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DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[RTID 0648-XR101]

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Marine Site Characterization Surveys off of Massachusetts, Rhode Island, Connecticut, New York and New Jersey

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

ACTION: Notice; proposed incidental harassment authorization; request for comments on proposed authorization and possible renewal.

SUMMARY: NMFS has received a request from Equinor Wind, LLC (Equinor) for authorization to take marine mammals incidental to marine site characterization surveys in the Atlantic Ocean in the area of the Commercial Leases of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0520 and OCS-A 0512) and along potential submarine cable routes to a landfall location in Massachusetts, Rhode Island, Connecticut, New York or New Jersey. Pursuant to the Marine Mammal Protection Act (MMPA), NMFS is requesting comments on its proposal to issue an incidental harassment authorization (IHA) to incidentally take marine mammals during the specified activities. NMFS is also requesting comments on a possible one-year renewal that could be issued under certain circumstances and if all requirements are met, as described in **Request for Public Comments** at the end of this notice. NMFS will consider public comments prior to making any final decision

on the issuance of the requested MMPA authorizations and agency responses will be summarized in the final notice of our decision.

DATES: Comments and information must be received no later than [*insert date 30 days after date of publication in the FEDERAL REGISTER*].

ADDRESSES: Comments should be addressed to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service. Physical comments should be sent to 1315 East-West Highway, Silver Spring, MD 20910 and electronic comments should be sent to *ITP.pauline@noaa.gov*.

Instructions: NMFS is not responsible for comments sent by any other method, to any other address or individual, or received after the end of the comment period. All comments received are a part of the public record and will generally be posted online at *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable* without change. All personal identifying information (*e.g.*, name, address) voluntarily submitted by the commenter may be publicly accessible. Do not submit confidential business information or otherwise sensitive or protected information.

FOR FURTHER INFORMATION CONTACT: Rob Pauline, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the applications and supporting documents, as well as a list of the references cited in this document, may be obtained by visiting the Internet at: *www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable*. In case of problems accessing these documents, please call the contact listed above.

SUPPLEMENTARY INFORMATION:

Background

The MMPA prohibits the "take" of marine mammals, with certain exceptions. Sections 101(a)(5)(A) and (D) of the MMPA (16 U.S.C. 1361 *et seq.*) direct the Secretary of Commerce (as delegated to NMFS) to allow, upon request, the incidental, but not intentional, taking of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographical region if certain findings are made and either regulations are issued or, if the taking is limited to harassment, a notice of a proposed incidental take authorization may be provided to the public for review.

Authorization for incidental takings shall be granted if NMFS finds that the taking will have a negligible impact on the species or stock(s) and will not have an unmitigable adverse impact on the availability of the species or stock(s) for taking for subsistence uses (where relevant). Further, NMFS must prescribe the permissible methods of taking and other "means of effecting the least practicable adverse impact" on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stocks for taking for certain subsistence uses (referred to in shorthand as "mitigation"); and requirements pertaining to the mitigation, monitoring and reporting of such takings are set forth.

The definitions of all applicable MMPA statutory terms cited above are included in the relevant sections below.

National Environmental Policy Act

To comply with the National Environmental Policy Act of 1969 (NEPA; 42 U.S.C. 4321 *et seq.*) and NOAA Administrative Order (NAO) 216-6A, NMFS must evaluate our proposed action (*i.e.*, the promulgation of regulations and subsequent issuance of incidental take authorization) and alternatives with respect to potential impacts on the human environment.

This action is consistent with categories of activities identified in Categorical Exclusion B4 of the Companion Manual for NAO 216-6A, which do not individually or cumulatively have the potential for significant impacts on the quality of the human environment and for which we have not identified any extraordinary circumstances that would preclude this categorical exclusion. Accordingly, NMFS has preliminarily determined that the proposed action qualifies to be categorically excluded from further NEPA review.

Information in Equinor's application and this notice collectively provide the environmental information related to proposed issuance of these regulations and subsequent incidental take authorization for public review and comment. We will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the request for incidental take authorization.

Summary of Request

On January 30, 2020, NMFS received a request from Equinor for an IHA to take marine mammals incidental to marine site characterization surveys in the Atlantic Ocean in the area of the Commercial Leases of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0520 and OCS-A 0512) and along potential submarine cable routes to a landfall location in Massachusetts, Rhode Island, Connecticut, New York or New Jersey. A revised application was received on March 31, 2020. NMFS deemed that request to be adequate and complete. On May 22, Equinor notified NMFS of a revision to their proposed activities and submitted a revised IHA application reflecting the change. Equinor's request is for the take of 17 marine mammal stocks, by Level B harassment only. Neither Equinor nor NMFS expects serious injury or mortality to result from this activity and the activity is expected to last no more than one year, therefore, an IHA is appropriate.

Description of the Proposed Activity

Overview

Equinor proposes to conduct marine site characterization surveys, including high-resolution geophysical (HRG) and geotechnical surveys, in the area of Commercial Leases of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf #OCS-A 0520 and #OCS-A 0512 (Lease Areas) and along potential submarine cable routes offshore Massachusetts, Rhode Island, Connecticut, New York and New Jersey.

The purpose of the proposed surveys is to support the preliminary site characterization, siting, and engineering design of offshore wind project facilities including wind turbine generators, offshore substations, and submarine cables within the Lease Areas and in export cable route areas (ECRAs). As many as two survey vessels may operate concurrently as part of the proposed surveys. Underwater sound resulting from Equinor's proposed surveys has the potential to result in the incidental take of marine mammals in the form of behavioral harassment.

Dates and Duration

The estimated duration of the HRG surveys is expected to be up to 218 total days over the course of one year. Geotechnical sampling is anticipated to occur for a total of 135 days over the course of one year. This schedule is based on 24-hour operations and includes potential down time due to inclement weather.

Specific Geographic Region

Equinor's survey activities would occur in the Northwest Atlantic Ocean within Federal and state waters. Surveys would occur in the Lease Areas and in ECRAs offshore Massachusetts, Rhode Island, Connecticut, New York and New Jersey (see Figure 1-1 in the IHA application).

Detailed Description of the Specified Activities

Equinor's proposed marine site characterization surveys include HRG and geotechnical survey activities. These survey activities would occur within the Lease Areas and within ECRAs between the Lease Areas and the coasts of Massachusetts, Rhode Island, Connecticut, New York and New Jersey. For the purpose of this IHA the Lease Areas and ECRAs are collectively referred to as the Project Area.

Geophysical and shallow geotechnical survey activities are anticipated to be supported by vessels which will maintain a speed of approximately 4 knots (kn) while transiting survey lines. The proposed HRG and geotechnical survey activities are described below.

Geotechnical Survey Activities

Equinor's proposed geotechnical survey activities would include the following:

- Sample boreholes to determine geological and geotechnical characteristics of sediments;
- Deep cone penetration tests (CPTs) to determine stratigraphy and in situ conditions of the deep surface sediments; and
- Vibracores to determine the geological and geotechnical characteristics of the sediments.

Geotechnical investigation activities are anticipated to be conducted from a drill ship equipped with dynamic positioning (DP) thrusters. It is anticipated that vibracore samples, borings and CPT may be obtained at each planned wind turbine location in the Lease Areas. Impact to the seafloor from this equipment will be limited to the minimal contact of the sampling equipment, and inserted boring and probes.

In considering whether marine mammal harassment is an expected outcome of exposure to a particular activity or sound source, NMFS considers the nature of the exposure itself (*e.g.*, the magnitude, frequency, or duration of exposure), characteristics of the marine mammals potentially exposed, and the conditions specific to the geographic area where the activity is expected to occur (*e.g.*, whether the activity is planned in a foraging area, breeding area, nursery or pupping area, or other biologically important area for the species). We then consider the expected response of the exposed animal and whether the nature and duration or intensity of that response is expected to cause disruption of behavioral patterns (*e.g.*, migration, breathing, nursing, breeding, feeding, or sheltering) or injury.

Geotechnical survey activities would be conducted from a drill ship equipped with DP thrusters. DP thrusters would be used to position the sampling vessel on station and maintain position at each sampling location during the sampling activity. Sound produced through use of DP thrusters is similar to that produced by transiting vessels and DP thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities. NMFS does not believe acoustic impacts from DP thrusters are likely to result in take of marine mammals in the absence of activity- or location-specific circumstances that may otherwise represent specific concerns for marine mammals (*i.e.*, activities proposed in area known to be of particular importance for a particular species), or associated activities that may increase the potential to result in take when in concert with DP thrusters. In this case, we are not aware of any such circumstances. Therefore, NMFS believes the likelihood of DP thrusters used during the proposed geotechnical surveys resulting in harassment of marine mammals to be so low as to be discountable. As DP thrusters are not expected to result in take of marine mammals, these activities are not analyzed further in this document.

Field studies conducted off the coast of Virginia to determine the underwater noise produced by CPTs and borehole drilling found that these activities did not result in underwater noise levels that exceeded current thresholds for Level B harassment of marine mammals

(Kalapinski, 2015). Given the small size and energy footprint of geotechnical survey activities, NMFS believes the likelihood that noise from these activities would exceed the Level B harassment threshold at any appreciable distance is so low as to be discountable. Therefore, geotechnical survey activities are not expected to result in harassment of marine mammals and are not analyzed further in this document.

Geophysical Survey Activities

Equinor has proposed that HRG survey operations would be conducted continuously 24 hours per day. Based on 24-hour operations, the estimated total duration of the proposed activities would be approximately 218 survey days (Table 1). These estimated durations include estimated weather down time.

Table 1 – Summary of Proposed HRG Survey Segments

Survey Segment	**Duration (Survey Days)**
ECRA 1	11.25
ECRA 2	70.25
ECRA 3	11.25
ECRA 4	125.25
All survey areas combined	218

Equinor's HRG survey activities would be supported by a maximum of two concurrently-operating source vessels. HRG equipment on the survey vessel would either be mounted to or towed behind the survey vessel. Vessels would operate at a typical survey speed of approximately 4 knots (7.4 km per hour) while surveying. Surveys within the Lease Areas would be conducted along tracklines spaced a minimum of 30 meters (m) (98 feet (ft)) apart. Up to two cable route corridors within the ECRAs (Figure 1-1 in the IHA application) would be surveyed along tracklines that would also be spaced a minimum of 30 m (98 ft) apart. The full survey protocol is designed to meet BOEM requirements as defined in the July 2015 “Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585” and the March 2017 “Guidelines for Providing Archeological and Historical Property Information Pursuant to 30 CFR Part 585.”

Equinor has proposed to deploy some types of HRG equipment on a Surveyor Remotely Operated Vehicle (SROV) (see Figure 1-3 in the IHA application). The SROV is fully controlled from the surface vessel and is equipped with multibeam echosounders, triangulating lasers, and video-photo mosaic cameras as well as side scan sonar, a shallow penetration sub-bottom profiler, and gradiometer. It is specially designed to increase the progress rate during the survey along tracklines where medium penetration sub-bottom profiler data is not required. SROV operations facilitate better trackline fidelity compared to traditional vessel-based survey operations as the SROV is de-coupled from the surface motion of the water and is not affected by wind or wave action. Equinor estimates that the SROV, which would not exceed the speed of the mother ship, has the potential to increase survey efficiency by 25 percent over vessel-based surveys due to an ability to survey with quicker line turns, resulting in fewer re-runs of tracklines. The SROV also minimizes limitations on surveys that may otherwise result from adverse weather conditions. The SROV would maintain a depth of no higher than 6 m above the seabed at all times while actively surveying, in accordance with BOEM guidelines for acceptable operation of a gradiometer.

The geophysical survey activities proposed by Equinor would include the following:

- Shallow Penetration sub-bottom profilers (SBP) (Pinger/CHIRP/Parametric) to map near-surface stratigraphy (0 to 5 m (0 to 16 ft) of sediment below the seabed). SBP emit sonar pulses that increase in frequency (3.5 to 200 kiloHertz (kHz)) over time. The pulse length frequency range can be adjusted depending on project needs. The shallow penetration SBPs are only operated from the SROV.

- Medium Penetration SBPs (Sparker/Boomer) to map deeper subsurface stratigraphy as needed. A medium SBP system emits acoustic pulses from 50 kHz to 4 kHz, omnidirectional from the source that can penetrate hundreds of meters into the seafloor. Medium penetration SBPs are usually towed behind the vessel with adjacent hydrophone arrays to detect the return signals.

- Ultra-Short Baseline (USBL) Positioning and Global Acoustic Positioning System (GAPS) to provide high accuracy ranges by measuring the time between the acoustic pulses transmitted by the vessel transceiver and the equipment necessary to produce the acoustic profile. USBL/GAPS are two-component systems usually with a hull or side pole mounted transceiver and one or more transponders on the seabed or the equipment.

- Single and Multibeam Depth Sounders to determine water depths and general topography. The multibeam echosounder sonar system projects sonar pulses in several angled beams from a transducer mounted to SROV. The beams radiate out from the transducer in a fan-shaped pattern orthogonally to the ship's direction. This equipment would only be operated from the SROV and operates above 180 kHz (outside the functional hearing ranges of all marine mammals).

- Side scan sonar (SSS) for seabed sediment classification purposes and to identify man-made acoustic targets on the seafloor. This sonar device emits conical or fan-shaped pulses down toward the seafloor in multiple beams at a wide angle, perpendicular to the path of the sensor through the water. The acoustic return of the pulses can be joined to form an image of the sea bottom within the swath of the beam. SSSs are typically towed behind the vessel or mounted to the hull. The SSS would only be operated from the SROV and operates above 180 kHz (outside the functional hearing ranges of all marine mammals).

- Sound Velocity Profiler to measure speed of sound to make corrections for calibration of equipment. Sound Velocity Profilers operate above 180 kHz (outside the functional hearing ranges of all marine mammals).

- Marine Gradiometer (magnetometer) to detect and map ferrous objects on and below the seafloor which may cause a hazard, including anchors, chains, cables, scattered shipwreck debris, unexploded ordnances, aircraft, and any other objects with a magnetic expression. Note that the magnetometer is not a sound source.

The deployment of HRG survey equipment, including some of the equipment planned for use during Equinor's proposed activity, produces sound in the marine environment that has the potential to result in harassment of marine mammals. However, sound propagation of HRG sources is dependent on several factors including operating mode, frequency, depth of source and beam direction of the equipment; thus, potential impacts to marine mammals from HRG equipment are driven by the specification of individual HRG sources. The specifications of the potential equipment planned for use during HRG survey activities (Table 1-1 in the IHA application) were analyzed to determine which types of equipment would have the potential to result in harassment of marine mammals. Based on the best available information, the likelihood of HRG equipment that operates either at frequency ranges that fall outside the functional hearing ranges of marine mammals (*e.g.*, above 180 kHz) or within marine mammal functional hearing ranges but with low sound source levels (*e.g.*, a single pulse at less than 200 decibel (dB) re re 1 micro-Pascal (μPa)) to result in the take of marine mammals is so low as to be discountable. These equipment types were therefore eliminated from further analysis. As noted above, these include: the multibeam echosounder, Sound Velocity Profiler, and SSS. As we have determined these sources will not result in the take of marine mammals, they are not analyzed further in this document. In addition, the Marine Gradiometer (magnetometer) is not a sound source and therefore does not have the potential to result in take of marine mammals, and is therefore not analyzed further in this document. As described above, the SROV would maintain a depth of no higher than 6 m above the seabed at all times while actively surveying. Thus, a marine mammal would have to pass between the SROV and the seabed and through the beam of the HRG source in order to be exposed to noise from HRG equipment operating from the SROV. As the SROV would never operate more than 6 m above the seabed while operating active HRG equipment, this is extremely unlikely to occur. In addition, the shallow penetration SBP that is operated from the SROV has a narrow beam (maximum of 36 degrees). Therefore, NMFS has determined the potential for take of marine mammals as a result of exposure to HRG equipment operated from the SROV is so low as to be discountable, and HRG equipment operated from the SROV is not analyzed further in this document.

Table 2 identifies the representative survey equipment that may be used in support of proposed vessel-based geophysical survey activities that has the potential to result in the take of marine mammals. As described above, HRG equipment operated from the SROV but not the vessel are not expected to result in the incidental take of marine mammals and are therefore not shown in Table 2 (all HRG equipment types proposed for use by Equinor, including those operated from the SROV, are shown in Table 1-1 of the IHA application). Geophysical surveys are expected to use multiple equipment types concurrently in order to collect multiple aspects of geophysical data along one transect.

Table 2 – Summary of Vessel-based HRG Survey Equipment Proposed for Use by Equinor with the Potential to Result in the Take of Marine Mammals

HRG Equipment Type	Equipment	Operating Frequency	SL rms (dB re 1 μPa m)	SL pk (dB re 1 μPa m)	Pulse Duration (milli-second)	Repetition Rate (Hz)	Beam Width (degrees)
Subsea Positioning / USBL [1]	Kongsberg HiPAP 501/502	21 - 31	190	207	2	1	15
Medium Sub-bottom Profiler [2]	Geo-Source 400 Tip Sparker Source (800 J)	0.25 to 3.25	203	213	2	4	Omni-directional

[1] Sound source characteristics from manufacturer specifications.

[2] SLs as reported for the ELC820 sparker in Crocker and Fratantonio (2016) which represents the most applicable proxy to the Geo-Source 800-J sparker expected for use during Equinor's proposed surveys.

Proposed mitigation, monitoring, and reporting measures are described in detail later in this document (please see **Proposed Mitigation** and **Proposed Monitoring and Reporting**).

Description of Marine Mammals in the Area of Specified Activity

Sections 3 and 4 of the IHA application summarize available information regarding status and trends, distribution and habitat preferences, and behavior and life history, of the potentially affected species. Additional information regarding population trends and threats may be found in NMFS' Stock Assessment Reports (SARs; *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments*) and more general information about these species (*e.g.*, physical and behavioral descriptions) may be found on NMFS' web site (*www.fisheries.noaa.gov/find-species*). All species that could potentially occur in the proposed survey areas are included in Table 4-1 of the IHA application. However, the temporal and/or spatial occurrence of several species listed in Table 7-2 of the IHA application is such that take of these species is not expected to occur either because they have very low densities in the project area or are known to occur further offshore than the project area. These are: the blue whale (*Balaenoptera musculus*), Bryde's whale (*Balaenoptera edeni*), Cuvier's beaked whale (*Ziphius cavirostris*), four species of Mesoplodont beaked whale (*Mesoplodon* spp.), dwarf and pygmy sperm whale (*Kogia sima* and *Kogia breviceps*), short-finned pilot whale (*Globicephala macrorhynchus*), northern bottlenose whale (*Hyperoodon ampullatus*), killer whale (*Orcinus orca*), pygmy killer whale (*Feresa attenuata*), false killer whale (*Pseudorca crassidens*), melon-headed whale (*Peponocephala electra*), striped dolphin (*Stenella coeruleoalba*), white-beaked dolphin (*Lagenorhynchus albirostris*), pantropical spotted dolphin (*Stenella attenuata*), Fraser's dolphin (*Lagenodelphis hosei*), rough-toothed dolphin (*Steno bredanensis*), Clymene dolphin (*Stenella clymene*), spinner dolphin (*Stenella longirostris*), and hooded seal (*Cystophora cristata*). As take of these species is not anticipated as a result of the proposed activities, these species are not analyzed further.

Table 3 summarizes information related to the population or stock, including regulatory status under the MMPA and Endangered Species Act (ESA) and potential biological removal (PBR), where known. For taxonomy, we follow Committee on Taxonomy (2019). PBR is defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (as described in NMFS' SARs). While no mortality is anticipated or authorized here, PBR is included here as a gross indicator of the status of the species and other threats.

Marine mammal abundance estimates presented in this document represent the total number of individuals that make up a given stock or the total number estimated within a particular study or survey area. NMFS' stock abundance estimates for most species represent the total estimate of individuals within the geographic area, if known, that comprises that stock. For some species, this geographic area may extend beyond U.S. waters. All managed stocks in this region are assessed in NMFS' U.S. Atlantic SARs. All values presented in Table 3 are the most recent available at the time of publication and are available in the 2019 draft Atlantic SARs (Hayes *et al.*, 2019), available online at*: www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region.*

Table 3 – Marine Mammals Known to Occur in the Survey Area That May be Affected by Equinor's Proposed Activity

Common Name (Scientific Name)	**Stock**	**MMPA and ESA Status; Strategic (Y/N)**[1]	**Stock Abundance (CV, N_{min}, most recent abundance survey)**[2]	**Predicted abundance (CV)**[3]	**PBR**[4]	**Annual M/SI**[4]	**Occurrence in project area**
Toothed whales (Odontoceti)							
Sperm whale (*Physeter macrocephalus)*	North Atlantic	E; Y	4,349 (0.28; 3,451; n/a)	5,353 (0.12)	6.9	0.0	Rare
Atlantic white-sided dolphin (*Lagenorhynchus acutus)*	W. North Atlantic	--; N	93,233(0.71; 54,443; n/a)	37,180 (0.07)	544	26	Common
Atlantic spotted dolphin (*Stenella frontalis*)	W. North Atlantic	--; N	39,921 (0.27; 32,032; 2012)	55,436 (0.32)	320	0	Common
Common dolphin (*Delphinus delphis)*	W. North Atlantic	--; N	172,825 (0.21; 145,216; 2011)	86,098 (0.12)	1,452	419	Common
Bottlenose dolphin (*Tursiops truncatus)*	W. North Atlantic, Offshore	--; N	62,851 (0.23; 51,914; 2011)	97,476 (0.06)[5]	519	28	Common offshore
	W. North Atlantic, Northern Coastal Migratory	--; N	6,639 (0.41; 4,759; 2015)		48	6.1-13.2	Common nearshore
Long-finned pilot whale (*Globicephala melas)*	W. North Atlantic	--; N	39,215 (0.3; 30,627; n/a)	18,977 (0.11)[5]	306	21	Rare

Risso's dolphin (*Grampus griseus*)	W. North Atlantic	--; N	35,493 (0.19; 30,289; 2011)	7,732 (0.09)	303	54.3	Rare
Harbor porpoise (*Phocoena phocoena)*	Gulf of Maine/Bay of Fundy	--; N	95,543 (0.31; 74,034; 2011)	45,089 (0.12)*	851	217	Common
Baleen whales (Mysticeti)							
Fin whale (*Balaenoptera physalus)*	W. North Atlantic	E; Y	7,418 (0.25; 6,025; n/a)	4,633 (0.08)	12	2.35	Year round in continental shelf and slope waters
Sei whale (*Balaenoptera borealis)*	Nova Scotia	E; Y	6,292 (1.015; 3,098; n/a)	717 (0.30)*	6.2	1.0	Year round in continental shelf and slope waters
Minke whale (*Balaenoptera acutorostrata)*	Canadian East Coast	--; N	24,202 (0.3; 18,902; n/a)	2,112 (0.05)*	8.0	7.0	Year round in continental shelf and slope waters
Humpback whale (*Megaptera novaeangliae)*	Gulf of Maine	--; N	1,396 (0; 1,380; n/a)	1,637 (0.07)*	22	12.15	Common year round
North Atlantic right whale (*Eubalaena glacialis)*	W. North Atlantic	E; Y	428 (0; 418; n/a)	535 (0.45)*	0.8	6.85	Occur seasonally
Earless seals (Phocidae)							
Gray seal [6] (*Halichoerus grypus)*	W. North Atlantic	--; N	27,131 (0.19; 23,158; n/a)	n/a	1,389	5,410	Common
Harbor seal (*Phoca vitulina)*	W. North Atlantic	--; N	75,834 (0.15; 66,884; 2012)	n/a	2,006	350	Common
Harp seal [7] (Pagophilus groenlandicus)	W. North Atlantic	--; N	Unknown (n/a; n/a; n/a)	n/a	unk.	232,422	Rare

[1] ESA status: Endangered (E), Threatened (T) / MMPA status: Depleted (D). A dash (-) indicates that the species is not listed under the ESA or designated as depleted under the MMPA. Under the MMPA, a strategic stock is one for which the level of direct human-caused mortality exceeds PBR (see footnote 3) or which is determined to be declining and likely to be listed under the ESA within the foreseeable future. Any species or stock listed under the ESA is automatically designated under the MMPA as depleted and as a strategic stock.

[2] Stock abundance as reported in NMFS marine mammal stock assessment reports (SAR) except where otherwise noted. SARs available online at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessments.* CV is coefficient of variation; N_{min} is the minimum estimate of stock abundance. In some cases, CV is not applicable. For certain stocks, abundance estimates are actual counts of animals and there is no associated CV. The most recent abundance survey that is reflected in the abundance estimate is presented; there may be more

recent surveys that have not yet been incorporated into the estimate. All values presented here are from the 2019 draft Atlantic SARs (Hayes *et al*., 2019).

[3] This information represents species- or guild-specific abundance predicted by recent habitat-based cetacean density models (Roberts *et al*., 2016, 2017, 2018). These models provide the best available scientific information regarding predicted density patterns of cetaceans in the U.S. Atlantic Ocean, and we provide the corresponding abundance predictions as a point of reference. Total abundance estimates were produced by computing the mean density of all pixels in the modeled area and multiplying by its area. For those species marked with an asterisk, the available information supported development of either two or four seasonal models; each model has an associated abundance prediction. Here, we report the maximum predicted abundance.

[4] Potential biological removal, defined by the MMPA as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population size (OSP). Annual M/SI, found in NMFS' SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (*e.g.*, commercial fisheries, subsistence hunting, ship strike). Annual M/SI values often cannot be determined precisely and is in some cases presented as a minimum value. All M/SI values are as presented in the draft 2019 SARs (Hayes *et al*., 2019).

[5] Abundance estimates are in some cases reported for a guild or group of species when those species are difficult to differentiate at sea. Similarly, the habitat-based cetacean density models produced by Roberts *et al*. (2016, 2017, 2018) are based in part on available observational data which, in some cases, is limited to genus or guild in terms of taxonomic definition. Roberts *et al*. (2016, 2017, 2018) produced density models to genus level for *Globicephala* spp. and produced a density model for bottlenose dolphins that does not differentiate between offshore and coastal stocks.

[6] NMFS stock abundance estimate applies to U.S. population only, actual stock abundance is approximately 505,000.

[7] Stock abundance estimate is not available in NMFS SARs and predicted abundance estimate is not provided in Roberts *et al*. (2016, 2017, 2018).

Four marine mammal species that are listed under the ESA may be present in the survey area and are included in the take request: the North Atlantic right, fin, sei, and sperm whale.

Below is a description of the species that have the highest likelihood of occurring in the project area and are thus expected to potentially be taken by the proposed activities. For the majority of species potentially present in the specific geographic region, NMFS has designated only a single generic stock (*e.g.*, "western North Atlantic") for management purposes. This includes the "Canadian east coast" stock of minke whales, which includes all minke whales found in U.S. waters, and is also a generic stock for management purposes. For humpback whales, NMFS defines stocks on the basis of feeding locations (*i.e.*, Gulf of Maine). However, references to humpback whales in this document refer to any individuals of the species that are found in the specific geographic region.

North Atlantic Right Whale

The North Atlantic right whale ranges from calving grounds in the southeastern United States to feeding grounds in New England waters and into Canadian waters (Hayes *et al*., 2018). Surveys have demonstrated the existence of seven areas where North Atlantic right whales congregate seasonally, including in Georges Bank, off Cape Cod, and in Massachusetts Bay (Hayes *et al*., 2018). In the late fall months (*e.g.* October), right whales are generally thought to depart from the feeding grounds in the North Atlantic and move south to their calving grounds off Georgia and Florida. However, recent research indicates our understanding of their movement patterns remains incomplete (Davis *et al.*, 2017). A review of passive acoustic monitoring data from 2004 to 2014 throughout the western North Atlantic demonstrated nearly continuous year-round right whale presence across their entire habitat range (for at least some individuals), including in locations previously thought of as migratory corridors, suggesting that not all of the population undergoes a consistent annual migration (Davis *et al.*, 2017).

Aerial surveys indicate that right whales are consistently detected within and near Lease Area 0520 and surrounding survey areas, particularly ECRA-1 and the eastern portion of ECRA-2 (see Figure 4-1 in the IHA application), during winter and early spring. It appears that right whales begin to arrive in this area in December and remain in the area through at least April. Acoustic detections of right whales within the MA and RI/MA Wind Energy Areas (WEAs), which include the proposed survey areas, were documented during all months of the year, although the highest number of detections between December and late May (Kraus *et al*. 2016). Aerial survey data indicate that right whales occur at elevated densities in the survey areas south and southwest of Martha’s Vineyard and Nantucket, and in Cape Cod Bay, between December and May (Roberts *et al.* 2018; Leiter *et al.* 2017; Kraus *et al*. 2016).

The western North Atlantic right whale population demonstrated overall growth of 2.8 percent per year between 1990 to 2010, despite a decline in 1993 and no growth between 1997 and 2000 (Pace *et al.* 2017). However, since 2010 the population has been in decline, with a 99.99 percent probability of a decline of just under 1 percent per year (Pace *et al.*, 2017). Between 1990 and 2015, calving rates varied substantially, with low calving rates coinciding with all three periods of decline or no growth (Pace *et al.*, 2017). On average, North Atlantic right whale calving rates are estimated to be roughly half that of southern right whales (*Eubalaena australis*) (Pace *et al.*, 2017), which are increasing in abundance (NMFS, 2015). In 2018, no new North Atlantic right whale calves were documented in their calving grounds, representing the first time since annual NOAA aerial surveys began in 1989 that no new right whale calves were observed. Seven right whale calves were documented in 2019 and ten right whale calves were observed in 2020. The current best estimate of population abundance for the species is 409 individuals, based on data as of September, 2019 (Pettis *et al*., 2019).

Elevated North Atlantic right whale mortalities have occurred since June 7, 2017 along the U.S. and Canadian coast. As of June, 2020, a total of 30 confirmed dead stranded whales (21 in Canada; 9 in the United States) have been documented. This event has been declared an Unusual Mortality Event (UME), with human interactions, including entanglement in fixed fishing gear and vessel strikes, implicated in at least 15 of the mortalities thus far. More information is available online at: *www.fisheries.noaa.gov/national/marine-life-distress/2017-2019-north-atlantic-right-whale-unusual-mortality-event.*

The proposed survey areas are part of a biologically important migratory area for North Atlantic right whales; this important migratory area is comprised of the waters of the continental shelf offshore the East Coast of the United States and extends from Florida through

Massachusetts. NMFS' regulations at 50 CFR part 224.105 designated nearshore waters of the Mid-Atlantic Bight as Mid-Atlantic U.S. Seasonal Management Areas (SMA) for right whales in 2008. SMAs were developed to reduce the threat of collisions between ships and right whales around their migratory route and calving grounds. Within SMAs, the regulations require a mandatory vessel speed (less than 10 knots) for all vessels greater than 65 ft. Five SMAs overlap spatially, either fully or partially, with the proposed survey areas. These include: the Off Race Point SMA (in effect from January 1 through May 15); the Cape Cod Bay SMA (in effect from March 1 through April 30); the Great South Channel SMA (in effect from April 1 through July 31); the Block Island Sound SMA (in effect from November 1 through April 30); and the New York / New Jersey SMA (in effect from November 1 through April 30).

NMFS has designated two critical habitat areas for the North Atlantic right whale under the ESA: the Gulf of Maine/Georges Bank region, and the southeast calving grounds from North Carolina to Florida. Portions of the proposed survey areas overlap spatially with the Gulf of Maine/Georges Bank critical habitat which was established due to the area's significance for right whale foraging (81 FR 4837, January 27, 2016). The rulemaking establishing critical habitat in the Gulf of Maine/Georges Bank region that partially overlaps the proposed survey area identified that area as particularly suitable to aggregations of *Calanus finmarchicus* (a species of copepod that is a preferred prey of the North Atlantic right whale) and recognized that features of habitat in the area were deemed essential to the conservation of the species (81 FR 4837, January 27, 2016). Measures to minimize potential impacts to North Atlantic right whales within SMAs and designated critical habitat are described under **Proposed Mitigation**.

Humpback Whale

Humpback whales are found worldwide in all oceans. Humpback whales were listed as endangered under the Endangered Species Conservation Act (ESCA) in June 1970. In 1973, the ESA replaced the ESCA, and humpback whales continued to be listed as endangered. On September 8, 2016, NMFS divided the species into 14 distinct population segments (DPS), removed the current species-level listing, and in its place listed four DPSs as endangered and one DPS as threatened (81 FR 62260; September 8, 2016). The remaining nine DPSs were not listed. The West Indies DPS, which is not listed under the ESA, is the only DPS of humpback whales that is expected to occur in the project area.

Humpback whales utilize the mid-Atlantic as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Waring *et al.* 2007). A key question with regard to humpback whales off the Mid-Atlantic states is their stock identity. Using fluke photographs of living and dead whales observed in the region, Barco *et al.* (2002) reported that 43 percent of 21 live whales matched to the Gulf of Maine, 19 percent to Newfoundland, and 4.8 percent to the Gulf of St Lawrence, while 31.6 percent of 19 dead humpbacks were known Gulf of Maine whales. Although the population composition of the mid-Atlantic is apparently dominated by Gulf of Maine whales, lack of photographic effort in Newfoundland makes it likely that the observed match rates under-represent the true presence of Canadian whales in the region (Waring *et al.*, 2016). Barco *et al.* (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpback whales.

Since January 2016, elevated humpback whale mortalities have occurred along the Atlantic coast from Maine to Florida. As of June, 2020, partial or full necropsy examinations have been conducted on approximately half of the 126 known cases. Of the whales examined, about 50 percent had evidence of human interaction, either ship strike or entanglement. While a portion of the whales have shown evidence of pre-mortem vessel strike, this finding is not consistent across all humpback whales examined and more research is needed. NOAA is consulting with researchers that are conducting studies on the humpback whale populations, and these efforts may provide information on changes in whale distribution and habitat use that could provide additional insight into how these vessel interactions occurred. Three previous UMEs involving humpback whales have occurred since 2000, in 2003, 2005, and 2006. More information is available at: *www.fisheries.noaa.gov/national/marine-life-distress/2016-2019-humpback-whale-unusual-mortality-event-along-atlantic-coast*.

Fin Whale

Fin whales are common in waters of the U. S. Atlantic Exclusive Economic Zone (EEZ), principally from Cape Hatteras northward (Waring *et al.*, 2016). Fin whales are present north of 35-degree latitude in every season and are broadly distributed throughout the western North Atlantic for most of the year (Waring *et al*., 2016). They are typically found in small groups of up to five individuals (Brueggeman *et al*., 1987). The main threats to fin whales are fishery interactions and vessel collisions (Waring *et al.*, 2016).

Sei Whale

The Nova Scotia stock of sei whales can be found in deeper waters of the continental shelf edge waters of the northeastern U.S. and northeastward to south of Newfoundland. The southern portion of the stock's range during spring and summer includes the Gulf of Maine and Georges Bank. Spring is the period of greatest abundance in U.S. waters, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (Waring *et* *al*., 2015). Sei whales occur in shallower waters to feed. Sei whales are listed as endangered under the ESA, and the Nova Scotia stock is considered strategic and depleted under the MMPA. The main threats to this stock are interactions with fisheries and vessel collisions.

Minke Whale

Minke whales can be found in temperate, tropical, and high-latitude waters. The Canadian East Coast stock can be found in the area from the western half of the Davis Strait (45ºW) to the Gulf of Mexico (Waring *et al.,* 2016). This species generally occupies waters less than 100 m deep on the continental shelf. There appears to be a strong seasonal component to minke whale distribution in the survey areas, in which spring to fall are times of relatively widespread and common occurrence while during winter the species appears to be largely absent (Waring *et al*., 2016). Since January 2017, elevated minke whale mortalities have occurred along the Atlantic coast from Maine through South Carolina. This event has been declared a UME. As of June, 2020 partial or full necropsy examinations have been conducted on more than 60 percent of the 88 known cases. Preliminary findings in several of the whales have shown evidence of human interactions or infectious disease, but these findings are not consistent across all of the whales examined, so more research is needed. More information is available at: *www.fisheries.noaa.gov/national/marine-life-distress/2017-2019-minke-whale-unusual-mortality-event-along-atlantic-coast*.

Sperm Whale

The distribution of the sperm whale in the U.S. EEZ occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Waring *et al*., 2014). The basic social unit of the sperm whale appears to be the mixed school of adult females plus their calves and some juveniles of both sexes, normally numbering 20-40 animals in all. There is evidence that some social bonds persist for many years (Christal *et al.*, 1998). This species forms stable social groups, site fidelity, and latitudinal range limitations in groups of females and juveniles (Whitehead, 2002). In summer, the distribution of sperm whales includes the area east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf (inshore of the 100-m isobath) south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf is at its highest level, and there remains a continental shelf edge occurrence in the mid-Atlantic bight. In winter, sperm whales are concentrated east and northeast of Cape Hatteras.

Long-finned Pilot Whale

Long-finned pilot whales prefer deep temperate to subpolar oceanic waters, but they have been known to occur in coastal waters in some areas. Larger groupings of animals have been documented on the continental edge and slope, depending on the season. In the Northern Hemisphere, their range includes the U.S. east coast, Gulf of St. Lawrence, the Azores, Madeira, North Africa, western Mediterranean Sea, North Sea, Greenland and the Barents Sea. In the winter and spring, they are more likely to occur in offshore oceanic waters or on the continental slope. In the summer and autumn, long-finned pilot whales generally follow their favorite foods farther inshore and on to the continental shelf. In U.S. Atlantic waters the species is distributed principally along the continental shelf edge off the northeastern U.S. coast in winter and early spring and in late spring, long-finned pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters and remain in these areas through late autumn (Waring *et al.*, 2016).

Atlantic White-sided Dolphin

Atlantic white-sided dolphins are found in temperate and sub-polar waters of the North Atlantic, primarily in continental shelf waters to the 100-m depth contour from central West Greenland to North Carolina (Waring *et al*., 2016). The Gulf of Maine stock is most common in continental shelf waters from Hudson Canyon to Georges Bank, and in the Gulf of Maine and lower Bay of Fundy. Sighting data indicate seasonal shifts in distribution (Northridge *et al*., 1997). During January to May, low numbers of white-sided dolphins are found from Georges Bank to Jeffreys Ledge (off New Hampshire), with even lower numbers south of Georges Bank, as documented by a few strandings collected on beaches of Virginia to South Carolina. From June through September, large numbers of white-sided dolphins are found from Georges Bank to the lower Bay of Fundy. From October to December, white-sided dolphins occur at intermediate densities from southern Georges Bank to southern Gulf of Maine (Payne and Heinemann 1990). Sightings south of Georges Bank, particularly around Hudson Canyon, occur year round but at low densities.

Atlantic Spotted Dolphin

Atlantic spotted dolphins are found in tropical and warm temperate waters ranging from southern New England, south to Gulf of Mexico and the Caribbean to Venezuela (Waring *et al*., 2014). This stock regularly occurs in continental shelf waters south of Cape Hatteras and in continental shelf edge and continental slope waters north of this region (Waring *et al*., 2014). There are two forms of this species, with the larger ecotype inhabiting the continental shelf and is usually found inside or near the 200 m isobaths (Waring *et al.*, 2014).

Common Dolphin

Common dolphins prefer warm tropical to cool temperate waters that are primarily oceanic and offshore. They can be found along the continental slope in waters 650 to 6,500 feet deep. The abundance and distribution of common dolphins vary based on interannual changes, oceanographic conditions, and seasons. In the western North Atlantic, they are often associated with the Gulf Stream current, and are more common north of Cape Hatteras, North Carolina. From summer through autumn, large aggregations of dolphins can be found near Georges Bank (extending from Cape Cod, Massachusetts, to Nova Scotia, Canada), Newfoundland, and the Scotian Shelf. In the North Atlantic, common dolphins are commonly found over the continental shelf between the 100-m and 2,000-m isobaths and over prominent underwater topography and east to the mid-Atlantic Ridge (Waring *et al*., 2016).

Bottlenose Dolphin

There are two distinct bottlenose dolphin morphotypes in the western North Atlantic: the coastal and offshore forms (Waring *et al.*, 2016). The offshore form is distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic Ocean from Georges Bank to the Florida Keys. The coastal morphotype is morphologically and genetically distinct from the larger, more robust morphotype that occupies habitats further offshore. Spatial distribution data, tag-telemetry studies, photo-ID studies and genetic studies demonstrate the existence of a distinct Northern Migratory stock of coastal bottlenose dolphins (Waring *et al.*, 2014). During summer months (July-August), this stock occupies coastal waters from the shoreline to approximately the 25 m isobath between the Chesapeake Bay mouth and Long Island, New York; during winter months (January-March), the stock occupies coastal waters from Cape Lookout, North Carolina, to the North Carolina/Virginia border (Waring *et al.*, 2014). The Western North Atlantic northern migratory coastal stock and the Western North Atlantic offshore stock may be encountered by the proposed survey.

Harbor Porpoise

Harbor porpoises live in northern temperate and subarctic coastal and offshore waters. In the North Atlantic, they range from West Greenland to Cape Hatteras, North Carolina, and from the Barents Sea to West Africa. In the proposed survey areas, only the Gulf of Maine/Bay of Fundy stock may be present. This stock is found in U.S. and Canadian Atlantic waters and is concentrated in the northern Gulf of Maine and southern Bay of Fundy region, generally in waters less than 150 m deep (Waring *et al.*, 2016). They are seen from the coastline to deep waters (>1800 m; Westgate *et al.* 1998), although the majority of the population is found over the continental shelf (Waring *et al*., 2016). The main threat to the species is interactions with fisheries, with documented take in the U.S. northeast sink gillnet, mid-Atlantic gillnet, and northeast bottom trawl fisheries and in the Canadian herring weir fisheries (Waring *et al.,* 2016).

Harbor Seal

The harbor seal is found in all nearshore waters of the North Atlantic and North Pacific Oceans and adjoining seas above about 30ºN (Burns, 2009). In the western North Atlantic, harbor seals are distributed from the eastern Canadian Arctic and Greenland south to southern New England and New York, and occasionally to the Carolinas (Waring *et al*., 2016). Haul out and pupping sites are located off Manomet, MA and the Isles of Shoals, ME, but generally do not occur in areas in southern New England (Waring *et al.*, 2016).

Since July 2018, elevated numbers of harbor seal and gray seal mortalities have occurred across Maine, New Hampshire and Massachusetts. This event has been declared a UME. Additionally, stranded seals have shown clinical signs as far south as Virginia, although not in elevated numbers, therefore the UME investigation now encompasses all seal strandings from Maine to Virginia. Lastly, ice seals (harp and hooded seals) have also started stranding with clinical signs, again not in elevated numbers, and those two seal species have also been added to the UME investigation. As of u, 2020 a total of 3,152 reported strandings (of all species) had occurred. Full or partial necropsy examinations have been conducted on some of the seals and samples have been collected for testing. Based on tests conducted thus far, the main pathogen found in the seals is phocine distemper virus. NMFS is performing additional testing to identify any other factors that may be involved in this UME. Information on this UME is available online at: *www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/2018-2019-pinniped-unusual-mortality-event-along*.

Gray Seal

There are three major populations of gray seals found in the world; eastern Canada (western North Atlantic stock), northwestern Europe and the Baltic Sea. Gray seals in the survey area belong to the western North Atlantic stock. The range for this stock is thought to be from New Jersey to Labrador. Current population trends show that gray seal abundance is likely increasing in the U.S. Atlantic EEZ (Waring *et al.,* 2016). Although the rate of increase is unknown, surveys conducted since their arrival in the 1980s indicate a steady increase in abundance in both Maine and Massachusetts (Waring *et al.,* 2016). It is believed that recolonization by Canadian gray seals is the source of the U.S. population (Waring *et al.*, 2016).

As described above, elevated seal mortalities, including gray seals, have occurred from Maine to Virginia since July 2018. This event has been declared a UME, with phocine distemper virus identified as the main pathogen found in the seals. NMFS is performing additional testing to identify any other factors that may be involved in this UME. Information on this UME is available online at: *www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/2018-2019-pinniped-unusual-mortality-event-along*.

Harp Seal

The harp seal occurs throughout much of the North Atlantic and Arctic Oceans (Ronald and Healey 1981; Lavigne and Kovacs 1988). There are three harp seal stocks in the world; the only stock that may occur in the project area is the western North Atlantic stock which breeds off the coast of Newfoundland and Labrador and near the Magdalen Islands in the middle of the Gulf of St. Lawrence (Sergeant 1965; Lavigne and Kovacs 1988). Harp seals are highly migratory (Sergeant 1965; Stenson and Sjare 1997). Breeding occurs at different times for each stock between late-February and April. Adults then assemble on suitable pack ice to undergo the annual molt. The migration then continues north to Arctic summer feeding grounds. In late September, after a summer of feeding, nearly all adults and some of the immature animals of the western North Atlantic stock migrate southward along the Labrador coast, usually reaching the entrance to the Gulf of St. Lawrence by early winter. The southern limit of the harp seal's habitat extends into the U.S. Atlantic EEZ during winter and spring. Since the early 1990s, numbers of sightings and strandings have been increasing off the east coast of the United States from Maine to New Jersey (Katona *et al.* 1993; Rubinstein 1994; Stevick and Fernald 1998; McAlpine 1999; Lacoste and Stenson 2000; Soulen *et al*. 2013). These appearances usually occur in January-May (Harris *et al.* 2002), when the western North Atlantic stock of harp seals is at its most southern point of migration.

As described above, elevated seal mortalities, including harp seals, have occurred from Maine to Virginia since July 2018. This event has been declared a UME, with phocine distemper virus identified as the main pathogen found in the seals. NMFS is performing additional testing to identify any other factors that may be involved in this UME. Information on this UME is available online at: *www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/2018-2019-pinniped-unusual-mortality-event-along*.

Marine Mammal Hearing

Hearing is the most important sensory modality for marine mammals underwater, and exposure to anthropogenic sound can have deleterious effects. To appropriately assess the potential effects of exposure to sound, it is necessary to understand the frequency ranges marine mammals are able to hear. Current data indicate that not all marine mammal species have equal hearing capabilities (*e.g.*, Richardson *et al.*, 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008). To reflect this, Southall *et al*. (2007) recommended that marine mammals be divided into functional hearing groups based on directly measured or estimated hearing ranges on the basis of available behavioral response data, audiograms derived using auditory evoked potential techniques, anatomical modeling, and other data. Note that no direct measurements of hearing ability have been successfully completed for mysticetes (*i.e.*, low-frequency cetaceans). Subsequently, NMFS (2016) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 dB threshold from the normalized composite audiograms, with the exception for lower limits for low-frequency cetaceans where the lower bound was deemed to be biologically implausible and the lower bound from Southall *et al*. (2007) retained. The functional groups and the associated frequencies are indicated below (note that these frequency ranges correspond to the range for the composite group, with the entire range not necessarily reflecting the capabilities of every species within that group):

- Low-frequency cetaceans (mysticetes): generalized hearing is estimated to occur between approximately 7 Hertz (Hz) and 35 kHz;
- Mid-frequency cetaceans (larger toothed whales, beaked whales, and most delphinids): generalized hearing is estimated to occur between approximately 150 Hz and 160 kHz;

- High-frequency cetaceans (porpoises, river dolphins, and members of the genera *Kogia* and *Cephalorhynchus*; including two members of the genus *Lagenorhynchus*, on the basis of recent echolocation data and genetic data): generalized hearing is estimated to occur between approximately 275 Hz and 160 kHz; and
- Pinnipeds in water; *Phocidae* (true seals): generalized hearing is estimated to occur between approximately 50 Hz to 86 kH.

The pinniped functional hearing group was modified from Southall *et al*. (2007) on the basis of data indicating that phocid species have consistently demonstrated an extended frequency range of hearing compared to otariids, especially in the higher frequency range (Hemilä *et al*., 2006; Kastelein *et al*., 2009; Reichmuth and Holt, 2013).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Fourteen marine mammal species (twelve cetacean and two pinniped (both phocid species) have the reasonable potential to co-occur with the proposed survey activities (see Table 3). Of the cetacean species that may be present, five are classified as low-frequency cetaceans (*i.e.*, all mysticete species), six are classified as mid-frequency cetaceans (*i.e.*, all delphinid species and the sperm whale), and one is classified as a high-frequency cetacean (*i.e.*, harbor porpoise).

Potential Effects of Specified Activities on Marine Mammals and their Habitat

This section includes a summary and discussion of the ways that components of the specified activity may impact marine mammals and their habitat. The **Estimated Take** section later in this document includes a quantitative analysis of the number of individuals that are expected to be taken by this activity. The **Negligible Impact Analysis and Determination** section considers the content of this section, the **Estimated Take** section, and the **Proposed**

Mitigation section, to draw conclusions regarding the likely impacts of these activities on the reproductive success or survivorship of individuals and how those impacts on individuals are likely to impact marine mammal species or stocks.

Background on Sound

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and is generally characterized by several variables. Frequency describes the sound's pitch and is measured in Hz or kHz, while sound level describes the sound's intensity and is measured in dB. Sound level increases or decreases exponentially with each dB of change. The logarithmic nature of the scale means that each 10-dB increase is a 10-fold increase in acoustic power (and a 20-dB increase is then a 100-fold increase in power). A 10-fold increase in acoustic power does not mean that the sound is perceived as being 10 times louder, however. Sound levels are compared to a reference sound pressure (µPa) to identify the medium. For air and water, these reference pressures are "re: 20 (µPa)" and "re: 1 µPa," respectively. Root mean square (RMS) is the quadratic mean sound pressure over the duration of an impulse. RMS is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick 1975). RMS accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels. This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units rather than by peak pressures.

When sound travels (propagates) from its source, its loudness decreases as the distance traveled by the sound increases. Thus, the loudness of a sound at its source is higher than the loudness of that same sound one km away. Acousticians often refer to the loudness of a sound at its source (typically referenced to one meter from the source) as the source level and the loudness of sound elsewhere as the received level (*i.e.*, typically the receiver). For example, a humpback whale 3 km from a device that has a source level of 230 dB may only be exposed to sound that is 160 dB loud, depending on how the sound travels through water (*e.g.*, spherical spreading (6 dB reduction with doubling of distance) was used in this example). As a result, it is important to understand the difference between source levels and received levels when discussing the loudness of sound in the ocean or its impacts on the marine environment.

As sound travels from a source, its propagation in water is influenced by various physical characteristics, including water temperature, depth, salinity, and surface and bottom properties that cause refraction, reflection, absorption, and scattering of sound waves. Oceans are not homogeneous and the contribution of each of these individual factors is extremely complex and interrelated. The physical characteristics that determine the sound's speed through the water will change with depth, season, geographic location, and with time of day (as a result, in actual active sonar operations, crews will measure oceanic conditions, such as sea water temperature and depth, to calibrate models that determine the path the sonar signal will take as it travels through the ocean and how strong the sound signal will be at a given range along a particular transmission path). As sound travels through the ocean, the intensity associated with the wavefront diminishes, or attenuates. This decrease in intensity is referred to as propagation loss, also commonly called transmission loss.

Acoustic Impacts

Geophysical surveys may temporarily impact marine mammals in the area due to elevated in-water sound levels. Marine mammals are continually exposed to many sources of sound. Naturally occurring sounds such as lightning, rain, sub-sea earthquakes, and biological sounds (*e.g.*, snapping shrimp, whale songs) are widespread throughout the world's oceans. Marine mammals produce sounds in various contexts and use sound for various biological functions including, but not limited to: (1) social interactions; (2) foraging; (3) orientation; and (4) predator detection. Interference with producing or receiving these sounds may result in adverse impacts. Audible distance, or received levels of sound depend on the nature of the sound source, ambient noise conditions, and the sensitivity of the receptor to the sound (Richardson *et al*., 1995). Type and significance of marine mammal reactions to sound are likely dependent on a variety of factors including, but not limited to, (1) the behavioral state of the animal (*e.g.*, feeding, traveling, *etc*.); (2) frequency of the sound; (3) distance between the animal and the source; and (4) the level of the sound relative to ambient conditions (Southall *et al*., 2007).

When considering the influence of various kinds of sound on the marine environment, it is necessary to understand that different kinds of marine life are sensitive to different frequencies of sound. Current data indicate that not all marine mammal species have equal hearing capabilities (Richardson *et al.*, 1995; Wartzok and Ketten, 1999; Au and Hastings, 2008).

Animals are less sensitive to sounds at the outer edges of their functional hearing range and are more sensitive to a range of frequencies within the middle of their functional hearing range.

Hearing Impairment

Marine mammals may experience temporary or permanent hearing impairment when exposed to loud sounds. Hearing impairment is classified by temporary threshold shift (TTS) and permanent threshold shift (PTS). PTS is considered auditory injury (Southall *et al*., 2007) and occurs in a specific frequency range and amount. Irreparable damage to the inner or outer cochlear hair cells may cause PTS; however, other mechanisms are also involved, such as exceeding the elastic limits of certain tissues and membranes in the middle and inner ears and resultant changes in the chemical composition of the inner ear fluids (Southall *et al.,* 2007). There are no empirical data for onset of PTS in any marine mammal; therefore, PTS-onset must be estimated from TTS-onset measurements and from the rate of TTS growth with increasing exposure levels above the level eliciting TTS-onset. PTS is presumed to be likely if the hearing threshold is reduced by ≥ 40 dB (that is, 40 dB of TTS).

Temporary Threshold Shift (TTS)

TTS is the mildest form of hearing impairment that can occur during exposure to a loud sound (Kryter 1985). While experiencing TTS, the hearing threshold rises and a sound must be stronger in order to be heard. At least in terrestrial mammals, TTS can last from minutes or hours to (in cases of strong TTS) days, can be limited to a particular frequency range, and can occur to varying degrees (*i.e.*, a loss of a certain number of dBs of sensitivity). For sound exposures at or somewhat above the TTS threshold, hearing sensitivity in both terrestrial and marine mammals recovers rapidly after exposure to the noise ends.

Marine mammal hearing plays a critical role in communication with conspecifics and in interpretation of environmental cues for purposes such as predator avoidance and prey capture. Depending on the degree (elevation of threshold in dB), duration (*i.e.*, recovery time), and frequency range of TTS and the context in which it is experienced, TTS can have effects on marine mammals ranging from discountable to serious. For example, a marine mammal may be able to readily compensate for a brief, relatively small amount of TTS in a non-critical frequency range that takes place during a time when the animals is traveling through the open ocean, where ambient noise is lower and there are not as many competing sounds present. Alternatively, a larger amount and longer duration of TTS sustained during a time when communication is critical for successful mother/calf interactions could have more serious impacts if it were in the same frequency band as the necessary vocalizations and of a severity that it impeded communication. The fact that animals exposed to levels and durations of sound that would be expected to result in this physiological response would also be expected to have behavioral responses of a comparatively more severe or sustained nature is also notable and potentially of more importance than the simple existence of a TTS.

Currently, TTS data only exist for four species of cetaceans (bottlenose dolphin, beluga whale (*Delphinapterus leucas*), harbor porpoise, and Yangtze finless porpoise (*Neophocaena phocaenoides*)) and three species of pinnipeds (northern elephant seal (*Mirounga angustirostris*), harbor seal, and California sea lion (*Zalophus californianus*)) exposed to a limited number of sound sources (*i.e.*, mostly tones and octave-band noise) in laboratory settings (*e.g.*, Finneran *et al*., 2002 and 2010; Nachtigall *et al*., 2004; Kastak *et al*., 2005; Lucke *et al*., 2009; Mooney *et al*., 2009; Popov *et al*., 2011; Finneran and Schlundt, 2010). In general, harbor seals (Kastak *et al*., 2005; Kastelein *et al*., 2012a) and harbor porpoises (Lucke *et al*., 2009; Kastelein *et al*., 2012b) have a lower TTS onset than other measured pinniped or cetacean species. However, even for these animals, which are better able to hear higher frequencies and may be more sensitive to higher frequencies, exposures on the order of approximately 170 dB RMS or higher for brief transient signals are likely required for even temporary (recoverable) changes in hearing sensitivity that would likely not be categorized as physiologically damaging (Lucke *et al*., 2009). Additionally, the existing marine mammal TTS data come from a limited number of individuals within these species. There are no data available on noise-induced hearing loss for mysticetes.

For summaries of data on TTS in marine mammals or for further discussion of TTS onset thresholds, please see Finneran (2015).

Scientific literature highlights the inherent complexity of predicting TTS onset in marine mammals, as well as the importance of considering exposure duration when assessing potential impacts (Mooney *et al.*, 2009a, 2009b; Kastak *et al.*, 2007). Generally, with sound exposures of equal energy, quieter sounds (lower sound pressure levels (SPL)) of longer duration were found to induce TTS onset more than louder sounds (higher SPL) of shorter duration (more similar to sub-bottom profilers). For intermittent sounds, less threshold shift will occur than from a continuous exposure with the same energy (some recovery will occur between intermittent exposures) (Kryter *et al.*, 1966; Ward 1997). For sound exposures at or somewhat above the TTS-onset threshold, hearing sensitivity recovers rapidly after exposure to the sound ends; intermittent exposures recover faster in comparison with continuous exposures of the same duration (Finneran *et al*., 2010). NMFS considers TTS as a non-injurious effect that is mediated by physiological effects on the auditory system.

Animals in the survey areas during proposed surveys are unlikely to incur TTS hearing impairment due to the characteristics of the sound sources, which include low source levels (208 to 221 dB re 1 µPa-m) and generally very short pulses and duration of the sound. Even for high-frequency cetacean species (*e.g.*, harbor porpoises), which may have increased sensitivity to TTS (Lucke *et al*., 2009; Kastelein *et al*., 2012b), individuals would have to make a very close approach and also remain very close to vessels operating these sources in order to receive multiple exposures at relatively high levels, as would be necessary to cause TTS. Intermittent exposures—as would occur due to the brief, transient signals produced by these sources—require a higher cumulative SEL to induce TTS than would continuous exposures of the same duration (*i.e.*, intermittent exposure results in lower levels of TTS) (Mooney *et al*., 2009a; Finneran *et al*., 2010). Moreover, most marine mammals would more likely avoid a loud sound source rather than swim in such close proximity as to result in TTS. Kremser *et al.* (2005) noted that the probability of a cetacean swimming through the area of exposure when a sub-bottom profiler emits a pulse is small—because if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause TTS and would likely exhibit avoidance behavior to the area near the transducer rather than swim through at such a close range. Further, the restricted beam shape of the majority of the geophysical survey equipment planned for use (Table 2) makes it unlikely that an animal would be exposed more than briefly during the passage of the vessel.

Masking

Masking is the obscuring of sounds of interest to an animal by other sounds, typically at similar frequencies. Marine mammals are highly dependent on sound, and their ability to recognize sound signals amid other sound is important in communication and detection of both predators and prey (Tyack 2000). Background ambient sound may interfere with or mask the ability of an animal to detect a sound signal even when that signal is above its absolute hearing threshold. Even in the absence of anthropogenic sound, the marine environment is often loud. Natural ambient sound includes contributions from wind, waves, precipitation, other animals, and (at frequencies above 30 kHz) thermal sound resulting from molecular agitation (Richardson *et al*., 1995).

Background sound may also include anthropogenic sound, and masking of natural sounds can result when human activities produce high levels of background sound. Conversely, if the background level of underwater sound is high (*e.g.*, on a day with strong wind and high waves), an anthropogenic sound source would not be detectable as far away as would be possible under quieter conditions and would itself be masked. Ambient sound is highly variable on continental shelves (Myrberg 1978; Desharnais *et al*., 1999). This results in a high degree of variability in the range at which marine mammals can detect anthropogenic sounds.

Although masking is a phenomenon which may occur naturally, the introduction of loud anthropogenic sounds into the marine environment at frequencies important to marine mammals increases the severity and frequency of occurrence of masking. For example, if a baleen whale is exposed to continuous low-frequency sound from an industrial source, this would reduce the size of the area around that whale within which it can hear the calls of another whale. The components of background noise that are similar in frequency to the signal in question primarily determine the degree of masking of that signal. In general, little is known about the degree to which marine mammals rely upon detection of sounds from conspecifics, predators, prey, or other natural sources. In the absence of specific information about the importance of detecting these natural sounds, it is not possible to predict the impact of masking on marine mammals (Richardson *et al.,* 1995). In general, masking effects are expected to be less severe when sounds are transient than when they are continuous. Masking is typically of greater concern for those marine mammals that utilize low-frequency communications, such as baleen whales, because of how far low-frequency sounds propagate.

Marine mammal communications would not likely be masked appreciably by the sub-bottom profiler signals given the directionality of the signals (for most geophysical survey equipment types planned for use (Table 2)) and the brief period when an individual mammal is likely to be within its beam.

Non-auditory Physical Effects (Stress)

Classic stress responses begin when an animal's central nervous system perceives a potential threat to its homeostasis. That perception triggers stress responses regardless of whether a stimulus actually threatens the animal; the mere perception of a threat is sufficient to trigger a stress response (Moberg 2000; Seyle 1950). Once an animal's central nervous system perceives a threat, it mounts a biological response or defense that consists of a combination of the four general biological defense responses: behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses.

In the case of many stressors, an animal's first and sometimes most economical (in terms of biotic costs) response is behavioral avoidance of the potential stressor or avoidance of continued exposure to a stressor. An animal's second line of defense to stressors involves the sympathetic part of the autonomic nervous system and the classical "fight or flight" response which includes the cardiovascular system, the gastrointestinal system, the exocrine glands, and the adrenal medulla to produce changes in heart rate, blood pressure, and gastrointestinal activity that humans commonly associate with "stress." These responses have a relatively short duration and may or may not have significant long-term effect on an animal's welfare.

An animal's third line of defense to stressors involves its neuroendocrine systems; the system that has received the most study has been the hypothalamus-pituitary-adrenal system (also known as the HPA axis in mammals). Unlike stress responses associated with the autonomic nervous system, virtually all neuro-endocrine functions that are affected by stress – including immune competence, reproduction, metabolism, and behavior – are regulated by pituitary hormones. Stress-induced changes in the secretion of pituitary hormones have been implicated in failed reproduction (Moberg 1987; Rivier 1995), altered metabolism (Elasser *et al*., 2000), reduced immune competence (Blecha 2000), and behavioral disturbance. Increases in the circulation of glucocorticosteroids (cortisol, corticosterone, and aldosterone in marine mammals; see Romano *et al*., 2004) have been equated with stress for many years.

The primary distinction between stress (which is adaptive and does not normally place an animal at risk) and distress is the biotic cost of the response. During a stress response, an animal uses glycogen stores that can be quickly replenished once the stress is alleviated. In such circumstances, the cost of the stress response would not pose a risk to the animal's welfare. However, when an animal does not have sufficient energy reserves to satisfy the energetic costs of a stress response, energy resources must be diverted from other biotic function, which impairs those functions that experience the diversion. For example, when mounting a stress response diverts energy away from growth in young animals, those animals may experience stunted growth. When mounting a stress response diverts energy from a fetus, an animal's reproductive success and its fitness will suffer. In these cases, the animals will have entered a pre-pathological or pathological state which is called "distress" (Seyle 1950) or "allostatic loading" (McEwen and Wingfield 2003). This pathological state will last until the animal replenishes its biotic reserves sufficient to restore normal function. Note that these examples involved a long-term (days or weeks) stress response exposure to stimuli.

Relationships between these physiological mechanisms, animal behavior, and the costs of stress responses have also been documented fairly well through controlled experiments; because this physiology exists in every vertebrate that has been studied, it is not surprising that stress responses and their costs have been documented in both laboratory and free-living animals (for examples see, Holberton *et al*., 1996; Hood *et al*., 1998; Jessop *et al*., 2003; Krausman *et al*., 2004; Lankford *et al*., 2005; Reneerkens *et al*., 2002; Thompson and Hamer, 2000). Information has also been collected on the physiological responses of marine mammals to exposure to anthropogenic sounds (Fair and Becker 2000; Romano *et al*., 2002). For example, Rolland *et al*. (2012) found that noise reduction from reduced ship traffic in the Bay of Fundy was associated with decreased stress in North Atlantic right whales.

Studies of other marine animals and terrestrial animals would also lead us to expect some marine mammals to experience physiological stress responses and, perhaps, physiological responses that would be classified as "distress" upon exposure to high frequency, mid-frequency and low-frequency sounds. For example, Jansen (1998) reported on the relationship between acoustic exposures and physiological responses that are indicative of stress responses in humans (for example, elevated respiration and increased heart rates). Jones (1998) reported on reductions in human performance when faced with acute, repetitive exposures to acoustic disturbance. Trimper *et al*. (1998) reported on the physiological stress responses of osprey to low-level aircraft noise while Krausman *et al*. (2004) reported on the auditory and physiology stress responses of endangered Sonoran pronghorn to military overflights. Smith *et al*. (2004a, 2004b), for example, identified noise-induced physiological transient stress responses in hearing-specialist fish (*i.e.,* goldfish) that accompanied short- and long-term hearing losses. Welch and Welch (1970) reported physiological and behavioral stress responses that accompanied damage to the inner ears of fish and several mammals.

Hearing is one of the primary senses marine mammals use to gather information about their environment and to communicate with conspecifics. Although empirical information on the relationship between sensory impairment (TTS, PTS, and acoustic masking) on marine mammals remains limited, it seems reasonable to assume that reducing an animal's ability to gather information about its environment and to communicate with other members of its species would be stressful for animals that use hearing as their primary sensory mechanism. Therefore, we assume that acoustic exposures sufficient to trigger onset PTS or TTS would be accompanied by physiological stress responses because terrestrial animals exhibit those responses under similar conditions (NRC 2003). More importantly, marine mammals might experience stress responses at received levels lower than those necessary to trigger onset TTS. Based on empirical studies of the time required to recover from stress responses (Moberg 2000), we also assume that stress responses are likely to persist beyond the time interval required for animals to recover from TTS and might result in pathological and pre-pathological states that would be as significant as behavioral responses to TTS.

In general, there is a small amount of data available on the potential for strong, anthropogenic underwater sounds to cause non-auditory physical effects in marine mammals. The available data do not allow identification of a specific exposure level above which non-auditory effects can be expected (Southall *et al.*, 2007). There is no definitive evidence that any of these effects occur even for marine mammals in close proximity to an anthropogenic sound source. In addition, marine mammals that show behavioral avoidance of survey vessels and related sound sources are unlikely to incur non-auditory impairment or other physical effects. NMFS does not expect that the generally short-term, intermittent, and transitory HRG and geotechnical activities would create conditions of long-term, continuous noise and chronic acoustic exposure leading to long-term physiological stress responses in marine mammals.

Behavioral Disturbance

Behavioral disturbance may include a variety of effects, including subtle changes in behavior (*e.g.*, minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Behavioral responses to sound are highly variable and context-specific and any reactions depend on numerous intrinsic and extrinsic factors (*e.g.*, species, state of maturity, experience, current activity, reproductive state, auditory sensitivity, time of day), as well as the interplay between factors (*e.g.*, Richardson *et al*., 1995; Wartzok *et al*., 2003; Southall *et al*., 2007; Weilgart, 2007; Archer *et al*., 2010). Behavioral reactions can vary not only among individuals but also within an individual, depending on previous experience with a sound source, context, and numerous other factors (Ellison *et al*., 2012), and can vary depending on characteristics associated with the sound source (*e.g.*, whether it is moving or stationary, number of sources, distance from the source). Please see Appendices B-C of Southall *et al*. (2007) for a review of studies involving marine mammal behavioral responses to sound.

Habituation can occur when an animal's response to a stimulus wanes with repeated exposure, usually in the absence of unpleasant associated events (Wartzok *et al*., 2003). Animals are most likely to habituate to sounds that are predictable and unvarying. It is important to note that habituation is appropriately considered as a "progressive reduction in response to stimuli that are perceived as neither aversive nor beneficial," rather than as, more generally, moderation in response to human disturbance (Bejder *et al*., 2009). The opposite process is sensitization, when an unpleasant experience leads to subsequent responses, often in the form of avoidance, at a lower level of exposure. As noted, behavioral state may affect the type of response. For example, animals that are resting may show greater behavioral change in response to disturbing sound levels than animals that are highly motivated to remain in an area for feeding (Richardson *et al*., 1995; NRC 2003; Wartzok *et al*., 2003). Controlled experiments with captive marine mammals have shown pronounced behavioral reactions, including avoidance of loud sound sources (Ridgway *et al*., 1997; Finneran *et al*., 2003). Observed responses of wild marine mammals to loud, pulsed sound sources (typically seismic airguns or acoustic harassment devices) have been varied but often consist of avoidance behavior or other behavioral changes suggesting discomfort (Morton and Symonds, 2002; see also Richardson *et al*., 1995; Nowacek *et al*., 2007).

Available studies show wide variation in response to underwater sound; therefore, it is difficult to predict specifically how any given sound in a particular instance might affect marine mammals perceiving the signal. If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population. However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (*e.g.*, Lusseau and Bejder, 2007; Weilgart 2007; NRC 2005). However, there are broad categories of potential response, which we describe in greater detail here, that include alteration of dive behavior, alteration of foraging behavior, effects to breathing, interference with or alteration of vocalization, avoidance, and flight.

Changes in dive behavior can vary widely and may consist of increased or decreased dive times and surface intervals as well as changes in the rates of ascent and descent during a dive (*e.g.*, Frankel and Clark 2000; Costa *et al*., 2003; Ng and Leung 2003; Nowacek *et al*., 2004; Goldbogen *et al.*, 2013a,b). Variations in dive behavior may reflect interruptions in biologically significant activities (*e.g.*, foraging) or they may be of little biological significance. The impact of an alteration to dive behavior resulting from an acoustic exposure depends on what the animal is doing at the time of the exposure and the type and magnitude of the response.

Disruption of feeding behavior can be difficult to correlate with anthropogenic sound exposure, so it is usually inferred by observed displacement from known foraging areas, the appearance of secondary indicators (*e.g.*, bubble nets or sediment plumes), or changes in dive behavior. As for other types of behavioral response, the frequency, duration, and temporal pattern of signal presentation, as well as differences in species sensitivity, are likely contributing factors to differences in response in any given circumstance (*e.g.*, Croll *et al*., 2001; Nowacek *et al*.; 2004; Madsen *et al*., 2006; Yazvenko *et al*., 2007). A determination of whether foraging disruptions incur fitness consequences would require information on or estimates of the energetic requirements of the affected individuals and the relationship between prey availability, foraging effort and success, and the life history stage of the animal.

Variations in respiration naturally vary with different behaviors and alterations to breathing rate as a function of acoustic exposure can be expected to co-occur with other behavioral reactions, such as a flight response or an alteration in diving. However, respiration rates in and of themselves may be representative of annoyance or an acute stress response. Various studies have shown that respiration rates may either be unaffected or could increase, depending on the species and signal characteristics, again highlighting the importance in understanding species differences in the tolerance of underwater noise when determining the potential for impacts resulting from anthropogenic sound exposure (*e.g.*, Kastelein *et al*., 2001, 2005b, 2006; Gailey *et al*., 2007).

Marine mammals vocalize for different purposes and across multiple modes, such as whistling, echolocation click production, calling, and singing. Changes in vocalization behavior in response to anthropogenic noise can occur for any of these modes and may result from a need to compete with an increase in background noise or may reflect increased vigilance or a startle response. For example, in the presence of potentially masking signals, humpback whales and killer whales have been observed to increase the length of their songs (Miller *et al*., 2000; Fristrup *et al*., 2003; Foote *et al*., 2004), while right whales have been observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks *et al*., 2007b). In some cases, animals may cease sound production during production of aversive signals (Bowles *et al*., 1994).

Avoidance is the displacement of an individual from an area or migration path as a result of the presence of a sound or other stressors, and is one of the most obvious manifestations of disturbance in marine mammals (Richardson *et al*., 1995). For example, gray whales are known to change direction – deflecting from customary migratory paths – in order to avoid noise from seismic surveys (Malme *et al*., 1984). Avoidance may be short-term, with animals returning to the area once the noise has ceased (*e.g.*, Bowles *et al*., 1994; Goold 1996; Stone *et al*., 2000; Morton and Symonds, 2002; Gailey *et al*., 2007). Longer-term displacement is possible, however, which may lead to changes in abundance or distribution patterns of the affected species in the affected region if habituation to the presence of the sound does not occur (*e.g.*, Blackwell *et al*., 2004; Bejder *et al*., 2006; Teilmann *et al*., 2006).

A flight response is a dramatic change in normal movement to a directed and rapid movement away from the perceived location of a sound source. The flight response differs from other avoidance responses in the intensity of the response (*e.g.*, directed movement, rate of travel). Relatively little information on flight responses of marine mammals to anthropogenic signals exist, although observations of flight responses to the presence of predators have occurred (Connor and Heithaus, 1996). The result of a flight response could range from brief, temporary exertion and displacement from the area where the signal provokes flight to, in extreme cases, marine mammal strandings (Evans and England, 2001). However, it should be noted that response to a perceived predator does not necessarily invoke flight (Ford and Reeves, 2008) and whether individuals are solitary or in groups may influence the response.

Behavioral disturbance can also impact marine mammals in more subtle ways. Increased vigilance may result in costs related to diversion of focus and attention (*i.e.*, when a response consists of increased vigilance, it may come at the cost of decreased attention to other critical behaviors such as foraging or resting). These effects have generally not been demonstrated for marine mammals, but studies involving fish and terrestrial animals have shown that increased vigilance may substantially reduce feeding rates (*e.g.*, Beauchamp and Livoreil, 1997; Fritz *et al*., 2002; Purser and Radford, 2011). In addition, chronic disturbance can cause population declines through reduction of fitness (*e.g.*, decline in body condition) and subsequent reduction in reproductive success, survival, or both (*e.g.*, Harrington and Veitch, 1992; Daan *et al*., 1996; Bradshaw *et al*., 1998). However, Ridgway *et al*. (2006) reported that increased vigilance in bottlenose dolphins exposed to sound over a five-day period did not cause any sleep deprivation or stress effects.

Many animals perform vital functions, such as feeding, resting, traveling, and socializing, on a diel cycle (24-hour cycle). Disruption of such functions resulting from reactions to stressors such as sound exposure are more likely to be significant if they last more than one diel cycle or recur on subsequent days (Southall *et al*., 2007). Consequently, a behavioral response lasting less than one day and not recurring on subsequent days is not considered particularly severe unless it could directly affect reproduction or survival (Southall *et al*., 2007). Note that there is a difference between multi-day substantive behavioral reactions and multi-day anthropogenic activities. For example, just because an activity lasts for multiple days does not necessarily mean that individual animals are either exposed to activity-related stressors for multiple days or, further, exposed in a manner resulting in sustained multi-day substantive behavioral responses.

Marine mammals are likely to avoid the HRG survey activity, especially the naturally shy harbor porpoise, while the harbor seals might be attracted to them out of curiosity. However, because the sub-bottom profilers and other HRG survey equipment operate from a moving vessel, and the maximum radius to the Level B harassment threshold is relatively small, the area and time that this equipment would be affecting a given location is very small. Further, once an area has been surveyed, it is not likely that it will be surveyed again, thereby reducing the likelihood of repeated HRG-related impacts within the survey area.

We have also considered the potential for severe behavioral responses such as stranding and associated indirect injury or mortality from Equinor's use of HRG survey equipment, on the basis of a 2008 mass stranding of approximately 100 melon-headed whales in a Madagascar lagoon system. An investigation of the event indicated that use of a high-frequency mapping system (12-kHz multibeam echosounder) was the most plausible and likely initial behavioral trigger of the event, while providing the caveat that there is no unequivocal and easily identifiable single cause (Southall *et al*., 2013). The investigatory panel's conclusion was based on (1) very close temporal and spatial association and directed movement of the survey with the stranding event; (2) the unusual nature of such an event coupled with previously documented apparent behavioral sensitivity of the species to other sound types (Southall *et al*., 2006; Brownell *et al*., 2009); and (3) the fact that all other possible factors considered were determined to be unlikely causes. Specifically, regarding survey patterns prior to the event and in relation to bathymetry, the vessel transited in a north-south direction on the shelf break parallel to the shore, ensonifying large areas of deep-water habitat prior to operating intermittently in a concentrated area offshore from the stranding site; this may have trapped the animals between the sound source and the shore, thus driving them towards the lagoon system. The investigatory panel systematically excluded or deemed highly unlikely nearly all potential reasons for these animals leaving their typical pelagic habitat for an area extremely atypical for the species (*i.e.*, a shallow lagoon system). Notably, this was the first time that such a system has been associated with a stranding event. The panel also noted several site- and situation-specific secondary factors that may have contributed to the avoidance responses that led to the eventual entrapment and mortality of the whales. Specifically, shoreward-directed surface currents and elevated chlorophyll levels in the area preceding the event may have played a role (Southall *et al*., 2013). The report also notes that prior use of a similar system in the general area may have sensitized the animals and also concluded that, for odontocete cetaceans that hear well in higher frequency ranges where ambient noise is typically quite low, high-power active sonars operating in this range may be more easily audible and have potential effects over larger areas than low frequency systems that have more typically been considered in terms of anthropogenic noise impacts. It is, however, important to note that the relatively lower output frequency, higher output power, and complex nature of the system implicated in this event, in context of the other factors noted here, likely produced a fairly unusual set of circumstances that indicate that such events would likely remain rare and are not necessarily relevant to use of lower-power, higher-frequency systems more commonly used for HRG survey applications. The risk of similar events recurring may be very low, given the extensive use of active acoustic systems used for scientific and navigational purposes worldwide on a daily basis and the lack of direct evidence of such responses previously reported.

Tolerance

Numerous studies have shown that underwater sounds from industrial activities are often readily detectable by marine mammals in the water at distances of many km. However, other studies have shown that marine mammals at distances more than a few km away often show no apparent response to industrial activities of various types (Miller *et al*., 2005). This is often true even in cases when the sounds must be readily audible to the animals based on measured received levels and the hearing sensitivity of that mammal group. Although various baleen whales, toothed whales, and (less frequently) pinnipeds have been shown to react behaviorally to underwater sound from sources such as airgun pulses or vessels under some conditions, at other times, mammals of all three types have shown no overt reactions (*e.g.*, Malme *et al*., 1986; Richardson *et al.*, 1995; Madsen and Mohl 2000; Croll *et al*., 2001; Jacobs and Terhune 2002; Madsen *et al*., 2002; Miller *et al*., 2005). In general, pinnipeds seem to be more tolerant of exposure to some types of underwater sound than are baleen whales. Richardson *et al*. (1995) found that vessel sound does not seem to affect pinnipeds that are already in the water.

Vessel Strike

Ship strikes of marine mammals can cause major wounds, which may lead to the death of the animal. An animal at the surface could be struck directly by a vessel, a surfacing animal could hit the bottom of a vessel, or a vessel's propeller could injure an animal just below the surface. The severity of injuries typically depends on the size and speed of the vessel (Knowlton and Kraus 2001; Laist *et al*., 2001; Vanderlaan and Taggart 2007).

The most vulnerable marine mammals are those that spend extended periods of time at the surface in order to restore oxygen levels within their tissues after deep dives (*e.g.,* the sperm whale). In addition, some baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek *et* *al*., 2004). These species are primarily large, slow moving whales. Smaller marine mammals (*e.g.*, bottlenose dolphin) move quickly through the water column and are often seen riding the bow wave of large ships. Marine mammal responses to vessels may include avoidance and changes in dive pattern (NRC 2003).

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death (Knowlton and Kraus 2001; Laist *et al*., 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007). In assessing records with known vessel speeds, Laist *et al*. (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 24.1 km/h (14.9 mph; 13 kn). Given the slow vessel speeds and predictable course necessary for data acquisition, ship strike is unlikely to occur during the geophysical and geotechnical surveys. Marine mammals would be able to easily avoid the survey vessel due to the slow vessel speed. Further, Equinor would implement measures (*e.g.*, protected species monitoring, vessel speed restrictions and separation distances; see **Proposed Mitigation**) set forth in the BOEM lease to reduce the risk of a vessel strike to marine mammal species in the survey area.

Marine Mammal Habitat

The HRG survey equipment will not contact the seafloor and does not represent a source of pollution. We are not aware of any available literature on impacts to marine mammal prey from sound produced by HRG survey equipment. However, as the HRG survey equipment introduces noise to the marine environment, there is the potential for it to result in avoidance of the area around the HRG survey activities on the part of marine mammal prey. Any avoidance of the area on the part of marine mammal prey would be expected to be short term and temporary.

Because of the temporary nature of the disturbance, and the availability of similar habitat and resources (*e.g.*, prey species) in the surrounding area, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations. Impacts on marine mammal habitat from the proposed activities will be temporary, insignificant, and discountable.

Estimated Take

This section provides an estimate of the number of incidental takes proposed for authorization through this IHA, which will inform both NMFS' consideration of "small numbers" and the negligible impact determination.

Harassment is the only type of take expected to result from these activities. Except with respect to certain activities not pertinent here, section 3(18) of the MMPA defines "harassment" as any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment).

Authorized takes would be by Level B harassment only, in the form of disruption of behavioral patterns for individual marine mammals resulting from exposure to HRG sources. Based on the nature of the activity and the anticipated effectiveness of the mitigation measures (*i.e.*, exclusion zones and shutdown measures), discussed in detail below in **Proposed Mitigation** section, Level A harassment is neither anticipated nor proposed to be authorized.

As described previously, no mortality is anticipated or proposed to be authorized for this activity. Below we describe how the take is estimated.

Generally speaking, we estimate take by considering: (1) acoustic thresholds above which NMFS believes the best available science indicates marine mammals will be behaviorally harassed or incur some degree of permanent hearing impairment; (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and, (4) and the number of days of activities. We note that while these basic factors can contribute to a basic calculation to provide an initial prediction of takes, additional information that can qualitatively inform take estimates is also sometimes available (*e.g.*, previous monitoring results or average group size). Below, we describe the factors considered here in more detail and present the proposed take estimate.

Acoustic Thresholds

Using the best available science, NMFS has developed acoustic thresholds that identify the received level of underwater sound above which exposed marine mammals would be reasonably expected to be behaviorally harassed (equated to Level B harassment) or to incur PTS of some degree (equated to Level A harassment).

Level B Harassment – Though significantly driven by received level, the onset of behavioral disturbance from anthropogenic noise exposure is also informed to varying degrees by other factors related to the source (*e.g.*, frequency, predictability, duty cycle), the environment (*e.g.*, bathymetry), and the receiving animals (hearing, motivation, experience, demography, behavioral context) and can be difficult to predict (Southall *et al.*, 2007, Ellison *et al.*, 2012). Based on what the available science indicates and the practical need to use a threshold based on a factor that is both predictable and measurable for most activities, NMFS uses a generalized acoustic threshold based on received level to estimate the onset of behavioral harassment. NMFS predicts that marine mammals are likely to be behaviorally harassed in a manner we consider Level B harassment when exposed to underwater anthropogenic noise above received levels of 160 dB re 1 μPa (rms) for impulsive and/or intermittent sources (*e.g.*, impact pile driving) and 120 dB rms for continuous sources (*e.g.*, vibratory driving). Equinor's proposed activity includes the use of intermittent sources (geophysical survey equipment) and therefore use of the 160 dB re 1 μPa (rms) threshold is applicable.

Level A harassment - NMFS' Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0) (Technical Guidance, 2018) identifies dual criteria to assess auditory injury (Level A harassment) to five different marine mammal groups (based on hearing sensitivity) as a result of exposure to noise from two different types of sources (impulsive or non-impulsive). The components of Equinor's proposed activity that may result in the take of marine mammals include the use of impulsive and non-impulsive intermittent sources.

These thresholds are provided in Table 4 below. The references, analysis, and methodology used in the development of the thresholds are described in NMFS 2018 Technical Guidance, which may be accessed at: *www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance.*

Table 4 – Thresholds Identifying the Onset of Permanent Threshold Shift

	PTS Onset Acoustic Thresholds* **(Received Level)**	
Hearing Group	**Impulsive**	**Non-impulsive**
Low-Frequency (LF) Cetaceans	*Cell 1* $L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB	*Cell 2* $L_{E,LF,24h}$: 199 dB
Mid-Frequency (MF) Cetaceans	*Cell 3* $L_{pk,flat}$: 230 dB $L_{E,MF,24h}$: 185 dB	*Cell 4* $L_{E,MF,24h}$: 198 dB
High-Frequency (HF) Cetaceans	*Cell 5* $L_{pk,flat}$: 202 dB $L_{E,HF,24h}$: 155 dB	*Cell 6* $L_{E,HF,24h}$: 173 dB

Phocid Pinnipeds (PW) (Underwater)	*Cell 7* $L_{pk,flat}$: 218 dB $L_{E,PW,24h}$: 185 dB	*Cell 8* $L_{E,PW,24h}$: 201 dB
Otariid Pinnipeds (OW) (Underwater)	*Cell 9* $L_{pk,flat}$: 232 dB $L_{E,OW,24h}$: 203 dB	*Cell 10* $L_{E,OW,24h}$: 219 dB
* Dual metric acoustic thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds should also be considered. <u>Note</u>: Peak sound pressure (L_{pk}) has a reference value of 1 µPa, and cumulative sound exposure level (L_E) has a reference value of 1µPa^{2}s. In this Table, thresholds are abbreviated to reflect American National Standards Institute standards (ANSI 2013). However, peak sound pressure is defined by ANSI as incorporating frequency weighting, which is not the intent for this Technical Guidance. Hence, the subscript "flat" is being included to indicate peak sound pressure should be flat weighted or unweighted within the generalized hearing range. The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans, and PW and OW pinnipeds) and that the recommended accumulation period is 24 hours. The cumulative sound exposure level thresholds could be exceeded in a multitude of ways (*i.e.,* varying exposure levels and durations, duty cycle). When possible, it is valuable for action proponents to indicate the conditions under which these acoustic thresholds will be exceeded.		

Ensonified Area

Here, we describe operational and environmental parameters of the activity that will feed into identifying the area ensonified above the acoustic thresholds, which include source levels and transmission loss coefficient.

The proposed survey would entail the use of HRG equipment. The distance to the isopleth corresponding to the threshold for Level B harassment was calculated for all HRG equipment with the potential to result in harassment of marine mammals. NMFS has developed an interim methodology for determining the rms sound pressure level (SPL_{rms}) at the 160-dB isopleth for the purposes of estimating take by Level B harassment resulting from exposure to HRG survey equipment (NMFS, 2019). This methodology incorporates frequency and some directionality to refine estimated ensonified zones and is described below:

If only peak source sound pressure level (SPL_{pk}) is given, the SPL_{rms} can be roughly approximated by:

(1) $SPL_{rms} = SPL_{pk} + 10\log_{10}\tau$

where τ is the pulse duration in second. If the pulse duration varies, the longest duration should be used, unless there is certainty regarding the portion of time a shorter duration will be used, in which case the result can be calculated/parsed appropriately.

In order to account for the greater absorption of higher frequency sources, we recommend applying 20 log(r) with an absorption term α□r/1000 to calculate transmission loss (TL), as described in Eq.s (2) and (3) below:

(2) $TL = 20\log_{10}(r) + \alpha \cdot r/1000$ (dB)

where *r* is the distance in meters, and α is absorption coefficient in dB/km.

While the calculation of absorption coefficient varies with frequency, temperature, salinity, and pH, the largest factor driving the absorption coefficient is frequency. A simple formula to approximate the absorption coefficient (neglecting temperature, salinity, and pH) is provided by Richardson et al. (1995):

(3) $\alpha \approx 0.036f^{1.5}$ (dB/km)

where *f* is frequency in kHz. When a range of frequencies, is being used, the lower bound of the range should be used for this calculation, unless there is certainty regarding the portion of time a higher frequency will be used, in which case the result can be calculated/parsed appropriately.

Further, if the beamwidth is less than 180^{o} and the angle of beam axis in respect to sea surface is known, the horizontal impact distance *R* should be calculated using

(4) $R = r\cos\left(\varphi - \frac{\theta}{2}\right)$ (m)

where *SL* is the SPL_{rms} at the source (1 m), θ is the beamwidth (in radian), and ϕ is the angle of beam axis in respect to sea surface (in radian).

Finally, if the beam is pointed at a normal downward direction, Eq. (4) can be simplified as:

(5) $$R = r\cos\left(\frac{\pi}{2} - \frac{\theta}{2}\right) = r\sin\frac{\theta}{2} \text{ (m)}$$

The interim methodology described above was used to estimate isopleth distances to the Level B harassment threshold for the proposed HRG survey. NMFS considers the data provided by Crocker and Fratantonio (2016) to represent the best available information on source levels associated with HRG equipment and therefore recommends that source levels provided by Crocker and Fratantonio (2016) be incorporated in the method described above to estimate isopleth distances to the Level B harassment threshold. In cases when the source level for a specific type of HRG equipment is not provided in Crocker and Fratantonio (2016), NMFS recommends that either the source levels provided by the manufacturer be used, or, in instances where source levels provided by the manufacturer are unavailable or unreliable, a proxy from Crocker and Fratantonio (2016) be used instead. Table 2 shows the HRG equipment types that may be used during the proposed vessel-based surveys that may result in take of marine mammals, and the sound levels associated with those HRG equipment types.

Results of modeling using the methodology described above indicated that, of the HRG survey equipment planned for use by Equinor that has the potential to result in harassment of marine mammals, sound produced by the GeoSource 800 J sparker would propagate furthest to the Level B harassment threshold (Table 5); therefore, for the purposes of the exposure analysis, it was assumed the GeoSource 800 J would be active during the entirety of the survey. Thus, the distance to the isopleth corresponding to the threshold for Level B harassment for the GeoSource 800 J (estimated at 141 m; Table 5) was used as the basis of the take calculation for all marine mammals. We note that this is a conservative assumption as there may be times during the proposed surveys when the GeoSource 800 J is not operated; if this were the case, the potential for the take of marine mammals by Level B harassment during these times would be much lower based on the modeled distance to the Level B harassment threshold associated with the USBL (Table 5).

Table 5 – Modeled Radial Distances from HRG Survey Equipment to Isopleths Corresponding to Level A Harassment and Level B Harassment Thresholds

Sound Source	Radial Distance to Level A Harassment Threshold (m)				Radial Distance to Level B Harassment Threshold (m)
	Low frequency cetaceans (peak SPL / SELcum)	Mid frequency cetaceans (peak SPL / SELcum)	High frequency cetaceans (peak SPL / SELcum)	Phocid pinnipeds (underwater) (peak SPL / SELcum)	All marine mammals
Kongsberg HiPAP 501/502 USBL	0	0	0	0	4
Geo-Source 400 Tip Sparker (800 J)	-/<1	-/0	3.5/<1	-/<1	141

Predicted distances to Level A harassment isopleths, which vary based on marine mammal functional hearing groups (Table 5), were also calculated. The updated acoustic thresholds for impulsive sounds (such as HRG survey equipment) contained in the Technical Guidance (NMFS, 2018) were presented as dual metric acoustic thresholds using both cumulative sound exposure level (SEL_{cum}) and peak sound pressure level metrics. As dual metrics, NMFS considers onset of PTS (Level A harassment) to have occurred when either one of the two metrics is exceeded (*i.e.*, the metric resulting in the largest isopleth). The SEL_{cum} metric considers both level and duration of exposure, as well as auditory weighting functions by marine mammal hearing group.

Modeled distances to isopleths corresponding to the Level A harassment thresholds are very small (< 4 m) for all marine mammal species and stocks that may be impacted by the proposed activities (Table 5). Based on the very small Level A harassment zones for all marine mammal species and stocks that may be impacted by the proposed activities, the potential for any marine mammals to be taken by Level A harassment is considered so low as to be discountable. As NMFS has determined that the likelihood of take in the form of Level A harassment of any marine mammals as a result of the proposed surveys is so low as to be discountable, we therefore do not propose to authorize the take by Level A harassment of any marine mammals.

Marine Mammal Occurrence

In this section we provide the information about the presence, density, or group dynamics of marine mammals that will inform the take calculations.

The habitat-based density models produced by the Duke University Marine Geospatial Ecology Laboratory (MGEL) (Roberts *et al*., 2016, 2017, 2018) represent the best available information regarding marine mammal densities in the proposed survey area. The density data presented by the Duke University MGEL incorporates aerial and shipboard line-transect survey data from NMFS and other organizations and incorporates data from 8 physiographic and 16 dynamic oceanographic and biological covariates, and controls for the influence of sea state, group size, availability bias, and perception bias on the probability of making a sighting. These density models were originally developed for all cetacean taxa in the U.S. Atlantic (Roberts *et al*., 2016). In subsequent years, certain models have been updated on the basis of additional data as well as certain methodological improvements. The updated models incorporate additional sighting data, including sightings from the NOAA Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys from 2010–2014 (NEFSC & SEFSC, 2011, 2012, 2014a, 2014b, 2015, 2016), and include updated density data for North Atlantic right whales, including in Cape Cod Bay (Roberts *et al*., 2018). Our evaluation of the changes leads to a conclusion that these represent the best scientific evidence available. More information is available online at *seamap.env.duke.edu/models/Duke-EC-GOM-2015/*. Marine mammal density estimates in the project area (animals/km^2) were obtained using these model results (Roberts *et al*., 2016, 2017, 2018).

For the exposure analysis, density data from the Duke University MGEL (Roberts *et al.* (2016, 2017, 2018)) were mapped using a geographic information system (GIS). The density coverages that included any portion of the proposed project area were selected for all potential survey months. For each of the survey areas (*i.e.*, ECRA-1, ECRA-2, ECRA-3 and ECRA-4), the densities of each species as reported by the Duke University MGEL (Roberts *et al.* (2016, 2017, 2018)) were averaged by season; thus, a density was calculated for each species for spring, summer, fall and winter. To be conservative, the greatest seasonal density calculated for each species be carried forward in the exposure analysis. Estimated seasonal densities (animals per km^2) of all marine mammal species that may be taken by the proposed surveys, for all seasons and all survey areas, are shown in Tables 6-2, 6-3, 6-4, 6-5 and 6-6 of the IHA application. The maximum seasonal density values used to estimate marine mammal exposure numbers are shown in Table 6 below. Note that Duke University MGEL density models do not differentiate by bottlenose dolphin stocks and instead provide estimates at the species level (Roberts *et al.* (2016, 2017, 2018)); the Western North Atlantic northern migratory coastal stock and the Western North Atlantic offshore stock of bottlenose dolphins may occur in the proposed survey areas (Hayes *et al*. 2018). Similarly, the Duke University MGEL produced density models for all seals and did not differentiate by seal species (Roberts *et al*. (2018)); harbor, gray and harp seals may occur in the proposed survey areas (Hayes *et al*. 2018).

Table 6 – Seasonal Marine Mammal Densities (Number of Animals per 100 km^2) in All Survey Areas Used in Exposure Estimates

Species	ECRA-1	ECRA-2	ECRA-3	ECRA-4
North Atlantic right whale	0.0063398	0.00192015	0.0002612	0.0008549
Humpback whale	0.0054269	0.00147951	0.0003133	0.0007076
Fin whale	0.0048318	0.00392609	0.000154	0.0029756
Sei whale	0.0003972	0.00028884	0.00002179	0.000146
Minke whale	0.0044061	0.0020292	0.00006959	0.0015375
Sperm Whale	0.0001033	0.00029419	0.00004323	0.0003508
Pilot whales	0.0014728	0.00011263	0.00002895	0.0058357
Bottlenose dolphins	0.0847306	0.02955662	0.0684936	0.0527685
Common dolphin	0.0224355	0.2121851	0.0043119	0.1539656
Atlantic white-sided dolphin	0.057509	0.05269613	0.0015548	0.0305044
Atlantic spotted dolphin	0.00005057	0.00212995	0.00008059	0.0020008
Risso’s dolphin	0.00007374	0.00294218	0.00000215	0.000818
Harbor porpoise	0.05438	0.07252193	0.1348293	0.0671625
Seals (all species)	0.3330293	0.0717368	0.0506316	0.0539549

Note: All density values derived from Roberts *et al*. (2016, 2017, 2018). Densities shown represent the maximum seasonal density values calculated, except pilot whales for which seasonal densities were not available.

Take Calculation and Estimates

Here we describe how the information provided above is brought together to produce a quantitative take estimate.

In order to estimate the number of marine mammals predicted to be exposed to sound levels that would result in harassment, radial distances to predicted isopleths corresponding to harassment thresholds are calculated, as described above. Those distances are then used to calculate the area(s) around the HRG survey equipment predicted to be ensonified to sound levels that exceed harassment thresholds. The area estimated to be ensonified to relevant thresholds in a single day is then calculated, based on areas predicted to be ensonified around the HRG survey equipment and the estimated trackline distance traveled per day by the survey vessel.

Equinor estimates that proposed surveys will achieve a maximum daily track line distance of 177.6 km (110.3 mi) per day during proposed HRG surveys. We note that this is a conservative estimate as it accounts for the vessel traveling at approximately 4 knots and accounts for non-active survey periods (*i.e.*, it assumes HRG equipment would be active 24 hours per day during all survey days when in fact there are likely to be periods when the equipment is not active). Based on the maximum estimated distance to the Level B harassment threshold of 141 m (Table 5) and the maximum estimated daily track line distance of 177.6 km (110.3 mi), an area of 50.08 km^2 would be ensonified to the Level B harassment threshold per day during Equinor's proposed surveys. As stated above, this is a conservative assumption as there may be times during the proposed surveys when the GeoSource 800 J is not operated; if this were the case, the ensonified area would be much smaller, based on the modeled Level B harassment threshold associated with the USBL (Table 5).

The number of marine mammals expected to be incidentally taken per day is then calculated by estimating the number of each species predicted to occur within the daily ensonified area (animals / km^2), incorporating the estimated marine mammal densities as described above. Estimated numbers of each species taken per day are then multiplied by the total number of survey days. The product is then rounded, to generate an estimate of the total number of instances of harassment expected for each species over the duration of the survey. A summary of this method is illustrated in the following formula:

Estimated Take = D × ZOI × # of days

Where: D = average species density (per km^2) and ZOI = maximum daily ensonified area to relevant thresholds.

In this case, the methodology described above was used to estimate marine mammal exposures separately in the four ECRAs. Thus, exposures were calculated separately for each of the four individual ECRAs based on estimated survey duration in each ECRA (Table 2) and using the maximum seasonal density estimates for each respective ECRA (Table 6). Exposure estimates for the four survey areas were then combined for a total estimated number of exposures (Table 7).

Though takes by Level B harassment of North Atlantic right whales were calculated based on the modeling approach described above, Equinor determined that take of the species could be avoided due to mitigation and therefore did not request take authorization for the North Atlantic right whale. However, given the size of modeled Level B harassment zone, the duration of the proposed surveys, and the fact that surveys will occur 24 hours per day, NMFS is not confident that all takes of right whales could be avoided due to mitigation, and we therefore propose to authorize 50 percent of the total number of exposures above the Level B harassment threshold that were modeled. We expect the proposed mitigation measures, including a 500-m exclusion zone for right whales (which exceeds the Level B harassment zone by over 350-m), will be effective in reducing the potential for takes by Level B harassment, but there is still a risk that right whales may not be detected within the Level B harassment zone during periods of diminished visibility, particularly at night. The numbers of takes proposed for authorization are shown in Table 7.

Table 7 – Numbers of Potential Incidental Take of Marine Mammals Proposed for Authorization and Proposed Takes as a Percentage of Population

Species	Estimated Takes by Level B Harassment ECRA-1	Estimated Takes by Level B Harassment ECRA-2	Estimated Takes by Level B Harassment ECRA-3	Estimated Takes by Level B Harassment ECRA-4	Total Takes by Level B Harassment Proposed for Authorization	Total Proposed Instances of Take as a Percentage of Population [1]
North Atlantic right whale	4	7	0	5	8	2.0
Humpback whale	3	5	1	4	13	0.8
Fin whale	3	14	0	19	36	0.8
Sei whale	1	1	0	1	3	0.4

Minke whale	3	7	0	10	20	0.9
Sperm Whale	0	1	0	2	3	0.1
Long-finned Pilot Whale	1	1	0	37	39	0.2
Bottlenose dolphin [2]	48	104	39	331	522	7.9
Common dolphin	13	747	2	966	1,728	2.0
Atlantic white-sided dolphin	33	185	1	191	410	1.1
Atlantic spotted dolphin	0	8	0	13	21	0.0
Risso's dolphin	0	10	0	5	15	0.2
Harbor porpoise	31	255	76	421	783	1.7
Seals [3]	188	253	29	338	808	1.1

[1] Calculations of percentage of stock taken are based on the best available abundance estimate as shown in Table 3. In most cases the best available abundance estimate is provided by Roberts *et al*. (2016, 2017, 2018), when available, to maintain consistency with density estimates derived from Roberts *et al*. (2016, 2017, 2018). For North Atlantic right whales the best available abundance estimate is derived from the North Atlantic Right Whale Consortium 2019 Annual Report Card (Pettis *et al*., 2019). For bottlenose dolphins and seals, Roberts *et al*. (2016, 2017, 2018) provides only a single abundance estimate and does not provide abundance estimates at the stock or species level (respectively), so abundance estimates used to estimate percentage of stock taken for bottlenose dolphins, gray, harbor and harp seals are derived from NMFS SARs (Hayes *et al*., 2019).

[2] Either the Western North Atlantic coastal migratory stock or the Western North Atlantic offshore stock may be taken. Total proposed instances of take as a percentage of population shown for Western North Atlantic coastal migratory stock (based on all 522 proposed authorized takes accruing to that stock). The total proposed instances of take as a percentage of population for the Western North Atlantic offshore stock is 0.8 (based on all 522 proposed authorized takes accruing to that stock).

[3] Harbor, gray or harp seals may be taken. Total proposed instances of take as a percentage of population shown for harbor seals (based on all 808 proposed authorized takes accruing to that species). The total proposed instances of take as a percentage of population for gray seals and harp seals is 0.2 and 0.0, respectively (based on all 808 proposed authorized takes accruing to each species).

As described above, the Duke University MGEL produced density models that did not differentiate by seal species. The underlying data in the Duke University MGEL seal models came almost entirely from AMAPPS aerial surveys which were unable to differentiate by seal species, with the majority of seal sightings reported as “unidentified seal” (Roberts *et al*., 2018). Given the fact that the in-water habitats of harbor seals and gray seals are not well described but likely overlap, and based on the few species identifications that were available, the Duke University MGEL did not attempt to classify the ambiguous “unidentified seal” sightings by species (Roberts *et al*., 2018) and instead produced models for seals as a guild. The take calculation methodology described above resulted in an estimate of 808 total seal takes. Based on this estimate, Equinor requested 808 takes each of harbor, gray and harp seals, based on an assumption that the modeled takes could accrue to any of the respective species. We instead propose to authorize 808 total takes of seals by Level B harassment. Based on the occurrence of harbor, gray and harp seals in the survey areas, we expect the proposed authorized takes would accrue roughly equally to gray and harbor seals, with only a handful of takes of harp seals at most.

The density models produced by the Duke University MGEL also did not differentiate by bottlenose dolphin stocks (Roberts *et al.* (2016, 2017, 2018). The Western North Atlantic northern migratory coastal stock and the Western North Atlantic offshore stock occur in the proposed survey areas. The northern migratory coastal stock occurs in coastal waters from the shoreline to approximately the 20-m isobath while the offshore stock occurs at depths of 20-m and greater (Hayes *et al*. 2019). The take calculation methodology described above resulted in an estimate of 522 total bottlenose dolphin takes. Depths across the proposed survey areas range from very shallow waters near landfall locations to approximately 75-m in offshore survey locations. As proposed surveys would occur in areas where either the northern migratory coastal stock or the offshore stock may occur, we expect the proposed authorized takes would accrue roughly equally to both stocks.

Equinor requested 39 total takes of pilot whales (either long-finned or short-finned). However, the range of short-finned pilot whales does not extend north of Delaware (Hayes et al., 2019) and therefore short-finned pilot whales are not expected to occur in the proposed survey areas. As such, we propose to authorize takes of long-finned pilot whales only.

As described above, NMFS has determined that the likelihood of take of any marine mammals in the form of Level A harassment occurring as a result of the proposed surveys is so low as to be discountable; therefore, we do not propose to authorize take of any marine mammals by Level A harassment.

Proposed Mitigation

In order to issue an IHA under Section 101(a)(5)(D) of the MMPA, NMFS must set forth the permissible methods of taking pursuant to such activity, and other means of effecting the least practicable impact on such species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of such species or stock for taking for certain subsistence uses (latter not applicable for this action). NMFS regulations require applicants for incidental take authorizations to include information about the availability and feasibility (economic and technological) of equipment, methods, and manner of conducting such activity or other means of effecting the least practicable adverse impact upon the affected species or stocks and their habitat (50 CFR 216.104(a)(11)).

In evaluating how mitigation may or may not be appropriate to ensure the least practicable adverse impact on species or stocks and their habitat, as well as subsistence uses where applicable, we carefully consider two primary factors:

(1) The manner in which, and the degree to which, the successful implementation of the measure(s) is expected to reduce impacts to marine mammals, marine mammal species or stocks,

and their habitat. This considers the nature of the potential adverse impact being mitigated (likelihood, scope, range). It further considers the likelihood that the measure will be effective if implemented (probability of accomplishing the mitigating result if implemented as planned), the likelihood of effective implementation (probability implemented as planned), and;

(2) The practicability of the measures for applicant implementation, which may consider such things as cost, impact on operations, and, in the case of a military readiness activity, personnel safety, practicality of implementation, and impact on the effectiveness of the military readiness activity.

Proposed Mitigation Measures

NMFS proposes the following mitigation measures be implemented during Equinor's proposed marine site characterization surveys.

Marine Mammal Exclusion Zones, Buffer Zone and Monitoring Zone

Marine mammal exclusion zones (EZ) would be established around the HRG survey equipment and monitored by protected species observers (PSO) during HRG surveys as follows:

- A 500-m EZ would be required for North Atlantic right whales; and
- A 100-m EZ would be required for all other marine mammal species.

If a marine mammal is detected approaching or entering the EZs during the proposed survey, the vessel operator would adhere to the shutdown procedures described below. In addition to the EZs described above, PSOs would visually monitor a 200 m Buffer Zone. During use of acoustic sources with the potential to result in marine mammal harassment (*i.e.*, anytime the acoustic source is active, including ramp-up), occurrences of marine mammals within the Buffer Zone (but outside the EZs) would be communicated to the vessel operator to prepare for potential shutdown of the acoustic source. The Buffer Zone is not applicable when the EZ is greater than 100 meters. PSOs would also be required to observe a 500-m Monitoring Zone and record the presence of all marine mammals within this zone. The zones described above would be based upon the radial distance from the active equipment (rather than being based on distance from the vessel itself).

Visual Monitoring

A minimum of one NMFS-approved PSO must be on duty and conducting visual observations at all times during daylight hours (*i.e.*, from 30 minutes prior to sunrise through 30 minutes following sunset). Visual monitoring would begin no less than 30 minutes prior to ramp-up of HRG equipment and would continue until 30 minutes after use of the acoustic source ceases or until 30 minutes past sunset. PSOs would establish and monitor the applicable EZs, Buffer Zone and Monitoring Zone as described above. Visual PSOs would coordinate to ensure 360° visual coverage around the vessel from the most appropriate observation posts, and would conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner. PSOs would estimate distances to observed marine mammals. It would be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate. Position data would be recorded using hand-held or vessel global positioning system (GPS) units for each confirmed marine mammal sighting.

Pre-Clearance of the Exclusion Zones

Prior to initiating HRG survey activities, Equinor would implement a 30-minute pre-clearance period. During pre-clearance monitoring (*i.e.*, before ramp-up of HRG equipment begins), the Buffer Zone would also act as an extension of the 100-m EZ in that observations of marine mammals within the 200-m Buffer Zone would also preclude HRG operations from beginning. During this period, PSOs would ensure that no marine mammals are observed within 200-m of the survey equipment (500-m in the case of North Atlantic right whales). HRG equipment would not start up until this 200-m zone (or, 500-m zone in the case of North Atlantic right whales) is clear of marine mammals for at least 30 minutes. The vessel operator would notify a designated PSO of the planned start of HRG survey equipment as agreed upon with the lead PSO; the notification time should not be less than 30 minutes prior to the planned initiation of HRG equipment order to allow the PSOs time to monitor the EZs and Buffer Zone for the 30 minutes of pre-clearance. A PSO conducting pre-clearance observations would be notified again immediately prior to initiating active HRG sources.

If a marine mammal were observed within the relevant EZs or Buffer Zone during the pre-clearance period, initiation of HRG survey equipment would not begin until the animal(s) has been observed exiting the respective EZ or Buffer Zone, or, until an additional time period has elapsed with no further sighting (*i.e.*, minimum 15 minutes for small odontocetes and seals, and 30 minutes for all other species). The pre-clearance requirement would include small delphinoids that approach the vessel (*e.g.*, bow ride). PSOs would also continue to monitor the zone for 30 minutes after survey equipment is shut down or survey activity has concluded. These requirements would be in effect only when the GeoSource 800 J sparker is being operated.

Ramp-Up of Survey Equipment

When technically feasible, a ramp-up procedure would be used for geophysical survey equipment capable of adjusting energy levels at the start or re-start of survey activities. The ramp-up procedure would be used at the beginning of HRG survey activities in order to provide additional protection to marine mammals near the survey area by allowing them to detect the presence of the survey and vacate the area prior to the commencement of survey equipment operation at full power. Ramp-up of the survey equipment would not begin until the relevant EZs and Buffer Zone has been cleared by the PSOs, as described above. HRG equipment would be initiated at their lowest power output and would be incrementally increased to full power. If any marine mammals are detected within the EZs or Buffer Zone prior to or during ramp-up, the HRG equipment would be shut down (as described below).

Shutdown Procedures

If an HRG source is active and a marine mammal is observed within or entering a relevant EZ (as described above) an immediate shutdown of the HRG survey equipment would be required. When shutdown is called for by a PSO, the acoustic source would be immediately deactivated and any dispute resolved only following deactivation. Any PSO on duty would have the authority to delay the start of survey operations or to call for shutdown of the acoustic source if a marine mammal is detected within the applicable EZ. The vessel operator would establish and maintain clear lines of communication directly between PSOs on duty and crew controlling the HRG source(s) to ensure that shutdown commands are conveyed swiftly while allowing PSOs to maintain watch. Subsequent restart of the HRG equipment would only occur after the marine mammal has either been observed exiting the relevant EZ, or, until an additional time period has elapsed with no further sighting of the animal within the relevant EZ (*i.e.*, 15 minutes for small odontocetes, pilot whales and seals, and 30 minutes for large whales).

Upon implementation of shutdown, the HRG source may be reactivated after the marine mammal that triggered the shutdown has been observed exiting the applicable EZ (*i.e.*, the animal is not required to fully exit the Buffer Zone where applicable), or, following a clearance period of 15 minutes for small odontocetes and seals and 30 minutes for all other species with no further observation of the marine mammal(s) within the relevant EZ. If the HRG equipment shuts down for brief periods (*i.e.*, less than 30 minutes) for reasons other than mitigation (*e.g.*, mechanical or electronic failure) the equipment may be re-activated as soon as is practicable at full operational level, without 30 minutes of pre-clearance, only if PSOs have maintained constant visual observation during the shutdown and no visual detections of marine mammals occurred within the applicable EZs and Buffer Zone during that time. For a shutdown of 30 minutes or longer, or if visual observation was not continued diligently during the pause, pre-clearance observation is required, as described above.

The shutdown requirement would be waived for certain genera of small delphinids (*i.e.*, *Delphinus*, *Lagenorhynchus*, *Stenella*, and *Tursiops)* under certain circumstances. If a delphinid(s) from these genera is visually detected approaching the vessel (*i.e.*, to bow ride) or towed survey equipment, shutdown would not be required. If there is uncertainty regarding identification of a marine mammal species (*i.e.*, whether the observed marine mammal(s) belongs to one of the delphinid genera for which shutdown is waived), PSOs would use best professional judgment in making the decision to call for a shutdown.

If a species for which authorization has not been granted, or, a species for which authorization has been granted but the authorized number of takes have been met, approaches or is observed within the area encompassing the Level B harassment isopleth while the sparker is operating (141 m), shutdown would occur.

Seasonal Restrictions

To minimize the potential for impacts to North Atlantic right whales, vessel-based HRG survey activities would be prohibited in the Off Race Point SMA and Cape Cod Bay SMA from January through May and in the Great South Channel SMA from April through July.

Vessel Strike Avoidance

- Vessel strike avoidance measures would include, but would not be limited to, the following: Vessel operators and crews must maintain a vigilant watch for all protected species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any protected species. A visual observer aboard the vessel must monitor a vessel strike avoidance zone around the vessel (distances stated below). Visual observers monitoring the vessel strike avoidance zone may be third-party observers (*i.e.*, PSOs) or crew members, but crew members responsible for these duties must be provided sufficient training to 1) distinguish protected species from other phenomena and 2) broadly to identify a marine mammal as a right whale, other whale (defined in this context as sperm whales or baleen whales other than right whales), or other marine mammal.
- All survey vessels, regardless of size, must observe a 10-knot speed restriction in specific areas designated by NMFS for the protection of North Atlantic right whales from vessel strikes: any Dynamic Management Areas (DMAs) when in effect, and the Off Race Point SMA (in effect from January 1 through May 15), Cape Cod Bay SMA (in effect from March 1 through April 30), Great South Channel SMA (in effect from April 1 through July 31), Block Island Sound SMA (in effect from November 1 through April 30); and New York / New Jersey SMA (in effect from November 1 through April 30). See *www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-ship-strikes-north-atlantic-right-whales* for specific detail regarding these areas.
- Vessel speeds must also be reduced to 10 knots or less when mother/calf pairs, pods, or large assemblages of cetaceans are observed near a vessel.

- All vessels must maintain a minimum separation distance of 500 m from right whales. If a whale is observed but cannot be confirmed as a species other than a right whale, the vessel operator must assume that it is a right whale and take appropriate action.
- All vessels must maintain a minimum separation distance of 100 m from sperm whales and all other baleen whales.
- All vessels must, to the maximum extent practicable, attempt to maintain a minimum separation distance of 50 m from all other protected species, with an understanding that at times this may not be possible (*e.g.*, for animals that approach the vessel).
- When protected species are sighted while a vessel is underway, the vessel must take action as necessary to avoid violating the relevant separation distance (*e.g.*, attempt to remain parallel to the animal's course, avoid excessive speed or abrupt changes in direction until the animal has left the area). If protected species are sighted within the relevant separation distance, the vessel must reduce speed and shift the engine to neutral, not engaging the engines until animals are clear of the area. This does not apply to any vessel towing gear or any vessel that is navigationally constrained.

These requirements do not apply in any case where compliance would create an imminent and serious threat to a person or vessel or to the extent that a vessel is restricted in its ability to maneuver and, because of the restriction, cannot comply.

Seasonal Operating Requirements

As described above, the proposed survey area partially overlaps with a portion of five North Atlantic right whale SMAs: Off Race Point SMA (in effect from January 1 through May 15); Cape Cod Bay SMA (in effect from March 1 through April 30); Great South Channel SMA (in effect from April 1 through July 31); Block Island Sound SMA (in effect from November 1 through April 30); and New York / New Jersey SMA (in effect from November 1 through April 30). All Equinor survey vessels, regardless of length, would be required to adhere to vessel speed restrictions (<10 knots) when operating within the SMAs during times when the SMAs are in effect. In addition, between watch shifts, members of the monitoring team would consult NMFS's North Atlantic right whale reporting systems for the presence of North Atlantic right whales throughout survey operations. Members of the monitoring team would also monitor the NMFS North Atlantic right whale reporting systems for the establishment of DMA. If NMFS should establish a DMA in the survey area while surveys are underway, Equinor would be required to contact NMFS within 24 hours of the establishment of the DMA to determine whether alteration or restriction of survey activities was warranted within the DMA to minimize impacts to right whales.

Also as described above, portions of the proposed survey areas overlap spatially with designated critical habitat for North Atlantic right whales, which was established due to the area's significance for right whale foraging (81 FR 4837, January 27, 2016). To minimize potential impacts to right whales during the seasons when they occur in high numbers in the Gulf of Maine/Georges Bank critical habitat, vessel-based HRG survey activities would be prohibited in the Off Race Point SMA and Cape Cod Bay SMA from January through May and in the Great South Channel SMA from April through July.

The proposed mitigation measures are designed to avoid the already low potential for injury in addition to some instances of Level B harassment, and to minimize the potential for vessel strikes. Further, we believe the proposed mitigation measures are practicable for the applicant to implement.

There are no known marine mammal rookeries or mating or calving grounds in the survey area that would otherwise potentially warrant increased mitigation measures for marine mammals or their habitat (or both). The proposed survey areas would overlap spatially with an area that has been identified as a biologically important area for migration for North Atlantic right whales. However, while the potential survey areas across the ECRAs are relatively large, the actual areas that will ultimately be surveyed are relatively small compared to the substantially larger spatial extent of the right whale migratory area. We have proposed mitigation measures, including seasonal restrictions and vessel speed restrictions as described above, to minimize potential impacts to right whale migration. Thus, the survey is not expected to appreciably reduce migratory habitat nor to negatively impact the migration of North Atlantic right whales. As described above, some portions of the proposed survey areas would overlap spatially with areas that are recognized as important for North Atlantic right whale foraging, including portions of areas that have been designated as critical habitat due to the significance of the area for right whale foraging. We have proposed mitigation measures, including seasonal restrictions and vessel speed restrictions as described above, to minimize potential impacts to right whale foraging. Thus, the survey is not expected to appreciably reduce foraging habitat nor to negatively impact North Atlantic right whales foraging.

Based on our evaluation of the applicant’s proposed measures, as well as other measures considered by NMFS, NMFS has preliminarily determined that the proposed mitigation measures provide the means effecting the least practicable impact on the affected species or stocks and their habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance.

Proposed Monitoring and Reporting

In order to issue an IHA for an activity, Section 101(a)(5)(D) of the MMPA states that NMFS must set forth requirements pertaining to the monitoring and reporting of such taking. The MMPA implementing regulations at 50 CFR 216.104 (a)(13) indicate that requests for authorizations must include the suggested means of accomplishing the necessary monitoring and reporting that will result in increased knowledge of the species and of the level of taking or impacts on populations of marine mammals that are expected to be present in the proposed action area. Effective reporting is critical both to compliance as well as ensuring that the most value is obtained from the required monitoring.

Monitoring and reporting requirements prescribed by NMFS should contribute to improved understanding of one or more of the following:

- Occurrence of marine mammal species or stocks in the area in which take is anticipated (*e.g.*, presence, abundance, distribution, density).

- Nature, scope, or context of likely marine mammal exposure to potential stressors/impacts (individual or cumulative, acute or chronic), through better understanding of: (1) action or environment (*e.g.*, source characterization, propagation, ambient noise); (2) affected species (*e.g.*, life history, dive patterns); (3) co-occurrence of marine mammal species with the action; or (4) biological or behavioral context of exposure (*e.g.*, age, calving or feeding areas).

- Individual marine mammal responses (behavioral or physiological) to acoustic stressors (acute, chronic, or cumulative), other stressors, or cumulative impacts from multiple stressors.

- How anticipated responses to stressors impact either: (1) long-term fitness and survival of individual marine mammals; or (2) populations, species, or stocks.

- Effects on marine mammal habitat (*e.g.*, marine mammal prey species, acoustic habitat, or other important physical components of marine mammal habitat).
- Mitigation and monitoring effectiveness.

Proposed Monitoring Measures

As described above, visual monitoring would be performed by qualified and NMFS-approved PSOs. Equinor would use independent, dedicated, trained PSOs, meaning that the PSOs must be employed by a third-party observer provider (with limited exceptions made only for inshore vessels), must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant vessel crew with regard to the presence of marine mammals and mitigation requirements (including brief alerts regarding maritime hazards), and must have successfully completed an approved PSO training course appropriate for their designated task. Equinor would provide resumes of all proposed PSOs (including alternates) to NMFS for review and approval prior to the start of survey operations.

During survey operations (*e.g.*, any day on which use of an HRG source is planned to occur), a minimum of one PSO must be on duty and conducting visual observations at all times on all active survey vessels during daylight hours (*i.e.*, from 30 minutes prior to sunrise through 30 minutes following sunset). Visual monitoring would begin no less than 30 minutes prior to initiation of HRG survey equipment and would continue until one hour after use of the acoustic source ceases or until 30 minutes past sunset. PSOs would coordinate to ensure 360 degree visual coverage around the vessel from the most appropriate observation posts, and would conduct visual observations using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner. PSOs may be on watch for a maximum of four consecutive hours followed by a break of at least two hours between watches and may conduct a maximum of 12 hours of observation per 24-hour period. In cases where multiple vessels are surveying concurrently, any observations of marine mammals would be communicated to PSOs on all survey vessels.

PSOs would be equipped with binoculars and have the ability to estimate distances to observed marine mammals. Reticulated binoculars will be available to PSOs for use as appropriate based on conditions and visibility to support the monitoring of marine mammals. Position data would be recorded using hand-held or vessel GPS units for each sighting. Observations would take place from the highest available vantage point on the survey vessel. General 360-degree scanning would occur during the monitoring periods, and target scanning by the PSO would occur when alerted of a marine mammal presence.

During good conditions (*e.g.*, daylight hours; Beaufort sea state (BSS) 3 or less), to the maximum extent practicable, PSOs would conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the acoustic source and between acquisition periods. Any observations of marine mammals by crew members aboard any vessel associated with the survey would be relayed to the PSO team.

Data on all PSO observations would be recorded based on standard PSO collection requirements. This would include dates, times, and locations of survey operations; dates and times of observations, location and weather; details of marine mammal sightings (*e.g.*, species, numbers, behavior); and details of any observed marine mammal take that occurs (*e.g.*, noted behavioral disturbances).

Proposed Reporting Measures

Within 90 days after completion of survey activities, a final technical report will be provided to NMFS that fully documents the methods and monitoring protocols, summarizes the data recorded during monitoring, summarizes the number of marine mammals estimated to have been taken during survey activities (by species, when known), (*i.e.*, observations of marine mammals within the Level B harassment zone must be reported as potential takes by Level B harassment) summarizes the mitigation actions taken during surveys (including what type of mitigation and the species and number of animals that prompted the mitigation action, when known), and provides an interpretation of the results and effectiveness of all mitigation and monitoring. Any recommendations made by NMFS must be addressed in the final report prior to acceptance by NMFS.

In addition to the final technical report, Equinor will provide the reports described below as necessary during survey activities. In the event that personnel involved in the survey activities covered by the authorization discover an injured or dead marine mammal, Equinor must report the incident to the NOAA Fisheries Office of Protected Resources (OPR) (301-427-8401), and to the NOAA Fisheries New England/Mid-Atlantic Regional Stranding Coordinator (978-282-8478) as soon as feasible. The report must include the following information:

- Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
- Species identification (if known) or description of the animal(s) involved;
- Condition of the animal(s) (including carcass condition if the animal is dead);
- Observed behaviors of the animal(s), if alive;
- If available, photographs or video footage of the animal(s); and
- General circumstances under which the animal was discovered.

In the event of a vessel strike of a marine mammal by any vessel involved in the activities covered by the authorization, the Equinor must report the incident to NOAA Fisheries OPR

(301-427-8401) and to the NOAA Fisheries New England/Mid-Atlantic Regional Stranding Coordinator (978-282-8478) as soon as feasible. The report must include the following information:

- Time, date, and location (latitude/longitude) of the incident;
- Species identification (if known) or description of the animal(s) involved;
- Vessel's speed during and leading up to the incident;
- Vessel's course/heading and what operations were being conducted (if applicable);
- Status of all sound sources in use;
- Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
- Environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike;
- Estimated size and length of animal that was struck;
- Description of the behavior of the marine mammal immediately preceding and following the strike;
- If available, description of the presence and behavior of any other marine mammals immediately preceding the strike;
- Estimated fate of the animal (*e.g.*, dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and
- To the extent practicable, photographs or video footage of the animal(s).

Negligible Impact Analysis and Determination

NMFS has defined negligible impact as an impact resulting from the specified activity that cannot be reasonably expected to, and is not reasonably likely to, adversely affect the species or stock through effects on annual rates of recruitment or survival (50 CFR 216.103). A negligible impact finding is based on the lack of likely adverse effects on annual rates of recruitment or survival (*i.e.*, population-level effects). An estimate of the number of takes alone is not enough information on which to base an impact determination. In addition to considering estimates of the number of marine mammals that might be "taken" through harassment, NMFS considers other factors, such as the likely nature of any responses (*e.g.*, intensity, duration), the context of any responses (*e.g.*, critical reproductive time or location, migration), as well as effects on habitat, and the likely effectiveness of the mitigation. We also assess the number, intensity, and context of estimated takes by evaluating this information relative to population status. Consistent with the 1989 preamble for NMFS's implementing regulations (54 FR 40338; September 29, 1989), the impacts from other past and ongoing anthropogenic activities are incorporated into this analysis via their impacts on the environmental baseline (*e.g.*, as reflected in the regulatory status of the species, population size and growth rate where known, ongoing sources of human-caused mortality, or ambient noise levels).

To avoid repetition, our analysis applies to all the species listed in Table 7, given that NMFS expects the anticipated effects of the proposed survey to be similar in nature. To be conservative, our analyses assume that a total of 808 exposures above the Level B harassment threshold could accrue to all of the potentially impacted seal species (*i.e.*, harbor, gray and harp seals), and that a total of 522 exposures above the Level B harassment threshold could accrue to both bottlenose dolphin stocks that may be present (*i.e.*, the Western North Atlantic offshore stock and the Western North Atlantic northern coastal migratory stock).

NMFS does not anticipate that serious injury or mortality would occur as a result of Equinor's proposed survey, even in the absence of proposed mitigation, thus the proposed authorization does not authorize any serious injury or mortality. As discussed in the **Potential Effects of Specified Activities on Marine Mammals and their Habitat** section, non-auditory physical effects and vessel strike are not expected to occur. Additionally and as discussed previously, given the nature of activity and sounds sources used and especially in consideration of the required mitigation, Level A harassment is neither anticipated nor authorized. We expect that all potential takes would be in the form of short-term Level B behavioral harassment in the form of temporary avoidance of the area, reactions that are considered to be of low severity and with no lasting biological consequences (*e.g.*, Southall *et al*., 2007).

Effects on individuals that are taken by Level B harassment, on the basis of reports in the literature as well as monitoring from other similar activities, will likely be limited to reactions such as increased swimming speeds, increased surfacing time, or decreased foraging (if such activity were occurring). Most likely, individuals will simply move away from the sound source and temporarily avoid the area where the survey is occurring. We expect that any avoidance of the survey area by marine mammals would be temporary in nature and that any marine mammals that avoid the survey area during the survey activities would not be permanently displaced. Even repeated Level B harassment of some small subset of an overall stock is unlikely to result in any significant realized decrease in viability for the affected individuals, and thus would not result in any adverse impact to the stock as a whole. Instances of more severe behavioral harassment are expected to be minimized by proposed mitigation and monitoring measures.

In addition to being temporary and short in overall duration, the acoustic footprint of the proposed survey is small relative to the overall distribution of the animals in the area and their use of the area. Feeding behavior is not likely to be significantly impacted. Prey species are mobile and are broadly distributed throughout the project area; therefore, marine mammals that may be temporarily displaced during survey activities are expected to be able to resume foraging once they have moved away from areas with disturbing levels of underwater noise. Because of the temporary nature of the disturbance and the availability of similar habitat and resources in the surrounding area, the impacts to marine mammals and the food sources that they utilize are not expected to cause significant or long-term consequences for individual marine mammals or their populations.

There are no rookeries, mating or calving grounds known to be biologically important to marine mammals within the proposed survey area. As described above, the proposed survey areas overlap spatially with a biologically important migratory area for North Atlantic right whales (effective March-April and November-December) that extends from Massachusetts to Florida (LaBrecque, *et al*., 2015). Off the coasts of Massachusetts, Rhode Island, Connecticut, New York and New Jersey, this biologically important migratory area extends from the coast to beyond the shelf break. Due to the fact that that the proposed survey is temporary and the spatial extent of sound produced by the survey would be very small relative to the spatial extent of the available migratory habitat in the area, and due to proposed mitigation measures including seasonal restrictions, right whale migration is not expected to be impacted by the proposed survey. As described above, some portions of the proposed survey areas overlap spatially with areas that are recognized as important for North Atlantic right whale foraging, including portions of areas that have been designated as ESA critical habitat due to the significance of the area for right whale feeding. Due to the fact that that the proposed survey is temporary and the spatial extent of sound produced by the survey would very small relative to the spatial extent of the available foraging habitat in the area, as well as proposed mitigation measures including seasonal restrictions in areas and seasons when right whale foraging is predicted to occur, North Atlantic right whale foraging is not expected to be impacted by the proposed surveys.

As described above, North Atlantic right, humpback, and minke whales, and gray, harbor and harp seals are experiencing ongoing UMEs. For North Atlantic right whales, as described above, no injury as a result of the proposed project is expected or proposed for authorization, and Level B harassment takes of right whales are expected to be in the form of avoidance of the immediate area of the proposed survey. In addition, the number of takes proposed for authorization above the Level B harassment threshold are relatively low (*i.e.*, 8), and the take numbers proposed for authorization do not account for the proposed mitigation measures, which would require shutdown of all survey equipment upon observation of a right whale prior to their entering the zone that would be ensonified above the Level B harassment threshold. As no injury or mortality is expected or proposed for authorization, and Level B harassment of North Atlantic right whales will be reduced to the level of least practicable adverse impact through use of proposed mitigation measures, the proposed authorized takes of right whales would not exacerbate or compound the ongoing UME in any way.

Similarly, no injury or mortality is expected or proposed for authorization for any of the other species with UMEs, Level B harassment will be reduced to the level of least practicable adverse impact through use of proposed mitigation measures, and the proposed authorized takes would not exacerbate or compound the ongoing UMEs. For minke whales, although the ongoing UME is under investigation (as occurs for all UMEs), this event does not provide cause for concern regarding population level impacts, as the likely population abundance is greater than 20,000 whales and annual M/SI does not exceed the calculated PBR value for minke whales. With regard to humpback whales, the UME does not yet provide cause for concern regarding population-level impacts. Despite the UME, the relevant population of humpback whales (the West Indies breeding population, or DPS) remains healthy. The West Indies DPS, which consists of the whales whose breeding range includes the Atlantic margin of the Antilles from Cuba to northern Venezuela, and whose feeding range primarily includes the Gulf of Maine, eastern Canada, and western Greenland is not listed under the ESA. The status review identified harmful algal blooms, vessel collisions, and fishing gear entanglements as relevant threats for this DPS, but noted that all other threats are considered likely to have no or minor impact on population size or the growth rate of this DPS (Bettridge *et al*., 2015). As described in Bettridge *et al*. (2015), the West Indies DPS has a substantial population size (*i.e.*, approximately 10,000; Stevick *et al*., 2003; Smith *et al*., 1999; Bettridge *et al*., 2015), and appears to be experiencing consistent growth. With regard to gray, harbor and harp seals, although the ongoing UME is under investigation, the UME does not yet provide cause for concern regarding population-level impacts to any of these stocks. For harbor seals, the population abundance is over 75,000 and annual M/SI (345) is well below PBR (2,006) (Hayes *et al*., 2019). For gray seals, the population abundance in the United States is over 27,000, with an estimated abundance including seals in Canada of approximately 505,000, and abundance is likely increasing in the U.S. Atlantic EEZ as well as in Canada (Hayes *et al*., 2019). For harp seals, while PBR is unknown, the minimum population estimate is 6.9 million and the population appears to be stable (Hayes *et al*., 2019).

The proposed mitigation measures are expected to reduce the number and/or severity of takes by (1) giving animals the opportunity to move away from the sound source before HRG survey equipment reaches full energy; (2) preventing animals from being exposed to sound levels that may otherwise result in injury or more severe behavioral responses. Additional vessel strike avoidance requirements will further mitigate potential impacts to marine mammals during vessel transit to and within the survey area.

NMFS concludes that exposures to marine mammal species and stocks due to Equinor's proposed survey would result in only short-term (temporary and short in duration) effects to individuals exposed. Marine mammals may temporarily avoid the immediate area, but are not expected to permanently abandon the area. Major shifts in habitat use, distribution, or foraging success are not expected. NMFS does not anticipate the proposed take estimates to impact annual rates of recruitment or survival.

In summary and as described above, the following factors primarily support our preliminary determination that the impacts resulting from this activity are not expected to adversely affect the species or stock through effects on annual rates of recruitment or survival:

- No mortality, serious injury, or Level A harassment is anticipated or authorized;
- The anticipated impacts of the proposed activity on marine mammals would primarily be in the form of temporary behavioral changes due to avoidance of the area around the survey vessel;
- The availability of alternate areas of similar habitat value (for foraging and migration) for marine mammals that may temporarily vacate the survey areas during the proposed surveys to avoid exposure to sounds from the activity;
- The proposed project area does not contain known areas of significance for mating or calving;
- Effects on species that serve as prey species for marine mammals from the proposed survey would be minor and temporary and would not be expected to reduce the availability of prey or to affect marine mammal feeding;

- The proposed mitigation measures, including visual monitoring, exclusion zones, and shutdown measures, are expected to minimize potential impacts to marine mammals.

Based on the analysis contained herein of the likely effects of the specified activity on marine mammals and their habitat, and taking into consideration the implementation of the proposed monitoring and mitigation measures, NMFS preliminarily finds that the total marine mammal take from the proposed activity will have a negligible impact on all affected marine mammal species or stocks.

Small Numbers

As noted above, only small numbers of incidental take may be authorized under Sections 101(a)(5)(A) and (D) of the MMPA for specified activities other than military readiness activities. The MMPA does not define small numbers and so, in practice, where estimated numbers are available, NMFS compares the number of individuals taken to the most appropriate estimation of abundance of the relevant species or stock in our determination of whether an authorization is limited to small numbers of marine mammals. When the predicted number of individuals to be taken is less than one third of the species or stock abundance, the take is considered to be of small numbers. Additionally, other qualitative factors may be considered in the analysis, such as the temporal or spatial scale of the activities.

We propose to authorize incidental take of 17 marine mammal stocks. The total amount of taking proposed for authorization is less than one third for all stocks (Table 7), which we preliminarily find are small numbers of marine mammals relative to the estimated overall population abundances for those stocks. To be conservative, our small numbers analysis assumes a total of 808 exposures above the Level B harassment threshold could accrue to any of the potentially impacted seal species (*i.e.*, harbor, gray or harp seals) and a total of 522 exposures above the Level B harassment threshold could accrue to both bottlenose dolphin stocks that may be present (*i.e.*, the Western North Atlantic offshore stock and the Western North Atlantic northern coastal migratory stock). Based on the analysis contained herein of the proposed activity (including the proposed mitigation and monitoring measures) and the anticipated take of marine mammals, NMFS preliminarily finds that small numbers of marine mammals will be taken relative to the population size of all affected species or stocks.

Unmitigable Adverse Impact Analysis and Determination

There are no relevant subsistence uses of the affected marine mammal stocks or species implicated by this action. Therefore, NMFS has determined that the total taking of affected species or stocks would not have an unmitigable adverse impact on the availability of such species or stocks for taking for subsistence purposes.

Endangered Species Act

Section 7(a)(2) of the Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq.*) requires that each Federal agency insure that any action it authorizes, funds, or carries out is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of designated critical habitat. To ensure ESA compliance for the issuance of IHAs, NMFS consults internally, in this case with the NMFS Greater Atlantic Regional Fisheries Office (GARFO), whenever we propose to authorize take for endangered or threatened species.

The NMFS OPR is proposing to authorize the incidental take of four species of marine mammals which are listed under the ESA: the North Atlantic right, fin, sei, and sperm whale. The NMFS OPR has requested initiation of Section 7 consultation with NMFS GARFO for the issuance of this IHA. NMFS will conclude the ESA section 7 consultation prior to reaching a determination regarding the issuance of the authorization.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to Equinor for conducting marine site characterization activities offshore of Massachusetts, Rhode Island, Connecticut, New York and New Jersey for a period of one year, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. A draft of the proposed IHA can be found at: *www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act*.

Request for Public Comments

We request comment on our analyses, the proposed authorization, and any other aspect of this Notice of Proposed IHA for Equinor's proposed activity. We also request at this time comment on the potential Renewal of this proposed IHA as described in the paragraph below. Please include with your comments any supporting data or literature citations to help inform decisions on the request for this IHA or a subsequent Renewal IHA.

On a case-by-case basis, NMFS may issue a one time, one-year Renewal IHA following notice to the public providing an additional 15 days for public comments when (1) up to another year of identical or nearly identical, or nearly identical, activities as described in the Specified Activities section of this notice is planned or (2) the activities as described in the Specified Activities section of this notice would not be completed by the time the IHA expires and a Renewal would allow for completion of the activities beyond that described in the *Dates and Duration* section of this notice, provided all of the following conditions are met:

- A request for renewal is received no later than 60 days prior to the needed Renewal IHA effective date (recognizing that the Renewal IHA expiration date cannot extend beyond one year from expiration of the initial IHA).

- The request for renewal must include the following:

(1) An explanation that the activities to be conducted under the requested Renewal IHA are identical to the activities analyzed under the initial IHA, are a subset of the activities, or include changes so minor (*e.g.*, reduction in pile size) that the changes do not affect the previous analyses, mitigation and monitoring requirements, or take estimates (with the exception of reducing the type or amount of take).

(2) A preliminary monitoring report showing the results of the required monitoring to date and an explanation showing that the monitoring results do not indicate impacts of a scale or nature not previously analyzed or authorized.

- Upon review of the request for Renewal, the status of the affected species or stocks, and any other pertinent information, NMFS determines that there are no more than minor changes in the activities, the mitigation and monitoring measures will remain the same and appropriate, and the findings in the initial IHA remain valid.

Dated: June 16, 2020.

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Donna Wieting,

Director, Office of Protected Resources,

National Marine Fisheries Service.

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