E 3510-22-P

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

[RTID 0648-XA852]

Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Marine Site Characterization Surveys off of Delaware

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 Skipjack Offshore Energy, LLC (Skipjack) for authorization to take marine mammals incidental to marine site characterization surveys offshore of Delaware in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0519) and along potential submarine cable routes to a landfall location in Delaware. 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. Written comments should be submitted via email 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. Comments, including all attachments, must not exceed a 25-megabyte file size. All comments received are a part of the public record and will generally be posted online at *www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act* 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: Robert Pauline, Office of Protected Resources, NMFS, (301) 427-8401. Electronic copies of the application and supporting documents, as well as a list of the references cited in this document, may be obtained online at: *https://www.fisheries.noaa.gov/permit/incidental-take-authorizations-under-marine-mammal-protection-act*. 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 the 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 the 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 review our proposed action (*i.e.*, the issuance of an IHA) with respect to potential impacts on the human environment.

This action is consistent with categories of activities identified in Categorical Exclusion B4 (IHAs with no anticipated serious injury or mortality) of the Companion Manual for NOAA Administrative Order 216-6A, which do not individually or cumulatively have the potential for significant impacts on the quality of the human environment and for which NMFS have not identified any extraordinary circumstances that would preclude this categorical exclusion. Accordingly, NMFS has preliminarily determined that the issuance of the proposed IHA qualifies to be categorically excluded from further NEPA review.

NMFS will review all comments submitted in response to this notice prior to concluding our NEPA process or making a final decision on the IHA request.

Summary of Request

On August 12, 2020, NMFS received a request from Skipjack for an IHA to take marine mammals incidental to marine site characterization surveys offshore of Delaware in the area of the Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf (OCS-A 0519) and along potential submarine cable routes to a landfall location in Delaware. Revised versions of the application were received on September 21, 2020 and November 5, 2020. The application was deemed adequate and complete on December 12, 2020. Skipjack's request is for take of a small number of 16 species of marine mammals by Level B harassment only. Neither Skipjack nor NMFS expects serious injury or mortality to result from this activity and, therefore, an IHA is appropriate.

NMFS previously issued an IHA to Skipjack for similar work in the same geographic area on December 3, 2019 (84 FR 66156) with effectives dates from November 26, 2019 through November 25, 2020. Skipjack complied with all the requirements (*e.g.*, mitigation, monitoring, and reporting) of the previous IHA and given the similarity in activities and location, relevant information regarding their previous marine mammal monitoring results may be found in the **Estimated Take** section.

Description of Proposed Activity

Overview

As part of its overall marine site characterization survey operations, Skipjack proposes to conduct high-resolution geophysical (HRG) surveys, in the area of Commercial Lease of Submerged Lands for Renewable Energy Development on the

Outer Continental Shelf #OCS-A 0519 (Lease Area) and along potential submarine cable routes to landfall locations in Delaware.

The purpose of the marine site characterization surveys are to obtain a baseline assessment of seabed (geophysical, geotechnical, and geohazard), ecological, and archeological conditions within the footprint of offshore wind facility development. Surveys are also conducted to support engineering design and to map Unexploded Ordinances (UXO survey). Underwater sound resulting from Skipjack's proposed site characterization survey activities, specifically HRG surveys have the potential to result in incidental take of marine mammals in the form of behavioral harassment.

Dates and Duration

The estimated duration of HRG survey activity is expected to be up to 200 survey days over the course of a single year. Skipjack proposes to start survey activity in April 2021. The IHA would be effective for one year from the date of issuance. This schedule is based on 24-hour operations and includes potential down time due to inclement weather.

Specific Geographic Region

The proposed survey activities will occur within the Project Area which includes the Lease Area and along potential submarine cable routes to landfall locations in the state of Delaware, as shown in **Figure 1**. The Lease Area is approximately 284 square kilometers (km^2) and is within the Delaware Wind Energy Area (WEA) of the Bureau of Ocean Energy Management (BOEM) Mid-Atlantic planning area. Water depths in the Lease Area range from 15 meters (m) to 40 m. Water depths in the submarine cable area extend from the shoreline to approximately 40 m.

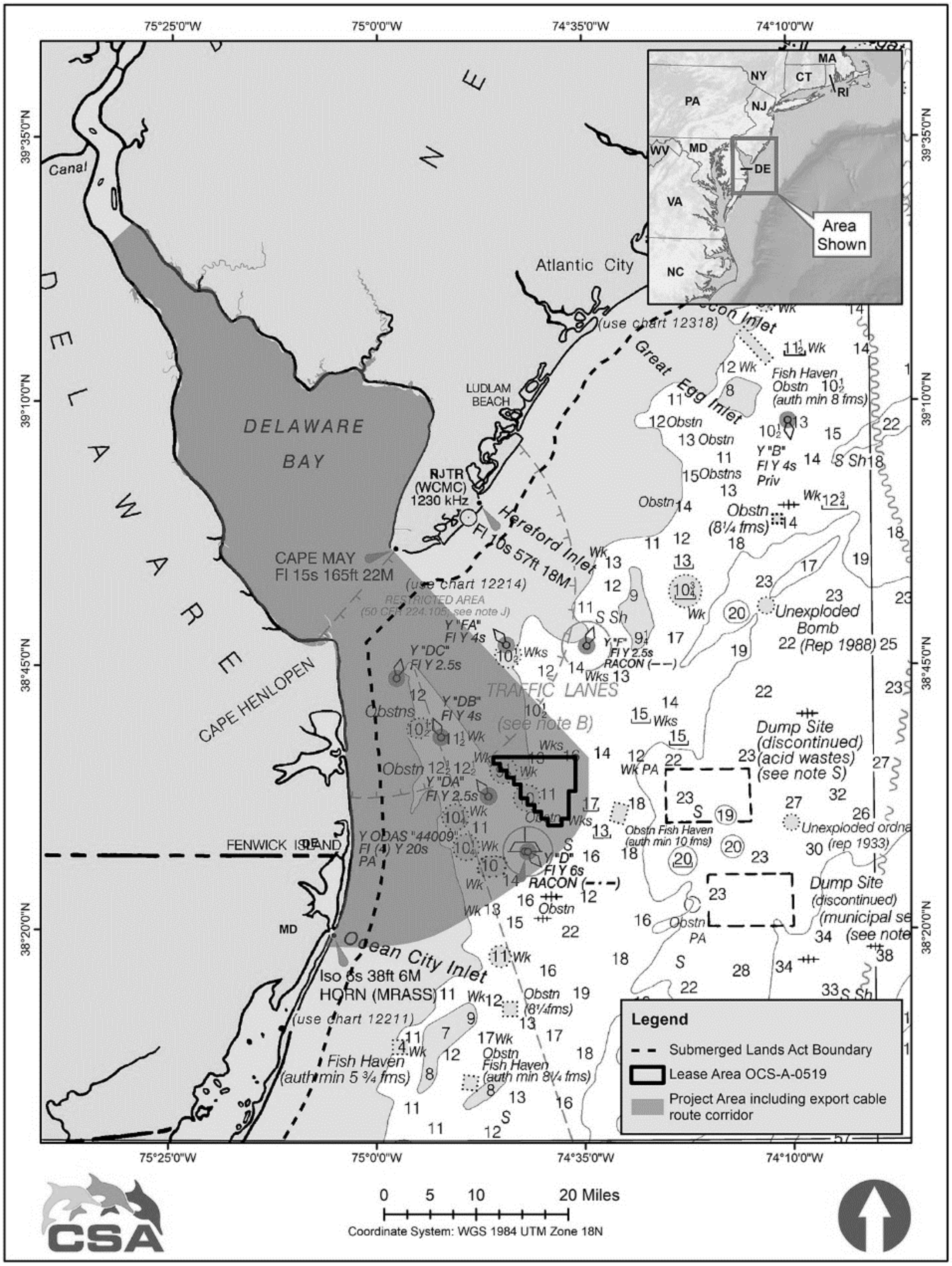

Figure 1—Project Area for the site characterization surveys which include the Lease Area and the potential submarine cable route area.

Detailed Description of Specific Activity

Skipjack has proposed that survey operations, including HRG survey activities operations would be conducted continuously 24 hours per day. Based on 24-hour operations, the estimated duration of the HRG survey activities would be approximately

200 days (including estimated weather down time). As many as four vessels may be engaged in HRG surveying activities during Skipjack's overall site characterization efforts with up to two working concurrently in the Lease Area or along the submarine cable route (*e.g.,* two vessels in the Lease Area; one vessel in the general area and one vessel on the portion of the submarine cable route within the area; two vessels on the submarine cable route outside of the area). Vessels working in shallow or very shallow waters would only operate during daylight hours. Vessels would be at least one kilometer (km) apart at all times. Vessels would maintain a speed of approximately 4 knots (kn) while transiting survey lines and cover approximately 70 km per day. The daily distance surveyed could be more or less than this based on weather and other factors, but an average of 70 km per day is assumed in estimating the total number of survey days and in estimating the daily ensonified area (see Estimated Take). Impulsive sources (e.g., sparker systems) would be utilized for 50 survey days while the non-impulsive sources (e.g., sub-bottom profilers (SBPs)) would be used for the remaining 150 days. See following discussion and Table 1. The survey activities proposed by Skipjack with acoustic source types that could result in take of marine mammals include the following:

- Shallow penetration, non-impulsive, non-parametric sub-bottom profilers (SBPs, also known as CHIRPs) are used to map the near-surface stratigraphy (top 0 to 10 m) of sediment below seabed. A CHIRP system emits signals covering a frequency sweep from approximately 2 to 20 kHz over time. The frequency range can be adjusted to meet project variables.
- Medium penetration, impulsive sources (boomers, sparkers) are used to map deeper subsurface stratigraphy as needed. A boomer is a broad-band sound source operating in the 3.5 Hz to 10 kHz frequency range. Sparkers are used to map deeper subsurface stratigraphy as needed. Sparkers create acoustic pulses from 50 Hz to 4 kHz omni-directionally from the source.

Operation of the following survey equipment types is not reasonably expected to result in take of marine mammals and will not be carried forward in the application analysis beyond the brief summaries provided below.

- Non-impulsive, parametric SBPs are used for providing high data density in sub-bottom profiles that are typically required for cable routes, very shallow water, and archaeological surveys. The narrow beamwidth (1° to 3.5°)significantly reduces the impact range of the source while the high frequencies of the source are rapidly attenuated in sea water. Because of the high frequency of the source and narrow bandwidth, parametric SBPs do not produce Level B harassment isopleths beyond 4 m. No Level B harassment exposures can be reasonably expected from the operation of these sources.
- Acoustic corers, unlike the other mobile geophysical sources, are stationary and made up of three distinct sound sources comprised of a HF parametric sonar (which will not be included in this assessment), a HF CHIRP sonar, and a LF CHIRP sonar with each source having its own transducer. The corer is seabed-mounted; therefore, propagation for similar towed equipment is unlikely to be fully comparable. The beam width of the parametric sonar is narrow (3.5° to 8°) and the sonar is operated roughly 3.5 m above the seabed with the transducer pointed directly downward. No take is expected to result from use of these highly directional, seabed-mounted sources.
- Ultra-short baseline (USBL) positioning systems are used to provide high accuracy ranges by measuring the time between the acoustic pulses transmitted by the vessel transceiver and a transponder (or beacon) necessary to produce the acoustic profile. USBLs have been shown to produce extremely small acoustic propagation distances in their typical operating configuration. Based on this

information, no Level B harassment exposures can be reasonably expected from the operation of these sources.

- Multibeam echosounders (MBESs) are used to determine water depths and general bottom topography. The proposed MBESs all have operating frequencies >180 kHz, they are outside the general hearing range of marine mammals likely to occur in the Project Area and are not likely to affect these species.
- Side scan sonars (SSS) are used for seabed sediment classification purposes and to identify natural and man-made acoustic targets on the seafloor. The proposed SSSs all have operating frequencies >180 kHz, they are outside the general hearing range of marine mammals likely to occur in the Project Area and are not likely to affect these species.

Table 1 identifies all the representative survey equipment that operate below 180 kHz (i.e., at frequencies that are audible to and therefore may be detected by marine mammals) that may be used in support of planned HRG survey activities, some of which have the expected potential to result in exposure of marine mammals. The make and model of the listed geophysical equipment may vary depending on availability and the final equipment choices will vary depending upon the final survey design, vessel availability, and survey contractor selection.

Table 1—Summary of Representative HRG Equipment

Equipment	Acoustic Source Type	Operating Frequency (kHz)	SL_{rms} (dB re 1 µPa m)	$SL_{0\text{-}pk}$ (dB re 1 µPa m)	Pulse Duration (width) (millisecond)	Repetition Rate (Hz)	Beamwidth (degrees)	**CF**= Crocker and Fratantonio (2016) **MAN** = Manufacturer
Non-impulsive, Non-parametric, Shallow Sub-bottom Profilers (CHIRP Sonars)								
ET 216 (2000DS or 3200 top unit)	Non-impulsive, mobile, intermittent	2–16 2–8	195	-	20	6	24	MAN
ET 424	Non-impulsive, mobile, intermittent	4–24	176	-	3.4	2	71	CF
ET 512	Non-impulsive, mobile, intermittent	0.7–12	179	-	9	8	80	CF
GeoPulse 5430A	Non-impulsive, mobile, intermittent	2–17	196	-	50	10	55	MAN
Teledyne Benthos Chirp III - TTV 170	Non-impulsive, mobile, intermittent	2–7	197	-	60	15	100	MAN
Impulsive, Medium Sub-bottom Profilers (Sparkers & Boomers)								
AA, Dura-spark UHD (400 tips, 500 J)[2]	Impulsive, mobile	0.3–1.2	203	211	1.1	4	Omni	CF
AA, Dura-spark UHD (400+400)[2]	Impulsive, mobile	0.3–1.2	203	211	1.1	4	Omni	CF (AA Dura-spark UHD Proxy)
GeoMarine, Geo-Source dual 400 tip sparker (800 J)[2]	Impulsive, mobile	0.4–5	203	211	1.1	2	Omni	CF (AA Dura-spark UHD Proxy)
GeoMarine Geo-Source 200 tip sparker (400 J)[2]	Impulsive, mobile	0.3–1.2	203	211	1.1	4	Omni	CF (AA Dura-spark UHD Proxy)
GeoMarine Geo-Source 200-400 tip sparker (400 J)[2]	Impulsive, mobile	0.3–1.2	203	211	1.1	4	Omni	CF (AA Dura-spark UHD Proxy)
AA, triple plate S-Boom (700–1,000 J)[3]	Impulsive, mobile	0.1–5	205	211	0.6	4	80	CF

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 Activities

Sections 3 and 4 of the 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's Stock Assessment Reports (SARs; *https://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's website (*https://www.fisheries.noaa.gov/find-species)*.

Table 2 lists all species or stocks for which take is expected and proposed to be authorized for this action, and 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, NMFS follows the Committee on Taxonomy (2020). 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's SARs). While no mortality is anticipated or authorized here, PBR and annual serious injury and mortality from anthropogenic sources are included here as gross indicators 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's 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's U.S. Atlantic and Gulf of Mexico SARs. All values presented in Table 2 are the most recent available at the time of publication and are available in the 2020 SARs (Hayes *et al.,* 2020) and draft 2021 SARS available at: *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports.*

Table 2—Marine Mammal Species Likely To Occur Near the Project Area That May be Affected by Skipjack's Activity

Common name	Scientific name	Stock	ESA/MMPA status; Strategic (Y/N)[1]	Stock abundance (CV, N_{min}, most recent abundance survey)[2]	PBR	Annual M/SI[3]
Order Cetartiodactyla – Cetacea – Superfamily Mysticeti (baleen whales)						
Family Balaenidae						
North Atlantic right whale	*Eubalaena glacialis*	Western North Atlantic	E/D; Y	412 (0; 408; 2018)	0.8	18.6
Family Balaenopteridae (rorquals)						
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	-/ -; Y	1,393 (0; 1,375; 2016)	22	58
Fin whale	*Balaenoptera physalus*	Western North Atlantic	E/D; Y	6,802 (0.24; 5,573; 2016)	11	2.35
Sei whale	*Balaenoptera borealis*	Nova Scotia	E/D; Y	6,292 (1.015; 3,098; see SAR)	6.2	1.2
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	-/-; N	21,968 (0.31; 17,002; 2016)	170	10.6
Superfamily Odontoceti (toothed whales, dolphins, and porpoises)						
Family Physeteridae						
Sperm whale	*Physeter macrocephalus*	NA	E; Y	4,349 (0.28;3,451; See SAR)	3.9	0

Family Delphinidae						
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	-/-; N	39,215 (0.30; 30,627; See SAR)	306	21
Short finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	-/-;Y	28,924 (0.24; 23,637; See SAR)	236	160
Bottlenose dolphin	*Tursiops truncatus*	Western North Atlantic Offshore	-/-; N	62,851 (0.23; 51,914; See SAR)	519	28
		W.N.A. Northern Migratory Coastal	-/-;Y	6,639 (0.41,4 ,759, 2016)	48	12.2-21.5
Common dolphin	*Delphinus delphis*	Western North Atlantic	-/-; N	172,897 (0.21; 145,216; 2016)	1,452	399
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	-/-; N	93,233 (0.71; 54,443; See SAR)	544	26
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	-/-; N	39,921 (0.27; 32,032; 2012)	320	0
Risso's dolphin	*Grampus griseus*	Western North Atlantic	-/-; N	35,493 (0.19; 30,289; See SAR)	303	54.3
Family Phocoenidae (porpoises)						
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	-/-; N	95,543 (0.31; 74,034; See SAR)	851	217
Order Carnivora – Superfamily Pinnipedia						
Family Phocidae (earless seals)						
Gray seal[4]	*Halichoerus grypus*	Western North Atlantic	-/-; N	27,131 (0.19; 23,158, 2016)	1,389	5,410
Harbor seal	*Phoca vitulina*	Western North Atlantic	-/-; N	75,834 (0.15; 66,884, 2018)	2,006	350

[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 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] NMFS marine mammal stock assessment reports online at: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-region. CV is coefficient of variation; Nmin is the minimum estimate of stock abundance. In some cases, CV is not applicable.
[3] These values, found in NMFS's SARs, represent annual levels of human-caused mortality plus serious injury from all sources combined (e.g., commercial fisheries, ship strike). Annual M/SI often cannot be determined precisely and is in some cases presented as a minimum value or range. A CV associated with estimated mortality due to commercial fisheries is presented in some cases.
[4] The NMFS stock abundance estimate applies to U.S. population only, however the actual stock abundance is approximately 451,431.

As indicated above, all 16 species (with 17 managed stocks) in Table 2 temporally and spatially co-occur with the activity to the degree that take is reasonably likely to occur, and NMFS has proposed authorizing it.

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.*, 2020). NMFS *et al.* 2020 identified seven areas where Western North Atlantic right whale aggregate seasonally: the coastal waters of the southeastern United States, the Great South Channel, Jordan Basin, Georges Basin along the northeastern edge of Georges Bank, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf (Brown *et al.*, 2001; Cole *et al.*, 2013). Several of these congregation areas correlate with seasonally high copepod concentrations (Pendleton *et al.*, 2009). New England waters are a primary feeding habitat for North Atlantic right whales during late winter through spring, with feeding moving into deeper and more northerly waters during summer and fall. Less is known regarding winter distributions; however, it is understood that calving takes place during this time in coastal waters of the Southeastern United States.

Passive acoustic studies of North Atlantic right whales have demonstrated their year-round presence in the Gulf of Maine (Morano *et al.*, 2012; Bort *et al.*, 2015), New

Jersey (Whitt *et al.*, 2013), and Virginia (Salisbury *et al.*, 2016). Additionally, North Atlantic right whales were acoustically detected off Georgia and North Carolina during 7 of the 11 months monitored (Hodge *et al.*, 2015). All of this work further demonstrates the highly mobile nature of North Atlantic right whales. Movements within and between habitats are extensive and the area off the Mid-Atlantic states is an important migratory corridor. While no critical habitat is listed within the Project Area, 11 North Atlantic right whales were identified in the Mid-Atlantic Baseline Studies (MABS) surveys conducted between 2012 and 2014 with a total of nine sightings occurring in February (n = 5) and March (n = 4) (Williams *et al.*, 2015a, b). Davis *et al.* (2017) recently examined detections from passive acoustic monitoring devices and documented a broad-scale use of much more of the U.S. eastern seaboard than was previously believed, and an apparent shift in habitat use patterns to the south of traditionally identified North Atlantic right whale congregations. Increased use of Cape Cod Bay and decreased use of the Great South Channel were also observed (Davis *et al.*, 2017).

Off the coast of New Jersey, North Atlantic right whales were acoustically detected in all seasons and visually observed in winter, spring, and summer during an environment baseline study (EBS) conducted by the New Jersey Department of Environmental Protection (NJDEP, 2010). The greatest number of acoustic detections occurred during April and May (Whitt *et al.*, 2013). Reports from the RWSAS for the Mid-Atlantic Region (New Jersey through Virginia) show 24 records off the coast of New Jersey since 2015: January (7), March (1), April (4), October (1) and December (11) (NOAA, 2019).

Elevated North Atlantic right whale mortalities have occurred since June 7, 2017 along the U.S. and Canadian coast. As of January 2021, a preliminary cumulative total number of animals in the North Atlantic right whale UME has been updated to 46 individuals to include both the confirmed mortalities (dead stranded or floaters) (n=32) and seriously injured free-swimming whales (n=14) to better reflect the confirmed number of whales likely removed from the population during the UME and more accurately reflect the population impacts. A total of 32 confirmed dead stranded whales (21 in Canada; 11 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/2017-2021-north-atlantic-right-whale-unusual-mortality-event.*

The proposed survey area is part of a migratory corridor Biologically Important Area (BIA) for North Atlantic right whales (effective March-April and November-December) that extends from Massachusetts to Florida (LeBrecque et al., 2015). Off the coast of Delaware, migratory BIA extends from the coast to beyond the shelf break. This important migratory area is approximately 269,488 km^2 in size and is comprised of the waters of the continental shelf offshore the East Coast of the United States and extends from Florida through Massachusetts. For comparative purposes, the size of the Lease Area is 284 km^2. 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. A portion of one SMA, which occurs off the mouth of Delaware Bay, overlaps spatially with a section of the proposed survey area. The SMA which occurs off the mouth of Delaware Bay is active from November 1 through April 30 of each year.

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 humpbacks continued to be listed as endangered. NMFS recently evaluated the status of the species, and 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 62259; 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 whale that is expected to occur in the Project Area.

Humpback whales have a global distribution and follow a migratory pattern of feeding in the high latitudes during summers and spending winters in the lower latitudes for calving and mating. The Gulf of Maine stock follows this pattern with winters spent in the Caribbean and West Indies, although acoustic recordings show a small number of males persisting in Stellwagen Bank throughout the year (Vu *et al.*, 2012). Barco et al. (2002) suggested that the mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks. However, with populations recovering, additional surveys that include photo identification and genetic sampling need to be conducted to determine which stocks are currently using the mid-Atlantic region.

Sightings of humpback whales in the Mid-Atlantic are common (Barco *et al.*, 2002), as are strandings (Wiley *et al.*, 1995). Barco *et al.* (2002) suggested that the Mid-Atlantic region primarily represents a supplemental winter feeding ground used by humpbacks. During the MABS surveys, a total of 13 humpback whales were recorded between 2012 and 2014: eight during the winter, one during the summer, and four during the fall (Williams *et al.*, 2015a, b). There was a total of 17 groups sighted during the NJDEP EBS, nine of which occurred during winter months (Whitt *et al.*, 2015).

Since January 2016, elevated humpback whale mortalities have occurred along the Atlantic coast from Maine to Florida. Partial or full necropsy examinations have been conducted on approximately half of the 145 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 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/2016-2021-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 (Hayes *et al.*, 2020). 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, though densities vary seasonally (Hayes *et al.*, 2020). Fin whales accounted for 46 percent of the large whales sighted during aerial surveys along the continental shelf (CETAP, 1982) between Cape Hatteras and Nova Scotia from 1978 to 1982. Fin whales were also the most frequently sighted large whale species during the New Jersey Department of Environmental Protection (NJDEP) Ecological Baseline Studies (EBS) with 37 groups sighted throughout all seasons (Whitt *et al.*, 2015). The MABS surveys (Williams *et al.*, 2015a, b) reported two fin whales during the winter and two during the spring.

Fin whales are 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 (Hayes *et al.*, 2020).

Sei Whale

The Nova Scotia stock of sei whales can be found in deeper waters of the continental shelf edge waters of the northeastern United States and northeastward to south of Newfoundland. Two subspecies of sei whales are currently recognized (Committee on Taxonomy, 2018) and the Northern sei whale (*B. b. borealis*) is known to occur within the Project Area. Sei whales are most common in deeper waters along the continental shelf edge (Hayes *et al.*, 2020) but will forage occasionally in shallower, inshore waters. 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 (Hayes *et al.*, 2020). Sei whales occur in shallower waters to feed. Sei whales are listed as engendered 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 (Hayes *et al.*, 2020).

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 (45º W) to the Gulf of Mexico (Hayes *et al.*, 2020). This species generally occupies waters less than 100 m deep on the continental shelf. Little is known about minke whales' specific movements through the mid-Atlantic region; however, there appears to be a strong seasonal component to minke whale distribution, with acoustic detections indicating that they migrate south in mid-October to early November, and return from wintering grounds starting in March through early April (Hayes *et al.*, 2020). Northward migration appears to track the warmer waters of the Gulf Stream along the continental shelf, while southward migration is made farther offshore (Risch *et al.*, 2014).

Since January 2017, elevated minke whale mortalities have occurred along the Atlantic coast from Maine through South Carolina, with a total of 103 strandings recorded through January 2021 This event has been declared a UME. Full or partial necropsy examinations were conducted on more than 60 percent of the whales. 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/2017-2021-minke-whale-unusual-mortality-event-along-atlantic-coast*.

Sperm Whale

The distribution of the sperm whale in the U.S. Exclusive Economic Zone (EEZ) occurs on the continental shelf edge, over the continental slope, and into mid-ocean regions (Hayes *et al*. 2020). 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 winter, sperm whales concentrate east and northeast of Cape Hatteras. In spring, distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central Mid-Atlantic Bight and the southern part of Georges Bank. In the fall, sperm whale occurrence on the continental shelf south of New England reaches peak levels, and there remains a continental shelf edge occurrence in the Mid-Atlantic Bight (Hayes *et al.*, 2020).

No sperm whales were recorded during the MABS surveys or the NJDEP EBS. CETAP and NMFS Northeast Fisheries Science Center sightings in shelf edge and off-shelf waters included many social groups with calves/juveniles (CETAP, 1982). Sperm whales were usually seen at the tops of seamounts and rises and did not generally occur over slopes. Sperm whales were recorded at depths varying from 800 to 3,500 m. Although the likelihood of occurrence within the Project Area remains very low, the sperm whale was included as an affected species due to its high seasonal densities east of the Project Area.

Long-finned Pilot Whale

Long-finned pilot whales are found from North Carolina and north to Iceland, Greenland and the Barents Sea (Hayes *et al.*, 2020). 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, pilot whales move onto Georges Bank and into the Gulf of Maine and more northern waters and remain in these areas through late autumn (Hayes *et al.*, 2020). Long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Delaware and the southern flank of Georges Bank. Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, but sightings of long-finned pilot whales south of Cape Hatteras would be considered unusual (Hayes *et al.,* 2020).The main threats to this species include interactions with fisheries and habitat issues including exposure to high levels of polychlorinated biphenyls and chlorinated pesticides, and toxic metals including mercury, lead, cadmium, and selenium (Hayes *et al.*, 2020).

Short-finned Pilot Whale

As described above, long-finned and short-finned pilot whales overlap spatially along the mid-Atlantic shelf break between Delaware and the southern flank of Georges Bank. There is limited information on the distribution of short-finned pilot whales; they prefer warmer or tropical waters and deeper waters offshore, and in the northeast United States, they are often sighted near the Gulf Stream (Hayes *et al.*, 2020). Short-finned pilot whales have occasionally been observed stranded as far north as Massachusetts but north of ~42°N short-finned pilot whale sightings would be considered unusual while south of Cape Hatteras most pilot whales would be expected to be short-finned pilot whales (Hayes *et al.,* 2020). In addition, short-finned pilot whales are documented along the continental shelf and continental slope in the northern Gulf of Mexico (Mullin and Fulling 2003), and they are also known from the wider Caribbean. As with long-finned pilot whales, the main threats to this species include interactions with fisheries and habitat issues including exposure to high levels of polychlorinated biphenyls and chlorinated pesticides, and toxic metals including mercury, lead, cadmium, and selenium (Hayes *et al.*, 2020).

Atlantic White-sided Dolphin

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 (Hayes *et al.*, 2020). 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. The Virginia and North Carolina observations appear to represent the southern extent of the species range. 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 (Hayes *et al.*, 2020). 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 (Hayes *et al.*, 2020). Atlantic spotted dolphins regularly occur in the inshore waters south of Chesapeake Bay, and near the continental shelf edge and continental slope waters north of this region (Payne *et al.*, 1984; Mullin and Fulling, 2003). Atlantic spotted dolphins north of Cape Hatteras also associate with the north wall of the Gulf Stream and warm-core rings (Hayes *et al.*, 2020). Four sightings of Atlantic spotted dolphins were recorded between 2012 and 2014 during the summer MABS surveys (Williams *et al.*, 2015a,b). There are 2 forms of this species, with the larger ecotype inhabiting the continental shelf and is usually found inside or near the 200 m isobaths (Hayes *et al.*, 2020).

Common Dolphin

The common dolphin is found world-wide in temperate to subtropical seas. 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 (Hayes *et al.*, 2020). Common dolphins are distributed in waters off the eastern U.S. coast from Cape Hatteras northeast to Georges Bank (35° to 42° N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to autumn (CETAP, 1982; Hayes *et al.*, 2020; Hamazaki, 2002; Selzer and Payne, 1988).

The Western North Atlantic offshore stock expected to occur in the Project Area. The offshore stock is distributed primarily along the outer continental shelf and slope, from Georges Bank to Cape Hatteras during the spring and summer (CETAP, 1982; Kenney, 1990). Spatial distribution data and genetic studies indicate the coastal morphotype comprises multiple stocks distributed throughout coastal and estuarine waters of the U.S. East Coast. One such stock, the northern migratory coastal stock, ranges from North Carolina to New York and is likely to occur in the Project Area (Hayes *et al.*, 2020). There is likely some interaction between the northern and southern migratory stocks, but the bottlenose dolphins in the Project Area are expected to be from the northern migratory stock (Hayes *et al.*, 2020). All coastal stocks are listed as depleted (Hayes *et al.*, 2020). The best abundance estimates for the northern migratory coastal stock of common bottlenose dolphin is 6,639 individuals (Hayes et al. 2020).

Bottlenose Dolphin

There are two distinct bottlenose dolphin morphotypes in the western North Atlantic: the coastal and offshore forms (Hayes *et al.*, 2020). 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 coastal stock of coastal bottlenose dolphins (Hayes *et al.*, 2020).

North of Cape Hatteras, there is separation of the offshore and coastal morphotypes across bathymetric contours during summer months. Aerial surveys flown from 1979 through 1981 indicated a concentration of common bottlenose dolphins in waters <25 m deep that corresponded with the coastal morphotype, and an area of high abundance along the shelf break that corresponded with the offshore stock (Hayes *et al.*, 2020). Torres *et al.* (2003) found a statistically significant break in the distribution of the morphotypes; almost all dolphins found in waters >34m depth and >34 km from shore were of the offshore morphotype. The coastal stock is best defined by its summer distribution, when it occupies coastal waters from the shoreline to the 20-m isobath between Virginia and New York (Hayes *et al.*, 2020). This stock migrates south during late summer and fall, and during colder months it occupies waters off Virginia and North Carolina (Hayes *et al.*, 2020). Therefore, during the summer, dolphins found inside the 20-m isobath in the Project Area are likely to belong to the coastal stock, while those found in deeper waters or observed during cooler months belong to the offshore stock.

Risso's Dolphin

Risso's dolphins are large dolphins with a characteristic blunt head and light coloration, often with extensive scarring. They are widely distributed in tropical and temperate seas. In the Western North Atlantic they occur from Florida to eastern Newfoundland (Leatherwood *et al.*, 1976; Baird and Stacey, 1991). Off the U.S. Northeast Coast, Risso's dolphins are primarily distributed along the continental shelf, but can also be found swimming in shallower waters to the mid-shelf (Hayes *et al.*, 2020).

Risso's dolphins occur along the continental shelf edge from Cape Hatteras to Georges Bank during spring, summer, and autumn. In winter, they are distributed in the Mid-Atlantic from the continental shelf edge outward (Hayes *et al.*, 2020). The majority of sightings during the 2011 surveys occurred along the continental shelf break with generally lower sighting rates over the continental slope (Palka, 2012). Risso's dolphins can be found in Mid-Atlantic waters year-round and are more likely to be encountered offshore given their preference for deeper waters along the shelf edge. However, previous surveys have commonly observed this species in shallower waters, making it possible this species could be encountered in the Project Area, particularly in summer when they are more abundant in this region (Curtice *et al.*, 2019; Williams *et al.*, 2015a, b; Hayes *et al.*, 2020).

Harbor Porpoise

Harbor porpoises commonly occur throughout Massachusetts Bay from September through April. During the fall and spring, harbor porpoises are widely distributed along the east coast from New Jersey to Maine. During the summer, the porpoises are concentrated in the Northern Gulf of Maine and Southern Bay of Fundy in water depths <150 m. In winter, densities increase in the waters off New Jersey to North Carolina and decrease in the waters from New York to New Brunswick; however, specific migratory timing or routes are not apparent. Although still considered uncommon, harbor porpoises were regularly detected offshore of Maryland during winter and spring surveys (Wingfield *et al.*, 2017). They were the second most frequently sighted cetacean during the NJDEP EBS, with 90 percent of the sightings during the winter, three during the spring, and one during the summer (Whitt *et al.*, 2015). The lack of sightings during the fall was attributed to low visibility conditions during those months, but available data indicate this species is likely present offshore New Jersey during fall and winter (Whitt *et al.*, 2015).

In the Lease Area, 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 (Hayes *et al.*, 2020). 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 (Hayes *et al.*, 2020).

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 (Hayes et al. 2020).

Harbor Seal

The harbor seal is found in all nearshore waters of the North Atlantic and North Pacific Oceans and adjoining seas above about 30º N (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 (Hayes *et al.*, 2020). The harbor seals within the Project Area are part of the single Western North Atlantic stock. Between September and May they undergo seasonal migrations into southern New England and the Mid-Atlantic (Hayes *et al.*, 2020). The NJDEP EBS reported one harbor seal offshore New Jersey in June 2008 in approximately 18 m of water (Whitt *et al.*, 2015). Three other pinnipeds were observed during this study, however, they could not be identified to species level.

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. A total of 1,593 reported strandings (of all species) had occurred as of the writing of this document. 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/2018-2020-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. Though gray seals are not regularly sighted offshore of Delaware their range has been expanding southward in recent years, and they have been observed recently as far south as the barrier islands of Virginia. Current population trends show that gray seal abundance is likely increasing in the U.S. Atlantic EEZ (Hayes *et al.*, 2020). 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 (Hayes *et al.*, 2020). It is believed that recolonization by Canadian gray seals is the source of the U.S. population (Hayes *et al.*, 2020). 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/2018-2020-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 (2018) described generalized hearing ranges for these marine mammal hearing groups. Generalized hearing ranges were chosen based on the approximately 65 decibel (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. Marine mammal hearing groups and their associated hearing ranges are provided in Table 3.

Table 3—Marine Mammal Hearing Groups (NMFS, 2018)

Hearing Group	Generalized Hearing Range*
Low-frequency (LF) cetaceans (baleen whales)	7 Hz to 35 kHz
Mid-frequency (MF) cetaceans (dolphins, toothed whales, beaked whales, bottlenose whales)	150 Hz to 160 kHz
High-frequency (HF) cetaceans (true porpoises, *Kogia*, river dolphins, cephalorhynchid, *Lagenorhynchus cruciger* & *L. australis*)	275 Hz to 160 kHz
Phocid pinnipeds (PW) (underwater) (true seals)	50 Hz to 86 kHz
Otariid pinnipeds (OW) (underwater) (sea lions and fur seals)	60 Hz to 39 kHz

* Represents the generalized hearing range for the entire group as a composite (*i.e.,* all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall *et al.* 2007) and PW pinniped (approximation).

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).

For more detail concerning these groups and associated frequency ranges, please see NMFS (2018) for a review of available information. Sixteen marine mammal species (14 cetacean and 2 pinniped (both phocid) species) have the reasonable potential to co-occur with the proposed survey activities. Please refer to Table 2. Of the cetacean species that may be present, five are classified as low-frequency cetaceans (*i.e.*, all mysticete species), eight 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 (micro-Pascal) to identify the medium. For air and water, these reference pressures are "re: 20 micro Pascals (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 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 depends 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 louder 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 sensitivities in both terrestrial and marine mammals recover 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 animal 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.*, 2009a,b; 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 Level B harassment that is mediated by physiological effects on the auditory system.

Animals in the survey area during the HRG survey are unlikely to incur TTS hearing impairment due to the characteristics of the sound sources, which include relatively low source levels (176 to 205 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 many of HRG survey devices planned for use (Table 1) 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 HRG survey equipment types planned for use (Table 1) 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), 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 long been equated with stress.

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 functions, 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.*, 2004). 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. 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, NMFS assumes 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), NMF also assumes 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 are few data 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 currently 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 NMFS describes 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 vocalizations (Miller *et al.*, 2000; Fristrup *et al.*, 2003; Foote *et al.*, 2004), while North Atlantic 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.*, 2007). 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 stressor 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). Disruptions 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 harbor seals might be attracted to survey vessels 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.

NMFS has also considered the potential for severe behavioral responses such as stranding and associated indirect injury or mortality from Skipjack'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 other 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. Richardson *et al.* (1995) went on to explain that seals on haul-outs sometimes respond strongly to the presence of vessels and at other times appear to show considerable tolerance of vessels, and Brueggeman *et al.* (1992) observed ringed seals (*Pusa hispida*) hauled out on ice pans displaying short-term escape reactions when a ship approached within 0.16-0.31 miles (0.25-0.5 km). Due to the relatively high vessel traffic in the survey area it is possible that marine mammals are habituated to noise (*e.g.*, DP thrusters) from vessels in the area.

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 Skipjack's proposed survey activities. Marine mammals would be able to easily avoid the survey vessel due to the slow vessel speed. Further, Skipjack 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. NMFS is 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. NMFS has preliminarily determined that 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 noise from certain 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 or and/or mortality is neither anticipated, even absent mitigation, nor proposed to be authorized. Below NMFS describes how the take is estimated.

Generally speaking, NMFS estimates 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. NMFS notes 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, NMFS describes the factors considered here in more detail and present the proposed take estimate.

Acoustic Thresholds

NMFS recommends the use of 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 for non-explosive sources – 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 NMFS considers Level B harassment when exposed to underwater anthropogenic noise above received levels of 120 dB re 1 μPa (rms) for continuous (*e.g.,* vibratory pile-driving, drilling) and above 160 dB re 1 μPa (rms) for non-explosive impulsive (*e.g.*, seismic airguns) or intermittent (*e.g.*, scientific sonar) sources. Skipjack's proposed activity includes the use of intermittent sources (HRG equipment) and therefore the 160 dB re 1 μPa (rms) is applicable.

Level A harassment for non-explosive sources - 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). Skipjack's proposed activity includes the use of impulsive (*e.g.,* sparkers and boomers) and non-impulsive (e.g., CHIRP) 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 *https://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.

Note: Peak sound pressure (L_{pk}) has a reference value of 1 μPa, and cumulative sound exposure level (L_E) has a reference value of 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, NMFS describes 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.

NMFS has developed a user-friendly methodology for determining the rms sound pressure level (SPL_{rms}) at the 160-dB isopleth for the purposes of estimating the extent of Level B harassment isopleths associated with HRG survey equipment (NMFS, 2020). This methodology incorporates frequency and some directionality to refine estimated ensonified zones. For sources that operate with different beam widths, the maximum beam width was used (see Table 1). The lowest frequency of the source was used when calculating the absorption coefficient (Table 1).

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 A and Level B harassment thresholds. 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 1 shows the HRG equipment types that may be used during the proposed surveys 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 Skipjack that has the potential to result in Level B harassment of marine mammals, sound produced by the Applied Acoustics Dura-Spark UHD sparkers and GeoMarine Geo-Source sparker would propagate furthest to the Level B harassment threshold (141 m; Table 5). As described above, only a portion of Skipjack's survey activity days will employ sparkers or boomers; therefore, for the purposes of the exposure analysis, it was assumed that sparkers would be the dominant acoustic source for 50 of the total 200 survey activity days. For the remaining 150 survey days, the TB Chirp III (48 m) was assumed to be the dominant source. Thus, the distances to the isopleths corresponding to the threshold for Level B harassment for sparkers (141 m) and the TB Chirp III (48m) were used as the basis of the take calculation for all marine mammals 25 percent and 75 percent of survey activity days, respectively. This is a conservative approach, as the actual sources used on individual survey days may produce smaller harassment distances.

When the NMFS Technical Guidance was first published in 2016, in recognition of the fact that ensonified area/volume could be more technically challenging to predict because of the duration component in the new thresholds, NMFS developed a User Spreadsheet that includes tools to help predict a simple isopleth that can be used in conjunction with marine mammal density or occurrence to help predict takes. NMFS notes that because of some of the assumptions included in the methods used for these tools, it is anticipated that isopleths produced are typically going to be overestimates of some degree, which may result in some degree of overestimate of Level A harassment take. However, these tools offer the best way to predict appropriate isopleths when more sophisticated 3D modeling methods are not available, and NMFS continues to develop ways to quantitatively refine these tools, and will qualitatively address the output where appropriate. For mobile sources such as HRG equipment, the User Spreadsheet predicts the closest distance at which a stationary animal would not incur PTS if the sound source traveled by the animal in a straight line at a constant speed. Inputs used in the User Spreadsheet are shown in Table 5 and Table 6 and the resulting isopleths are reported in Table 7.

Table 5—User Spreadsheet Inputs for Non-impulsive, Non-parametric, Shallow Sub-bottom Profilers (CHIRP Sonars)

Device	EdgeTech 216	Edgetech 424	Edgetech 512	GeoPulse 5430	Teledyne Chirp III
Spreadsheet Tab Used	D1) Mobile Source; Non-impulsive, Intermittent	D1) Mobile Source; Non-impulsive, Intermittent	D1) Mobile Source; Non-impulsive, Intermittent	D1) Mobile Source; Non-impulsive, Intermittent	D1) Mobile Source; Non-impulsive, Intermittent
Frequency used for Weighting Factor Adjustment (kHz)[1,2]	2; 16; 16; 6.2	4; 24; 24; 6.2	1.7; 12; 12; 6.2	2; 17; 17 ; 6.2	2; 7; 7; 6.2
Source Level (RMS SPL)	195	176	179	196	197
Source Velocity (m/sec)	2.057	2.057	2.057	2.057	2.057
Pulse Duration (sec)	0.02	0.0034	0.009	0.05	0.06
1/Repetition rate (sec)	0.17	0.5	0.125	0.1	0.07

[1]Values for WFA represented =(LFC; MFC; HFC; PPW)
[2]WFAs were selected in the User Spreadsheet for each marine mammal hearing group based on estimated hearing sensitivities of each group and the operational frequency of the source.

Table 6—User Spreadsheet Inputs for Impulsive, Medium Sub-bottom Profilers (Sparkers & Boomers)

Device	AA, Dura-spark UHD (400 tips, 500 J)[1]	AA, Dura-spark UHD (400+400)[1]	GeoMarine, Geo-Source dual 400 tip sparker (800 J)[1]	GeoMarine Geo-Source 200 tip sparker (400 J)[1]	GeoMarine Geo-Source 200-400 tip sparker (400 J)[1]	AA, triple plate S Boom (700–1,000 J)[2]
Spreadsheet Tab Used	F1) Mobile Source: Impulsive, Intermittent	F1) Mobile Source: Impulsive, Intermittent	F1) Mobile Source: Impulsive, Intermittent	F1) Mobile Source: Impulsive, Intermittent	F1) Mobile Source: Impulsive, Intermittent	F1) Mobile Source: Impulsive, Intermittent
Frequency used for Weighting Factor Adjustment (kHz)*	1	1	1.5	1	1	3.4
Source Level (RMS SPL; PK SPL)	203; 211	203; 211	203; 211	203; 211	203; 211	205; 211
Source Velocity (m/sec)	2.057	2.057	2.057	2.057	2.057	2.057
Pulse Duration (sec)	0.0011	0.0011	0.0011	0.0011	0.0011	0.0006
1/Repetition rate (sec)	0.25	0.25	0.25	0.25	0.25	0.25

[1]The Dura-spark measurements and specifications provided in Crocker and Fratantonio (2016) were used for all sparker systems proposed for the survey. The data provided in Crocker and Fratantonio (2016) represent the most applicable data for similar sparker systems with comparable operating methods and settings when manufacturer or other reliable measurements are not available.

[2]Crocker and Fratantonio (2016) provide S-Boom measurements using two different power sources (CSP-D700 and CSP-N). The CSP-D700 power source was used in the 700 J measurements but not in the 1,000 J measurements. The CSP-N source was measured for both 700 J and 1,000 J operations but resulted in a lower SL; therefore, the single maximum SL value was used for both operational levels of the S Boom.

Table 7—Modeled Radial Distances From HRG Survey Equipment to Isopleths Corresponding to Level B Harassment Thresholds

Source	Distance to Level B Harassment Threshold (m) (SPL_{rms} threshold)
Non-impulsive, Non-parametric, Shallow SBPs	
ET 216 CHIRP	9
ET 424 CHIRP	4
ET 512i CHIRP	6
GeoPulse 5430	21
TB CHIRP III	48
Impulsive, Medium SBPs	
AA Triple plate S-Boom (700/1,000 J)	34
AA, Dura-spark UHD (500 J /400 tip)	141
AA, Dura-spark UHD 400+400	141
GeoMarine, Geo-Source dual 400 tip sparker	141
GeoMarine, Geo-Source 200 tip sparker	141
GeoMarine, Geo-Source 200-400 tip sparker	141

Isopleth distances to Level A harassment thresholds for all types of HRG equipment and all marine mammal functional hearing groups were modeled using the NMFS User Spreadsheet and NMFS Technical Guidance (2018). The dual criteria (peak SPL and SEL_{cum}) were applied to all HRG sources using the modeling methodology as described above, and the isopleth distances for each functional hearing group were then carried forward in the exposure analysis. Distances to the Level A harassment threshold based on the larger of the dual criteria (peak SPL and SEL_{cum}) are shown in Table 7. Modeled distances to isopleths corresponding to the Level A harassment thresholds are very small for all marine mammals and stocks (<5 m) with the exception of HF cetaceans (36.5 m from GeoPulse 5430). Note that the modeled distances to isopleths corresponding to the Level A harassment threshold are also assumed to be conservative. Level A harassment would also be more likely to occur at close approach to the sound source or as a result of longer duration exposure to the sound source, and mitigation measures—including a 100 m exclusion zone for harbor porpoises—are expected to minimize the potential for close approach or longer duration exposure to active HRG sources. In addition, harbor porpoises are a notoriously shy species which is known to avoid vessels. Harbor porpoise would also be expected to avoid a sound source prior to that source reaching a level that would result in injury (Level A harassment). Therefore, NMFS has determined that the potential for take by Level A harassment of harbor porpoises is so low as to be discountable.

Given the information described above regarding porpoises and 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. Therefore, Skipjack did not request and NMFS does not propose to authorize the take by Level A harassment of any marine mammals.

Marine Mammal Occurrence

In this section NMFS provides 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 (Roberts *et al.,* 2016a,b, 2017, 2018, 2020) represent the best available information regarding marine mammal densities in the proposed survey area. The density data presented by Roberts *et al.* (2016, 2017, 2018, 2020) 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 based on additional data as well as certain methodological improvements. More information is available online at *seamap.env.duke.edu/models/Duke-EC-GOM-2015/.* Marine mammal density estimates in the survey area (animals/km^2) were obtained using the most recent model results for all taxa (Roberts *et al.,* 2016, 2017, 2018, 2020). The updated models incorporate additional sighting data, including sightings from the NOAA Atlantic Marine Assessment Program for Protected Species (AMAPPS) surveys (e.g., NEFSC & SEFSC, 2011, 2012, 2014a, 2014b, 2015, 2016).

For the exposure analysis, density data from Roberts *et al.* (2016, 2017, 2018, 2020) were mapped using a geographic information system (GIS). Density grid cells that included any portion of the proposed survey area were selected for all survey months.

Densities from each of the selected density blocks were averaged for each month available to provide monthly density estimates for each species (when available based on the temporal resolution of the model products), along with the average annual density (Table 8).

Table 8—Estimated Monthly and Average Annual Density (Animals/km²) of Potentially Affected Marine Mammals within the Project Area Based on Monthly Habitat Density Models (Roberts *et al.* 2016; Roberts, 2018, 2020)

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Average Annual Density (km^{-2})
Low-Frequency Cetaceans													
Fin whale	0.0010	0.0008	0.0015	0.0020	0.0017	0.0012	0.0005	0.0004	0.0011	0.0014	0.0010	0.0009	0.0011
Sei whale	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Minke whale	0.0002	0.0002	0.0002	0.0009	0.0010	0.0005	0.0001	0.0000	0.0001	0.0003	0.0001	0.0001	0.0003
Humpback whale	0.0013	0.0006	0.0006	0.0005	0.0005	0.0004	0.0001	0.0001	0.0002	0.0004	0.0004	0.0014	0.0005
North Atlantic right whale	0.0037	0.0042	0.0043	0.0028	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0003	0.0020	0.0015
Mid-Frequency Cetaceans													
Sperm whale	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000
Atlantic white-sided dolphin	0.0017	0.0009	0.0012	0.0028	0.0035	0.0022	0.0006	0.0003	0.0008	0.0026	0.0036	0.0034	0.0020
Atlantic spotted dolphin	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017	0.0017
Common bottlenose dolphin (Offshore)[1]	0.0134	0.0088	0.0125	0.0193	0.1224	0.1138	0.1361	0.1663	0.0800	0.0713	0.0524	0.0201	0.0680
Common bottlenose dolphin (Migratory)[1]	0.0317	0.0271	0.0444	0.0910	0.5921	0.4623	0.5903	0.6439	0.2388	0.2015	0.1335	0.0459	0.2585
Short-finned pilot whale[2]	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Long-finned pilot whale[2]	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003	0.0003
Risso's dolphin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Common dolphin	0.0071	0.0035	0.0040	0.0092	0.0167	0.0110	0.0125	0.0143	0.0109	0.0109	0.0200	0.0152	0.0113
High-Frequency Cetaceans													
Harbor porpoise	0.0261	0.0247	0.0225	0.0095	0.0031	0.0000	0.0000	0.0000	0.0000	0.0005	0.0153	0.0535	0.0129
Pinnipeds[3]													
Gray seal	0.0003	0.0003	0.0003	0.0003	0.0003	0.0007	0.0007	0.0007	0.0003	0.0003	0.0003	0.0003	0.0004
Harbor seal	0.0003	0.0003	0.0003	0.0003	0.0003	0.0007	0.0007	0.0007	0.0003	0.0003	0.0003	0.0003	0.0004

[1]Bottlenose dolphin stocks were delineated based on the 20-m isobath as identified in NMFS 2017 Stock Assessment Report; all density blocks falling inland of the 20-m depth contour were assumed to belong to the migratory coastal stock, and those beyond this depth were assumed to belong to the offshore stock.
[2]Roberts (2018) only provides density estimates for "generic" pilot whales. It is assumed that each species has density levels that are equivalent to the generic pilot whale Density levels.
[3]Seal densities are not given by individual months or species, instead, seasons are divided as summer (June, July, August) and Winter (September – May) and applied to "generic" seals; as a result, reported seasonal densities for spring and fall are the same and are not provided for each species (Roberts 2018). Densities were evenly split between both species.

Level B harassment exposures were estimated by multiplying the average annual density of each species (Table 8) by the daily ZOI that was estimated to be ensonified to an SPL_{rms} exceeding 160 dB re 1 μPa (Table 9), times the number of operating days expected for the survey in each area assessed.

Take Calculation and Estimation

Here NMFS describes 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 Level B 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. The daily area is multiplied by the mean annual density of a given marine mammal species. This value is then multiplied by the number of proposed vessel days.

The estimated potential daily active survey distance of 70 km was used as the estimated areal coverage over a 24-hour period. This distance accounts for the vessel traveling at roughly 4 knots and only for periods during which equipment <180 kHz is in operation. A vessel traveling 4 knots can cover approximately 110 km per day; however, based on data from 2017, 2018, and 2019 surveys, survey coverage over a 24-hour period is closer to 70 km per day. For daylight only vessels, the distance is reduced to 35 km per day. To maintain the potential for 24-hour surveys, the Level B harassment ZOIs provided in Table 9 were calculated for each source based on the Level B harassment threshold distances in Table 7 with a 24-hour (70 km) operational period.

Table 9—Calculated Zone of Influence (ZOI) encompassing Level B thresholds for each sound source or comparable sound source category.

Source	Level B ZOI (km²)
Hearing Group	All
ET 216 CHIRP	1.3
ET 424 CHIRP	0.6
ET 512i CHIRP	0.8
GeoPulse 5430	2.9
TB CHIRP III	6.7
AA Triple plate S-Boom (700-1,000 J)	4.8
AA, Dura-spark UHD	19.8
AA, Dura-spark UHD 400+400	19.8
GeoMarine, Geo-Source dual 400 tip Sparker	19.8

AA = Applied Acoustics; CHIRP = Compressed High-Intensity Radiated Pulse; ET = EdgeTech; HF = high-frequency; J = joules; LF = low-frequency; MF = mid-frequency; PW = phocid pinnipeds in water; SBP = sub-bottom profiler; TB = Teledyne Benthos; UHD = ultra-high definition.

Level B exposures were estimated by multiplying the average annual density of each species (Table 7) (Roberts *et al.*, 2016; Roberts, 2018) by the daily ZOI that was estimated to be ensonified to an SPL_{rms} exceeding 160 dB re 1 μPa (Table 9), times the number of operating days expected for the survey in each area assessed. As described previously, it was assumed that that sparker systems with 141-m Level B harassment isopleths would operate for 50 survey days and the non-sparker TB CHIRP III with 48-m Level B harassment isopleth would operate for the remaining 150 survey days. The results of these calculations are shown in Table 10.

Table 10—Summary of Take Numbers Proposed for Authorization

Species		Abundance	Level B Takes[1]	Max % Population
Low-Frequency Cetaceans				
Fin whale		7,418	2	0.03%
Sei whale		6,292	0 (1)	0.02%
Minke whale		24,202	0 (2)	0.01%
Humpback whale		1,396	2	0.14%
North Atlantic right whale		428	3	0.70%
Mid-Frequency Cetaceans				
Sperm whale[3]		4,349	0 (3)	0.07%
Atlantic white-sided dolphin		93,233	4	0.00%
Atlantic spotted dolphin		39,921	4 (2,000)	5.00%
Common bottlenose dolphin[2]	Offshore Stock	62,851	135	0.21%
	Migratory Stock	6,639	516	7.77%
Pilot Whales[3]	Short-finned pilot whale	28,924	0 (10)	0.03%
	Long-finned pilot whale	39,215	0 (10)	0.03%
Risso's dolphin		35,493	0 (30)	0.08%
Common dolphin		178,825	24 (70)	0.04%

High-Frequency Cetaceans				
Harbor porpoise		95,543	22	0.03%
Pinnipeds				
Seals[4]	Gray seal	27,131	0 (10)	0.04%
	Harbor seal	75,834	0 (10)	0.01%

[1]Parenthesis denote changes from calculated take estimates.
[2]Roberts *et al.* (2016) does not provide density estimates for individual stocks of common bottlenose dolphins; therefore, stock densities were delineated using the 20-m isobath.
[3]Roberts (2018) only provides density estimates for "generic" pilot whales and seals; therefore, an equal potential for takes has been assumed either for species or stocks within the larger group.
[4]Roberts (2018) only provides density estimates for "generic" seals; therefore, densities were split evenly between the two species.

No takes were calculated for the sei whale, minke whale, sperm whale, short- and long-finned pilot whale, or Risso's dolphin. However, based on anticipated species distributions and data from previous surveys conducted in the DE WEA, it is possible that these species could be encountered. Therefore, Skipjack based its take requests on estimated group sizes for these species (1 for sei whales, 2 for minke whales, 3 for sperm whales, 10 for short- and long-finned pilot whales, and 30 for Risso's dolphins). For species with no modeled exposures, requested takes for HRG surveys are based on mean group sizes derived from the following references:

- Sei whale: Kenney and Vigness-Raposa, 2010;
- Minke whale: Kenney and Vigness-Raposa, 2020;
- Sperm whale: Barkaszi and Kelly, 2018;
- Short- and long-finned pilot whales: Kenney and Vigness-Raposa, 2010; and
- Risso's dolphin: Barkaszi and Kelly, 2018.

NMFS concurred with this approach and based its proposed authorization for takes of these species on Skipjack's requests. Additionally, the number of takes proposed in Table 10 for Atlantic white-sided dolphin, bottlenose dolphin, harbor porpoise are equivalent to the numbers requested by Skipjack.

Roberts *et al.* (2018) produced density models for all seals and did not differentiate by seal species. The take calculation methodology as described above resulted in close to zero takes. The marine mammal monitoring report associated with the previous IHA issued to Skipjack in this survey area (84 FR 66156; December 3, 2019) did not record any takes of seals. However, the proposed survey area for this proposed IHA includes a portion of Delaware Bay which is not covered by Roberts *et al.* (2018) and was not included as part of the previous IHA. Therefore, Skipjack did not request take of any harbor or gray seals. However, since seals are known to occur in the Bay, mostly during winter months, NMFS is conservatively proposing to authorize 10 takes of each species by Level B harassment of both harbor and gray seals.

Skipjack had requested 4 takes of spotted dolphin and 24 takes of common dolphin by Level B harassment. However, recent HRG surveys in the Mid-Atlantic area off the coast of Virginia have recorded unexpectedly large numbers of both Atlantic spotted dolphin and common dolphin. These events have led NMFS to modify another offshore wind energy company's existing IHA (85 FR 81879; December 17, 2020) in order to accommodate larger take numbers. The spotted dolphins had been recorded at a rate of up 15 per day while common dolphins were recorded at a rate of 62 animals in a single week. Note that there were many days in which there were no sightings of spotted dolphins and that all of the 62 common dolphin sightings occurred during a single week. The previous Skipjack marine mammal monitoring report from this area recorded up to 8 common dolphins over 23 days of active surveying (0.35 animals/day).. Given this data, NMFS will assume that 0.35 common dolphins could be exposed within the Level B harassment zone per day over 200 days resulting in the 70 proposed takes of common dolphin by Level B harassment. NMFS will also assume that there could be up to 10 exposures of spotted dolphin per day resulting in the proposed 2000 takes by Level B harassment.

Note that Skipjack submitted a marine mammal monitoring report under the previous IHA covering the period of June 4, 2020 through June 26, 2020. Over the 23-day monitoring period there were 110 sightings consisting of 112 individual animals.

Only three bottlenose dolphins were recorded as occurring within estimated Level B harassment zones which is well below the 1,465 takes that were authorized. However, due to a range of factors only 23 actual survey days occurred out of 200 that were anticipated.

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 the activity, and other means of effecting the least practicable impact on the species or stock and its habitat, paying particular attention to rookeries, mating grounds, and areas of similar significance, and on the availability of the 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 the 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, NMFS carefully considers 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.

Mitigation for Marine Mammals and their Habitat

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

Marine Mammal Exclusion Zones and Harassment Zones

Marine mammal exclusion zones (EZ) would be established around the HRG survey equipment and monitored by protected species observers (PSOs):

- 500 m EZ for North Atlantic right whales during use of all acoustic sources;
- 100 m EZ for all marine mammals, with certain exceptions specified below, during operation of impulsive acoustic sources (boomer and/or sparker).

If a marine mammal is detected approaching or entering the EZs during the HRG survey, the vessel operator would adhere to the shutdown procedures described below to minimize noise impacts on the animals. These stated requirements will be included in the site-specific training to be provided to the survey team.

Pre-Clearance of the Exclusion Zones

Skipjack would implement a 30-minute pre-clearance period of the exclusion zones prior to the initiation of ramp-up of HRG equipment. During this period, the exclusion zone will be monitored by the PSOs, using the appropriate visual technology. Ramp-up may not be initiated if any marine mammal(s) is within its respective exclusion zone. If a marine mammal is observed within an exclusion zone during the pre-clearance period, ramp-up may not begin until the animal(s) has been observed exiting its respective exclusion zone or until an additional time period has elapsed with no further sighting (*i.e.*, 15 minutes for small odontocetes and seals, and 30 minutes for all other species).

Ramp-Up of Survey Equipment

When technically feasible, a ramp-up procedure would be used for HRG survey equipment capable of adjusting energy levels at the start or restart 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 vacate the area prior to the commencement of survey equipment operation at full power.

A ramp-up would begin with the powering up of the smallest acoustic HRG equipment at its lowest practical power output appropriate for the survey. When technically feasible, the power would then be gradually turned up and other acoustic sources would be added.

Ramp-up activities will be delayed if a marine mammal(s) enters its respective exclusion zone. Ramp-up will continue if the animal has been observed exiting its respective exclusion zone or until an additional time period has elapsed with no further sighting (*i.e.*, 15 minutes for small odontocetes and seals and 30 minutes for all other species).

Activation of survey equipment through ramp-up procedures may not occur when visual observation of the pre-clearance zone is not expected to be effective (*i.e.*, during inclement conditions such as heavy rain or fog).

Shutdown Procedures

An immediate shutdown of the impulsive HRG survey equipment would be required if a marine mammal is sighted entering or within its respective exclusion zone. The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement between the Lead PSO and vessel operator should be discussed only after shutdown has occurred. Subsequent restart of the survey equipment can be initiated if the animal has been observed exiting its respective exclusion zone or until an additional time period has elapsed *(i.e.*, 30 minutes for all other species).

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 Level B harassment zone (48 m, non-impulsive; 141 m impulsive), shutdown would occur.

If the acoustic source is shut down for reasons other than mitigation (e.g., mechanical difficulty) for less than 30 minutes, it may be activated again without ramp-up if PSOs have maintained constant observation and no detections of any marine mammal have occurred within the respective exclusion zones. If the acoustic source is shut down for a period longer than 30 minutes and PSOs have maintained constant observation, then pre-clearance and ramp-up procedures will be initiated as described in the previous section.

The shutdown requirement would be waived for small delphinids of the following genera: *Delphinus, Lagenorhynchus, Stenella,* and *Tursiops* and seals. Specifically, if a delphinid from the specified genera or a pinniped is visually detected approaching the vessel (*i.e.*, to bow ride) or towed equipment, shutdown is not required. Furthermore, 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 must use best professional judgement in making the decision to call for a shutdown. Additionally, shutdown is required if a delphinid or pinniped detected in the exclusion zone and belongs to a genus other than those specified.

Vessel Strike Avoidance

Skipjack will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds and slow down or stop their vessels to avoid striking these species. Survey vessel crew members responsible for navigation duties will receive site-specific training on marine mammals sighting/reporting and vessel strike avoidance measures. Vessel strike avoidance measures would include the following, except under circumstances when complying with these requirements would put the safety of the vessel or crew at risk:

- 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 based on the appropriate separation distance 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 vessels (e.g., source vessels, chase vessels, supply 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 including seasonal management areas (SMAs) and dynamic management areas (DMAs) when in effect;
- All vessels greater than or equal to 19.8 m in overall length operating from November 1 through April 30 will operate at speeds of 10 knots or less while transiting to and from Project Area;
- All vessels must reduce their speed 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 marine mammals, with an understanding that at times this may not be possible (*e.g.,* for animals that approach the vessel).
- When marine mammals are sighted while a vessel is underway, the vessel shall 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 marine mammals 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

Members of the monitoring team will consult NMFS North Atlantic right whale reporting system and Whale Alert, as able, for the presence of North Atlantic right whales throughout survey operations, and for the establishment of a DMA. If NMFS should establish a DMA in the Lease Areas during the survey, the vessels will abide by speed restrictions in the DMA.

Project-specific training will be conducted for all vessel crew prior to the start of a survey and during any changes in crew such that all survey personnel are fully aware and understand the mitigation, monitoring, and reporting requirements. Prior to implementation with vessel crews, the training program will be provided to NMFS for review and approval. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew member understands and will comply with the necessary requirements throughout the survey activities.

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 of effecting the least practicable impact on marine mammal 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); and
- Mitigation and monitoring effectiveness.

Proposed Monitoring Measures

Visual monitoring will be performed by qualified, NMFS-approved PSOs, the resumes of whom will be provided to NMFS for review and approval prior to the start of survey activities. Skipjack would employ independent, dedicated, trained PSOs, meaning that the PSOs must 1) be employed by a third-party observer provider, 2) 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 3) have successfully completed an approved PSO training course appropriate for their designated task. On a case-by-case basis, non-independent observers may be approved by NMFS for limited, specific duties in support of approved, independent PSOs on smaller vessels with limited crew capacity operating in nearshore waters.

The PSOs will be responsible for monitoring the waters surrounding each survey vessel to the farthest extent permitted by sighting conditions, including exclusion zones, during all HRG survey operations. PSOs will visually monitor and identify marine mammals, including those approaching or entering the established exclusion zones during survey activities. It will be the responsibility of the Lead PSO on duty to communicate the presence of marine mammals as well as to communicate the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate.

During all HRG 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 during daylight operations on each survey vessel, 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). Two PSOs will be on watch during nighttime operations. The PSO(s) would ensure 360° visual coverage around the vessel from the most appropriate observation posts and would conduct visual observations using binoculars and/or night vision goggles 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 nearby survey vessels.

PSOs must be equipped with binoculars and have the ability to estimate distance and bearing to detect marine mammals, particularly in proximity to exclusion zones. Reticulated binoculars must also be available to PSOs for use as appropriate based on conditions and visibility to support the sighting and monitoring of marine mammals. During nighttime operations, night-vision goggles with thermal clip-ons and infrared technology would be used. Position data would be recorded using hand-held or vessel GPS units for each sighting.

During good conditions (*e.g.*, daylight hours; Beaufort sea state (BSS) 3 or less), to the maximum extent practicable, PSOs would also conduct observations when the acoustic source is not operating for comparison of sighting rates and behavior with and without use of the active acoustic sources. 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 behavior that occurs (*e.g.*, noted behavioral disturbances).

Proposed Reporting Measures

Within 90 days after completion of survey activities or expiration of this IHA, whichever comes sooner, 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 observed during survey activities (by species, when known), 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. All draft and final marine mammal and acoustic monitoring reports must be submitted to

PR.ITP.MonitoringReports@noaa.gov and *ITP.Pauline@noaa.gov*. The report must contain at minimum, the following:

- PSO names and affiliations
- Dates of departures and returns to port with port name
- Dates and times (Greenwich Mean Time) of survey effort and times corresponding with PSO effort
- Vessel location (latitude/longitude) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts
- Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any line change
- Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort sea state, Beaufort wind force, swell height, weather conditions, cloud cover, sun glare, and overall visibility to the horizon
- Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (*e.g.*, vessel traffic, equipment malfunctions)
- Survey activity information, such as type of survey equipment in operation, acoustic source power output while in operation, and any other notes of significance (*i.e.*, pre-clearance survey, ramp-up, shutdown, end of operations, etc.)

If a marine mammal is sighted, the following information should be recorded:

- Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
- PSO who sighted the animal;
- Time of sighting;
- Vessel location at time of sighting;

- Water depth;
- Direction of vessel's travel (compass direction);
- Direction of animal's travel relative to the vessel;
- Pace of the animal;
- Estimated distance to the animal and its heading relative to vessel at initial sighting;
- Identification of the animal (*e.g.*, genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;
- Estimated number of animals (high/low/best) ;
- Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);
- Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);
- Detailed behavior observations (*e.g.*, number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);
- Animal's closest point of approach and/or closest distance from the center point of the acoustic source;
- Platform activity at time of sighting (*e.g.*, deploying, recovering, testing, data acquisition, other);
- Description of any actions implemented in response to the sighting (*e.g.*, delays, shutdown, ramp-up, speed or course alteration, etc.) and time and location of the action.

If a North Atlantic right whale is observed at any time by PSOs or personnel on any project vessels, during surveys or during vessel transit, Skipjack must immediately report sighting information to the NMFS North Atlantic Right Whale Sighting Advisory System: (866) 755-6622. North Atlantic right whale sightings in any location may also be reported to the U.S. Coast Guard via channel 16.

In the event that Skipjack personnel discover an injured or dead marine mammal, Skipjack would report the incident to the NMFS Office of Protected Resources (OPR) and the NMFS New England/Mid-Atlantic Stranding Coordinator as soon as feasible. The report would 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 unanticipated event of a ship strike of a marine mammal by any vessel involved in the activities covered by the IHA, Skipjack would report the incident to the NMFS OPR and the NMFS New England/Mid-Atlantic Stranding Coordinator as soon as feasible. The report would 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. NMFS also assesses 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 10, given that NMFS expects the anticipated effects of the proposed survey to be similar in nature. Where there are meaningful differences between species or stocks - as is the case of the North Atlantic right whale - they are included as separate subsections below. NMFS does not anticipate that serious injury or mortality would occur as a result from HRG surveys, even in the absence of mitigation, and no serious injury or mortality is proposed to be authorized. As discussed in the **Potential Effects** section, non-auditory physical effects and vessel strike are not expected to occur. NMFS expects 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 or decreased foraging (if such activity was occurring), reactions that are considered to be of low severity and with no lasting biological consequences (*e.g.*, Southall *et al.*, 2007). 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. As described above, Level A harassment is not expected to occur given the nature of the operations, the estimated size of the Level A harassment zones,, and the required shutdown zones for certain activities.

In addition to being temporary, the maximum expected harassment zone around a survey vessel is 141 m; 75 percent of survey days would include activity with a reduced acoustic harassment zone of 48 m per vessel, producing expected effects of particularly low severity. Therefore, the ensonified area surrounding each vessel is relatively small compared to the overall distribution of the animals in the area and their use of the habitat. Feeding behavior is not likely to be significantly impacted as prey species are mobile and are broadly distributed throughout the survey 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 and there are no feeding areas known to be biologically important to marine mammals within the proposed survey area. There is no designated critical habitat for any ESA-listed marine mammals in the proposed survey area.

North Atlantic right whales

The status of the North Atlantic right whale population is of heightened concern and, therefore, merits additional analysis. As noted previously, elevated North Atlantic right whale mortalities began in June 2017 and there is an active UME. Overall, preliminary findings support human interactions, specifically vessel strikes and entanglements, as the cause of death for the majority of right whales. The proposed survey area overlaps a migratory corridor Biologically Important Area (BIA) for North Atlantic right whales (effective March-April and November-December) that extends from Massachusetts to Florida (LeBrecque *et al.*, 2015). Off the coast of Delaware, this migratory BIA extends from the coast to beyond the shelf break. Due to the fact that that the proposed survey activities are 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 BIA, right whale migration is not expected to be impacted by the proposed survey. Given the relatively small size of the ensonified area, it is unlikely that prey availability would be adversely affected by HRG survey operations. Required vessel strike avoidance measures will also decrease risk of ship strike during migration; no ship strike is expected to occur during Skipjack's proposed activities. Additionally, only very limited take by Level B harassment of North Atlantic right whales has been requested and is being proposed by NMFS as HRG survey operations are required to maintain a 500 m EZ and shutdown if a North Atlantic right whale is sighted at or within the EZ. The 500 m shutdown zone for right whales is conservative, considering the Level B harassment isopleth for the most impactful acoustic source (*i.e.*, GeoMarine Geo-Source 400 tip sparker) is estimated to be 141 m, and thereby minimizes the potential for behavioral harassment of this species. As noted previously, Level A harassment is not expected due to the small PTS zones associated with HRG equipment types proposed for use. NMFS does not anticipate North Atlantic right whales takes that would result from Skipjack's proposed activities would impact annual rates of recruitment or survival. Thus, any takes that occur would not result in population level impacts.

Other marine mammal species with active UMEs

As noted previously, there are several active UMEs occurring in the vicinity of Skipjack's proposed survey area. Elevated humpback whale mortalities have occurred along the Atlantic coast from Maine through Florida since January 2016. Of the cases examined, approximately half had evidence of human interaction (ship strike or entanglement). 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 distinct population segment (DPS)) remains stable at approximately 12,000 individuals.

Beginning in January 2017, elevated minke whale strandings have occurred along the Atlantic coast from Maine through South Carolina, with highest numbers in Massachusetts, Maine, and New York. This event does not provide cause for concern regarding population level impacts, as the likely population abundance is greater than 20,000 whales.

Elevated numbers of harbor seal and gray seal mortalities were first observed in July 2018 and have occurred across Maine, New Hampshire, and Massachusetts. Based on tests conducted so far, the main pathogen found in the seals is phocine distemper virus, although additional testing to identify other factors that may be involved in this UME are underway. 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 (350) is well below PBR (2,006) (Hayes *et al.*, 2020). The population abundance for gray seals in the United States is over 27,000, with an estimated abundance, including seals in Canada, of approximately 505,000. In addition, the abundance of gray seals is likely increasing in the U.S. Atlantic EEZ as well as in Canada (Hayes *et al.*, 2020).

The required mitigation measures are expected to reduce the number and/or severity of proposed takes for all species listed in Table 10, including those with active UME's to the level of least practicable adverse impact. In particular they would provide animals the opportunity to move away from the sound source throughout the survey area before HRG survey equipment reaches full energy, thus preventing them from being exposed to sound levels that have the potential to cause injury (Level A harassment) or more severe Level B harassment. No Level A harassment is anticipated, even in the absence of mitigation measures, or authorized.

NMFS expects that takes would be in the form of short-term Level B behavioral harassment by way of brief startling reactions and/or temporary vacating of the area, or decreased foraging (if such activity was occurring)—reactions that (at the scale and intensity anticipated here) are considered to be of low severity, with no lasting biological consequences. Since both the sources and marine mammals are mobile, animals would only be exposed briefly to a small ensonified area that might result in take. Additionally, required mitigation measures would further reduce exposure to sound that could result in more severe behavioral harassment.

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 or serious injury is anticipated or proposed for authorization;
- No Level A harassment (PTS) is anticipated, even in the absence of mitigation measures, or proposed for authorization;
- Foraging success is not likely to be significantly impacted as effects on species that serve as prey species for marine mammals from the survey are expected to be minimal;
- The availability of alternate areas of similar habitat value for marine mammals to temporarily vacate the survey area during the planned survey to avoid exposure to sounds from the activity;
- Take is anticipated to be primarily Level B behavioral harassment consisting of brief startling reactions and/or temporary avoidance of the survey area;
- While the survey area is within areas noted as a migratory BIA for North Atlantic right whales, the activities would occur in such a comparatively small area such that any avoidance of the survey area due to activities would not affect migration. In addition, mitigation measures to shutdown at 500 m to minimize potential for Level B behavioral harassment would limit any take of the species.
- The proposed mitigation measures, including visual monitoring and shutdowns, 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 fewer 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.

NMFS proposes to authorize incidental take of 16 marine mammal species (with 17 managed stocks.) The total amount of takes proposed for authorization is less than eight percent for one stock (bottlenose dolphin northern coastal migratory stock) and less than one percent of all other species and stocks, which NMFS preliminarily finds are small numbers of marine mammals relative to the estimated overall population abundances for those stocks. See Table 10. 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 the affected species or stocks.

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 the 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 (ESA: 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 whenever NMFS proposes to authorize take for endangered or threatened species, in this case with NMFS Greater Atlantic Regional Fisheries Office (GARFO).

The NMFS Office of Protected Resources Permits and Conservation Division 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 whales. The Permits and Conservation Division 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 proposed issuance of the authorization.

Proposed Authorization

As a result of these preliminary determinations, NMFS proposes to issue an IHA to Skipjack for conducting marine site characterization surveys off the coast of Delaware for one year from the date of issuance, provided the previously mentioned mitigation, monitoring, and reporting requirements are incorporated. A draft of the proposed IHA can be found at *https://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 the proposed marine site characterization surveys. 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 **Description of Proposed Activities** section of this notice is planned or (2) the activities as described in the **Description of Proposed 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: February 19, 2021.

Donna S. Wieting,

Director, Office of Protected Resources,

National Marine Fisheries Service.

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