 h	Approximated
General	Shore following (m)	2	Wells et al. (2008)

Behavior	Variable	Value	Reference
	Depth limit on seeding (m)	2.0 (minimum), 10000.0 (maximum)	Approximated

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-32. *Sea otter*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Forage	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser (2006)
	Termination coefficient	0.2	Houser (2006)
	Travel rate (m/s)	Random 0.4 - 0.6	Approximated, based on Bodkin et al. (2004)
	Ascent rate (m/s)	Gaussian 0.41 (0.04)	Bodkin et al. (2004)
	Descent rate (m/s)	Gaussian 0.38 (0.02)	Bodkin et al. (2004)
	Dive depth (m)	Gaussian 18.9 (4.6)	Bodkin et al. (2004)
	Bottom following	Not implemented	Not implemented
	Reversals	Not implemented	Approximated (bottom feeders)
	Surface interval (s)	Random 36.1 - 117.0	Tinker et al. (2008) Bodkin et al. (2004)
	Bout duration (s)	Gaussian 100 (1): 1800 - 0600 h Gaussian 3300 (90): 0600 - 1800 h	Approximated, (Laidre and Jameson 2006)
Travel	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser (2006)
	Termination coefficient	0.2	Houser (2006)
	Travel rate (m/s)	Gaussian 0.4 (0.3)	Approximated, based on (Bodkin et al. 2004)
	Ascent rate (m/s)	Gaussian 0.41 (0.04)	Bodkin et al. (2004)
	Descent rate (m/s)	Gaussian 0.38 (0.02)	Bodkin et al. (2004)
	Dive depth (m)	Gaussian 2.7 (0.2)	Bodkin et al. (2004)
	Bottom following	Not implemented	Bodkin et al. (2004)
	Reversals	Not implemented	Bodkin et al. (2004)
	Surface interval (s)	Random 43.0 - 53.0	Bodkin et al. (2004)

Behavior	Variable	Value	Reference
	Bout duration (s)	Gaussian 100 (1): 1800 - 0600 h Gaussian 600 (120): 0600 - 1800 h	Approximated
Resting	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Houser (2006)
	Termination coefficient	0.2	Houser (2006)
	Travel rate (m/s)	Random 0.0 - 0.0	Approximated
	Ascent rate (m/s)	Random 0.0 - 0.0	Approximated
	Descent rate (m/s)	Random 0.0 - 0.0	Approximated
	Dive depth (m)	Random 0.0 - 0.0	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 21600.0 (0.0)	Approximated
	Bout duration (s)	Gaussian 100 (1)	Approximated
General	Shore following (m)	2	Bodkin et al. (2004)
	Depth limit on seeding (m)	2.0 (minimum), 30.0 (maximum)	Bodkin et al. (2004)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-33. *Short-finned pilot whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Shallow	Travel direction	Random walk	Approximated Baird et al. (2003)
	Termination coefficient	0.2	Approximated Baird et al. (2003)
	Travel rate (m/s)	Gaussian 0.875 (0.572)	Wells et al. (2013)
	Ascent rate (m/s)	Gaussian 2.2 (0.2)	Aguilar Soto et al. (2009)
	Descent rate (m/s)	Gaussian 2.0 (0.2)	Aguilar Soto et al. (2009)
	Dive depth (m)	Gaussian 30.0 (20.0)	Wells et al. (2013)
	Bottom following	Not implemented	Wells et al. (2013)
	Reversals	Not implemented	Aguilar Soto et al. (2009)
	Surface interval (s)	Gaussian 165.0 (69.0)	Sakai et al. (2011)
	Bout duration (s)	Gaussian 3600 (420)	Approximated Baird et al. (2003)
Deep	Travel direction	Random walk	Approximated Baird et al. (2003)
	Termination coefficient	0.2	Approximated Baird et al. (2003)
	Travel rate (m/s)	Gaussian 0.875 (0.572)	Wells et al. (2013)
	Ascent rate (m/s)	Gaussian 3.2 (0.4)	
	Descent rate (m/s)	Gaussian 3.0 (0.4)	Aguilar Soto et al. (2009)
	Dive depth (m)	Gaussian 300.0 (100.0)	Wells et al. (2013)
	Bottom following	Not implemented	Wells et al. (2013)
	Reversals	Not implemented	Aguilar Soto et al. (2009)
	Surface interval (s)	Gaussian 165.0 (69.0)	Sakai et al. (2011)
	Bout duration (s)	Gaussian 3600 (420)	Approximated Baird et al. (2003)
General	Shore following (m)	10	Approximated Baird et al. (2003)

Behavior	Variable	Value	Reference
	Depth limit on seeding (m)	14.0 (minimum), 100000.0 (maximum)	Approximated Baird et al. (2003)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-34. *Short-beaked common dolphin*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.035 (1.22)	Au and Perryman (1982)
	Ascent rate (m/s)	Gaussian 0.6 (0.368)	Minamikawa et al. (2003)
	Descent rate (m/s)	Gaussian 0.538 (0.343)	Minamikawa et al. (2003)
	Dive depth (m)	Gaussian 22.6 (17.5)	Minamikawa et al. (2003)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 55.7 (32.1)	Minamikawa et al. (2003)
	Bout duration (s)	Sigmoidal T50 = 3600, k = 7	Approximated spotted dolphin value (Scott and Chivers 2009)
Night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.035 (1.22)	Au and Perryman (1982)
	Ascent rate (m/s)	Gaussian 1.542 (0.709)	Minamikawa et al. (2003)
	Descent rate (m/s)	Gaussian 1.463 (0.668)	Minamikawa et al. (2003)
	Dive depth (m)	Gaussian 126.7 (120.9)	Minamikawa et al. (2003)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 3.0 (2.0)	Approximated spotted dolphin value (Scott and Chivers 2009)
	Probability of reversal	0.5	Approximated spotted dolphin value (Scott and Chivers 2009)
	Reversal ascent dive rate (m/s)	Gaussian 1.542 (0.709)	Minamikawa et al. (2003)

Behavior	Variable	Value	Reference
	Reversal descent dive rate (m/s)	Gaussian 1.463 (0.668)	Minamikawa et al. (2003)
	Time in reversal (s)	Gaussian 39.0 (55.2)	Approximated spotted dolphin value (Scott and Chivers 2009)
	Surface interval (s)	Gaussian 65.8 (32.0)	Minamikawa et al. (2003)
	Bout duration (s)	Sigmoidal T50 = 3600, k = 7	Approximated spotted dolphin value (Scott and Chivers 2009)
General	Shore following (m)	200	Approximated spotted dolphin value (Scott and Chivers 2009)
	Depth limit on seeding (m)	200.0 (minimum), 8000.0 (maximum)	Approximated spotted dolphin value (Scott and Chivers 2009)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-35. *Sperm whale*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Deep foraging dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.88 (0.27)	Miller et al. (2004)
	Ascent rate (m/s)	Gaussian 1.3 (0.2)	Watwood et al. (2006)
	Descent rate (m/s)	Gaussian 1.1 (0.2)	Watwood et al. (2006)
	Average depth (m)	Gaussian 546.9 (130)	Watwood et al. (2006)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 8.2 (4.2)	Aoki et al. (2007)
	Probability of reversal	1	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	1.8 (0.5)	Aoki et al. (2007)
	Reversal descent dive rate (m/s)	1.8 (0.5)	Aoki et al. (2007)
	Time in reversal (s)	Gaussian 141 (82.7)	Aoki et al. (2007) Amano and Yoshioka (2003)
	Surface interval (s)	Gaussian 540.0 (180.0)	Watwood et al. (2006)
	Bout duration (s)	Gaussian 42012 (20820)	Approximated (Watwood and Buonantony 2012)
V Dive	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.88 (0.27)	Miller et al. (2004)
	Ascent rate (m/s)	Gaussian 0.67 (0.43)	Amano and Yoshioka (2003)

Behavior	Variable	Value	Reference
	Descent rate (m/s)	Gaussian 0.85 (0.05)	Amano and Yoshioka (2003)
	Average depth (m)	Gaussian 282.7 (69.9)	Amano and Yoshioka (2003)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 408 (114)	Approximated (Watwood and Buonantony 2012)
	Bout duration (s)	Gaussian 2286 (384)	Approximated (Watwood and Buonantony 2012)
Inactive bottom time	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.88 (0.27)	Miller et al. (2004)
	Ascent rate (m/s)	Gaussian 1.13 (0.07)	Amano and Yoshioka (2003)
	Descent rate (m/s)	Gaussian 1.4 (0.13)	Amano and Yoshioka (2003)
	Dive depth (m)	Gaussian 492.0 (74.6)	Amano and Yoshioka (2003)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 1 (0)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	1	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	0.1 (0.1)	Approximated (Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
	Reversal descent dive rate (m/s)	0.1 (0.1)	Approximated (Watwood and Buonantony 2012)
	Time in reversal (s)	Gaussian 1188 (174.6)	Amano and Yoshioka (2003)
	Surface interval (s)	Gaussian 546 (351)	Watwood et al. (2006)
	Bout duration (s)	Gaussian 6192 (4518)	Approximated (Watwood and Buonantony 2012)
Surface active	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.88 (0.27)	Miller et al. (2004)
	Ascent rate (m/s)	Gaussian 0.67 (0.43)	Amano and Yoshioka (2003)
	Descent rate (m/s)	Gaussian 0.85 (0.05)	Amano and Yoshioka (2003)
	Average depth (m)	Gaussian 25 (25)	Amano and Yoshioka (2003)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Not implemented	Approximated (Watwood and Buonantony 2012)
	Surface interval (s)	Gaussian 408 (114)	Amano and Yoshioka (2003)
	Bout duration (s)	Gaussian 3744 (2370)	Approximated (Watwood and Buonantony 2012)
Surface inactive–head up	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0 (0)	Approximated (Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
	Ascent rate (m/s)	Gaussian 0.0 (0.0)	Approximated (Watwood and Buonantony 2012)
	Descent rate (m/s)	Gaussian 0.1 (0.1)	Miller et al. (2008)
	Dive depth (m)	Gaussian 8.6 (4.8)	Miller et al. (2008)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 1 (0)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	1	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	0 (0)	Miller et al. (2008)
	Reversal descent dive rate (m/s)	0 (0)	Miller et al. (2008)
	Time in reversal (s)	Gaussian 708 (522)	Miller et al. (2008)
	Surface interval (s)	Gaussian 462 (360)	Miller et al. (2008)
	Bout duration	T50 = 486 (s), k = 0.9	Approximated (Watwood and Buonantony 2012)
Surface inactive–head down	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0 (0)	Approximated (Watwood and Buonantony 2012)
	Ascent rate (m/s)	Gaussian 0.0 (0.0)	Approximated (Watwood and Buonantony 2012)

Behavior	Variable	Value	Reference
	Descent rate (m/s)	Gaussian 0.0 (0.0)	Approximated (Watwood and Buonantony 2012)
	Dive depth (m)	Gaussian 16.5 (4.9)	Miller et al. (2008)
	Bottom following	Not implemented	Approximated (Watwood and Buonantony 2012)
	Reversals	Gaussian 1 (0)	Approximated (Watwood and Buonantony 2012)
	Probability of reversal	1	Approximated (Watwood and Buonantony 2012)
	Reversal ascent dive rate (m/s)	0 (0)	Miller et al. (2008)
	Reversal descent dive rate (m/s)	0 (0)	Miller et al. (2008)
	Time in reversal (s)	Gaussian 804 (522)	Miller et al. (2008)
	Surface interval (s)	Gaussian 462 (360)	Miller et al. (2008)
	Bout duration	T50 = 486 (s), k = 0.9	Approximated (Watwood and Buonantony 2012)
General	Shore following (m)	1000	Herzing and Elliser (2016)
	Depth limit on seeding (m)	1000.0 (minimum), 8000.0 (maximum)	Herzing and Elliser (2016)

Approximated: Value based on the best fit for diving profile. Those values were not available from literature but were estimated producing a diving profile similar to D-tag results for example.

Table C-36. *Spinner dolphin*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.72 (0.83)	Würsig et al. (1994)
	Ascent rate (m/s)	Gaussian 0.42 (0.24)	Scott and Chivers (2009)
	Descent rate (m/s)	Gaussian 0.58 (0.34)	Scott and Chivers (2009)
	Dive depth (m)	Gaussian 22.1 (15.71)	Scott and Chivers (2009)
	Bottom following	Yes	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 68.4 (304.8)	Scott and Chivers (2009)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated
Night	Travel direction	Random walk	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 0.875 (0.572)	Würsig et al. (1994)
	Ascent rate (m/s)	Gaussian 3.2 (0.4)	Scott and Chivers (2009)
	Descent rate (m/s)	Gaussian 3.0 (0.4)	Scott and Chivers (2009)
	Dive depth (m)	Gaussian 300.0 (100.0)	Scott and Chivers (2009)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Probability of reversal	0.5	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 0.74 (0.41)	Scott and Chivers (2009)
	Reversal descent dive rate (m/s)	Gaussian 0.93 (0.54)	Scott and Chivers (2009)
	Time in reversal (s)	Gaussian 39.0 (55.2)	Approximated
	Surface interval (s)	Gaussian 49.8 (108.6)	Scott and Chivers (2009)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated
General	Shore following (m)	200	Herzing and Elliser (2016)

Behavior	Variable	Value	Reference
	Depth limit on seeding (m)	200.0 (minimum), 100000.0 (maximum)	Approximated

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-37. *Striped dolphin*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Day	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.035 (1.22)	Au and Perryman (1982)
	Ascent rate (m/s)	Gaussian 0.6 (0.368)	Minamikawa et al. (2003)
	Descent rate (m/s)	Gaussian 0.538 (0.343)	Minamikawa et al. (2003)
	Dive depth (m)	Gaussian 22.6 (17.5)	Minamikawa et al. (2003)
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 55.7 (32.1)	Minamikawa et al. (2003)
	Bout duration (s)	Sigmoidal T_{50} = 3600, k = 7	Approximated
Night	Travel direction	Correlated random walk	Approximated
	Perturbation value	10	Approximated
	Termination coefficient	0.2	Approximated
	Travel rate (m/s)	Gaussian 3.03 (1.22)	Au and Perryman (1982)
	Ascent rate (m/s)	Gaussian 1.542 (0.709)	Minamikawa et al. (2003)
	Descent rate (m/s)	Gaussian 1.463 (0.668)	Minamikawa et al. (2003)
	Dive depth (m)	Gaussian 126.7 (120.9)	Minamikawa et al. (2003)
	Bottom following	Not implemented	Approximated
	Reversals	Gaussian 3.0 (2.0)	Approximated
	Probability of reversal	0.5	Approximated
	Reversal ascent dive rate (m/s)	Gaussian 1.542 (0.709)	Approximated
	Reversal descent dive rate (m/s)	Gaussian 1.463 (0.668)	Minamikawa et al. (2003)
	Time in reversal (s)	Gaussian 39.0 (55.2)	Minamikawa et al. (2003)
	Surface interval (s)	Gaussian 65.8 (32.0)	Approximated
	Bout duration (s)	Sigmoidal T50 = 3600, k = 7	Approximated

Behavior	Variable	Value	Reference
General	Shore following (m)	200	Ringelstein et al. (2006)
	Depth limit on seeding (m)	200.0 (minimum), 700.0 (maximum)	Ringelstein et al. (2006)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Table C-38. *Walrus*: Data values and references input in JASMINE to create diving behavior (number values represent means [standard deviations] unless otherwise indicated).

Behavior	Variable	Value	Reference
Forage	Travel direction	Correlated random walk	Default
	Perturbation value	10	Houser (2006)
	Termination coefficient	0.2	Houser (2006)
	Travel rate (m/s)	Gaussian 0.5 (0.3)	Approximated, based on Gjertz et al. (2001)
	Ascent rate (m/s)	Gaussian 0.8 (0.3)	Gjertz et al. 2001
	Descent rate (m/s)	Gaussian 0.8 (0.3)	Gjertz et al. 2001
	Dive depth (m)	Gaussian 22.5 (11.5)	Gjertz et al. 2001
	Bottom following	Not implemented	Not implemented
	Reversals	Not implemented	Approximated (bottom feeders)
	Surface interval (s)	Random 6 - 240	Born et al. 2003
	Bout duration (s)	Gaussian 402 (96)	Born et al. 2003
Travel	Travel direction	Correlated random walk	Default
	Perturbation value	10	Houser (2006)
	Termination coefficient	0.2	Houser (2006)
	Travel rate (m/s)	Gaussian 0.5 (0.3)	Approximated, based on Gjertz et al. (2001)
	Ascent rate (m/s)	Gaussian 0.5 (0.3)	Gjertz et al. 2001
	Descent rate (m/s)	Gaussian 0.4 (0.2)	Gjertz et al. 2001
	Dive depth (m)	Gaussian 3.6 (3.4)	Gjertz et al. 2001
	Bottom following	Not implemented	Approximated
	Reversals	Not implemented	Approximated
	Surface interval (s)	Gaussian 60.0 (30.0)	Approximated, based on Born et al. 2003
	Bout duration (s)	Gaussian 162 (240)	Jay et al. (2001) (s.d.: Approximated)
General	Shore following (m)	1	Approximated (amphibious lifestyle)

Behavior	Variable	Value	Reference
	Depth limit on seeding (m)	1.0 (minimum), 500.0 (maximum)	Approximated (based on maximum dive depth)

Approximated: Value based on the best fit for diving profile. Those values were unavailable from literature, but they were estimated to produce a diving profile similar to D-tag results, for example.

Appendix D. Acoustic Sources

Table D-1. Acoustic sources and parameters provided by NOS operators.

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
CO-OPS	Throughout U.S.	Nortek	AWAC	Acoustic Release Interrogator	omni	26	UNK	omni	omni	184
CO-OPS	Throughout U.S.	Nortek	AWAC	Acoustic Release Interrogator	omni	25-32	UNK	omni	omni	180
NCCOS	Pacific Islands	Teledyne	Benthos	multi-frequency pinger	UNK	25-40	UNK	UNK	UNK	177
NCCOS	Gulf of Mexico	UNK	UNK	ADCP	Upward	>200	UNK	UNK	UNK	UNK
NCCOS	Hawaiian Archipelago	UNK	UNK	ADCP	Upward	UNK	UNK	UNK	UNK	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Edgetech	Offshore 4410C Trackpoint II	Ultra-short baseline telemetry	UNK	4.5-30	UNK	UNK	UNK	193
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM710 Mk1 0.5x1	MBES	Downward	70-100	CW/FM	0.5	140	225-229
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EM710 Mk2 0.5x1	MBES	Downward	40-120	CW/FM	0.5	140	225-231
OCS/JHC	Northeast	Kongsberg	EM710	MBES	Downward	70-120	CW/FM	0.5	140	225-231
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Datasonics DPL-275A Pinger Locator	DPL-275	pinger locator	UNK	25-32	UNK	UNK	UNK	180

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
NCCOS	northwest, southwest, southern atlantic bight, Southeast Continental Shelf/GOM, Northeast Caribbean	Applied Acoustics Engineering	1300A Series Micro Beacon	receiving beacon on the ROV	omni-directional	21.5-30.5	UNK	UNK	UNK	183
NCCOS	Global	UNK	UNK	WHOI acoustic mircromodem	omni-directional	25-Oct	UNK	UNK	UNK	185
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	LinkQuest	TN1505b transponder	Ultra-short baseline telemetry	omni-directional	31-43.2	UNK	UNK	UNK	185
NCCOS	northwest, southwest, southern atlantic bight, Southeast Continental Shelf/GOM, Northeast Caribbean	Teledyne	Ore Trackpoint III	Ultra-short baseline telemetry	omni-directional	8-30	UNK	UNK	UNK	190
NCCOS	Pacific Islands	Tracklink	5000 USBL	Ultra-short baseline telemetry	120 degrees	14.2-19.8	UNK	120	120	190
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Link Quest	TrackLink 1500 HA System	Ultra-short baseline telemetry	120-150 degrees	31-43.2	UNK	UNK	UNK	UNK
NCCOS	Global	Tracklink navigation system	5000 MA	USBL tracking system	120 degrees, unknown	14.2-19.8	UNK	UNK	UNK	190
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Edgetech	ORE Offshore 4377A transponder with depth telemetry	Ultra-short baseline telemetry	UNK	23-24	UNK	UNK	UNK	197
OCS/JHC	Northeast	EdgeTech	3200-XS w/ SB-0512i	SBP	Downward	0.5-12	FM	16-41	16-41	

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
NCCOS	southeast -GOM	Teledyne	RDI Ocean Surveyor	Acoustic Doppler Current Profiler (ADCP) System	downward	75-1200	UNK	UNK	UNK	UNK
CO-OPS	Throughout U.S.	TRDI	Workshorse/ Sentinel	ADCP	vertical	75	Broadband Chirp	20	20	213
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Tritech PA500/ 6-S	Tritech PA500/6-S	altimeter	UNK	500	UNK	6	6	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Imagenex	881 sonar	imaging sonar	UNK	675	UNK	UNK	UNK	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Tritech PA500/6-S	Tritech PA500/6-S	altimeter	UNK	500	UNK	6	6	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Imagenex	881 sonar	imaging sonar	UNK	675	UNK	UNK	UNK	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Reson 7125	Reson 7125	multibeam sonar	downward 140 degrees (165)	400	UNK	1	0.5	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	RDI	Ocean Surveyor	ADCP	Downward	150	CW	UNK	UNK	220
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	UNK	UNK	Doppler velocity Logger	UNK	300	UNK	UNK	UNK	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Knudsen	320 B/R	SBES/ SubBottom	Downward	3.5/12	CW/FM	28	28	213-222

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
OCS/JHC	Northeast	Custom cylinderical array echo sounder	N/A	MBES	Omni	100 - 500	UNK	360	20	226
CO-OPS	Throughout U.S.	TRDI	Workshorse/Sentinel	ADCP	UNK	150	Broadband Chirp	20	20	233
NCCOS	Pacific Islands	Tritech	SeaKing digital HD sonar	digital HD CHIRP sonar	325kHz- 20 deg vertical, 3.0 deg horizontal 650kHz - 40deg vertical, 1.5 deg horizonta	325-650	UNK	ukinown	unknown	210
NCCOS	Global	Klein	3000	side scan sonar	Beam tilt 5°, 10°, 15°, 20°, 25° down, adjustable	100-500	UNK	0.7	40	234
NCCOS	Southeast -GOM	Teledyne	RDI bottom mounted	Acoustic Doppler Current Profiler (ADCP) System	upward	300-600	UNK	UNK	UNK	UNK
NCCOS	Global	RDI Workhorse Navigator	Workhorse Navigator	Acoustic Doppler Velocity Log	1.2 degrees	1200	UNK	UNK	UNK	214
OCS/JHC	Northeast	Teledyne Odom	CV100	SBES	Downward	100-750	CW	24-200	20/4	300 watts
NCCOS	Global	Teledyne Blueview	UNK	multibeam on ROV	Downward	1350	UNK	1	76	206-207
ORR / MDD	Potentially all, except Chukchi Sea, Beaufort Sea	Klein	3900	Side Scan Sonar	Horizontal	445-900	UNK	0.2	40	UNK
ORR / MDD	Potentially all, except Chukchi Sea, Beaufort Sea	EdgeTech	6205	Side Scan Sonar	Horizontal	520-1610	UNK	0.47	200	215

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
ORR / MDD	Potentially all, except Chukchi Sea, Beaufort Sea	Humminbird	898 SI	Side Scan Sonar - "Side Imaging"	Downward	200	UNK	UNK	UNK	UNK
ORR / MDD	Potentially all, except Chukchi Sea, Beaufort Sea	Marine Sonic	Sea Scan	Side Scan Sonar	Downward	300	UNK	UNK	UNK	UNK
ORR / MDD	Potentially all, except Chukchi Sea, Beaufort Sea	Teledyne BlueView	BlueView 3D Multibeam Scanning Sonar	ROV Imaging Sonar	Downward	900	UNK	UNK	UNK	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Teledyne Odom	CV200	SBES	Downward	24-200	CW	24-200	20/4	20/4
CO-OPS	Throughout U.S.	TRDI	Workshorse/Sentin el	ADCP	UNK	300	Broadband Chirp	20	20	215
CO-OPS	Throughout U.S.	TRDI	Workshorse/Sentin el	ADCP	UNK	600	Broadband Chirp	20	20	217
CO-OPS	Throughout U.S.	TRDI	Workshorse/Sentin el	ADCP	Side-looking across channel, sensor mounted ~ 3m below surface	1200	Broadband Chirp	20	20	214
CO-OPS	Throughout U.S.	Nortek	Aquadopp	ADCP	"- Side-looking across channel, sensor mounted 2-3m below surface - Bottom mounted - upward looking, sensor mounted 15-30m below surface"	600	Narrowband Chirp	20	20	250

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
CO-OPS	Throughout U.S.	Nortek	Aquadopp	ADCP	"- Side-looking across channel, sensor mounted 2-3m below surface - Bottom mounted - upward looking, sensor mounted 15-30m below surface"	2000	Narrowband Chirp	20	20	250
CO-OPS	Throughout U.S.	Nortek	AWAC	ADCP	"- Side-looking across channel, sensor mounted 2-3m below surface - Bottom mounted - upward looking, sensor mounted 15-30m below surface"	600	Narrowband Chirp	20	20	250
CO-OPS	Throughout U.S.	Nortek	AWAC	ADCP	"- Side-looking across channel, sensor mounted 2-3m below surface - Bottom mounted - upward looking, sensor mounted 15-30m below surface"	1000	Narrowband Chirp	20	20	250
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Teledyne Odom	CV200	SB	Downward	50-200	CW	20/4	20/4	2 kW

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
NCCOS	Pacific Islands	kongsberg-simrad	1007- 200m altimeter	alitmeter	conical beamwidth	120-675	UNK	UNK	UNK	UNK
CO-OPS	Throughout U.S.	Lowrance Simrad Fathometer	UNK	SSS	Downward from surface	455-800	UNK	UNK	3.7	196
CO-OPS	Throughout U.S.	Aquatrak	4100/4110 SERIES	Water gauge acoustic sensor at many CO-OPS tide stations	Orientation is down, contained within a 1/2" PVC tube that is mounted inside a 4" PVC well	0.3	N/A	N/A	N/A	50
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Edgetech	4200MP	SSS	Side/Downward	300-600	CW/FM	0.5/0.3	50	UNK

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Edgetech	4200MP	SSS	Side/Downward	300-600	CW/FM	0.5/0.3	50	UNK
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Edgetech	4200MP	SSS	Side/Downward	300-600	CW/FM	0.5/0.3	50	UNK
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Edgetech	4200MP	SSS	Side/Downward	300-600	CW/FM	0.5/0.3	50	UNK
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Klein	5000 v1	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Klein	5000 v1	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Klein	5000 v1	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	Northwest CS, Southwest CS, SoCal Bight, and all Alaska Regions	Klein	5000 v1	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
NCCOS	Global	UNK	UNK	Altimeter	UNK	170	UNK	UNK	UNK	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Benthos	UAT-376 transponders	transponder	UNK	25-27	UNK	UNK	UNK	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
NCCOS	Pacific Islands	The Seabeam 3012 Phase 1 hybrid 12 kHz multibeam sonar bathymetric mapping system	3012 Phase 1 hybrid 12 kHz multibeam sonar bathymetric mapping system	3012 Phase 1 hybrid 12 kHz multibeam sonar bathymetric mapping system	Downward	UNK	UNK	UNK	UNK	UNK
ONMS	Olympic Coast NMS	Simrad	EM302	MBES	UNK	30	UNK	UNK	UNK	UNK
NCCOS	Gulf of Mexico	Reson	7125	MBES	UNK	40	UNK	UNK	UNK	UNK
ONMS	Channel Is NMS	Simrad	ME70	MBES	UNK	70	UNK	UNK	UNK	UNK
NCCOS	Gulf of Mexico	Simrad	EM710	MBES	UNK	100	UNK	UNK	UNK	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EA 60	SBES	Downward	200	CW	7	7	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Klein	5000 v1	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Klein	5000 v2	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Klein	5000 v1	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Klein	5000 v1	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Klein	5000 v2	SSS	Side/Downward	455	CW/FM	0.4	40	214.9
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	R2Sonics	2022	MBES	Downward	200-400	CW	0.9-2	160	UNK
OCS	Gulf of Mexico	Kongsberg	EM2040C	MBES	Downward	200-400	CW/FM	1 @ 400kHz	130	220
OCS	Gulf of Mexico	Edgetech	4125	SSS	Side/Downward	400-900	CW	0.46 / 0.28	50	220
OCS	Gulf of Mexico	Teledyne Odom	CV100	SBES	Downward	200	CW	8	8	UNK
OCS	Gulf of Mexico	Teledyne Odom	CV100	SBES	Downward	200	CW	8	8	UNK
OCS	Gulf of Mexico	Tritech	Starfish 450F	SSS	Side/Downward	450	FM	1.7	60	210
OCS	Gulf of Mexico	Teledyne Odom	CV200	SBES	Downward	200	CW	24-200	20/4	220
OCS	All regions	MarineSonics	Sea Scan ARC	SSS	Downward	600-1200	FM	0.4	24	UNK
OCS	All regions	Kongsberg	EM3002	MBES	Downward	300	CW	1	1	220
OCS	Southeast CS and Mid Atlantic Bight	Kongsberg	EM2040C	MBES	Downward	200-400	CW/FM	1 @ 400kHz	130	220
OCS	Southeast CS and Mid Atlantic Bight	Reson	T-20P	MBES	Downward	200-400	CW/FM	2/2	1/1	220
OCS	Southeast CS and Mid Atlantic Bight	Edgetech	4125	SSS	Side/Downward	400-900	CW	0.46 / 0.28	50	220
OCS	Southeast CS and Mid Atlantic Bight	Teledyne Odom	CV200	SBES	Downward	200	CM	24-200	20/4	220
OCS	Northwest CS	Kongsberg	EM2040C	MBES	Downward	200-400	CW/FM	1 @ 400kHz	130	220

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
OCS	Northwest CS	Kongsberg	3002	MBES	Downward	300	CW	1	1	220
OCS	Northwest CS	Edgetech	4125	SSS	Side/Downward	400-900	CW	0.46 / 0.28	50	220
OCS	Northwest CS	Teledyne Odom	CV200	SBES	Downward	200	CW	24-200	20/4	220
OCS	Gulf of Mexico	Kongsberg	EM3002	MBES	Downward	300	CW	1	1	220
OCS	Gulf of Mexico	Kongsberg	EM2040C	MBES	Downward	200-400	CW/FM	1 @ 400kHz	130	220
OCS	Gulf of Mexico	Edgetech	4125	SSS	Side/Downward	400-900	CW	0.46 / 0.28	50	220
OCS	Gulf of Mexico	Teledyne Odom	CV200	SBES	Downward	200	CW	24-200	20/4	220
OCS	Gulf of Maine, Southern New England, Mid Atlantic Bight	Kongsberg	3002	MBES	Downward	300	CW	1	1	220
OCS	Gulf of Maine, Southern New England, Mid Atlantic Bight	Edgetech	4125	SSS	Side/Downward	400-900	CW	0.46 / 0.28	50	220
OCS	Gulf of Maine, Southern New England, Mid Atlantic Bight	Kongsberg	EM2040C	MBES	Downward	200-400	CW/FM	1 @ 400kHz	130	220
OCS	Gulf of Maine, Southern New England, Mid Atlantic Bight	Teledyne Odom	CV200	SBES	Downward	200	CW	24-200	20/4	220
OCS	All Atlantic regions	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	0.5	200	218
OCS	All Atlantic regions	Edgetech	4200	SSS	Side/Downward	300-600	CW	0.5/0.26	50	220
OCS	All Atlantic regions	Teledyne Odom	CV200	SBES	Downward	200	CW	24-200	20/4	220
OCS/ Contractor	All regions	Teledyne Reson	7101	MBES	Downward	240	CW	2/1	140	220
OCS/ Contractor	All regions	Teledyne Reson	7125	MBES	Downward	200-400	CW/FM	2/1	140	220

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
OCS/ Contractor	All regions	R2Sonics	2024	MBES	Downward	200 - 400	CW/FM	0.5 - 1.0	160	UNK
OCS/NGI	Gulf of Mexico	Reson	7125	MBES	Downward	200 - 400	CW	2/1	140	220
OCS/NGI	Gulf of Mexico	Kongsberg	EM2040C	MBES	Downward	200 - 400	CW/FM	1	1	204.5
OCS/NGI	Gulf of Mexico	Norbit	iWBMS	MBES	Down	200-700	CW/FM	.9	0.9	UNK
OCS/JHC	Northeast	Klein	3500	PMBS	Side/Downward	455	FM	0.4	50	UNK
OCS/JHC	Northeast	Edgetech	6205	PMBS	Side/Downward	230	UNK	0.7	1	UNK
OCS/JHC	Northeast	PingDSP	3DSS	PMBS	Side/Downward	450	UNK	0.4	UNK	UNK
OCS/JHC	Northeast	Kongsberg	HISAS 2040	SAS	Side/Downward	220 - 280	UNK	UNK	UNK	UNK
OCS/JHC	Northeast	Kraken	AquaPix INSAS	SAS	Side/Downward	337	FM	UNK	UNK	UNK
OCS/JHC	Northeast	Kongsberg	EM2040	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/JHC	Northeast	Kongsberg	EM2040P	MBES	Downward	200-400	CW/FM	1.5/1/0.7	180-200	212
OCS/JHC	Northeast	Kongsberg	M3	MBES	Downward or Side Looking	500	FM/CW/ Doppler	3-30	120-140	UNK
OCS/JHC	Northeast	Teledyne Odom	MB1	MBES	Downward	170-220	CW	UNK	120	UNK
OCS/JHC	Northeast/ Southwest CS	Custom Sub-Bottom	N/A	SBP	Downward	1-10	FM	UNK	UNK	UNK
OCS/JHC	Northeast	Teledyne RDI	Workhorse Sentinel	ADCP	Downward/ Upward	300-1200	Doppler	20	20	UNK
OCS/JHC	Northeast	Teledyne Odom	MB2	MBES	Downward	200-460	CW	1.8	140	UNK
OCS/JHC	Northeast and Southeast CS	Teledyne Reson	7125	MBES	Downward	200-400	CW/FM	2/1	140	220
OCS/JHC	Northeast	Imagenix	Delta T	Imaging	Downward/Side Looking	260	CW	3	120	UNK

NOS Office	Region(s)	Manufacturer	Model	Type	Orientation	Frequencies (kHz)	Signal type (CW/FM/ Impulse)	Beamwidth (°)		Source Level (dB re 1uPa @ 1m)
								Alongtrack	Acrosstrack	
OCS/JHC	Northeast	Sound Metrics	Didson	Imaging	Downward/Side Looking	1100	CW	0.4	14	UNK
OCS/JHC	Northeast	Kongsberg	HISAS 1032	SAS	Side/Downward	60-120	UNK	UNK	UNK	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EA 60	SBES	Downward	12	CW	16	16	UNK
ONMS	Stellwagen Banks NMS	Simrad	ES60	SBES	UNK	12	UNK	UNK	UNK	UNK
OCS/ OMAO	All Atlantic regions, Gulf of Mexico, and Carribbean	Kongsberg	EA 60	SBES	Downward	38	CW	7	7	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Edgetech	CHIRP	chirp subbottom profiler -	UNK	4-24	UNK	UNK	UNK	UNK
NCCOS	Southwest Continental Shelf	Simrad	EK60	SES	UNK	38	UNK	UNK	UNK	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	UNK	UNK	pinger is on the Glider	UNK	10	UNK	UNK	UNK	UNK
NCCOS	Southeast Continental Shelf/GOM, Northeast Caribbean	Helle pingers	UNK	pingers	UNK	25 - 27	UNK	UNK	UNK	UNK
ONMS	Stellwagen Banks NMS	Klein	3000	SSS	UNK	100	UNK	UNK	UNK	UNK
ONMS	Hawaii	Klein	3000	SSS	UNK	120	UNK	UNK	UNK	UNK
OCS/JHC	Northeast/ Southwest CS	Custom CBW	N/A	UNK	UNK	10-500	UNK	UNK	UNK	UNK

Appendix E. Animal Movement Modeling Results

Table E-1. Injurious exposures for each year broken down into two categories of active acoustic surveys for activities associated with proposed Alternative A summed over all simulated regions.

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Blue whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Bowhead whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryde's whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Minke whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0	0	0	0	0	0	0
North Atlantic right whale	0	0	0	0	0	0	0	0	0	0	0	0	0
North Pacific right whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Sei whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Baird's beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Beluga whale	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Gervais beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Blainville beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesoplodont beaked whales (all)	0	0	0	0	0	0	0	0	0	0	0	0	0
Clymene's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Common bottlenose dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuvier's beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
False killer whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Fraser's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Resident Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Transient Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Offshore Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Longman's (Indo-Pacific) beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Melon-headed whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern right whale dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacific white-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pantropical spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales, long finned	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales, short finned	0	0	0	0	0	0	0	0	0	0	0	0	0
Pygmy killer whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Risso's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Rough-toothed dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Sowerby's Beaked Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Spinner dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Striped dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
White-beaked dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
True's Beaked Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Dwarf sperm whale	0.53	0.04	0.44	0.01	0.53	0.04	0.44	0.01	0.53	0.04	0.53	0.04	3.18
Pygmy sperm whale	0.35	0.05	0.2	0.03	0.35	0.03	0.2	0.01	0.35	0.02	0.35	0.02	1.96
Dall's porpoise	3.92	4.01	3.92	4.16	3.91	3.98	3.91	3.98	3.91	3.98	3.91	3.98	47.57
Harbor porpoise	4.49	7.1	4.48	7.62	4.52	9.44	4.52	8.32	4.52	6.39	4.52	6.39	72.31
Bearded seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe fur seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Hawaiian monk seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Harp seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Hooded seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern fur seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribbon seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Ringed seals	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Manatee	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Sea otter	0	0	0	0	0	0	0	0	0	0	0	0	0
Walrus	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern elephant seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Polar Bear	0	0	0	0	0	0	0	0	0	0	0	0	0
California sea lion	0	0	0	0	0	0	0	0	0	0	0	0	0
Steller sea lion	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E-2. Injurious exposures for each year broken down into two categories of active acoustic surveys for activities associated with proposed Alternative B summed over all simulated regions.

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Blue whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Bowhead whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryde's whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Minke whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0	0	0	0	0	0	0
North Atlantic right whale	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
North Pacific right whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Sei whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Baird's beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Beluga whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Gervais beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Blainville beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Mesoplodont beaked whales (all)	0	0	0	0	0	0	0	0	0	0	0	0	0
Clymene's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Common bottlenose dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuvier's beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
False killer whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Fraser's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Resident Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Transient Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Offshore Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Longman's (Indo-Pacific) beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Melon-headed whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern right whale dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pacific white-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pantropical spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales, long finned	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales, short finned	0	0	0	0	0	0	0	0	0	0	0	0	0
Pygmy killer whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Risso's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Rough-toothed dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Sowerby's Beaked Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Spinner dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Striped dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
White-beaked dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
True's Beaked Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Dwarf sperm whale	0.66	0.04	0.55	0.02	0.66	0.05	0.55	0.02	0.66	0.04	0.66	0.04	3.95
Pygmy sperm whale	0.43	0.05	0.25	0.03	0.43	0.03	0.25	0.01	0.43	0.02	0.43	0.02	2.38
Dall's porpoise	4.89	4.95	4.89	5.13	4.88	4.94	4.88	4.94	4.78	4.6	4.88	4.94	58.7
Harbor porpoise	5.49	8.03	5.49	8.6	5.53	10.6	5.53	9.35	4.68	3.29	5.53	7.24	79.36
Bearded seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe fur seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Hawaiian monk seal	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Harp seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Hooded seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern fur seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribbon seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Ringed seals	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Manatee	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea otter	0	0	0	0	0	0	0	0	0	0	0	0	0
Walrus	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern elephant seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Polar Bear	0	0	0	0	0	0	0	0	0	0	0	0	0
California sea lion	0	0	0	0	0	0	0	0	0	0	0	0	0
Steller sea lion	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E-3. Injurious exposures for each year broken down into two categories of active acoustic surveys for activities associated with proposed Alternative C summed over all simulated regions.

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Blue whale	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Bowhead whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryde's whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Common Minke whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Fin whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Gray whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Humpback whale	0	0	0	0	0	0	0	0	0	0	0	0	0
North Atlantic right whale	0	0	0	0	0	0	0	0	0	0	0	0	0
North Pacific right whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Sei whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Atlantic white-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Baird's beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Beluga whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Gervais beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Blainville beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Mesoplodont beaked whales (all)	0	0	0	0	0	0	0	0	0	0	0	0	0
Clymene's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Common bottlenose dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Cuvier's beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
False killer whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Fraser's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Resident Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Transient Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Offshore Killer Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Long-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Longman's (Indo-Pacific) beaked whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Melon-headed whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern right whale dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Pacific white-sided dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pantropical spotted dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales, long finned	0	0	0	0	0	0	0	0	0	0	0	0	0
Pilot whales, short finned	0	0	0	0	0	0	0	0	0	0	0	0	0
Pygmy killer whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Risso's dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Rough-toothed dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Short-beaked common dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Sperm whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Sowerby's Beaked Whale	0	0	0	0	0	0	0	0	0	0	0	0	0
Spinner dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
Striped dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
White-beaked dolphin	0	0	0	0	0	0	0	0	0	0	0	0	0
True's Beaked Whale	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Dwarf sperm whale	0.8	0.06	0.66	0.02	0.8	0.06	0.66	0.02	0.8	0.06	0.8	0.06	4.8
Pygmy sperm whale	0.52	0.06	0.3	0.03	0.52	0.04	0.3	0.02	0.52	0.03	0.52	0.03	2.89
Dall's porpoise	5.85	5.91	5.86	5.83	5.85	5.88	5.85	5.89	5.76	5.54	5.85	5.88	69.95
Harbor porpoise	6.51	8.96	6.49	5.73	6.54	11.77	6.54	10.41	5.77	3.94	6.54	8.11	87.31
Bearded seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Grey seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Guadalupe fur seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Hawaiian monk seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Harbor seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Harp seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Hooded seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Northern fur seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Ribbon seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Ringed seals	0	0	0	0	0	0	0	0	0	0	0	0	0
Spotted seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Manatee	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea otter	0	0	0	0	0	0	0	0	0	0	0	0	0
Walrus	0	0	0	0	0	0	0	0	0	0	0	0	0

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Northern elephant seal	0	0	0	0	0	0	0	0	0	0	0	0	0
Polar Bear	0	0	0	0	0	0	0	0	0	0	0	0	0
California sea lion	0	0	0	0	0	0	0	0	0	0	0	0	0
Steller sea lion	0	0	0	0	0	0	0	0	0	0	0	0	0

Table E-4. Behavioral disruption exposures for each year broken down into two categories of active acoustic surveys for activities associated with proposed Alternative A summed over all simulated regions.

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Blue whale	24.85	19.95	24.91	19.98	24.71	19.91	24.77	19.98	24.71	19.91	24.71	19.91	268.3
Bowhead whale	0	76.83	0	36.71	0	2.36	0	577.83	0	0.43	0	0.43	694.59
Bryde's whale	6.15	4.63	11.11	7.79	6.15	4.38	11.11	7.59	6.15	4.29	6.15	4.29	79.79
Common Minke whale	136.21	360.03	136.11	438.04	136.29	549.1	136.29	433.48	136.29	384.4	136.29	384.4	3366.93
Fin whale	86.19	152.17	86.58	176.2	85.99	207.3	86.42	173.62	85.99	157.79	85.99	157.79	1542.03
Gray whale	101.27	103.53	101.26	97.43	101.05	98.59	101.05	182.71	101.05	88.41	101.05	88.41	1265.81
Humpback whale, Gulf of Maine	5.68	130.84	5.68	149.39	5.68	156.78	5.68	146.25	5.68	171.56	5.68	171.56	960.46
Humpback whale, Central North Pacific	10.46	16.99	14.97	29.08	10.47	30.52	14.97	34.29	10.47	14.99	10.47	14.99	212.67
Humpback whale, Western North Pacific	1.46	2.38	2.1	4.07	1.47	4.27	2.1	4.8	1.47	2.1	1.47	2.1	29.79
Humpback whale, CA/OR/WA	76.4	68.29	76.37	66.43	76.18	64.36	76.18	63.65	76.18	64.18	76.18	64.18	848.58
North Atlantic right whale	0.02	0.06	0.02	0.06	0.02	0.07	0.02	0.06	0.02	0.07	0.02	0.07	0.51
North Pacific right whale	0	0.02	0	0.04	0	0	0	0.08	0	0	0	0	0.14
Sei whale	16.15	29.75	23.67	42.09	16.11	40.64	23.63	39.81	16.11	34.26	16.11	34.26	332.59
Atlantic spotted dolphin	606.24	2005.78	520	1931.25	605.95	2349.61	520	1588.46	605.94	1723.19	605.94	1723.18	14785.54
Atlantic white-sided dolphin	21.88	3189.03	1232.3	4943.99	21.88	5438.22	1232.3	4549.33	21.88	4123.42	21.88	4123.42	28919.53
Baird's beaked whale	111.07	95.78	111.06	95.58	110.43	95.55	110.43	95.54	110.43	95.54	110.43	95.54	1237.38

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Beluga whale	0	166.34	0	53.36	0	73.35	0	1350.88	0	18.47	0	18.47	1680.87
Beluga whale, Cooke inlet	3.91	7.44	3.91	8.74	3.91	14.59	3.91	10.79	3.91	7.07	3.91	7.07	79.16
Gervais beaked whale	17.24	33.14	17.21	33.11	17.23	33.19	17.21	33.11	17.22	33.14	17.22	33.14	302.16
Blainville beaked whale	17.09	29.83	17.83	30.61	17.09	29.88	17.83	30.61	17.08	29.83	17.08	29.83	284.59
Mesoplodont beaked whales (all)	42.48	36.63	42.47	36.55	42.23	36.54	42.23	36.54	42.23	36.54	42.23	36.54	473.21
Clymene's dolphin	0.79	3.41	0.45	2.04	0.79	1.96	0.45	0.91	0.79	1.46	0.79	1.46	15.3
Common bottlenose dolphin	473.75	2658.56	476.34	3205.57	473.86	3953.95	476.92	2847.59	473.86	2739.46	473.86	2739.46	20993.18
Cuvier's beaked whale	32.22	32.64	34.09	43.19	33.64	43.05	33.8	43.19	31.93	32.64	31.93	32.64	424.96
False killer whale	210.32	157.45	382.55	245.99	210.53	148.66	382.55	239.16	210.53	145.72	210.53	145.72	2689.71
Fraser's dolphin	1701.02	1082.66	3123.01	2460.22	1702.69	1081.31	3123.01	2460.22	1702.69	1080.74	1702.69	1080.74	22301
Resident Killer Whale	21.8	21.17	22.05	21.65	21.82	22.31	22.04	22.96	21.82	16.85	21.82	16.85	253.14
Transient Killer Whale	10.72	8.45	10.9	8.5	10.73	8.05	10.9	7.63	10.73	7.54	10.73	7.54	112.42
Offshore Killer Whale	13.63	10.65	13.62	10.97	13.59	10.69	13.59	10.67	13.59	10.66	13.59	10.66	145.91
Long-beaked common dolphin	12223.23	10656.52	12216.59	10278.4	12246.76	9856.81	12246.76	9714.35	12246.76	9820.61	12246.76	9820.61	133574.16
Longman's (Indo-Pacific) beaked whale	3.44	2.02	6.35	4.68	3.44	2.02	6.35	4.68	3.44	2.02	3.44	2.02	43.9
Melon-headed whale	12.51	8.68	15.19	6.7	12.52	8.74	15.19	6.7	12.52	8.68	12.52	8.68	128.63
Northern right whale dolphin	1340.76	1618.37	1339.4	1485	1348.8	1328.93	1348.8	1276.06	1348.8	1315.65	1348.8	1315.65	16415.02
Pacific white-sided dolphin	3122.79	2621.78	3121.6	2604.07	3128.25	2638.78	3128.25	2484.39	3128.25	2385.1	3128.25	2385.1	33876.61

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Pantropical spotted dolphin	3138.31	2900.16	4683.57	3514.7	3139.82	2815.77	4683.57	3514.7	3139.82	2780.41	3139.82	2780.41	40231.06
Pilot whales, long finned	0.31	0.63	0.27	0.62	0.32	0.76	0.28	0.63	0.31	0.67	0.31	0.67	5.78
Pilot whales, short finned	40.77	62.85	51.15	58.07	40.81	47.62	51.15	45.61	40.77	41.95	40.77	41.94	563.46
Pygmy killer whale	565.66	289.69	1043.87	491.02	566.23	288.67	1043.87	490.23	566.23	288.33	566.23	288.33	6488.36
Risso's dolphin	414.37	1010.78	464.8	1209.85	413.78	1404.3	464.41	1131.34	413.78	1070.66	413.78	1070.66	9482.51
Rough-toothed dolphin	5327.37	3016.1	9832.68	5120.61	5332.67	3008.78	9832.68	5114.91	5332.67	3006.33	5332.67	3006.33	63263.8
Short-beaked common dolphin	141297.38	116254.34	141218.29	121759.28	141566.94	119180.7	141566.92	117207.89	141566.94	116923.46	141566.94	116923.46	1557032.54
Sperm whale	36.46	29.96	36.41	25.56	36.35	29.63	36.28	25.07	36.34	29.46	36.34	29.46	387.32
Sowerby's Beaked Whale	17.24	33.14	17.21	33.11	17.23	33.19	17.21	33.11	17.22	33.14	17.22	33.14	302.16
Spinner dolphin	249.31	316.55	198.47	59.7	249.18	298.83	198.47	59.7	249.18	291.4	249.18	291.4	2711.37
Striped dolphin	8803.04	8563.13	13332.43	14271.22	8806.54	8551.24	13332.43	14270.14	8806.54	8549.2	8806.54	8549.2	124641.65
White-beaked dolphin	2.44	337.08	2.44	378.22	2.44	378.22	2.44	373.65	2.44	373.65	2.44	373.65	2229.11
True's Beaked Whale	17.24	33.14	17.21	33.11	17.23	33.19	17.21	33.11	17.22	33.14	17.22	33.14	302.16
Dwarf sperm whale	15.46	8.44	27.06	16.16	15.49	8.52	27.06	16.16	15.47	8.36	15.47	8.36	182.01
Pygmy sperm whale	898.48	608.57	1658.26	1033.5	899.37	607.23	1658.26	1032.45	899.37	606.76	899.37	606.76	11408.38
Dall's porpoise	83.01	76.56	83.03	79.67	82.78	76.19	82.78	76.22	82.78	76.15	82.78	76.15	958.1
Harbor porpoise	82.17	163.54	82.03	174.02	82.8	203.01	82.8	184.01	82.8	152.17	82.8	152.17	1524.32
Bearded seal	0	748.29	0	1733.47	0	2382.69	0	2568.91	0	599.9	0	599.9	8633.16
Grey seal	117.48	635.25	117.35	795.84	117.35	1019.13	117.35	745.45	117.35	723.82	117.35	723.82	5347.54
Guadalupe fur seal	136.81	130.32	136.76	134.24	136.42	130.83	136.42	130.57	136.42	130.44	136.42	130.44	1606.09
Hawaiian monk seal	285.01	230.67	526.35	322	285.29	230.67	526.35	322	285.29	230.67	285.29	230.67	3760.26

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Harbor seal	5211.18	6531.45	5211.3	7400.56	5216.65	8408.29	5216.65	7030.74	5216.65	5918.39	5216.65	5918.39	72496.9
Harp seal	54	9545.5	54	10710.37	54	10710.37	54	10580.94	54	10580.94	54	10580.94	63033.06
Hooded seal	0.5	1.76	0.26	2.11	0.5	2.87	0.26	1.97	0.5	2.01	0.5	2.01	15.25
Northern fur seal	2970.72	11366.04	2970.4	21019.98	2970.4	29506.03	2970.4	26621.74	2970.4	8758.82	2970.4	8758.82	123854.15
Ribbon seal	91.17	789.47	91.25	990.85	91.25	1480.98	91.25	3698.98	91.25	456.62	91.25	456.62	8420.94
Ringed seals	0	607.52	0	770.24	0	1058.71	0	3582.31	0	266.56	0	266.56	6551.9
Spotted seal	0	5157.13	0	8359.64	0	12933.61	0	26665.19	0	3261.25	0	3261.25	59638.07
Manatee	0	42.23	10.06	70.89	46.02	42.23	56.08	70.89	46.02	42.23	46.02	42.23	514.9
Sea otter, Southeast AK	206.84	120.62	206.9	139.11	206.9	51.79	206.9	51.79	206.9	51.79	206.9	51.79	1708.23
Sea otter, Southcentral AK	41.9	96.15	41.94	117.53	41.94	213.32	41.94	151.06	41.94	90.14	41.94	90.14	1009.94
Sea otter, Southwest AK	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea otter, OR/WA	118.93	279.63	119.05	184.6	119.05	169.83	119.05	147.12	119.05	174.59	119.05	174.59	1844.54
Sea otter, CA	282.93	409.4	281.76	409	286.83	399.53	286.83	420.79	286.83	399.53	286.83	399.53	4149.79
Walrus	0	291	0	368.94	0	507.12	0	1715.92	0	127.68	0	127.68	3138.34
Northern elephant seal	2873.28	3562.79	2872.84	3682.51	2877.56	3993.94	2877.56	3556.31	2877.56	3181.93	2877.56	3181.93	38415.77
Polar Bear	0	12.79	0	20.73	0	32.08	0	66.13	0	8.09	0	8.09	147.91
California sea lion	4665.33	1914.95	4670	3285.04	4670	2199.73	4670	1914.95	4670	1914.95	4670	1914.95	41159.9
Steller sea lion	2020.87	2101	2022.36	2133.29	2022.36	1949.22	2022.36	1873.64	2022.36	1600.57	2022.36	1600.57	23390.96

Table E-5. Behavioral disruption exposures for each year broken down into two categories of active acoustic surveys for activities associated with proposed Alternative B summed over all simulated regions.

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Blue whale	30.86	24.45	30.93	24.49	30.71	24.4	30.78	24.48	29.37	20.83	30.71	24.39	326.4
Bowhead whale	0	84.51	0	40.38	0	2.6	0	635.61	0	0.47	0	0.47	764.04
Bryde's whale	7.68	5.73	13.89	9.7	7.69	5.46	13.89	9.48	7.69	5.36	7.69	5.36	99.62
Common Minke whale	169.06	412.76	168.96	498.58	169.15	620.74	169.15	493.54	161.3	208.41	169.15	439.58	3680.38
Fin whale	106.99	177.13	107.48	203.62	106.77	237.78	107.3	200.79	101.79	103.46	106.77	183.3	1743.18
Gray whale	125.68	123.06	125.68	116.34	125.46	117.62	125.46	210.15	119.14	84.45	125.46	106.42	1504.92
Humpback whale, Gulf of Maine	6.99	144.84	6.98	165.23	6.98	173.36	6.98	161.79	6.98	43.05	6.98	189.63	919.79
Humpback whale, Central North Pacific	13.07	20.17	18.71	34.18	13.09	35.05	18.71	39.91	13.09	17.97	13.09	17.97	255.01
Humpback whale, Western North Pacific	1.83	2.82	2.62	4.79	1.83	4.91	2.62	5.59	1.83	2.52	1.83	2.52	35.71
Humpback whale, CA/OR/WA	94.65	81.62	94.63	79.58	94.43	77.3	94.43	76.52	88.54	57.2	94.43	77.1	1010.43
North Atlantic right whale	0.03	0.07	0.03	0.07	0.03	0.08	0.03	0.07	0.03	0.04	0.03	0.08	0.59
North Pacific right whale	0	0.02	0	0.04	0	0	0	0.09	0	0	0	0	0.15
Sei whale	19.99	34.23	29.39	49.14	19.95	46.2	29.35	46.64	18.79	17.51	19.95	39.19	370.33
Atlantic spotted dolphin	757.12	2305.96	649.32	2192.31	756.76	2684.19	649.32	1815.26	756.75	1085.01	756.75	1995.12	16403.87
Atlantic white-sided dolphin	24.07	3507.93	1537.1	5611.31	24.07	5982.04	1537.1	5177.18	24.07	923.72	24.07	4535.76	28908.42
Baird's beaked whale	137.91	117.35	137.91	117.13	137.22	117.1	137.22	117.09	131.24	99.95	137.22	117.09	1504.43
Beluga whale	0	182.97	0	58.7	0	80.68	0	1485.96	0	20.31	0	20.31	1848.93

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Beluga whale, Cooke inlet	4.88	8.91	4.89	10.34	4.89	16.78	4.89	12.59	4.89	8.5	4.89	8.5	94.95
Gervais beaked whale	21.31	40.94	21.26	40.91	21.29	41	21.26	40.91	21.28	40.94	21.28	40.94	373.32
Blainville beaked whale	21.26	37.1	22.18	38.08	21.26	37.16	22.18	38.08	21.25	37.1	21.25	37.1	354
Mesoplodont beaked whales (all)	52.74	44.88	52.74	44.79	52.48	44.78	52.48	44.78	50.19	38.22	52.48	44.78	575.34
Clymene's dolphin	0.99	3.95	0.56	2.33	0.99	2.34	0.56	1.08	0.99	1.79	0.99	1.8	18.37
Common bottlenose dolphin	590.61	2983.85	593.88	3586.13	590.68	4408.78	594.51	3192.34	578.61	986.72	590.68	3072.84	21769.63
Cuvier's beaked whale	40.23	40.79	42.58	53.99	42.06	53.81	42.26	53.99	39.92	40.79	39.92	40.79	531.13
False killer whale	262.9	194.91	478.19	306.14	263.16	185.24	478.19	298.63	263.16	182	263.16	182	3357.68
Fraser's dolphin	2126.28	1353.03	3903.77	3075.28	2128.36	1351.55	3903.77	3075.28	2128.36	1350.92	2128.36	1350.92	27875.88
Resident Killer Whale	27.22	25.22	27.51	25.77	27.23	26.45	27.5	27.2	26.96	19.56	27.23	20.44	308.29
Transient Killer Whale	13.4	10.22	13.63	10.28	13.42	9.78	13.63	9.33	13.42	8.49	13.42	9.22	138.24
Offshore Killer Whale	16.88	12.8	16.88	13.15	16.84	12.85	16.84	12.82	15.79	9.38	16.84	12.81	173.88
Long-beaked common dolphin	15099.83	12560.83	15094.19	12144.91	15127.39	11681.16	15127.39	11524.44	13799.57	7597.54	15127.39	11641.34	156525.98
Longman's (Indo-Pacific) beaked whale	4.3	2.52	7.94	5.85	4.3	2.52	7.94	5.85	4.3	2.52	4.3	2.52	54.86
Melon-headed whale	15.63	10.85	18.98	8.37	15.64	10.92	18.98	8.37	15.64	10.85	15.64	10.85	160.72
Northern right whale dolphin	1650.19	1827.87	1648.88	1681.16	1659.22	1509.48	1659.22	1451.33	1462.79	623.97	1659.22	1494.88	18328.21
Pacific white-sided dolphin	3864.01	3096.71	3863.11	3077.24	3870.42	3115.41	3870.42	2945.58	3577.94	1985.74	3870.42	2836.37	39973.37
Pantropical spotted dolphin	3922.88	3607.25	5854.47	4393.38	3924.76	3514.41	5854.47	4393.38	3924.76	3475.52	3924.76	3475.52	50265.56

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Pilot whales, long finned	0.38	0.76	0.34	0.74	0.4	0.91	0.34	0.75	0.38	0.64	0.39	0.8	6.83
Pilot whales, short finned	50.84	74.64	63.83	69.66	50.88	57.92	63.82	55.94	49.99	48.41	50.83	51.62	688.38
Pygmy killer whale	707.08	361.9	1304.84	613.62	707.78	360.77	1304.84	612.74	707.78	360.4	707.78	360.4	8109.93
Risso's dolphin	515.78	1168.51	578.86	1392.8	515.14	1601.39	578.41	1306.43	502.58	615.64	515.14	1234.37	10525.05
Rough-toothed dolphin	6659.22	3768.53	12290.85	6399.65	6665.84	3760.47	12290.85	6393.38	6665.84	3757.76	6665.84	3757.77	79076
Short-beaked common dolphin	174546.75	137683.71	174478.72	143739.13	174862.24	140902.7	174862.21	138732.59	159522.69	86646.68	174862.24	138419.74	1819259.4
Sperm whale	45.4	36.98	45.31	31.48	45.27	36.62	45.17	30.94	44.05	33.57	45.26	36.41	476.46
Sowerby's Beaked Whale	21.31	40.94	21.26	40.91	21.29	41	21.26	40.91	21.28	40.94	21.28	40.94	373.32
Spinner dolphin	311.64	391.92	248.08	74.62	311.47	372.43	248.08	74.62	311.47	364.26	311.47	364.26	3384.32
Striped dolphin	10964.22	10603.89	16626.36	17740.93	10968.99	10590.82	16626.36	17739.75	10775.57	10032.17	10968.99	10588.57	154226.62
White-beaked dolphin	2.68	370.79	2.68	416.04	2.68	416.04	2.68	411.01	2.68	8.8	2.68	411.01	2049.77
True's Beaked Whale	21.31	40.94	21.26	40.91	21.29	41	21.26	40.91	21.28	40.94	21.28	40.94	373.32
Dwarf sperm whale	19.33	10.54	33.83	20.2	19.37	10.64	33.83	20.2	19.35	10.46	19.35	10.46	227.56
Pygmy sperm whale	1123.1	760.42	2072.82	1291.65	1124.21	758.94	2072.82	1290.49	1124.2	758.41	1124.21	758.43	14259.7
Dall's porpoise	103.38	94.8	103.43	98.23	103.15	94.4	103.15	94.43	100.74	88.23	103.15	94.35	1181.44
Harbor porpoise	100.6	183.92	100.43	195.41	101.29	227.31	101.29	206.42	85.08	58.92	101.29	171.38	1633.34
Bearded seal	0	823.12	0	1906.82	0	2620.96	0	2825.8	0	659.89	0	659.89	9496.48
Grey seal	146.54	719.77	146.37	896.42	146.37	1142.03	146.37	840.99	146.37	296.42	146.37	817.19	5591.21
Guadalupe fur seal	169.49	156.7	169.46	161	169.08	157.25	169.08	156.97	158.49	114.79	169.08	156.82	1908.21
Hawaiian monk seal	356.26	288.33	657.94	402.49	356.61	288.33	657.94	402.49	356.61	288.33	356.61	288.33	4700.27
Harbor seal	6481.65	7694.9	6482.27	8650.92	6488.16	9759.42	6488.16	8244.14	6252.61	5254.56	6488.16	7020.54	85305.49
Harp seal	59.4	10500.05	59.4	11781.41	59.4	11781.41	59.4	11639.04	59.4	249.15	59.4	11639.04	57946.5

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Hooded seal	0.63	1.98	0.32	2.36	0.62	3.21	0.32	2.2	0.62	0.75	0.62	2.26	15.89
Northern fur seal	3713.4	12839.85	3713.01	23459.18	3713.01	32793.83	3713.01	29621.11	3713.01	9971.91	3713.01	9971.91	140936.24
Ribbon seal	113.96	887.02	114.06	1108.54	114.06	1647.68	114.06	4087.48	114.06	520.88	114.06	520.88	9456.74
Ringed seals	0	668.27	0	847.27	0	1164.58	0	3940.54	0	293.21	0	293.21	7207.08
Spotted seal	0	5672.84	0	9195.61	0	14226.98	0	29331.71	0	3587.37	0	3587.37	65601.88
Manatee	0	46.45	12.58	82.28	50.62	46.45	63.2	82.28	0	0	50.62	46.45	480.93
Sea otter, Southeast AK	258.55	139.43	258.62	159.76	258.62	63.71	258.62	63.71	258.62	63.71	258.62	63.71	2105.68
Sea otter, Southcentral AK	52.37	113.86	52.42	137.37	52.42	242.74	52.42	174.25	52.42	107.24	52.42	107.24	1197.17
Sea otter, Southwest AK	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea otter, OR/WA	148.66	311.47	148.81	206.95	148.81	190.69	148.81	165.72	148.81	115.58	148.81	195.93	2079.05
Sea otter, CA	339.79	456.72	338.53	456.28	344.1	445.86	344.1	469.24	238.27	53.14	344.1	445.86	4275.99
Walrus	0	320.1	0	405.84	0	557.83	0	1887.51	0	140.45	0	140.45	3452.18
Northern elephant seal	3563.56	4220.45	3563.43	4352.15	3568.63	4694.71	3568.63	4213.32	3360.89	2920.93	3568.63	3801.5	45396.83
Polar Bear	0	14.07	0	22.81	0	35.28	0	72.74	0	8.9	0	8.9	162.7
California sea lion	5831.67	2393.69	5837.5	3900.79	5837.5	2706.94	5837.5	2393.69	5837.5	2393.69	5837.5	2393.69	51201.66
Steller sea lion	2526.09	2478.77	2527.95	2514.29	2527.95	2311.81	2527.95	2228.67	2527.95	1742.67	2527.95	1928.3	28370.35

Table E-6. Behavioral disruption exposures for each year broken down into two categories of active acoustic surveys for activities associated with proposed Alternative C summed over all simulated regions.

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Blue whale	36.87	28.95	36.96	26.27	36.7	28.89	36.79	28.99	35.56	25.31	36.7	28.89	386.88
Bowhead whale	0	92.19	0	44.05	0	2.83	0	693.4	0	0.52	0	0.52	833.51
Bryde's whale	9.22	6.84	16.66	11.61	9.23	6.54	16.66	11.38	9.29	6.47	9.23	6.43	119.56
Common Minke whale	201.91	465.48	201.79	310.87	202	692.37	202	553.63	196.95	250.21	202	494.74	3973.95
Fin whale	127.79	202.1	128.39	147.24	127.55	268.25	128.19	227.95	123.84	124.68	127.55	208.82	1942.35
Gray whale	150.09	142.58	150.1	116.07	149.86	136.65	149.86	237.59	144.07	101.94	149.86	124.43	1753.1
Humpback whale, Gulf of Maine	8.3	158.83	8.29	19.21	8.29	189.95	8.29	177.32	9.97	51.21	8.29	207.69	855.64
Humpback whale, Central North Pacific	15.69	23.34	22.45	39.28	15.7	39.58	22.45	45.54	15.76	21	15.7	20.95	297.44
Humpback whale, Western North Pacific	2.2	3.27	3.14	5.5	2.2	5.54	3.14	6.38	2.21	2.94	2.2	2.93	41.65
Humpback whale, CA/OR/WA	112.91	94.96	112.9	75.35	112.67	90.24	112.67	89.4	107.27	69.65	112.67	90.02	1180.71
North Atlantic right whale	0.03	0.07	0.03	0.04	0.03	0.09	0.03	0.08	0.03	0.05	0.03	0.08	0.59
North Pacific right whale	0	0.03	0	0.05	0	0	0	0.1	0	0	0	0	0.18
Sei whale	23.84	38.69	35.1	33.25	23.79	51.76	35.06	53.48	22.94	21.14	23.79	44.1	406.94
Atlantic spotted dolphin	908	2606.16	778.65	1448.1	907.57	3018.76	778.65	2042.04	920.67	1299.63	907.55	2267.05	17882.83
Atlantic white-sided dolphin	26.25	3826.84	1841.89	2288.96	26.25	6525.86	1841.89	5805.03	72.92	1089.78	26.25	4948.1	28320.02
Baird's beaked whale	164.75	138.92	164.77	125.52	164.01	138.65	164.01	138.64	158.88	121.42	164.01	138.64	1782.22
Beluga whale	0	199.6	0	64.04	0	88.02	0	1621.05	0	22.16	0	22.16	2017.03

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Beluga whale, Cooke inlet	5.86	10.38	5.87	11.95	5.87	18.97	5.87	14.4	5.87	9.94	5.87	9.94	110.79
Gervais beaked whale	25.37	48.76	25.32	48.72	25.36	48.83	25.32	48.72	25.35	48.76	25.35	48.76	444.62
Blainville beaked whale	25.45	44.37	26.53	45.54	25.43	44.44	26.53	45.54	25.42	44.37	25.42	44.37	423.41
Mesoplodont beaked whales (all)	63	53.13	63.01	48	62.72	53.02	62.72	53.02	60.76	46.43	62.72	53.02	681.55
Clymene's dolphin	1.19	4.47	0.67	2.59	1.19	2.73	0.67	1.25	1.19	2.13	1.19	2.14	21.41
Common bottlenose dolphin	707.48	3309.13	711.38	1673.97	707.51	4863.6	712.08	3537.07	719.51	1190.38	707.51	3406.2	22245.82
Cuvier's beaked whale	48.25	48.96	51.04	65.06	50.47	64.58	50.7	64.79	48.34	48.96	47.91	48.96	638.02
False killer whale	315.49	232.35	573.83	366.25	315.79	221.81	573.83	358.11	318.51	219.87	315.79	218.28	4029.91
Fraser's dolphin	2551.54	1623.42	4684.52	3690.33	2554.03	1621.79	4684.52	3690.33	2554.03	1621.11	2554.03	1621.11	33450.76
Resident Killer Whale	32.63	29.24	32.99	29.09	32.65	30.59	32.98	31.42	32.4	23.14	32.65	24.04	363.82
Transient Killer Whale	16.07	11.99	16.35	11.17	16.09	11.51	16.35	11.01	16.11	10.26	16.09	10.91	163.91
Offshore Killer Whale	20.14	14.96	20.14	12.34	20.1	15.01	20.1	14.98	19.13	11.45	20.1	14.97	203.42
Long-beaked common dolphin	17976.43	14465.15	17971.8	10424.15	18008.01	13505.5	18008.01	13334.54	16680.07	9321.49	18008.01	13462.06	181165.22
Longman's (Indo-Pacific) beaked whale	5.16	3.03	9.53	7.02	5.16	3.03	9.53	7.02	5.16	3.03	5.16	3.03	65.86
Melon-headed whale	18.76	13.01	22.78	10.04	18.77	13.09	22.78	10.04	18.77	13.01	18.77	13.01	192.83
Northern right whale dolphin	1959.62	2037.37	1958.36	1049.93	1969.63	1690.04	1969.63	1626.59	1776.35	770.1	1969.63	1674.11	20451.36
Pacific white-sided dolphin	4605.24	3571.64	4604.63	2795.8	4612.6	3592.04	4612.6	3406.77	4320.1	2416.64	4612.6	3287.63	46438.29
Pantropical spotted dolphin	4707.46	4314.33	7025.37	5272.05	4709.72	4213.06	7025.37	5272.05	4709.72	4170.62	4709.72	4170.62	60300.09

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Pilot whales, long finned	0.46	0.89	0.41	0.69	0.48	1.07	0.41	0.87	0.46	0.76	0.46	0.93	7.89
Pilot whales, short finned	60.91	86.4	76.5	78.19	60.97	68.2	76.49	66.27	60.24	58.08	60.91	61.3	814.46
Pygmy killer whale	848.49	434.09	1565.82	736.21	849.33	432.86	1565.82	735.27	856.83	435.78	849.33	432.45	9742.28
Risso's dolphin	617.18	1326.24	692.91	903.59	616.49	1798.48	692.44	1481.53	613.04	742.6	616.49	1398.08	11499.07
Rough-toothed dolphin	7991.06	4520.96	14749.02	7678.64	7999	4512.17	14749.02	7671.86	8069.58	4543.98	7999	4509.23	94993.52
Short-beaked common dolphin	207796.09	159113.08	207739.14	119106.3	208157.53	162624.7	208157.5	160257.3	192861.66	106779.79	208157.53	159916.02	2100666.64
Sperm whale	54.32	43.99	54.24	35.22	54.2	43.64	54.09	36.82	53.15	40.53	54.19	43.39	567.78
Sowerby's Beaked Whale	25.37	48.76	25.32	48.72	25.36	48.83	25.32	48.72	25.35	48.76	25.35	48.76	444.62
Spinner dolphin	373.96	467.29	297.69	89.54	373.77	446.02	297.69	89.54	373.77	437.11	373.77	437.11	4057.26
Striped dolphin	13125.4	12644.66	19920.28	20765.01	13131.45	12630.39	19920.28	21209.35	12935.2	12068.95	13131.45	12627.94	184110.36
White-beaked dolphin	2.92	404.5	2.92	9.6	2.92	453.86	2.92	448.38	8.12	18.74	2.92	448.38	1806.18
True's Beaked Whale	25.37	48.76	25.32	48.72	25.36	48.83	25.32	48.72	25.35	48.76	25.35	48.76	444.62
Dwarf sperm whale	23.2	12.64	40.59	24.24	23.25	12.76	40.59	24.24	23.22	12.55	23.22	12.55	273.05
Pygmy sperm whale	1347.72	912.27	2487.38	1549.79	1349.06	910.66	2487.39	1548.56	1360.96	917.09	1349.06	910.1	17130.04
Dall's porpoise	123.76	113.05	123.81	112.08	123.51	112.6	123.51	112.64	121.44	106.41	123.51	112.56	1408.88
Harbor porpoise	119.01	204.28	118.85	103.65	119.78	251.63	119.78	228.84	104.29	71.95	119.78	190.62	1752.46
Bearded seal	0	897.95	0	2080.17	0	2859.22	0	3082.69	0	719.88	0	719.88	10359.79
Grey seal	175.6	804.29	175.39	422.9	175.39	1264.94	175.39	936.53	181.41	357	175.39	910.57	5754.8
Guadalupe fur seal	202.17	183.07	202.15	151.07	201.74	183.68	201.74	183.36	192.03	140.17	201.74	183.21	2226.13
Hawaiian monk seal	427.51	346	789.53	482.99	427.94	346	789.53	482.99	433.61	350.01	427.94	346	5650.05
Harbor seal	7752.11	8858.37	7753.24	8154.06	7759.67	11110.54	7759.67	9457.51	7533.37	6273.05	7759.67	8122.67	98293.93
Harp seal	64.8	11454.6	64.8	271.8	64.8	12852.45	64.8	12697.13	180	530.67	64.8	12697.13	51007.78

Species	Year1 <30kHz	Year1 <200kHz	Year2 <30kHz	Year2 <200kHz	Year3 <30kHz	Year3 <200kHz	Year4 <30kHz	Year4 <200kHz	Year5 <30kHz	Year5 <200kHz	Year6 <30kHz	Year6 <200kHz	Total Exposures
Hooded seal	0.75	2.21	0.39	0.93	0.75	3.55	0.39	2.43	0.77	0.9	0.75	2.51	16.33
Northern fur seal	4456.09	14313.65	4455.61	25898.38	4455.61	36081.63	4455.61	32620.49	4455.61	11184.99	4455.61	11184.99	158018.27
Ribbon seal	136.75	984.57	136.87	1226.23	136.87	1814.38	136.87	4475.98	136.87	585.14	136.87	585.14	10492.54
Ringed seals	0	729.03	0	924.29	0	1270.45	0	4298.77	0	319.87	0	319.87	7862.28
Spotted seal	0	6188.55	0	10031.57	0	15520.34	0	31998.22	0	3913.5	0	3913.5	71565.68
Manatee	0	50.68	15.09	42.99	55.22	50.68	70.32	93.67	4.14	3.8	55.22	50.68	492.49
Sea otter, Southeast AK	310.26	158.24	310.35	180.42	310.35	75.64	310.35	75.64	310.35	75.64	310.35	75.64	2503.23
Sea otter, Southcentral AK	62.85	131.57	62.9	157.21	62.9	272.16	62.9	197.45	62.9	124.34	62.9	124.34	1384.42
Sea otter, Southwest AK	0	0	0	0	0	0	0	0	0	0	0	0	0
Sea otter, OR/WA	178.4	343.32	178.58	131.9	178.58	211.56	178.58	184.31	180.25	135.95	178.58	217.28	2297.29
Sea otter, CA	396.64	504.03	395.3	165.05	401.38	492.19	401.38	517.7	294.48	81.13	401.38	492.19	4542.85
Walrus	0	349.2	0	442.73	0	608.54	0	2059.1	0	153.22	0	153.22	3766.01
Northern elephant seal	4253.84	4878.11	4254.02	4240.62	4259.69	5395.48	4259.69	4870.34	4051.93	3519.43	4259.69	4421.07	52663.91
Polar Bear	0	15.35	0	24.88	0	38.49	0	79.36	0	9.71	0	9.71	177.5
California sea lion	6998	2872.42	7005.01	4516.54	7005.01	3214.16	7005.01	2872.42	7005.01	2872.42	7005.01	2872.42	61243.43
Steller sea lion	3031.31	2856.55	3033.55	2670.29	3033.55	2674.4	3033.55	2583.72	3037.53	2090.65	3033.55	2256.03	33334.68