Request for an Incidental Harassment Authorization to Allow the Non-Lethal Take of Marine Mammals Incidental to Site Characterization Surveys in the Carolina Long Bay Call Area

Submitted To

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

Submitted By

TerraSond Limited

TERRASOND
PRECISION GEOSPATIAL SOLUTIONS®

Submitted September 2022
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List of Acronyms

~	approximately
ADC	analogue-digital converter
AMAPPS	Atlantic Marine Assessment Program for Protected Species
BIA	Biologically Important Area
BOEM	Bureau of Ocean Energy Management
CETAP	Cetacean and Turtle Assessment Program
CPT	cone penetration test
dB	decibel
DMA	Dynamic Management Area
e.g.	for example
EEZ	Exclusive Economic Zone
ESA	Endangered Species Act
hr	hour
HRG	high-resolution geophysical
ITA	Incidental Take Authorization
IR	infrared
IWC	International Whaling Commission
J	Joule
kHz	kilohertz
kJ	kilo-Joule
km	kilometer
LED	light-emitting diode
m	meter
MBES	multibeam echo sounder
MMPA	Marine Mammal Protection Act
NARW	North Atlantic right whale
NEFSC	NOAA Northeast Fisheries Science Center
NJ	New Jersey
NLPSC	Northeast Large Pelagic Survey Collaborative
NMFS	National Marine Fisheries Service
NVD	night vision device
NY	New York
OCS	Outer Continental Shelf
OSP	optimum sustainable population
PAM	passive acoustic monitoring
PSO	protected species observer
re 1 µ Pa	referenced to one micro Pascal
RL	received level
RWSAS	Right Whale Sightings Advisory System
SBP	Sub-bottom Profiler
SEFSC	NOAA Southeast Fisheries Science Center
SEL	sound exposure level
SMA	Seasonal Management Area
SPL	sound pressure level
SPL_{rms}	root-mean-square sound pressure level
SPL_{cum}	cumulative sound pressure level
SSS	side scan sonar
SZ	Shutdown Zone
UME	unusual mortality event

U. S	United States
USBL	Ultra-short baseline
USFWS	United States Fish and Wildlife Service

1 Description of Specified Activity

TerraSond Limited (TerraSond) is an Acteon company which collects and interprets geospatial and geophysical information by conducting offshore surveys. TerraSond intends to conduct marine site characterization surveys off the BOEM Lease Areas OCS-A 0545 and 0546 to support the development of offshore wind farms off the coasts of North Carolina and South Carolina (Survey Area). The survey has been designed to meet the BOEM guidelines for providing geophysical, geotechnical, and geohazard information for site assessment plan (SAP) surveys and/or construction and operations plan (COP) development.

The high resolution geophysical (HRG) and geotechnical surveys will take place between February 1, 2023, and February 1, 2024. The objective of the survey is to acquire HRG and geotechnical data on the bathymetry, seafloor morphology, subsurface geology, environmental/biological sites, seafloor obstructions, soil conditions, and locations of any man-made, historical or archaeological resources within the Carolina Long Bay Area. For the HRG surveys, there are three possible vessel and tow configurations that may be used within the Survey Area; these are broken down into three separate survey phases as described below. Phase 1 may take place concurrently with Phases 2 and 3 and multiple vessels may be used for each stage. A total of 2 HRG survey vessels may be active at one time. Nonetheless, given vessel availability and logistical constraints, survey activities are anticipated to occur over a minimum of 6–8 months, and likely throughout most of a year.

Phase 1 will be completed to acquire geophysical, geotechnical, and geohazard information that meet SAP requirements. Phase 1 involves the use of a single source vessel towing one sparker source composed of two “decks” of 400 electrode tips each stacked on top of each other. The two decks will be discharged in alternating fashion (often referred to as “flip flop” pattern) such that only one deck is discharged at a time. The discharge of a single deck at a time will be true for all survey operations described in this application.

Phase 2 is a brief period of survey work for Research and Development (R&D) purposes. This will involve the use of a single source vessel towing 3 of the same sparker sources with a horizontal separation between the sources of 150 m. The three sources will operate independently while collecting geophysical data along separate lines. This Phase 2 R&D survey effort will occur for up to 14 days of survey time.

Phase 3 will involve a single vessel towing two of the same sparker sources described in Phase 1 with a horizontal separation between the sources of 30 m. As described in Phase 1, the two sources will operate independently of each other while collecting geophysical data along two separate lines. Phase 3 activities may occur simultaneously with Phase 1 and 2 activities.

An additional vessel may be used to conduct geotechnical sampling activities (vibracores and seabed core penetration tests (CPTs)) during the same period as the geophysical surveys. However, geotechnical sampling activities may also take place from the same vessel used for geophysical surveys or from a similar sized vessel.

1.1 HRG Survey Details

Figure 1 shows the Carolina Long Bay HRG Survey Area including BOEM Lease Area OCS-A 0545 and 0546. The linear distance (survey tracklines) and number of active sound source days for the anticipated survey activity (Phases 1–3) are summarized in Table 1. The number of active sound source days was calculated by dividing the total vessel trackline length by the approximate vessel distance per day (100 km) with active survey equipment anticipated to be achieved. The estimates provided assume 24-hour survey operations.

Table 1. Activity Details for TerraSond Geophysical Surveys in the Carolina Long Bay.

Survey Phase	Approximate Vessel Trackline (km)	Approximate Vessel Distance Per Day (km)	Active Sound Source Days
Phase 1	4,054	100	40.5
Phase 2	1,400	100	14
Phase 3	12,488	100	124.9

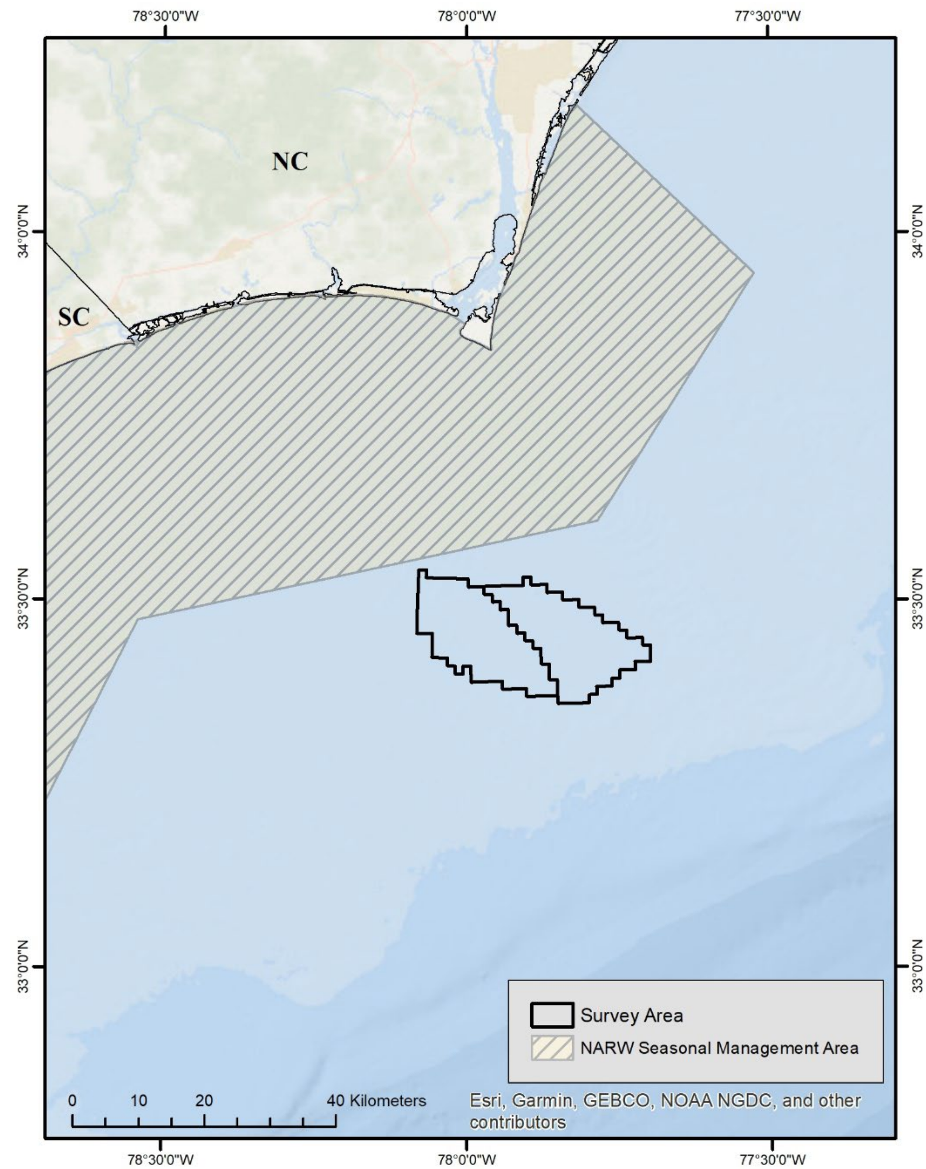

Figure 1. Map of the survey area in the Carolina Long Bay and other nearby Lease Areas.

1.2 HRG Survey Sound Sources

Some of the sounds produced during the planned surveys have the potential to be audible to marine mammals (MacGillivray et al. 2014). Potential sound-generating equipment that may be used during the geophysical and geotechnical surveys are shown in Table 2, Table 3, and Table 4.

The survey instrument listed in Table 2 produces sounds that fall within the range of marine mammal hearing and has the potential to result in behavioral harassment (see Section 6). Survey equipment shown in Table 3 have operating frequencies that exceed the upper frequency range of marine mammal hearing and thus are not considered when estimating potential takes. Although USBL systems (Table 4) produce sounds audible to some marine mammals, they are used for safe vessel navigation and equipment positioning purposes during HRG surveys and are not considered to have the potential to result in take. Similarly, parametric sub-bottom profilers produce sounds that some marine mammals may be able to hear, but the beam pattern is very narrow so the likelihood of a marine mammal occurring within it and being disturbed is very low.

Table 2. TerraSond Geophysical Survey Equipment with Operating Frequencies Below 180 kHz.

Equipment Type	System	Operating Frequency
Sparker	Applied Acoustics Dura-Spark UHRS 400 + 400 800 tips total, up to 1,400 J	0.3 – 1.2 kHz

Table 3. TerraSond Geophysical Survey Equipment with Operating Frequencies Above 180 kHz.

Equipment Type	System	Operating Frequency
Sidescan Sonar	EdgeTech 4200	300/600 kHz
Multibeam Echosounder	Reson T50 Dual head	200-400 kHz

1.3 Geotechnical Survey

Within the Survey Area, a geotechnical campaign including vibracores and seabed CPT may be conducted from December, 15 2022 through December, 15 2023. Vibracoring and CPT may be conducted from the geophysical survey vessel or by an additional geotechnical vessel.

During geotechnical surveying, sounds produced by vibracoring and CPT are within marine mammal hearing ranges. However, NMFS recently reported that the likelihood of vibracoring sounds rising to the level of take is so low as to be discountable because of the short duration of the activity. (NMFS 2018c, b, 2021j). NMFS also reported recently that field studies have shown that CPT sounds are unlikely to exceed marine mammal acoustic harassment thresholds and are thus unlikely to result in takes. Thus, the geotechnical sampling is not anticipated to result in marine mammal take and therefore is not considered further in this application.

Table 4. TerraSond geophysical survey equipment, geotechnical survey equipment, and navigational equipment not expected to cause take of marine mammals.

Equipment Type	System	Operating Frequency
Parametric Sub-bottom Profiler	Innomar SES-2000 SBP	Primary frequencies: ~100kHz (band 85 – 115kHz) Secondary low frequencies (band 2 – 22 kHz)
USBL	IXSEA GAPS M7	21.5 – 30.5 kHz
	Kongsberg HiPAP	20-30 kHz
	Sonardyne Ranger Pro	19-34 kHz
Surface Navigation including DGNSS/Gyrocompass/Attitude Sensors	Applanix POS M/V OceanMaster	N/A
Surface Navigation including DGNSS/Gyrocompass/Attitude Sensors	IXSEA Hydrins	N/A
Gradiometer	Geometrics TVG with 822 Magnetometer	N/A
Vibracore	6 m Vibrocore	N/A
CPT	Ronson CPT	N/A

2 Dates, Duration, and Specified Geographic Region

TerraSond's site characterization survey will occur within BOEM Renewable Energy Lease Areas OCS-A 0545 and 0546 off the coasts of North Carolina and South Carolina (Figure 1). The Survey Area comprises approximately 445.5 km^2 (110,085.5 acres) in BOEM Lease Area OCS-A 0545 and 0546 in the Carolina Long Bay region to support the development of offshore wind farms off the coasts of North Carolina and South Carolina (Figure 1). The Survey Area comprises approximately 445.5 km^2 (110,085.5 acres) located approximately 34 km offshore of Cape Fear NC and extends as far as 56 km offshore. Water depths within the Survey Area range from 20–35 m (66–115 ft). All three phases of the Survey will occur within the designated total Survey Area (110,085.5 acres).

The survey is expected to begin on or after February 1, 2023 and conclude by February 1, 2024, inclusive of any weather downtime and crew transfer. All three phases, as described above in Section 1, are to be completed during the designated one-year period and may involve multiple survey vessels. The planned survey activities are anticipated to require up to approximately 41 days for Phase 1, 14 days for Phase 2, and 125 days for Phase 3.

3 Species and Numbers of Marine Mammals

Table 5 lists the 40 marine mammal species and/or stocks that could occur within the Carolina Long Bay Area and surrounding waters, along with their listing status under the *Endangered Species Act* (ESA), hearing group, their relative likelihood of occurrence within the Survey Area, seasonality, and their documented abundance in the region. Additional details of species distribution, abundance and status are provided in Section 4 below in the individual species descriptions.

The species and/or stocks in the region include six species of large baleen whale (mysticetes); twenty-nine species and/or stocks of large and small toothed whales, dolphins, and porpoise (odontocetes); four species of earless seals (phocid pinnipeds), and one sirenian species. It is unlikely that all 40 species and/or stocks would be present in the Survey Area during the site characterization survey because some of them are seasonal migrants and because their distributions vary among years based on factors such as oceanographic characteristics and prey availability. Seasonality and abundance reported in Table 5 and discussed below were mainly derived from the Northeast large pelagic survey collaborative (NLPSC) aerial and acoustic surveys for large whales and sea turtles during 2011–2015 (Kraus et al. 2016), Roberts et al. (2016; 2022) habitat-based density models, the Kenney and Vigness-Raposa (2010) marine mammal assessment for the Rhode Island Ocean Special Area Management Plan, and the NMFS 2019, 2020, and Draft 2021 Stock Assessment Reports ((Hayes et al. 2019, 2020, 2022)). Additional sighting data from Atlantic Marine Assessment Program for Protected Species (AMAPPS) shipboard and aerial surveys is also reported where relevant (Palka et al. 2017).

Of the 40 marine mammal species and/or stocks listed in Table 5, 20 species are considered to be "rare" in the area based on sighting and distribution data: blue whale (*Balaenoptera musculus*), minke whale (*Balaenoptera acutorostrata*), Atlantic white-sided dolphin (*Lagenorhynchus acutus*), Clymene dolphin (*Stenella Clymene*), dwarf sperm whale (*Kogia sima*), pygmy sperm whale (*Kogia breviceps*), false killer whale (*Pseudorca crassidens*), Fraser's dolphin (*Lagenodelphis hosei),* killer whale (*Orcinus orca*), melon-headed whale (*Peponocephala electra*), northern bottlenose whale (*hyperoodon ampullatus*), pantropical spotted dolphin (*Stenella attenuate*), Risso's Dolphin (*Grampus griseus*), pygmy killer whale (*Feresa attenuate*), spinner dolphin (*Stenella longirostris*), striped dolphin (*Stenella coeruleoalba*), white-beaked dolphin (*Lagenorhynchus albirotris*), harp seal (*Pagophilus groenlandicus*), hooded seal (*Cystophora cristata*), and the West Indian manatee (Vigness-Raposa et al. 2010; Kraus et al. 2016; Roberts et al. 2016; Roberts et al. 2017; Roberts et al. 2018; Roberts et al. 2021; Hayes et al. 2022).

The majority of these species are highly migratory and are not expected to spend extended periods of time in a localized area. Additionally, the minke, sei, and blue whale are more pelagic and/or northern species, and their presence within the Survey Area is unlikely (Hayes et al. 2022). The West Indian manatee has been sighted in North Carolina waters; however, such events are infrequent. Because the potential for the West Indian manatee, blue whale, minke whale, Atlantic white-sided dolphin, and Risso's dolphin within the Survey Area is low and no take is requested, these species will not be described further in this analysis. The sperm, humpback, and fin whale are also unlikely to occur within the Survey Area; however, given these three species' ESA status and occasional occurrence, they have been included for further analysis.

Table 5. Marine mammal species that could be present within the Survey Area.

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Hearing Group[b]	Occurrence in the Survey Area[c]	Seasonality in the Survey Area[d]	Abundance[e] (NMFS Best Available)
Mysticetes					
Blue whale* (*Balaenoptera musculus*) Western North Atlantic Stock	Endangered/ Strategic	Low-frequency cetacean	Rare	Spring, Summer	402
Fin whale (*Balaenoptera physalus*) Western North Atlantic Stock	Endangered/ Strategic	Low-frequency cetacean	Regular	Year-round, but mainly spring, summer, and fall	6,802
Humpback whale (*Megaptera novaeangliae*) Gulf of Maine Stock	Not Listed/Not Strategic	Low-frequency cetacean	Regular	Year-round, but mainly spring and summer	1,396
Minke whale (*Balaenoptera acutorostrata*) Canadian East Coast Stock	Not Listed/Not Strategic	Low-frequency cetacean	Rare	Spring, summer, and winter	21,968
North Atlantic right whale (*Eubalaena glacialis*) Western North Atlantic Stock	Endangered/ Strategic	Low-frequency cetacean	Regular	Year-round	368
Sei whale (*Balaenoptera borealis*) Nova Scotia Stock	Endangered/ Strategic	Low-frequency cetacean	Uncommon	Spring and summer (March to June)	6,292
Odontocetes					
Atlantic spotted dolphin (*Stenella frontalis*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Common	Summer and fall	39,921
Atlantic white-sided dolphin (*Lagenorhynchus acutus*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	Winter	93,233
Clymene dolphin (*Stenella clymene*) Western North Atlantic Stock	MMPA Non-strategic	Mid-frequency cetacean	Rare	NA	4,237
Common bottlenose dolphin (*Tursiops truncatus*) Western North Atlantic Offshore Stock[h]	Not Listed/Not Strategic	Mid-frequency cetacean	Regular	Year-round	62,851

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Hearing Group[b]	Occurrence in the Survey Area[c]	Seasonality in the Survey Area[d]	Abundance[e] (NMFS Best Available)
Common bottlenose dolphin (*Tursiops truncatus truncatus*) Western North Atlantic Northern Migratory Coastal Stock	MMPA Depleted and Strategic	Mid-frequency cetacean	Common	Year-round	6,639
Common dolphin (*Delphinus delphis delphis*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Common	Year-round, but more abundant in fall and winter	172,974
Cuvier's beaked whale (*Ziphius cavirostris*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Uncommon	NA	21,818
Dwarf and pygmy sperm whale (*Kogia sima and K. breviceps*) Western North Atlantic Stock	Not Listed/Not Strategic	High-frequency cetacean	Rare	NA	7,750
False Killer Whale (*Pseudorca crassidens*) Western North Atlantic Stock	MMPA Depleted and Strategic	Mid-frequency cetacean	Rare	NA	1,791
Fraser's Dolphin (*Lagenodelphis hosei)* Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	Unknown
Harbor porpoise (*Phocoena phocoena*) Gulf of Maine/Bay of Fundy Stock	Not Listed/Not Strategic	High-frequency cetacean	Uncommon	Year-round, but less abundant in summer	95,543
Killer Whale (*Orcinus orca*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	Unknown
Melon-headed whale (*Peponocephala electra*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	Unknown
Mesoplodont Beaked Whales: Blainville's, Gervais', True's, and Sowerby's beaked whales (*Mesoplodon densitostris, M. europaeus, M. mirus, and M. bidens*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Uncommon	NA	10,107[f]
Northern Bottlenose Whale (*Hyperoodon ampullatus*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	Unknown

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Hearing Group[b]	Occurrence in the Survey Area[c]	Seasonality in the Survey Area[d]	Abundance[e] (NMFS Best Available)
Pantropical spotted dolphin (*Stenella attenuate*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	6,593
Pilot whale, long-finned (*Globicephalus melas*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Uncommon	Year-round	39,215
Pilot whale, short-finned (*Globicaphalus macrorhynchus*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Uncommon	Year-round	28,924
Pygmy Killer Whale (*Feresa attenuate*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	Unknown
Risso's dolphin (*Grampus griseus*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	Year-round	35,215
Rough Toothed Dolphin (*Steno bredanensis*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Regular	NA	136
Sperm whale (*Physeter macrocephalus*) North Atlantic Stock	Endangered/ Strategic	Mid-frequency cetacean	Uncommon	Mainly summer and fall	4,349
Spinner Dolphin (*Stenella longirostris*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	4,102
Striped dolphin (*Stenella coeruleoalba*) Western North Atlantic Stock	Not Listed/Not Strategic	Mid-frequency cetacean	Rare	NA	67,036
Whited-beaked Dolphin (*Lagenorhynchus albirotris*) Western North Atlantic Stock		Mid-frequency cetacean	Rare	NA	536,016
Pinnipeds					
Gray seal (Halichoerus grypus) Western North Atlantic Stock	Not Listed/Not Strategic	Phocid pinniped	Uncommon	Year-round	27,300
Harbor seal (*Phoca vitulina*) Western North Atlantic Stock	Not Listed/Not Strategic	Phocid pinniped	Uncommon	Year-round, but rare in summer	61,336

Common Name (Species Name) and Stock	ESA/MMPA Status[a]	Hearing Group[b]	Occurrence in the Survey Area[c]	Seasonality in the Survey Area[d]	Abundance[e] (NMFS Best Available)
Harp seal (*Pagophilus groenlandicus*) Western North Atlantic Stock	Not Listed/Not Strategic	Phocid pinniped	Rare	Winter and spring	7.6 M[g]
Hooded Seal (*Cystophora cristata*) Western North Atlantic Stock	Not Listed/Not Strategic	Phocid pinniped	Rare	Spring and Winter	Unknown
Sirenia Trichechidae					
West Indian Manatee (*Trichechus manatus*)	Threatened/ Strategic	Sirenian	Rare	Unknown	Unknown

* No occurrence of this species within the Survey Area (Navy 2007; NJDEP 2010)

[a] Listing status under the US Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA).

[b] Hearing group according to NMFS technical guidance (NMFS 2018a). NOTE: Hearing groups names were recently revised by Southall et al. (Southall et al. 2019).

[c] Occurrence in the Survey Area (Carolina Long Bay Area) is mainly derived from Hayes et al. (2022), Kenney and Vigness-Raposa (2010), Kraus et al. (2016), and Roberts et al. (2016).

[d] Seasonality in the Survey Area (Carolina Long Bay Area) is mainly derived from Kraus et al. (2016), Kenney and Vigness-Raposa (2010), and Roberts et al. (2016).

[e] "Best Available" population estimate is from NMFS 2019, 2020, and 2021 Draft Stock Assessment Report ((Hayes et al. 2019, 2020, 2022)).

[f] Mesoplodont beaked whale abundance estimate accounts for all undifferentiated beaked whale species within the Western Atlantic (2022).

[g] Hayes et al. (2022) report insufficient data to estimate the population size of harp seals in U.S. waters; however, the best estimate for the whole population is 7.6 million and this appears to be stable.

4 Affected Species Status and Distribution

As discussed in Section 3 above, 20 species and/or stocks of marine mammals are known to occur either commonly, uncommonly, or regularly within the Survey Area and surrounding waters (Table 5). The North Atlantic right whale (NARW), fin whale, sei whale, and sperm whale are all considered endangered under the ESA. These four species are also all considered strategic stocks under the *Marine Mammal Protection Act* (NMFS 2021g; Hayes et al. 2022). The northern migratory coastal and North Carolina estuarine system stock of common bottlenose dolphins, which are expected to have a common occurrence in the Survey Area are considered depleted under the MMPA and therefore a strategic stock. The sections below provide additional details on the distribution, abundance, and status of the marine mammal species or stocks that could occur in the Survey Area.

4.1 Mysticetes

4.1.1 Fin Whale (*Balaenoptera physalus*)

Fin whales off the eastern United States, Nova Scotia, and the southeastern coast of Newfoundland are believed to constitute a single stock under the present International Whaling Commission (IWC) management scheme (Donovan 1991), which has been called the Western North Atlantic stock.

Fin whales produce characteristic vocalizations that can be distinguished during passive acoustic monitoring (PAM) surveys (BOEM 2013; Erbe et al. 2017). The most commonly observed calls are the "20-Hz signals," a short down sweep falling from 30 to 15 Hz over a 1-sec period. Fin whales can also produce higher frequency sounds up to 310 Hz, and SLs as high as 195 dB re 1 µPa @ 1 m SPL_{rms} have been reported, making it one of the most powerful biological sounds in the ocean (Erbe et al. 2017). Anatomical modeling based on fin whale ear morphology suggests their greatest hearing sensitivity is between 20 Hz and 20 kHz (Cranford and Krysl 2015; Southall et al. 2019).

4.1.1.1 Distribution

The fin whale is the second largest baleen whale and is widely distributed in all the world's oceans but is most abundant in temperate and cold waters (Aguilar and Garcia-Vernet 2018). Fin whales are presumed to migrate seasonally between feeding and breeding grounds, but their migrations are less well defined than for other baleen whales. In the North Atlantic, some feeding areas have been identified but there are no known wintering areas (Aguilar and Garcia-Vernet 2018). Fin whales are found in the summer from Baffin Bay, Spitsbergen, and the Barents Sea south to North Carolina and the coast of Portugal (Rice 1998). Apparently not all individuals migrate, because in winter they have been sighted from Newfoundland to the Gulf of Mexico and the Caribbean Sea, and from the Faroes and Norway south to the Canary Islands (Rice 1998).

Western North Atlantic fin whales typically feed in the Gulf of Maine and the waters surrounding New England, but mating and calving (and general wintering) areas are largely unknown (Hain et al. 1992; Hayes et al. 2022). It is likely that fin whales occurring in the U.S. Atlantic EEZ undergo migrations into Canadian waters, open-ocean areas, and perhaps even subtropical or tropical regions. Hain et al. (Hain et al. 1992) suggest that calving takes place during October to January in Central Atlantic region.

Fin Whales can be found in the Carolina Long Bay Area during all four seasons; although, sighting data indicates that they are more abundant during winter, spring, and summer months (Hayes et al. 2022). Records show fin whales with the lowest abundance off North Carolina during the fall season; however, they have not been observed to fully depart from the area. Fin whales have been observed to exhibit habitat fidelity (Hayes et al. 2022). Stranding data indicate that calving may take place in the Central-Atlantic region during October through January for the fin whale (Hain et al. 1992).

4.1.1.2 Abundance

The best abundance estimate available for the Western North Atlantic stock is 6,802 based on data from NOAA shipboard and aerial surveys and the 2016 NEFSC and Department of Fisheries and Oceans Canada (DFO) surveys (Hayes et al. 2020). A population trend analysis does not currently exist for this species because of insufficient data; however, based on photographic identification, the gross annual reproduction rate is 8% with a mean calving interval of 2.7 years (Agler et al. 1993; Hayes et al. 2020).

4.1.1.3 Status

Fin whales are listed as Endangered under the ESA and are listed as Vulnerable by the International Union for Conservation of Nature (IUCN) Red List (Hayes et al. 2020; IUCN 2020). This stock is listed as strategic and depleted under the MMPA due to its Endangered status (Hayes et al. 2020). Potential Biological Removal (PBR) for the western North Atlantic fin whale is 11 (Hayes et al. 2020). PBR being the product of minimum population size, one-half the maximum net productivity rate and recovery factor for endangered, depleted, threatened, or stocks of unknown status relative to the optimal sustainable population (OSP) (Hayes et al. 2020). Annual human-caused mortality and serious injury for the period between 2015 and 2019 was estimated to be 1.8 per year (Hayes et al. 2022). This estimate includes incidental fishery interactions (i.e., bycatch/entanglement) and vessel collisions, but other threats to fin whales include contaminants in their habitat and potential climate-related shifts in distribution of prey species (Hayes et al. 2020). Vessel strike may be a more serious threat to fine whales. Past records on mortality reported by NMFS data indicate that four fin whales were confirmed killed by collision from 2014 – 2018 (Hayes et al. 2022). A review of recent NOAA Fisheries records from 2014 through 2018 confirm an additional nine reports observed of fin whales entangled with fishing gear in the U.S. and Canada North Atlantic waters (Hayes et al. 2022). There is no designated critical habitat for this species in or near the Survey Area.

4.1.2 Humpback Whale (*Megaptera novaeangliae*)

Humpback whale females are larger than males and can reach lengths of up to 18 m (60 ft) (NMFS 2021d). Body coloration is primarily dark gray, but individuals have a variable amount of white on their pectoral fins, belly, and flukes. These distinct coloration patterns are used by scientists to identify individuals. These baleen whales feed on small prey often found in large concentrations, including krill and fish such as herring and sand lance (Kenney and Vigness-Raposa 2010). Humpback whales use unique behaviors, including bubble nets, bubble clouds, and flicking of their flukes and fins, to herd and capture prey (NMFS 1991).

During migration and breeding seasons, male humpback whales are often recorded producing vocalizations arranged into repetitive sequences termed “songs” that can last for hours or even days. These songs have been well studied in the literature to document changes over time and geographic differences. Generally, the frequencies produced during these songs range from 20 Hz to over 24 kHz.

Most of the energy is focused between 50 and 1,000 Hz and reported SLs range from 151 to 189 dB re 1 μPa @ 1 m SPL_{rms} (Erbe et al. 2017). Other calls produced by humpbacks, both male and female, include pulses, moans, and grunts used for foraging and communication. These calls are lower frequency (under 2 kHz) with SLs ranging from 162 to 190 dB re 1 μPa @ 1 m SPL_{rms} (Thompson et al. 1986; Erbe et al. 2017). Anatomical modeling based on humpback whale ear morphology indicate that their best hearing sensitivity is between 18 Hz and 15 kHz (Ketten et al. 2014; Southall et al. 2019).

4.1.2.1 Distribution

Humpback whales are found in all ocean basins (Clapham 2018). This species is highly migratory, traveling between mid- to high-latitude waters where it feeds during spring through fall and lower latitude wintering grounds where it calves and generally does not feed. Routine migratory distances are thousands of kilometers (Kennedy et al. 2014). Although considered to be mainly a coastal species, humpback whales often traverse deep pelagic areas while migrating (Baker et al. 1998; Calambokidis et al. 2001; Garrigue et al. 2002). In the North Atlantic, six separate humpback whale sub-populations have been identified by their consistent maternally determined fidelity to different feeding areas (Clapham and Mayo 1987). These populations are found in the Gulf of Maine, Gulf of St. Lawrence, Newfoundland/Labrador, western Greenland, Iceland, and Norway (Hayes et al. 2022). The large majority of humpback whales that inhabit the waters in the U.S. Atlantic EEZ belong to the Gulf of Maine stock. In the western North Atlantic, the Gulf of Maine humpback whale stock is recognized as a distinct feeding stock on the basis of strong site fidelity by individual whales to the region and more recent genetic analysis (Palsbøll et al. 2001; Vigness-Raposa et al. 2010; Hayes et al. 2022).

Humpback whales in the Gulf of Maine stock typically feed in waters between the Gulf of Maine and Newfoundland during spring, summer, and fall, but have been observed feeding in other areas, such as off the coast of New York (Sieswerda et al. 2015). Some humpback whales from the Gulf of Maine migrate to the West Indies in the winter, where they mate and calve their young (Katona and Beard 1990; Palsbøll et al. 1997). However, not all humpback whales from the Gulf of Maine stock migrate to the West Indies every winter because significant numbers of animals are observed in mid- and high-latitude regions at this time (Swingle et al. 1993).

Humpback whales utilize the Carolina Long Bay Area as a migration pathway between calving/mating grounds to the south and feeding grounds in the north (Hayes et al. 2022). Since 1989, observations of juvenile humpbacks in the Central-Atlantic and Carolina Long Bay Area have been increasing during the winter months, peaking between January through March (Swingle et al. 1993). Biologists theorize that non-reproductive animals may be establishing a winter-feeding range in the Central-Atlantic since they are not participating in reproductive behavior in the Caribbean. Swingle et al. (1993) identified a shift in distribution of juvenile humpback whales in the nearshore waters of Virginia, primarily in winter months. Similarly, increased levels of juvenile humpback whale strandings have been reported along the North Carolina coasts (Wiley et al. 1995). Humpback whales are expected to occur within the Carolina Long Bay Area most frequently during fall, winter, and spring months (Hayes et al. 2019).

4.1.2.2 Abundance

The best available abundance estimate of the Gulf of Maine stock is 1,396, derived from modeled sighting histories constructed using photo-identification data collected through October 2016 (Hayes et al.

2020). Available data indicate that this stock is characterized by a positive population trend, with an estimated increase in abundance of 2.8% per year (Hayes et al. 2020).

4.1.2.3 Status

NMFS revised the listing status for humpback whales under the ESA in 2016 (81 FR 62260 2016). Globally, there are 14 distinct population segments (DPSs) recognized for humpback whales, four of which are listed as Endangered. The Gulf of Maine stock (formerly known as the Western North Atlantic stock) which occurs in the Survey Area is considered non-strategic under the MMPA and does not coincide with any ESA-list DPS (Hayes et al. 2020). This stock is considered non-strategic because the detected level of U.S. fishery-caused mortality and serious injury derived from the available records do not exceed the calculated PBR of 22, with a set recovery factor at 0.5 (Hayes et al. 2019). Because the observed mortality is estimated to be only 20% of all mortality, total annual mortality may be 60-70 animals in this stock (Hayes et al. 2019). If anthropogenic causes are responsible for as little as 31% of potential total mortality, this stock could be over PBR. While detected mortalities yield an estimated minimum fraction anthropogenic mortality at 0.85, additional research is being done before apportioning mortality to anthropogenic versus natural causes for undetected mortalities and making a potential change to the MMPA status of this stock. A UME was declared for this species in January 2016, which as of August 2022 has resulted in 161 stranded humpback whales, with 22 occurring in North Carolina and 1 occurring in South Carolina (Hayes et al. 2020; NMFS 2022a). Major threats to humpback whales include vessel strikes, entanglement, and climate-related shifts in prey distribution (Hayes et al. 2020). There is no designated critical habitat for this stock in the Survey Area.

4.1.3 North Atlantic Right Whale (*Eubalaena glacialis*)

NARWs are among the rarest of all marine mammal species in the Atlantic Ocean. They average approximately 15 m (50 ft) in length (NMFS 2021h). They have stocky, black bodies with no dorsal fin, and bumpy, coarse patches of skin on their heads called callosities. NARWs feed mostly on zooplankton and copepods belonging to the *Calanus* and *Pseudocalanus* genera (Hayes et al. 2020). NARWs are slow-moving grazers that feed on dense concentrations of prey at or below the water's surface, as well as at depth (NMFS 2021h). Research suggests that NARWs must locate and exploit extremely dense patches of zooplankton to feed efficiently (Mayo and Marx 1990). These dense zooplankton patches are a primary characteristic of the spring, summer, and fall NARW habitats (Kenney et al. 1995). NARWs are usually observed in groups of less than 12 individuals, and most often as single individuals or pairs. Larger groups may be observed in feeding or breeding areas (Jefferson et al. 2008).

NARW vocalizations most frequently observed during PAM studies include upsweeps rising from 30 to 450 Hz, often referred to as "upcalls," and broadband (30 to 8,400 Hz) pulses, or "gunshots," with SLs between 172 and 187 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). However, recent studies have shown that mother-calf pairs reduce the amplitude of their calls in the calving grounds, possibly to avoid detection by predators (Parks et al. 2019). Modeling conducted using right whale ear morphology suggest that the best hearing sensitivity for this species is between 16 Hz and 25 kHz (Ketten et al. 2014; Southall et al. 2019).

4.1.3.1 Distribution

The NARW is a migratory species that travels from high-latitude feeding waters to low-latitude calving and breeding grounds, though this species has been observed feeding in winter in the Central-

Atlantic and Carolina Long Bay Area (Whitt et al. 2013). These whales undertake a seasonal migration from their northeast feeding grounds (generally spring, summer, and fall habitats) south along the U.S. east coast to their calving grounds in the waters of the southeastern U.S. (Kenney and Vigness-Raposa 2010).

NARWs are considered to be comprised of two separate stocks: Eastern and Western Atlantic stocks. The Eastern North Atlantic stock was largely extirpated by historical whaling (Aguilar 1986). NARWs in U.S. waters belong to the Western Atlantic stock. This stock ranges primarily from calving grounds in coastal waters of the southeastern U.S. to feeding grounds in New England waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence (Hayes et al. 2018). Since 2010, NARWs have been declining in and around once key habitats in the Gulf of Maine and the Bay of Fundy (Davies et al. 2015; Davis et al. 2017), while sightings have increased in other areas including Cape Cod Bay, Massachusetts Bay, the Mid-Atlantic Bight, and the Gulf of St. Lawrence (Whitt et al. 2013; Davis et al. 2017; Mayo et al. 2018; Davies and Brillant 2019; Ganley et al. 2019; Charif et al. 2020). An 8-year analysis of NARW sightings within Southern New England (SNE) show that the NARW distribution has been shifting (Quintana-Rizzo et al. 2021). The study area of SNE (shores of Martha's Vineyard and Nantucket to and covering all the offshore wind lease sites of Massachusetts and Rhode Island) recorded sightings of NARWs in almost all months of the year with the highest sighting rates occurring during winter months into early spring (Quintana-Rizzo et al. 2021).

The winter distribution of NARWs is largely unknown. Some evidence provided through acoustic monitoring suggests that not all individuals of the population participate in annual migrations, with a continuous presence of NARWs occupying their entire habitat rage throughout the year, particularly north of Cape Hatteras (Davis et al. 2017). These data also recognize changes in population distribution throughout the NARW habitat range that could be due to environmental or anthropogenic effects, a response to short-term changes in the environment, or a longer-term shift in the NARW distribution cycle (Davis et al. 2017). A climate-driven shift in the Gulf of Maine/western Scotian Shelf region occurred in 2010 and impacted the foraging environment, habitat use, and demography of the NARW population (Meyer-Gutbrod et al. 2021). In 2010, the number of NARWs returning to the traditional summertime foraging grounds in the eastern Gulf of Maine/Bay of Fundy region began to decline rapidly (Davies et al. 2019; Davies and Brillant 2019; Record et al. 2019). Despite considerable survey effort, the location of most of the population during the 2010-2014 foraging seasons are largely unknown; however, sporadic sightings and acoustic detections in Canadian waters suggest a dispersed distribution (Davies et al. 2019) and a significant increase in the presence of whales in the southern Gulf of St. Lawrence beginning in 2015 (Simard et al. 2019). During a single winter season, one NARW was observed in waters offshore northeastern Florida, Cape Cod, southeastern Georgia, and Cape Cod once more exhibiting a possible Southeast round-trip migration (Brown and Marx 2000).

Surveys demonstrate the existence of seven areas where NARWs congregate seasonally: the coastal waters of the southeastern US, 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 (Hayes et al. 2018). National Oceanic and Atmospheric Administration (NOAA) Fisheries has designated two critical habitat areas for the NARW under the ESA: the Gulf of Maine/Georges Bank region, and the southeast calving grounds from North Carolina to Florida (DoC 2016). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009).

NARW are most common in the Carolina Long Bay Area in the spring (late March) during their northern migration and in the fall (i.e., October and November) during their southern migration (NMFS 2017). Right whales use the offshore waters in the Carolina Long Bay Area including North Carolina during seasonal movements north or south between their feeding and breeding grounds (Knowlton et al. 2002; Firestone et al. 2008). Right whales have been observed in or near North Carolina from October – December, as well as in February and March, which aligns with the migratory timeframe for this species (Knowlton et al. 2002). They have been acoustically detected off Georgia and North Carolina in seven of eleven months monitored (Hodge et al. 2015). Reports from the Right Whale Sightings Advisory System (RWSAS) show 12 visual records in the Carolina Long Bay area since January 2020 (NMFS 2022c).

4.1.3.2 Abundance

The Western North Atlantic population size was estimated to be 368 individuals in the most recent draft 2021 SAR, which used data from the photo-identification database maintained by the New England Aquarium that were available in October 2019 (Hayes et al. 2022). However, the Right Whale Consortium 2020 Report Card estimates the NARW population to be 336 individuals (Pettis et al. 2021). A population trend analysis conducted on the abundance estimates from 1990 to 2011 suggest an increase at about 2.8% per year from an initial abundance estimate of 270 individuals in 1998 to 481 in 2011, but there was a 100% chance the abundance declined from 2011 to 2019 when the final estimate was 368 individuals (Hayes et al. 2022). Based on the abundance estimates between 2011 and 2019, there was an overall abundance decline of 23.5% (CI= 21.4 to 26%) (Hayes et al. 2022). Modeling conducted by Pace et al. (2021) showed a decline in annual abundance after 2011, which has likely continued as evidenced by the decrease in the abundance estimate from 451 in 2018 (Hayes et al. 2019) to 412 in 2020 (Hayes et al. 2020). Highly variable data exists regarding the productivity of this stock. Over time, there have been periodic swings of per capita birth rates (Hayes et al. 2020). Net productivity rates do not exist as the Western North Atlantic stock lacks any definitive population trend (Hayes et al. 2020).

4.1.3.3 Status

The NARW is listed as Endangered under the ESA and are listed as Critically Endangered by the IUCN Red List (Hayes et al. 2020; IUCN 2020). NARWs are considered to be the most critically Endangered large whales in the world (Hayes et al. 2019). The average annual human-related mortality/injury rate exceeds that of the calculated PBR of 0.7, classifying this population as strategic and depleted under the MMPA (Hayes et al. 2022). Estimated human-caused mortality and serious injury between 2015 and 2019 was 7.7 whales per year (Hayes et al. 2022). Using refined methods of Pettis et al. (2021), the estimated annual rate of total mortality for the period of 2014-2018 was 27.4, which is 3.4 times larger than the 8.15 total derived from reported mortality and serious injury for the same period (Hayes et al. 2022).

The predominant threats to NARWs are entanglement and vessel collisions. Available data from 2000 to 2017 suggest an increase in the percent of injuries and mortalities (per capita) caused by entanglement (Hayes et al. 2020). There have been elevated numbers of mortalities reported since 2017 and continuing to through 2021 totaling 34 dead NARWs which prompted NMFS to designate an Unusual Mortality Event (UME) for NARWs (NMFS 2022b). This includes 21 dead stranded whales in Canada and 13 in the United States. The leading category for the cause of death for this UME is “human interaction”, specifically from entanglements or vessel strikes” (NMFS 2022b). In addition to the documented mortalities, since 2017, seventeen individuals have been documented with serious injury resulting from entanglement and two have been reported with serious injury resulting from a vessel strike (NMFS 2022b).

To protect this species from ship strikes, NMFS designated Seasonal Management Areas (SMAs) in U.S. waters in 2008 (NMFS 2008). All vessels greater than 65 ft in overall length must operate at speeds of 10 knots or less within these areas during specific time periods. The Mid-Atlantic SMA is active between November 1 and April 30 each year when right whales are most likely to pass through these waters. The proposed Survey Area has components located both within and outside of the right whale Chesapeake Bay SMA along the mouth of the Chesapeake Bay and the North Carolina-Georgia Coast SMA. In addition, the rule provides for the establishment of Dynamic Management Areas (DMAs) when and where NARWs are sighted outside SMAs. DMAs are generally in effect for two weeks and the 10 knots or less speed restriction is voluntary.

NMFS has designated two critical habitat areas for the NARW under the ESA: the Gulf of Maine/Georges Bank region and the southeast calving grounds from North Carolina to Florida (NMFS 2016). Two additional critical habitat areas in Canadian waters, Grand Manan Basin and Roseway Basin, were identified in Canada's final recovery strategy for the NARW (Brown et al. 2009). As of January 26, 2016, NMFS expanded the NARW critical habitat Southeastern U.S. calving area from Cape Fear, North Carolina, southward to 29 degrees N latitude (approximately 69 km north of Cape Canaveral, Florida) (Hayes et al. 2022). The Survey Area overlaps with the Southeastern U.S. calving area critical habitat (NMFS 2016; Hayes et al. 2022). The Survey Area also overlaps with a BIA for migration of NARWs. Based on the current knowledge of right whale occurrence, the establishment of SMAs around approaches to Chesapeake Bay and the overlap with the NARW calving area and migration BIAs, right whales have the potential to occur in the Survey Area, particularly during peak migration times. NARWs are expected to be common within the Survey Area, except during summer months.

4.2 Odontocetes

4.2.1 Atlantic Spotted Dolphin (*Stenella frontalis*)

There are two species of spotted dolphins in the Atlantic Ocean, the Atlantic spotted dolphin (*Stenella frontalis*). and the pantropical spotted dolphin (*Stenella attenuata*) (Perrin 1987). In addition, two forms of the Atlantic spotted dolphin exist: one that is large and heavily spotted and usually inhabits the continental shelf, and the other is smaller in size with less spots and occurs in the Atlantic Ocean but is not known to occur in the Gulf of Mexico (Fulling and Fertl 2003; Mullin and Fulling 2003; Viricel and Rosel 2014). Where they co-occur, the offshore form of the Atlantic spotted dolphin and the pantropical spotted dolphin can be difficult to differentiate (Hayes et al. 2022). Atlantic spotted dolphins in the western Atlantic belong to the Western North Atlantic stock (Hayes et al. 2022). The Atlantic spotted dolphin diet consists of a wide variety of fish and squid, as well as benthic invertebrates (Herzing 1997). Its hearing is in the mid-frequency range (Southall et al. 2007b). They have an auditory bandwidth of 150 Hz to 160 kHz with vocalizations typically ranging from 100 Hz to 130 kHz (DoN 2008).

4.2.1.1 Distribution

The Atlantic spotted dolphin prefers tropical to warm temperate waters along the continental shelf 10 to 200 m (33 to 650 ft) deep to slope waters greater than 500 m (1,640 ft) deep. It has been suggested that the species may move inshore seasonally during the spring, but data to support this theory are limited (Caldwell and Caldwell 1966; Fritts et al. 1983). They occur in the U.S. Atlantic waters year-round, ranging from the Central Atlantic south through the Caribbean and the Gulf of Mexico (Hayes et al. 2022). This species inhabits inshore waters and along the continental shelf edge and slope, with sightings concentrated north of Cape Hatteras.

Atlantic spotted dolphins regularly occur in the inshore waters of Chesapeake Bay as well as 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 (Waring et al. 2015). Atlantic spotted dolphins were observed during 2021 HRG surveys offshore North Carolina during the months of September – December (Marine-Ventures 2022). Spotted dolphins were also observed during all seasons except winter during 2019 digital aerial baseline surveys in a nearby survey area (Normandeau-APEM 2020).

4.2.1.2 Abundance

The best available abundance estimate for Atlantic spotted dolphins is 39,921 from 2016 surveys (Hayes et al. 2022).

4.2.1.3 Status

The Atlantic spotted dolphin is not listed under the ESA and is not considered strategic under the MMPA. There have been no recent UMEs declared for the Atlantic spotted dolphin. No fishing-related mortality of spotted dolphin was reported for 1998 through 2003 (Yeung 1999, 2001; Garrison 2003; Garrison and Richards 2004). From 2007 through 2011, the estimated mean annual fishery-related mortality and serious injury for this species was 42 Atlantic spotted dolphins (Hayes et al. 2017). More recent observer data are not available. The commercial fisheries that interact or potentially interact with the Atlantic spotted dolphin are the pelagic longline fishery and the shrimp trawl fishery (Hayes et al. 2017). From 2013 – 2017, 21 Atlantic spotted dolphins were reported stranded between North Carolina and Florida (Hayes et al. 2020). It could not be determined whether there was evidence of human interaction for 9 of these strandings, and for 12 dolphins, no evidence of human interaction was detected (Hayes et al. 2020). However, stranding data likely underestimates the extent of fishery-related mortality (and serious injury) because not all of the marine mammals that die or are seriously injured are reported.

4.2.2 Common Bottlenose Dolphin (*Tursiops truncatus*)

Bottlenose dolphins are one of the most well-known and widely distributed species of marine mammal, found in most warm temperate and tropical seas in coastal as well as offshore waters (Wells and Scott 2018). These dolphins reach 2–4 m (6–12.5 ft) in length (NMFS 2021a). The snout is stocky and set off from the head by a crease. They are typically light to dark grey in color with a white underside (Jefferson et al. 1993). They are commonly found in groups of two to 15 individuals, though aggregations of more than 1,000 individuals have been reported. They are considered generalist feeders and consume a wide variety of organisms, including fish, squid, and shrimp and other crustaceans (Jefferson et al. 2008).

Whistles produced by bottlenose dolphins can vary over geographic regions, and newborns are thought to develop “signature whistles” within the first few months of their lives that are used for intraspecific communication. Whistles generally range in frequency from 300 Hz to 39 kHz with SLs between 114 and 163 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). Bottlenose dolphins also make burst-pulse sounds and echolocation clicks, which can range from a few kHz to over 150 kHz. As these sounds are used for locating and capturing prey, they are directional calls; the recorded frequency and sound level can vary depending on whether the sound was received head-on or at an angle relative to the vocalizing dolphin. SLs for burst-pulses and clicks range between 193 and 228 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). There are sufficient available data for bottlenose dolphin hearing sensitivity using both behavioral and AEP methods as well as anatomical modeling studies, which show hearing for the species is most sensitive between approximately 400 Hz and 169 kHz (Southall et al. 2019).

4.2.2.1 Distribution

The common bottlenose dolphin is a cosmopolitan species that occurs in temperate and tropical waters worldwide. There are two distinct morphotypes of bottlenose dolphin: migratory coastal and offshore (Hersh and Duffield 1990; Mead and Potter 1995; Curry and Smith 1997; Rosel et al. 2009). The offshore morphotype inhabits outer continental shelf and slope regions from Georges Bank to the Florida Keys, and the coastal morphotype is continuously distributed south of Long Island, New York into the Gulf of Mexico (Hayes et al. 2022). The migratory coastal bottlenose dolphins often move into or reside in water typically less than 20-25 m deep, along the inner continental shelf (within 7.5 km of shore) and around islands (Hayes et al. 2022). The migratory coastal bottlenose dolphins are subdivided into seven stocks, two of which occur in the mid-Atlantic region, but only one of which is likely to occur in the Survey Area. Therefore, two stocks may be found in the vicinity of the Survey Area, the Western North Atlantic Southern Migratory Coastal Stock (WNASMCS) and the Western North Atlantic Offshore Stock (WNAOS).

North of Cape Hatteras the offshore and coastal morphotypes are separated by bathymetric contours during summer months. Aerial surveys flown from 1979 through 1981 indicated a concentration of 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. 2019). Torres et al. (2003) found a statistically significant break in the distribution of the morphotypes; almost all dolphins found in waters >34 m 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. 2019). This stock migrates south during late summer and fall, and during colder months it occupies waters off Virginia and North Carolina (Hayes et al. 2019). Therefore, during the summer, dolphins found inside the 20-m isobath in the Survey 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.

The WNASMCS is the coastal stock found south of Assateague, Virginia, to northern Florida, and is liked to be encountered within the Survey Area. These dolphins move into or reside in bays, estuaries, the lower reaches of rivers, and coastal waters within the 25 m depth isobath when north of Cape Hatteras (Reeves et al. 2002; Waring et al. 2016). From October to December, this stock is mostly found in southern North Carolina (south of Cape Lookout). They migrate further south between January through March as far as northern Florida and move back north to coastal North Carolina from April to June. WNASMCS bottlenose dolphins occupy waters north of Cape Lookout to as far north as Chesapeake Bay from July to August (Hayes et al. 2022).

WNAOS dolphins are distributed widely during the spring and summer months from Georges Bank to the Florida Keys, with late summer and fall sightings as far north as the Gulf of Maine depending on water temperature (Kenney 1990; Hayes et al. 2017). Dolphins of the WNAOS reside along outer portions of the continental shelf and over the continental slope. These dolphins are typically found seaward of 34 km and in water with depths greater than 34 km (Torres et al. 2003), but WNAOS dolphins have been found as close as 7.3 km from the shore in water depths of 13 m (Hayes et al. 2017). Therefore, the range of this stock south of Cape Hatteras has recently been found to overlap with that of the WNASMCS stock.

Both stocks described are expected to occur within the vicinity of the Survey Area offshore North Carolina. Bottlenose dolphins were observed during the months of July–November during 2019 HRG surveys in a nearby survey area (Tetra-Tech 2022). Additional digital aerial baseline surveys in a nearby survey area off the coast of North Carolina observed bottlenose dolphins in the months of January and March (Normandeau-APEM 2020).

4.2.2.2 Abundance

The best abundance estimate for the Western North Atlantic offshore stock is 62,851 based on recent surveys between the lower Bay of Fundy and Florida (Hayes et al. 2020). A population trend analysis for the offshore stock was conducted using abundance estimates from 2004, 2011, and 2016, which show no statistically significant trend (Hayes et al. 2020). The best abundance estimate for the Western North Atlantic Southern Migratory Coastal stock is estimated at approximately 3,751 derived from aerial surveys conducted during the summer of 2016 covering coastal and shelf waters from Florida to New Jersey (Hayes et al. 2020).

4.2.2.3 Status

Common bottlenose dolphins of the Western North Atlantic are not listed as threatened or endangered under the ESA. The Western North Atlantic Offshore Stock is not considered strategic under the MMPA (Hayes et al. 2022). However, the Western North Atlantic Southern Migratory Coastal stock of common bottlenose dolphins is considered strategic by NMFS because it is listed as depleted under the MMPA (Hayes et al. 2020). The PBR for the Offshore Stock is 519, and the average annual human-cause mortality and serious injury from 2013-2017 was estimated to be 28, attributed to fisheries interactions (Hayes et al. 2022). The PBR for the Southern Migratory Coastal stock is 24, and the average annual human-cause mortality and serious injury from 2014-2018 is unknown (Hayes et al. 2020). The largest threat to the population is bycatch, as they are frequently caught in fishing gear, gillnets, purse seins, and shrimp trawls (Hayes et al. 2020). In addition to fisheries, threats to common bottlenose dolphins include non-fishery related human interaction; anthropogenic noise; offshore development; contaminants in their habitat; and climate-related changes in prey distribution (Hayes et al. 2020). There is no designated critical habitat for either stock in the Survey Area.

4.2.3 Common Dolphin (*Delphinus delphis delphis*)

Until very recently, short-beaked and long-beaked common dolphins were thought to be separate species but evidence now suggests that this character distinction is based on ecology rather than genetics (Perrin 2018). Cunha et al. (2015) summarized the relevant data and analyses, along with additional molecular data and analysis, and recommended that the long-beaked common dolphin not be further used for the Atlantic stock. Common dolphins can reach 2.7 m (9 ft) in length and have a distinct color pattern with a white ventral patch, yellow or tan flank, and dark gray dorsal "cape" (NMFS 2021i). This species feeds on schooling fish and squid found near the surface at night (NMFS 2021i). They have been known to feed on fish escaping from fishermen's nets or fish that are discarded from boats (NMFS 1993). This highly social and energetic species usually travels in large pods consisting of 50 to >1,000 individuals

(Cañadas and Hammond 2008). The common dolphin can frequently be seen performing acrobatics and interacting with large vessels and other marine mammals. These dolphins occur in schools of hundreds or thousands of individuals and often associate with pilot whales or other dolphin species (Perrin 2018). The common dolphins occurring in the Survey Area would belong to the subspecies *Delphinus delphis delphis* and be of the short-beaked variety (Perrin 2018).

Common dolphin clicks are broadband sounds between 17 and 45 kHz with peak energy between 23 and 67 kHz. Burst-pulse sounds are typically between 2 and 14 kHz while the key frequencies of common dolphin whistles are between 3 and 24 kHz (Erbe et al. 2017). No hearing sensitivity data are available for this species (Southall et al. 2019).

4.2.3.1 Distribution

The common dolphin is one of the most abundant and widely distributed cetaceans, occurring in warm temperate and tropical regions worldwide from about 60°N to 50°S (Perrin 2018). Within the U.S. Atlantic EEZ, common dolphins general occur from Cape Hatteras, North Carolina to the Scotian Shelf (Hayes et al. 2020). This species is highly seasonal and migratory. In the U.S. Atlantic EEZ, they are distributed along the continental shelf between the 100- and 2,000-m isobaths (328–6,561.6 ft) and are associated with Gulf Stream features (CeTAP 1982; Selzer and Payne 1988; Hamazaki 2002; Hayes et al. 2019). Common dolphins occur 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 fall (Selzer and Payne 1988). Migration onto the Scotian Shelf and continental shelf off Newfoundland occurs when water temperatures exceed 11°C (51.8°F) (Sergeant et al. 1970; Gowans and Whitehead 1995). Breeding usually takes place between the months of June and September and females have an estimated calving interval of two to three years (Hayes et al. 2018).

This species is less common south of Cape Hatteras. Although pods have been reported as far south as the Georgia/South Carolina border and points south (Jefferson et al. 2015; Hayes et al. 2022). Common dolphins were observed off the coast of North Carolina during HRG surveys in a nearby survey area during the months of March and January 2019 (Normandeau-APEM 2020).

4.2.3.2 Abundance

The best population estimate in the US Atlantic EEZ for the Western North Atlantic common dolphin is 70,184 (Hayes et al. 2018) while Roberts et al. (2016) habitat-based density models provide an abundance estimate of 86,098 common dolphins in the US Atlantic EEZ. The current best abundance estimate for the entire Western North Atlantic stock is 172,974 based on recent surveys conducted between Newfoundland and Florida (Hayes et al. 2020). A trend analysis was not conducted for this stock because of the imprecise abundance estimate and long survey intervals (Hayes et al. 2020).

4.2.3.3 Status

The common dolphin is not listed under the ESA and is classified as Least Concern by the IUCN Red List (Hayes et al. 2020; IUCN 2020). Historically, this species was hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from vessel collisions and Eastern North American fishing activities within the Atlantic, most prominently yellowfin tuna (*Thunnus albacares*) nets, driftnets, and bottom-set gillnets (Kraus et al. 2016; Hayes et al. 2020). The common dolphin faces anthropogenic threats because of its utilization of nearshore habitat and highly social nature, but it is not considered a strategic stock under the MMPA because the average annual human-caused mortality and serious injury does not exceed the calculated PBR of 1,452 for this stock (Hayes et al. 2020). The annual estimated human-caused mortality and serious injury for 2015 to 2019 was 390.4, which included fishery-interactions and research takes (Hayes et al. 2022). Other threats to this species include contaminants in their habitat and climate-related changes in prey distribution (Hayes et al. 2020). There is no designated critical habitat for this stock in the Survey Area.

4.2.4 Cuvier's Beaked Whale (*Ziphius cavirostris*)

Cuvier's beaked whales have the most extensive range of all beaked whale species and are distributed globally in tropical, subtropical, and temperate oceans of the world (Perrin 2009). Coloration for this species ranges from dark gray to reddish brown, with a lighter counter-shaded stomach. A reddish-brown to orange yellow coloration can be attributed to infestations of microscopic diatoms and algae. The species can be identified by a sloping, concave head with no obvious melon, an indistinct beak, and a large slit-like blowhole (Perrin 2009). The Cuvier's beaked whale has a slight upturn in the mouth making the whale to appear as though it is smiling. Little is known about the feeding preferences of Cuvier's beaked whales; however, they may feed on cephalopods and fish within the mid-water column and the seafloor (Perrin et al. 2009). Cuvier's beaked whales are mid-frequency cetaceans (NMFS 2018a).

4.2.4.1 Distribution

Cuvier's beaked whales prefer deep pelagic waters with bottom depths exceeding 1,100 m along the continental slope edge and are known to favor steep underwater geological features such as banks, seamounts, and submarine canyons. They are also occasionally sighted in boral waters. Strandings have been reported from Nova Scotia to Florida and the Caribbean.

The species can be found year-round within the Carolina Long Bay Area off the coast of North Carolina (Hayes et al. 2019). Roberts et al. (2018) data demonstrates the potential occurrence of beaked whales within the Carolina Long Bay Area, with an increased potential for beaked whales to occur in more shallow regions off the coast of North Carolina.

4.2.4.2 Abundance

The best available abundance estimate for Cuvier's beaked whale is 5,744 individuals based on surveys conducted in 2016 from central Florida to the lower Bay of Fundy (Garrison 2020; Palka 2020; Hayes et al. 2022). Due to insufficient sighting data, the stock structure is unknown for this species. However, because the stock occupies multiple marine ecoregions and tagged individuals have been exhibited restricted movements and site fidelity, it is possible that the western North Atlantic stock contains multiple demographically independent populations (Hayes et al. 2022).

4.2.4.3 Status

The Cuvier's beaked whale is not ESA listed and is not considered strategic under the MMPA (Hayes et al. 2022). The PBR for the stock is 43 and the estimated human-caused annual mortality and serious injury from 2013 – 2017 averaged 0.2 animals per year. This is based on a single stranding record that reported signs of human interaction (plastic ingestion) (Hayes et al. 2019). Internationally, small numbers of Cuvier's beaked whales have been directly hunted in fisheries in Japan, and more have been caught incidentally by fisheries in the Caribbean Sea, Chile, Indonesia, Peru, and Taiwan. Other incidents resulting in mass stranding of beaked whales have occurred globally and been associated with naval activities (Hayes et al. 2019).

4.2.5 Harbor Porpoise (*Phocoena phocoena*)

This species is among the smallest of the toothed whales and is the only porpoise species found in Northeastern U.S. waters. A distinguishing physical characteristic is the dark stripe that extends from the flipper to the eye. The rest of its body has common porpoise features; a dark gray back, light gray sides, and small, rounded flippers (Jefferson et al. 1993). It reaches a maximum length of 1.8 m (6 ft) and feeds on a wide variety of small fish and cephalopods (Reeves and Read 2003; Kenney and Vigness-Raposa 2010). They are usually seen in small groups of one to three; occasionally they form much larger groups (Bjørge and Tolley 2018).

Harbor porpoises produce high frequency clicks with a peak frequency between 129 and 145 kHz and an estimated SLs that ranges from 166 to 194 dB re 1 µPa @ 1 m SPL_{rms} (Villadsgaard et al. 2007). Available data estimating auditory sensitivity for this species suggest that they are most receptive to noise between 300 Hz and 160 kHz (Southall et al. 2019).

4.2.5.1 Distribution

The harbor porpoise inhabits cool temperate to subarctic waters of the Northern Hemisphere, generally within shallow coastal waters of the continental shelf but occasionally traveling over deeper, offshore waters (Jefferson et al. 2008). There are likely four populations in the western North Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Gaskin 1984; Hayes et al. 2019). Individuals found in the Survey Area would be almost exclusively from the Gulf of Maine/Bay of Fundy stock. During summer months (July through September), harbor porpoises from the Gulf of Maine/Bay of Fundy stock are concentrated along the continental shelf within the northern Gulf of Maine and southern Bay of Fundy region (Hayes et al. 2022). During fall months (October through December) and spring months (April through June), they are more widely dispersed from New Jersey to Maine. During winter months (January through March), they range from New Brunswick, Canada, to North Carolina (Hayes et al. 2022).

Harbor porpoises are likely to occur in the waters of the Central-Atlantic and Carolina Long Bay Area during winter months, as this species prefers cold-temperate and subarctic waters (Hayes et al. 2022). Harbor porpoises generally move out of this region during spring months as they migrate north to the Gulf of Maine. One harbor porpoise was sighted in January off the coast of North Carolina during HRG surveys in a nearby survey area in 2019 (Normandeau-APEM 2020).

4.2.5.2 Abundance

The best available abundance estimate for the Gulf of Maine/Bay of Fundy stock is 95,543 based on combined survey data from NMFS and the Department of Fisheries and Oceans Canada between the Gulf of St. Lawrence/Bay of Fundy/Scotian Shelf and Central Virginia (Hayes et al. 2020). A population trend analysis is not available because data are insufficient for this species (Hayes et al. 2019).

4.2.5.3 Status

This species is not listed under the ESA and is considered non-strategic under the MMPA (Hayes et al. 2020). Harbor porpoise is listed as Least Concern by the IUCN Red List (IUCN 2020). The PBR for this stock is 851, and the estimated human-caused annual mortality and serious injury from 2015 to 2019 was 164 harbor porpoises per year (Hayes et al. 2022). This species faces major anthropogenic impacts because of its nearshore habitat. Historically, Greenland populations were hunted in large numbers for food and oil. Currently, they continue to suffer incidental mortality from Western North Atlantic fishing activities such as gillnets and bottom trawls (Hayes et al. 2020). From 2012 to 2018, a total of 315 harbor porpoises were stranded along the U.S. Canadian Atlantic Coast, 30 of which were reported in North Carolina (Hayes et al. 2022). Harbor porpoises also face threats from contaminants in their habitat, vessel traffic, habitat alteration due to offshore development, and climate-related shifts in prey distribution (Hayes et al. 2020). There is no designated critical habitat for this species near the Survey Area.

4.2.6 Mesoplodont Beaked Whales: Blainville's Beaked Whale (*Mesoplodon densirostris*), True's Beaked Whale (*Mesoplodon mirus*), Gervais' Beaked Whale (*Ziphius cavirostris*), Sowerby's Beaked Whale (*Mesoplodon bidens*)

Four species in the genus *Mesoplodon* are known to reside in the northwest Atlantic Ocean, including Blainville's beaked whale (*M. densirostris*), Gervais' beaked whale (*M. europaeus*), Sowerby's beaked whale (*M. bidens*), and True's beaked whale (*M. mirus*). Due to the difficulty distinguishing between these species at sea, most available information is at the undifferentiated genus level. Coloration of Mesoplodont can vary by species but is generally dark gray to a light rusty brown, with a lighter coloration around the head (DoN (U.S. Department of the Navy) 2008; Jefferson et al. 2015). Mesoplodont whales often have visual scratching and scarring on the body (DoN (U.S. Department of the Navy) 2008; Jefferson et al. 2015). The shape of the species' head is concave and similar to Cuvier's beaked whales, the jaw line curves up giving the whale an appearance of a smile (DoN (U.S. Department of the Navy) 2008). Dorsal and pectoral fins are small and spindle shaped.

Blainville's beaked whales have round bodies with small, wide, and slightly falcate dorsal fins. The coloration of Blainville's beaked whales varies from dark gray to a blue and brown combination on the cape and a light gray around the face and stomach. This species is often found individually or in pods of 3-12 individuals.

Gervais' beaked whales are small to medium in size and are identified by their long beaks, sloped foreheads, and small, wide, and slightly falcate dorsal fins. They are sexually dimorphic, meaning the adult females are often larger than males in size. Coloration of Gervais' beaked whales in dark gray to a blue and black combination on the cape and lighter on the central side. Dark patches around the eyes and faint stripes down the centerline of the back make these species easier to identify. Individuals can be found alone or in small pods.

Sowerby's beaked whales are small to medium in size and have long, slender beaks and distinct melons. Similar to Gervais' beaked whales, they are sexually dimorphic with females exceeding males in size. The coloration of Sowerby's beaked whales is charcoal gray on the cape and lighter on the ventral side. Additionally, adults may be identified by their gray spotting (DoN (U.S. Department of the Navy) 2008; Jefferson et al. 2015). Sowerby's beaked whales can be observed in pods of 3-10 individuals.

True's beaked whales are most similar in appearance to Gervais' beaked whales; however, they do not have a defined dorsal stripe and have a less curved jawline. They are found in pods of 5-6 individuals and are often observed to present cryptic and skittish behavior (DoN (U.S. Department of the Navy) 2008; Jefferson et al. 2015).

4.2.6.1 Distribution

Mesoplodont whales are found globally but prefer the continental slope and oceanic waters with depths exceeding 200 m (DoN (U.S. Department of the Navy) 2008; Pitman 2009). Similar to Cuvier's beaked whales, Mesoplodont whales' distribution has been linked to physical features including continental slope, canyons, escarpments, and oceanic islands (DoN (U.S. Department of the Navy) 2008; Pitman 2018). The continental edge of the western North Atlantic borders with bottom depths down to 5,000 m from Cape Hatteras to southern Nova Scotia, which have been identified as key areas for mesoplodont whales (DoN (U.S. Department of the Navy) 2008; Hayes et al. 2019). Roberts et al. (2018) modelling suggests the occurrence of beaked whales within the survey area with an increased potential for beaked whales to occur in more shallow regions off the coast of North Carolina.

Distribution of individual Mesoplodont beaked whale species may vary with water temperature. Blainville's and Gervais' whales occur in warmer southern waters, while Sowerby's and True's whales are typically found farther North (DoN (U.S. Department of the Navy) 2008). Blainville's whales occur throughout tropical, subtropical, and warmer temperature areas; within the western North Atlantic, they have been observed from Nova Scotia to Florida in, though sparsely distributed (Hayes et al. 2019). Gervais' whales are distributed throughout tropical and warm-temperate Atlantic waters; they are the most common Mesoplodont species to strand along the U.S Atlantic Coast and have been reported from Cape Cod to Florida and the Caribbean (Hayes et al. 2019). Sowerby's whales are a temperate species native to the North Atlantic Ocean. This species has been observed from the Carolina Long Bay Area waters north to the ice pack (Hayes et al. 2019). True's whales are a temperate species and have been reported from Nova Scotia to Florida and the Bahamas (Hayes et al. 2019). Based on the descriptions of each species' distribution, Blainville's Gervais', and True's whales are expected to occur regularly off the coast of North Carolina, while Sowerby's whales are expected to be rare within the Survey Area (DoN (U.S. Department of the Navy) 2008).

4.2.6.2 Abundance

The best available abundance estimate for Mesoplodont beaked whales is 10,107 individuals based on surveys conducted in 2016 from central Florida to the lower Bay of Fundy (Garrison 2020; Palka 2020; Hayes et al. 2022). This abundance estimate accounts for all undifferentiated beaked whale species within the Western Atlantic (Hayes et al. 2022).

4.2.6.3 Status

Mesoplodont whales are not ESA listed and the western North Atlantic stock is not considered strategic under the MMPA (Hayes et al. 2022). The PBR for Mesoplodont beaked whales is 81 (Hayes et al. 2022). Average annual estimated U.S. fishery related mortality or serious injury to Mesoplodont whales from 2014 to 2017 was zero (Hayes et al. 2019). The primary known source of incidental fishery mortality in the U.S. was from the pelagic drift gillnet fisheries, which has since been permanently closed. From 2013- 2017 a total of 4 Blainville's beaked whales, 12 Gervais' whales, 3 Sowerby's whales, and 6 True's whales stranded along the U.S. Atlantic Coast between Massachusetts and Florida (Hayes et al. 2019). Six of these strandings were attributed to human interaction in the form of ingested plastic (Hayes et al. 2019).

4.2.7 Pilot Whales (*Globicephala* spp.)

Two species of pilot whale occur within the Western North Atlantic: the long-finned pilot whale and the short-finned pilot whale. These species are difficult to differentiate at sea and cannot be reliably distinguished during most surveys (Rone et al. 2012; Hayes et al. 2017). Both short-finned and long-finned pilot whales are similar in coloration and body shape. Pilot whales have bulbous heads, are dark gray, brown, or black in color, and can reach approximately 7.3 m (25 ft) in length (NMFS 2021f). However, long-finned pilot whales can be distinguished by their long flippers, which are 18 to 27% of the body length with a pointed tip and angled leading edge (Jefferson et al. 1993). These whales form large, relatively stable aggregations that appear to be maternally determined (ACS 2018). Pilot whales feed primarily on squid, although they also eat small to medium-sized fish and octopus when available (NMFS 2021f). These whales largely feed at depths of 200 – 500 m; however, they can forage at deeper depths in necessary (Reeves et al. 2002).

Like dolphin species, long-finned pilot whales can produce whistles and burst-pulses used for foraging and communication. Whistles typically range in frequency from 1 to 11 kHz while burst-pulses cover a broader frequency range from 100 Hz to 22 kHz (Erbe et al. 2017). Auditory evoked potential (AEP) measurements conducted by Pacini et al. (2010) indicate that the hearing sensitivity for this species ranges from <4 kHz to 89 kHz.

4.2.7.1 Distribution

In general, short-finned pilot whales tend to have a tropical and subtropical distribution whereas long-finned pilot whales prefer colder temperate waters (Olson 2018). In U.S. Atlantic waters, pilot whales are distributed principally along the continental shelf edge at depths of 100 – 1,000 m off the northeastern U.S. coast in winter and early spring (CeTAP 1982; Payne and Heinemann 1993; Abend and Smith 1999; Hamazaki 2002). In late spring, pilot whales move onto Georges Bank, into the Gulf of Maine, and into more northern waters, where they remain through late fall (CeTAP 1982; Payne and Heinemann 1993). Long-finned and short-finned pilot whales overlap spatially along the Central-Atlantic shelf break between New Jersey and the southern flank of Georges Bank (Payne and Heinemann 1993; Hayes et al. 2019). Long-finned pilot whales have occasionally been observed stranded as far south as South Carolina, and short-finned pilot whale have stranded as far north as Massachusetts (Hayes et al. 2019). The latitudinal ranges of the two species therefore remain uncertain. However, south of Cape Hatteras, most pilot whale sightings are expected to be short-finned pilot whales, while north of approximately 42°N, most pilot whale sightings are expected to be long-finned pilot whales (Hayes et al. 2020). Therefore, it is possible that both species of pilot whale may be found within the Survey Area (Hayes et al. 2022). Recent tagging studies have observed short-finned pilot whales as far north as Nantucket Shoals; however in the northern extent of their range, short-finned pilot whales are thought to inhabit primarily offshore waters along the shelf breaking (Hayes et al. 2022).

4.2.7.2 Abundance

According to NMFS, the best available population estimate for long-finned pilot whales in the western North Atlantic is 39,215 which is the sum of the estimates generated from the northeast U.S summer 2016 survey covering U.S waters from central Virginia to Maine and the Department of Fisheries and Oceans Canada summer 2016 survey covering Canadian waters from the U.S to Labrador (Lawson and Gosselin 2016; Garrison 2020; Hayes et al. 2020; Palka 2020). For short-finned pilot whales, the best available estimate is 28,924 from summer 2016 surveys from central Florida to George's Bank because those surveys covered the full range of this species in the U.S Atlantic waters (Hayes et al. 2019).

4.2.7.3 Status

Neither pilot whale species is listed as threatened or endangered under the ESA and neither stock is considered strategic under the MMPA (Hayes et al. 2022). Long-finned pilot whales have a propensity to mass strand in U.S. waters, although the role of human activity in these strandings remains unknown (Hayes et al. 2020). The PBR for the long-finned pilot whale is 306, and the annual human-caused mortality and serious injury was estimated to be 9 whales between 2015 and 2019 (Hayes et al. 2022). Threats to this population include entanglement in fishing gear, contaminants, climate-related shifts in prey distribution, and anthropogenic noise (Hayes et al. 2020). Total annual estimated average mortality or serious injury for the short-finned pilot whale was estimated to be 136 whales between 2015 and 2019 (Hayes et al. 2022). Strandings involving hundreds of individuals are not unusual and demonstrate that these large schools have a high degree of social cohesion (Reeves et al. 2002). From 2013 – 2017, 16 long-finned pilot whales were reported as stranded between Maine and Florida (Hayes et al. 2020). There is no designated critical habitat for this stock in the Survey Area.

4.2.8 Rough-toothed Dolphin (*Steno bredanensis*)

Rough-toothed dolphins are distributed globally in tropical, subtropical, and warm water temperate waters generally between 40° and 35° South (Jefferson et al. 2015; Hayes et al. 2019). Coloration for this species is dark gray with a prominent, narrow dorsal cape that dips just below the dorsal fin (DoN (U.S. Department of the Navy) 2008). Rough-toothed dolphins are often identified by their small, cone-shaped head with a long beak (Reeves et al. 2002; DoN (U.S. Department of the Navy) 2008; Jefferson et al. 2015). The lower jaw and lops of the dolphin are white and many individuals have white scratches and spots on their body (DoN (U.S. Department of the Navy) 2008). Rough-toothed dolphins form groups of 10-20 individuals; however, pods of up to 100 individuals have been reported (Jefferson et al. 2015). These larger pods often include other cetacean species such as pantropical spotted dolphins, bottlenose dolphins, spinner dolphins and short-finned pilot whales. The species primarily feeds on epipelagic squids and fishes; however, individuals have been known to dive up to 150 m in search of prey (DoN (U.S. Department of the Navy) 2008; Jefferson et al. 2015). Rough-toothed dolphin hearing is in the mid-frequency range.

4.2.8.1 Distribution

Rough-toothed dolphins are found in the Atlantic, Pacific and Indian Oceans ranging from shallow, nearshore waters to deeper, offshore water (Hayes et al. 2019). Most vessel sightings along the U.S. Atlantic Coast have occurred in waters with bottom depths exceeding 1,000 m and tagged individuals have ranged out to waters up to 5,000 m in depth (DoN (U.S. Department of the Navy) 2008; Hayes et al. 2019). The species has been observed from Virginia to Florida and in the Gulf of Mexico, West Indies, and the northeast coast of South America with occasional sightings on the continental shelf especially in North Carolina and Florida (DoN (U.S. Department of the Navy) 2008; OBIS 2021).

Off the coast of North Carolina, the species is expected to reside seaward of the shelf break in the warm waters following the western edge of the Gulf Stream with occasional forays into the more landward waters (DoN (U.S. Department of the Navy) 2008; OBIS 2021). Roberts et al. (2018) density mapping also indicates that potential occurrence of rough-toothed dolphins is increasing along the East Coast, starting in the southern half of coastal Virginia and moving southwards.

4.2.8.2 Abundance

The best population estimate in the US Atlantic EEZ for the Western North Atlantic rough-toothed dolphin is 136 individuals based on surveys conducted in 2011 and 2016 from central Florida to the lower Bay of Fundy (Garrison 2020; Palka 2020; Hayes et al. 2022).

4.2.8.3 Status

The rough-toothed dolphin is not listed under the ESA and the western North Atlantic stock is not considered strategic under the MMPA (Hayes et al. 2022). There is insufficient data to determine whether the western North Atlantic stock comprises multiple independent populations and population trends for this stock have not been investigated due to the small number of sightings in any single year (Hayes et al. 2018). The PBR for the rough-toothed dolphin is 0.7 (Hayes et al. 2018). The annual estimated human-caused mortality and serious injury for 2012 to 2016 was zero, as there were no reports of mortality or serious injury of rough-toothed dolphins (Hayes et al. 2018). No rough-toothed dolphins were reported stranded between Maine and Florida from 2012 – 2016, though prior mass strandings have shown persistent organic pollutant and polychlorinated biphenyl concentrations above the toxic threshold suggested by Kannan et al. (2000). Although there are currently no known habitat issues or other factors causing decline or impeding recovery, potential sources of human-caused mortality for this stock are poorly understood.

4.2.9 Sperm Whale (*Physeter macrocephalus*)

The sperm whale is the largest of the toothed whales, with males reaching lengths of 16 m and the much smaller females reaching lengths of 11 m (Whitehead 2018). Sperm whales have extremely large heads, which account for 25-5% of the total length of the animal. This species tends to be uniformly dark gray in color, though lighter spots may be present on the ventral surface. This species can remain submerged for over an hour and dive to depths as great as 1,000 m. Sperm whales form stable social groups and exhibit a geographic social structure—females and juveniles form mixed groups and primarily reside in tropical and subtropical waters whereas males are more solitary and wide-ranging and occur at higher latitudes (Whitehead 2018). In the northern hemisphere, the peak breeding season for sperm whales occurs between March and June, and in the Southern hemisphere, the peak breeding season occurs between October and December (NMFS 2018b). Calving grounds are believed to exist around Cape Hatteras (Constidis et al. 2017).

Unlike mysticete whales that produce various types of calls used solely for communication, sperm whales produce clicks that are used for echolocation and foraging as well as communication (Erbe et al. 2017). Sperm whale clicks have been grouped into five classes based on the click rate, or number of clicks per second; these include "squeals," "creaks," "usual clicks," "slow clicks," and "codas." In general, these clicks are broadband sounds ranging from 100 Hz to 30 kHz with peak energy centered around 15 kHz. Depending on the class, SLs for sperm whale calls range between approximately 166 and 236 dB re 1 µPa @ 1 m SPL_{rms} (Erbe et al. 2017). Hearing sensitivity data for this species are currently unavailable (Southall et al. 2019).

4.2.9.1 Distribution

This species is widely distributed, occurring from the edge of the polar pack ice to the equator in both hemispheres (Whitehead 2018). In general, they are distributed over large temperate and tropical areas that have high secondary productivity and steep underwater topography, such as volcanic islands (Jacquet and Whitehead 1996). In the Atlantic, sperm whales are found throughout the Gulf Stream and North Central Atlantic Gyre (Hayes et al. 2020). Their distribution is typically associated with waters over the continental shelf break, the continental slope, and farther offshore, with higher concentrations near drop-offs and areas with strong currents and steep topography regardless of season (Whitehead et al. 1992; Jefferson et al. 2015; Hayes et al. 2020). Their distribution and relative abundance can also vary in response to prey availability, most notably squid (Jaquet and Gendron 2002). A single stock of sperm whales is recognized for the North Atlantic, and Reeves and Whitehead (1997) and Dufault et al. (1999) suggest that sperm whale populations lack clear geographic structure. In the U.S. Atlantic EEZ waters, sperm whales appear to exhibit seasonal movement patterns (CeTAP 1982; Scott and Sadove 1997).

During the winter, sperm whales concentrate to the east and north of Cape Hatteras. This distribution shifts northward in spring, when sperm whales are most abundant to east of Delaware and Virginia to the central Mid-Atlantic and the southern region of Georges Bank. In summer, this distribution continues to move northward, including the area east and north of Georges Bank and the continental shelf to the south of New England. In fall months, sperm whales are most abundant along the continental shelf edge in the Central-Atlantic. Sperm whales have been known to concentrate off Cape Hatteras during winter months and conduct a northward migration to Delaware and Virginia come spring (Constidis et al. 2017).

4.2.9.2 Abundance

The IWC recognizes only one stock of sperm whales for the North Atlantic, and Reeves and Whitehead (1997) and Dufault et al. (1999) suggest the sperm whale populations lack clear geographic structure. The most recent best available population estimate for the U.S. Atlantic EEZ from NMFS stock assessments is 4,349 which was derived from the sum of the 2016 surveys from Central Florida to the lower Bay of Fundy (Hayes et al. 2020). This estimate was generated from the sum of surveys conducted in 2016, and is likely an underestimate of total abundance, because these surveys were not corrected for sperm whale dive time. No population trend analysis is available for this stock.

4.2.9.3 Status

The Western North Atlantic stock is considered strategic under the MMPA due to its listing as Endangered under the ESA, and the global population is listed as Vulnerable on the IUCN Red List (Hayes et al. 2020; IUCN 2020). Between 2013 and 2017, 12 sperm whale strandings were documented along the U.S. East Coast, but none of the strandings showed evidence of human interactions (Hayes et al. 2020). A moratorium on sperm whale hunting was adopted in 1986 and currently no hunting is allowed for any purposes in the North Atlantic. Occasionally, sperm whales will become entangled in fishing gear or be struck by ships off the east coast of the U.S. However, this rate of mortality is not believed to have biologically significant impacts. The current PBR for this stock is 6.9, and because the total estimated human-caused mortality and serious injury is <10% of this calculated PBR, it is considered insignificant (Hayes et al. 2020).

A recovery plan for sperm whales was finalized in 2010 (NMFS 2010), and a five-year review of the species was completed in 2015 and yielded no change in status (NMFS 2015). NMFS announced the initiation of a five-year review in May 2021 (NMFS 2021e). Other threats to sperm whales include contaminants, climate-related changes in prey distribution, and anthropogenic noise, although the severity of these threats on sperm whales is currently unknown (Hayes et al. 2020). There is no designated critical habitat for this population in the Survey Area.

4.3 Pinnipeds

4.3.1 Gray Seal (Halichoerus grypus)

Gray Seals are the second most common pinniped in the US Atlantic EEZ (Jefferson et al. 2008). Gray Seals are large, reaching 2–3 m (7.5–10 ft) in length, and have a silver-gray coat with scattered dark spots (NMFS 2021b). These seals are generally gregarious and live in loose colonies while breeding (Jefferson et al. 2008). Though they spend most of their time in coastal waters, Gray Seals can dive to depths of 300 m (984 ft), and frequently forage on the outer shelf (Hammill et al. 2001; Jefferson et al. 2008). These opportunistic feeders primarily consume fish, crustaceans, squid, and octopus (Bonner et al. 1971; Reeves 1992; Jefferson et al. 2008). They often co-occur with Harbor Seals because their habitat and feeding preferences overlap (NMFS 2021b).

Two types of underwater vocalizations have been recorded for male and female gray seals; clicks and hums. Clicks are produced in a rapid series resulting in a buzzing noise with a frequency range between 500 Hz and 12 kHz. Hums, which is described as being similar to that of a dog crying in its sleep, are lower frequency calls, with most of the energy <1 kHz (Schusterman et al. 1970). AEP studies indicate that hearing sensitivity for this species is greatest between 140 Hz and 100 kHz (Southall et al. 2019).

4.3.1.1 Distribution

This species inhabits temperate and sub-arctic waters and lives on remote, exposed islands, shoals, and unstable sandbars (Jefferson et al. 2008). In the northwestern Atlantic, they occur from Labrador south to Massachusetts (King 1983). The Northwest Atlantic population of gray seals ranges from New Jersey to Labrador (Hayes et al. 2019). There are three breeding concentrations in eastern Canada: Sable Island, the Gulf of St. Lawrence, and along the east coast of Nova Scotia (Lavigueur and Hammill 1993). In U.S. waters, gray seals currently pup at four established colonies from late December to mid-February: Muskeget and Monomoy Islands in Massachusetts, and Green and Seal Islands in Maine (Hayes et al. 2019). Pupping was also observed in the early 1980s on small islands in Nantucket-Vineyard Sound and since 2010 at Nomans Island in Massachusetts (Hayes et al. 2019). The distributions of individuals from different breeding colonies overlap outside the breeding season.

Historically, gray seals were relatively absent from the Carolina Long Bay Area with coastal Virginia thought to represent the southern extent of the species' habitat range with scattered sightings and strandings reported as far south as North Carolina (Hayes et al. 2018). Further research has reported a southern shift/expansion of gray seal distribution along the U.S. Atlantic coast (DiGiovanni et al. 2011; Johnson et al. 2015; DiGiovanni et al. 2018). Both harbor and gray seals are now seen regularly between fall and spring seasons within the Central-Atlantic (DoN (U.S. Department of the Navy) 2018; Jones and Rees 2020). Based on the Roberts et al. (2016; 2022) density models, seals may occur within the Survey Area from November through May and are expected to be absent from June through October.

4.3.1.2 Abundance

Estimates of the entire Western North Atlantic gray seal population are not available. Some estimates are available for portions of the stock, although recent genetic evidence suggests that all Western North Atlantic gray seals may actually comprise a single stock (Hayes et al. 2020). The best available current abundance estimate for gray seals of the Canadian gray seal stock is 424,300 and the current U.S. population estimate is 27,300 (Hayes et al. 2022). The population of gray seals is likely increasing in the U.S. Atlantic EEZ; recent data show approximately 28,000 to 40,000 gray seals were observed in Southeastern Massachusetts in 2015 (Hayes et al. 2020). A population trend is not currently available for this stock, although the observed increase in the number of pops born in U.S. pupping colonies between 1991 and 2019 is currently being evaluated (Hayes et al. 2020).

4.3.1.3 Status

This species is not listed under the ESA and is non-strategic under the MMPA because anthropogenic mortality does not exceed PBR (Hayes et al. 2020). Gray seal is listed as Least Concern by the IUCN Red List (IUCN 2020). The PBR for this population is 1,458, and the annual human-caused mortality and serious injury between 2015 and 2019 was estimated to be 4,453 in both the U.S. and Canada (Hayes et al. 2022). Like harbor seals, the gray seal was commercially and recreationally hunted until 1972. Mortality is currently attributed to fishery interactions, non-fishery related human interactions and hunting, research activities, Canadian commercial harvest, and removals of nuisance animals in Canada (Hayes et al. 2020). Other threats to this population include disease, predation, and natural phenomena like storms (Hayes et al. 2020). There is no designated critical habitat for this species in the Survey Area.

4.3.2 Harbor Seal (*Phoca vitulina vitulina*)

The harbor seal is one of the smaller pinnipeds, and adults are often light to dark grey or brown with a paler belly and dark spots covering the head and body (Jefferson et al. 1993; Kenney and Vigness-Raposa 2010). This species is approximately 2 m (6 ft) in length (NMFS 2021c). Harbor seals complete both shallow and deep dives during hunting, depending on the availability of prey (Tollit et al. 1997). Harbor seals consumes a variety of prey, including fish, shellfish, and crustaceans (Bigg 1981; Reeves 1992; Burns 2002; Jefferson et al. 2008). They commonly occur in coastal waters and on coastal islands, ledges, and sandbars (Jefferson et al. 2008).

Male harbor seals have been documented producing an underwater roar call which is used for competition with other males and attracting mates. These are relatively short calls with a duration of about 2 sec and a peak frequency between 1 and 2 kHz (Van Parijs et al. 2003). Behavioral audiometric studies for this species estimate peak hearing sensitivity between 100 Hz and 79 kHz (Southall et al. 2019).Most harbor seals haul out on land daily, although they can spend several days at sea feeding (Jefferson et al. 2008). Harbor seals complete both shallow and deep dives during hunting, depending on the availability of prey (Tollit et al. 1997). Although the stock structure of the Western North Atlantic population is unknown, it is thought that harbor seals found along the eastern U.S. and Canadian coasts represent one population that is termed the Western North Atlantic Stock (Andersen and Olsen 2010).

4.3.2.1 Distribution

The harbor Seal is found throughout coastal waters of the Atlantic Ocean and adjoining seas above 30°N and is the most abundant pinniped in the U.S. Atlantic EEZ (Hayes et al. 2018). Harbor seals, also known as common seals, are one of the most widely distributed seal species in the Northern Hemisphere. They can be found inhabiting coastal and inshore waters from temperate to polar latitudes. In recent years, this species has been seen regularly as far south as North Carolina, and regular seasonal haul-out sites of up to 40-60 animals have been documented on the eastern shore of Virginia and the Chesapeake Bay (Jones and Rees 2020). During the summer, most harbor seals can be found north of New York, within the coastal waters of central and northern Maine, as well as the Bay of Fundy (DoN (U.S. Department of the Navy) 2005; Hayes et al. 2020). While harbor seals occur year-round north of Cape Cod, they only occur during winter migration, typically September through May, south of Cape Cod (Southern New England to New Jersey) (Kenney and Vigness-Raposa 2009; Hayes et al. 2020). Genetic variability from different geographic populations has led to five subspecies being recognized. Peak breeding and pupping times range from February to early September, and breeding occurs in open water (Temte 1994).

Historical stranding data for harbor and gray seals along the Central-Atlantic Coast south of New Jersey previously indicated the species' preference for colder, northern waters. Additional historical data has shown that their presence along the Virginia and North Carolina coasts was considered unlikely during the summer and fall (Hayes et al. 2022). Winter haul-out sites for harbor seals have been identified within the Chesapeake Bay region and Outer Banks beaches; however, sightings as far south as the Carolinas are only occasionally recorded (Hayes et al. 2022). Based on the 2020 SAR (Hayes et al. 2020), the southern extent of the harbor seal distribution is now considered North Carolina. This expansion is not thought to be related to an increase in population, but rather due to a rapid growth of the gray seal population in Canada and the Northeastern U.S. (Hayes et al. 2020). The rapid growth of the harbor seal population may be causing displacement of harbor seals at haul-out sites due to competitive exclusion and physical interference (Cammen et al. 2018; Pace et al. 2019; Wood et al. 2019). Both harbor and gray seals are now sound regularly between fall and spring seasons (DoN (U.S. Department of the Navy) 2018; Jones and Rees 2020). Based on the Roberts et al. (2016; 2022) density models, seals may occur within the Survey Area from November through May and are expected to be absent from June through October. Of the two seal species likely to be observed within the Survey Area (harbor and gray seals), harbor seals are the more likely to be observed.

4.3.2.2 Abundance

The best available abundance estimate for harbor seals in the Western North Atlantic is 61,366, with global population estimates reaching 610,000 to 640,000 (Bjørge et al. 2010; Hayes et al. 2020; IUCN 2020; Hayes et al. 2022). Estimates of abundance are based on surveys conducted during the pupping season, when most of the population is assumed to be congregated along the Maine coast. Abundance estimates do not reflect the portion of the stock that might pup in Canadian waters (Hayes et al. 2022). Trend in population from 1993 to 2018 was estimated for non-pups and pups using a Bayesian hierarchical model to account for missing data both within and between survey years. The estimated mean change in non-pup harbor seal abundance per year was a positive from 2001 to 2004, but close to zero or negative between 2005 and 2018 (Hayes et al. 2022). After 2005, mean change in pup abundance was steady or declining until 2018 but these changes were not significant (Hayes et al. 2022).

4.3.2.3 Status

Harbor seals are not listed under the ESA, are listed as Least Concern by the IUCN Red List and are considered non-strategic because anthropogenic mortality does not exceed PBR (Hayes et al. 2020; IUCN 2020). The PBR for this population is 1,729 and the annual human-caused mortality and serious injury from 2015 to 2019 was estimated to be 399 seals per year (Hayes et al. 2022). This mortality and serious injury was attributed to fishery interactions, non-fishery related human interactions, and research activities (Hayes et al. 2020). Until 1972, harbor seals were commercially and recreationally hunted. Currently, only Alaska natives can hunt harbor seals for sustenance and the creation of authentic handicrafts. Other threats to harbor seals include disease and predation (Hayes et al. 2020). There is no designated critical habitat for this species in the Survey Area.

5 Type of Incidental Taking Authorization Requested

TerraSond is requesting an IHA pursuant to section 101(a)(5)(D) of the MMPA for incidental take by Level B harassment of small numbers of marine mammals during the site characterization survey activities described in Sections 1 and 2 in and around the continental shelf waters in the Carolina Long Bay Area (Figure 1).

Site characterization surveys have the potential to take marine mammals by “Level B” harassment as a result of sound energy introduced to the marine environment. In the absence of mitigation measures, sounds that may “harass” marine mammals include pulsed sounds generated by the HRG survey equipment including the sparker. The potential effects will depend on the species of marine mammal, the behavior of the animal at the time of reception of the stimulus, as well as the received level (RL) of the sound. Disturbance reactions are likely to vary among some of the marine mammals in the general vicinity of the sound source. No Level A “take” by serious injury is reasonably expected, given the nature of the specified activities and the mitigation measures that are planned.

6 Take Estimates for Marine Mammals

All anticipated takes would be “takes by harassment”, involving temporary changes in behavior (i.e., Level B harassment). That is, acoustic exposure could result in temporary displacement of marine mammals from within ensonified zones or other temporary changes in behavioral state. The mitigation measures to be applied will reduce the already very low probability of Level A takes to the point of being discountable. The planned geophysical surveys are not expected to “take” more than small numbers of marine mammals and will have a negligible effect on the affected species or stocks. In the sections below, we describe methods to estimate “take by harassment” and present estimates of the numbers of marine mammals that might be affected during the planned activities.

6.1 Basis for Estimating Potential “Take”

The amount of potential “take by harassment” is calculated in this section by multiplying the expected densities of marine mammals in the Survey Area by the area of water likely to be ensonified by geophysical survey equipment above the applicable NMFS defined thresholds. The estimated numbers are based on the densities (individuals per unit area) of marine mammals expected to occur in the Survey Area in the absence of survey activities. Thus, the take estimates are likely overestimates of the numbers of animals exposed to a specified level of sound because some marine mammals tend to move away from anthropogenic sounds before the sound level reaches the threshold level.

Secondly, the mean group size of each species was calculated from available sightings data in the region and compared to the results of the density-based calculations show in Table 6 (Kraus et al. 2016; Palka et al. 2017). Although the Kraus et al. (2016) study area does not directly overlap with the proposed Study Area, the group size for harbor porpoise and Mesoplodont whales were pulled from Kraus et al. (2016) due to a lack of sightings of those species during the Palka et al. (2017) study. The larger of the two estimates, density-based exposures or mean group size was selected as the "Requested Take" for each species.

Table 6: Mean group sizes of species for which incidental take is being requested.

Species	Individuals	Sightings	Mean Group Size	Source
Mysticetes				
Fin Whale*	29	21	1.4	Palka et al. (2017)
Humpback Whale	12	11	1.1	Palka et al. (2017)
North Atlantic Right Whale*	17	7	2.4	Palka et al. (2017)
Odontocetes				
Atlantic Spotted Dolphin	1961	94	20.9	Palka et al. (2017)
Common Bottlenose Dolphin	7223	669	10.8	Palka et al. (2017)
Common Dolphin	3892	80	48.7	Palka et al. (2017)
Cuvier's Beaked Whale	1	1	2.4	Palka et al. (2017)
Harbor Porpoise	121	45	2.7	Kraus et al. (2016)
Mesoplodont Beaked Whales	-	-	2.9	Kraus et al. (2016)
Pilot Whales	941	37	25.4	Palka et al. (2017)
Rough-toothed Dolphin	19	1	19.0	Palka et al. (2017)
Sperm Whale*	8	8	1.0	Palka et al. (2017)
Pinnipeds				
Seals (Harbor and Gray)	201	144	1.4	Palka et al. (2017)

6.2 Acoustic Thresholds

To assess potential auditory injury, Level A harassment, NMFS has established technical guidance (NMFS 2018a) that establishes dual criteria for five different marine mammal hearing groups, four of which occur in the Survey Area (Table 7). Scientific recommendations for revisions to these classifications were recently published by Southall et al. (2019) but have not yet been incorporated into the NMFS guidelines.

The received level at which marine mammals may behaviorally respond to anthropogenic sounds varies by numerous factors including the frequency content, predictability, and duty cycle of the sound as well as the experience, demography and behavioral state of the marine mammals (Richardson et al. 1995; Southall et al. 2007b; Ellison et al. 2012). Despite this variability, there is a practical need for a reasonable and specific threshold. NMFS currently defines the threshold for behavioral harassment, Level B take, as 160 dB re 1 µPa SPL_{rms} [unless otherwise noted, all dB values hereafter are referenced to 1 µPa] for impulsive or intermittent sounds such as those produced by the HRG survey equipment to be used during the planned survey.

Table 7. Marine mammal functional hearing groups and Level A thresholds as defined by NMFS (2018) for species present in the Survey Area.

Marine Mammal Hearing Group	Generalized Hearing Range	Acoustic Thresholds
Low-frequency cetaceans (LF)	7 Hz to 35 kHz	$L_{pk,flat}$: 219 dB $L_{E,LF,24h}$: 183 dB
Mid-frequency cetaceans (MF)	150 Hz to 160 kHz	$L_{pk,flat}$: 230 dB $L_{E,LF,24h}$: 185 dB
High-frequency cetaceans (HF)	275 Hz to 160 kHz	$L_{pk,flat}$: 202 dB $L_{E,LF,24h}$: 155 dB
Phocid pinnipeds (underwater) (PW)	50 Hz to 86 kHz	$L_{pk,flat}$: 218 dB $L_{E,LF,24h}$: 185 dB

6.3 Area Potentially Exposed to Sounds above Threshold Levels

As described in Section 1.2 of this request, only some of the in-water equipment planned for use during this survey produces sounds audible to marine mammals. This includes sparkers, USBL systems, and parametric sub-bottom profilers. The USBL systems are necessary for navigational and equipment positioning purposes which are activities for which NMFS does not require authorization, so they are not considered further in this section. The parametric sub-bottom profiler produces a very narrow beam of sound and is therefore unlikely to be encountered by a marine mammal or cause a disturbance reaction if it is. Equipment that operates in the water but outside the range of marine mammal hearing, at or above 180 kHz, includes the multi-beam echosounders and sidescan sonars, neither of which are considered further in this section.

6.3.1 Level A

Table 8 provides details of the sparker that is used here as a surrogate for the sparker identified in Table 2 and planned for use during the survey. The sparker system that TerraSond plans to use during the surveys, the Applied Acoustics UHRS 400 + 400, is essentially two of the same Applied Acoustic Dura-Spark sources measured by Crocker and Fratantonio (2016) stacked on top of each other creating two “decks” to the sparker. However, the decks will not be discharged simultaneously. Instead, they will be used in an alternating “flip-flop” pattern. Thus, for all source configurations described in Section 1, the maximum power expected when discharging the sparker source (single deck) will be 800 J. The Applied Acoustics Dura-Spark was measured by Crocker and Fratantonio (2016) but not with an energy setting near 800 J. A similar alternative system, the SIG ELC 820 sparker, was measured with an input voltage of 750 J so that has been used as a surrogate as recommended by NMFS.

Distances to Level A thresholds were calculated using the NMFS user spreadsheet tool for an impulsive-mobile source (Tab F) (NMFS 2020b). Based on measurements from Crocker and Fratantonio (2016) as well as manufacturer specifications, the following were used as inputs to the user spreadsheet: SPL_{rms} source level of 203 dB, peak (PK) source level of 213 dB, source velocity of 1.8 meters/second (3.5 knots), pulse duration of 0.0011 seconds, and a repetition rate of 0.25 seconds. A weighting factor adjustment of 1 kHz was used in the calculation as recommended by NMFS for a seismic airgun source.

Using the inputs described above for the SIG ELC 820 with an input energy of 750 J (203 dB SPL_{rms}) measured by Crocker and Fratantonio (2016), the distance to the high-frequency cetacean SEL_{cum} threshold was estimated to be 131.7 m while the distance to the SPL_{peak} threshold was estimated to be 3.5 m (Table 8). Distances to threshold criteria for all other hearing groups were either not reached or were less than 1 m.

The only high-frequency cetacean species present in this region is the harbor porpoise. Harbor porpoises are known to largely avoid vessels and anthropogenic sounds; thus, even in the absence of the mitigation measures proposed in Section 11, the potential for Level A harassment of this or any other species is very unlikely. Therefore, no Level A takes are expected or are being requested.

Table 8. Estimated distances to Level A take thresholds for the planned survey equipment.

Equipment Type	Representative System(s)	Operating Frequency (kHz)	Source Level	Distance (m) to Level A Threshold (pk / cum)				
				LFC	MFC	HFC	PPW	OPW
Sparker	SIG ELC 820 @ 750 J	0.3 – 1.2	213 dB_{peak} 203 dB_{rms}	– / 0.5	– / 0.3	3.5 / 131.7	– / 0.5	– / <1

"NA" Not Applicable as there are no SPL_{peak} threshold criteria for intermittent sources.
"–" Indicates the HRG equipment source level is below the relevant threshold level.

6.3.2 Level B

In April, 2020, NMFS issued interim guidance for calculating distances to the 160 dB SPL_{rms} Level B threshold from HRG sources (NMFS 2020a). The recommendations provided specific equations for incorporating absorption loss at higher frequencies and accounting for narrow beamwidths and angles when calculating transmission loss from equipment source levels. Due to substantial variability in back-propagated source levels calculated from field verification measurements received by NMFS, the recommendations also stated that source levels in Crocker and Fratantonio (2016) should be used when the same equipment measured in that study are planned for use. If different makes or models of similar equipment are used, then the guidance stated that manufacturer provided source levels should be used in the calculations. Below we summarize the parameters used to estimate the 160 dB SPL_{rms} threshold range for the sparker based on the July 2020 NMFS guidance.

The measured source level of the SIG ELC 820 sparker with an input voltage of 750 J was 203 dB SPL_{rms} (Table 10 *in* Crocker and Fratantonio (2016)). Using this source level and assuming it is an omnidirectional source (180° beamwidth), the calculated horizontal distance to the 160 dB SPL_{rms} threshold is 141 m (Table 9).

6.3.2.1 Ensonified Area

The distance to the 160 dB SPL_{rms} Level B of 141 m from the sparker was used as described in this section to estimate the area of water potentially exposed above the Level B threshold by the planned activities.

Table 9. Estimated distances to Level B take thresholds for the planned survey equipment.

Equipment Type	Representative System(s)	Operating Frequency (kHz)	Source Level (dB rms)	Out-of-Beam Source Level (dB rms)	Beamwdith (degrees)	Distance to Level B Threshold (m)
Sparker	SIG ELC 820 J	0.3 – 1.2	203	N/A	180	141

For Phase 1, where each survey vessel would tow a single sparker source, up to 4,054 km of survey vessel activity may occur within the Survey Area. The vessel(s) will conduct surveys at a speed of approximately 3–4 knots (5.6–7.4 km/hr) during 24-hr operations. Allowing for weather and equipment downtime, the survey vessel(s) are expected to collect geophysical data over an average distance of 100 km per day. Distributing the 4,054 km of vessel survey activity across the 12-month period of anticipated activity results in approximately 3.38 survey days per month total, or 1.7 days per vessel if two survey vessels were used. Using a 160 dB SPL_{rms} threshold distance of 141 m, the per vessel survey day ensonified area is estimated to be 28.26 km^2 (calculated by multiplying the daily survey distance by two times the 160 dB threshold distance plus the area of a circle with a radius of the 160 dB distance: [(100 km x 2 x 0.141 km) + (π x $(0.141 \text{ km})^2$)] resulting in a monthly ensonified area of 95.5 km^2.

For Phase 2, where each survey vessel would tow three sparker sources with 150 m horizontal separation between them, up to 1,400 km of survey vessel activity may occur within the Survey Area. The vessel(s) will travel at a speed of 3-4 knots (5.6-7.4 km/hr) during 24-hr operations with the sources being active for an average of 100 km per day. Distributing the 1,400 km of survey vessel activity across the 12-month period of anticipated activity results in approximately 1.17 survey days per month. Towing the three sparker sources with a horizontal separation distance of 150 m between them will result in a larger cross line 160 dB distance than in Phase 1. The total daily ensonified area was calculated by multiplying the daily survey distance (100 km) by two times the crossline distance to the 160 dB threshold, which is 141 m plus an additional 150 m to account for the separation distance between the two outermost sources from the vessel sail line [(100 km x 2 x (0.141 km + 0.15 km)) + (π x $(0.291 \text{ km})^2$)]. This results in a daily ensonified area of 58.47 km^2 and a total monthly ensonified area of 68.2 km^2 for Phase 2.

For Phase 3, up to 12,488 km of survey vessel activity may occur within the Survey Area. The vessel will travel at a speed of 3–4 knots (5.6–7.4 km/hr) during 24-hr operations with the sources being active for an average of 100 km per day. Distributing the 12,488 km of survey vessel activity across the 12-month period of anticipated activity results in approximately 10.4 survey days per month total, or 5.2 days per vessel if two survey vessels were used. During Phase 3, two sparker sources will be towed behind the survey vessel(s) with a horizontal separation distance of 30 m between the sources, resulting in a slightly larger cross line 160 dB distance than in Phase 1. The total daily ensonified area was calculated by multiplying the daily survey distance (100 km) by two times the crossline distance to the 160 dB threshold, which is 141 m plus an additional 15 m to account for the separation distance between the two sources from the vessel sail line [(100 km x 2 x (0.141 km + 0.015 km)) + (π x $(0.156 \text{ km})^2$)]. This results in a daily ensonified area of 31.3 km^2 and a total monthly ensonified area of 325.5 km^2 for Phase 3.

6.4 Marine Mammal Densities

Density estimates for all species within the Survey Area were derived from habitat-based density modeling results reported by Roberts et al. (2016; 2022). Those data provide density estimates for species or species guilds within 5 km x 5 km grid cells (25 km^2), on a monthly or annual basis, depending on the species. In order to select a representative sample of grid cells in and near the Survey Area, a 5-km wide perimeter around the Survey Area (Figure 1) was created in GIS (ESRI 2017). The perimeter was then intersected with the density grid cells to select those nearest to the Survey Area (Roberts et al. 2016; Roberts 2022). The average density of each species in each month was then calculated from the selected grid cells (Table 10).

The estimated monthly density of seals provided in Roberts et al. (2016; 2022) includes all seal species present in the region as a single guild. To split the resulting "seal" density-based exposure estimate by species, we multiplied the estimate by the proportion of the combined abundance attributable to each species. Specifically, we summed the SAR N_{best} abundance estimates (Hayes et al. 2022) for the two species (gray seal = 27,300, harbor seal = 61,336; total = 88,636) and divided the total by the estimate for each species to get the proportion of the total for each species (gray seal = 0.308; harbor seal = 0.692). The "seal" density provided by Roberts et al. (2016; 2022) was then multiplied by these proportions to get the species specific densities shown in Table 10.

The same approach described above was used to split the monthly density of common bottlenose dolphins provided in Roberts et al. (2016; 2022) into the two stocks that may be present in the Survey Area. Specifically, we summed the SAR N_{best} abundance estimates (Hayes et al. 2022) for the two stocks (Western North Atlantic Offshore Stock = 62,851, Southern Migratory Coastal Stock = 3,751; total = 66,602) and divided the total by the estimate for each stock to get the proportion of the total for each stock (Western North Atlantic Offshore Stock = 0.9437; Southern Migratory Coastal Stock = 0.0563). The bottlenose dolphin density calculated from Roberts et al. (2016; 2022) was then multiplied by these proportions to get the stock-specific densities shown in Table 10.

Table 10. Average monthly densities (Individuals per 100 km^2) for species that may occur in the Survey Area during the planned survey period.

Species	Estimated Monthly Densities (Individuals / 100 km^2)											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Mysticetes												
Fin Whale*	0.0011	0.0012	0.0015	0.0023	0.0018	0.0003	0.0000	0.0000	0.0000	0.0001	0.0004	0.0007
Humpback Whale	0.0023	0.0039	0.0033	0.0030	0.0010	0.0001	0.0000	0.0000	0.0000	0.0003	0.0014	0.0016
North Atlantic Right Whale*	0.0148	0.0190	0.0165	0.0033	0.0018	0.0000	0.0000	0.0000	0.0000	0.0013	0.0013	0.0074
Odontocetes												
Atlantic Spotted Dolphin	7.8582	8.8452	10.6806	11.6705	8.2267	15.9191	21.5664	14.6442	14.8441	5.0148	4.1017	4.8490
Common Bottlenose Dolphin (Offshore Stock)	14.6355	13.1251	13.6047	13.1655	10.3031	7.0155	6.9483	6.4375	7.0450	9.4337	12.9151	14.3570
Common Bottlenose Dolphin (Southern Migratory Coastal Stock)	0.8735	0.7833	0.8119	0.7857	0.6149	0.4187	0.4147	0.3842	0.4205	0.5630	0.7708	0.8568
Common Dolphin	0.2469	0.3304	0.2089	0.0381	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0012	0.0437
Cuvier's Beaked Whales	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Harbor Porpoise	0.0001	0.0002	0.0002	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pilot Whales	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108	0.0108
Mesoplodont Beaked Whales	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Rough-toothed Dolphin	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280	0.1280
Sperm 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
Pinnipeds												
Gray Seal	0.0005	0.0010	0.0017	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Harbor Seal	0.0012	0.0023	0.0038	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

* Denotes species listed under the Endangered Species Act.

6.5 Requested Take

The requested take has been calculated for each individual phase as well as a "total requested take" value including a summation of takes across all three phases (Table 11). The potential number of Level B takes was calculated by multiplying the monthly density for each species in the Survey Area shown in Table 10 by the respective monthly ensonified area for each Phase (see Section 6.3) and then summing across the 12 months. The requested number of Level B takes as a percentage of the "best available" abundance estimates provided in the NMFS Stock Assessment Reports (SARs) (Hayes et al. 2022) are also provided in Table 11.

For North Atlantic right whales, the implementation of a 500 m acoustic exclusion zone and the 500 m vessel separation distance identified in the vessel strike avoidance measures means that the likelihood of an exposure to received sound levels greater than 160 dB SPL_{rms} is very low. Nonetheless, it is possible that North Atlantic right whales could occur within 500 m of the vessel without first being detected by a PSO, so we have requested the calculated potential take consistent with other species.

Table 11. Total Number of Level B takes requested and percentages of each stock abundance.

	Density-Based Take			Mean Group Size	Total Requested Take	Abundance NMFS[a]	Percent of NMFS[a] Stock Abundance
	Phase 1	Phase 2	Phase 3				
Mysticetes							
Fin Whale*	0.0	0.0	0	1.4	2	6,802	0.0
Humpback Whale	0.0	0.0	0	1.1	2	1,396	0.1
North Atlantic Right Whale*	0.1	0.0	0	2.4	3	368	0.8
Odontocetes							
Atlantic Spotted Dolphin	122.4	87.5	417	20.9	628	39,921	1.6
Common Bottlenose Dolphin (Offshore Stock)	123.2	88.0	420	10.8	631	62,851	1.0
Common Bottlenose Dolphin (Southern Migratory Coastal Stock)	7.4	5.3	25	10.8	38	6,639	0.6
Common Dolphin	0.8	0.6	3	48.7	49	172,974	0.0
Cuvier's Beaked Whale	0.0	0.0	0	2.4	3	5,744	0.1
Harbor Porpoise	0.0	0.0	0	2.7	3	95,543	0.0
Pilot Whales	0.1	0.1	0	25.4	26	68,139	0.0
Mesoplodont Whales	0.0	0.0	0	2.9	3	10,107	0.0
Rough-toothed Dolphin	1.5	1.0	5	19.0	19	136	14.0
Sperm Whale*	0.0	0.0	0	1.0	1	4,349	0.0
Pinnipeds							
Gray Seal	0.0	0.0	0	1.4	2	27,300	0.0
Harbor Seal	0.0	0.0	0	1.4	2	61,336	0.0

* Denotes species listed under the Endangered Species Act.
[a] Source – Hayes et al. (2020); The "Seal" abundance value shown is the sum of gray and harbor seals.
[b] Source – Hayes et al. (2020); The "Pilot Whales" abundance value shown is the sum of long-finned and short-finned pilot whales.

7 Anticipated Impact of the Activity

The ability to hear and transmit sound (echolocation and vocalization) is vital for marine mammals to perform basic life functions. Marine mammals use sound to gather and understand information about their current environment, including detection of prey and predators. They also use sound to communicate with one another. The distances to which a sound travels through the water and remains audible depends on existing environmental conditions and propagation characteristics (e.g., sea floor topography, stratification, and ambient noise levels) and characteristics of the sound (SLs and frequency; (Richardson et al. 1995)). Impacts on marine mammals can vary among species based on their sensitivity to sound, life stage, orientation to the sound and depth in the water column, and their ability to hear different frequencies. The effects of sounds from HRG surveys could include either masking of natural sounds, behavioral disturbance, and hearing impairment (Richardson et al. 1995; Nowacek et al. 2007; Southall et al. 2007a). The level of impact on marine mammals will vary depending on species, the distance between the marine mammal and the activity, the intensity and duration of the activity, and environmental conditions affecting sound propagation.

7.1 Masking

Masking is the obscuring of sounds of interest by interfering sounds, generally at similar frequencies. Introduced underwater sound will, through masking, reduce the effective listening area and/or communication distance of a marine mammal species if the frequency of the source is close to that used as a signal by the marine mammal, and if the anthropogenic sound is present for a significant fraction of the time (Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Erbe et al. 2016; Tennessen and Parks 2016; Guan and Miner 2020). Conversely, if little or no overlap occurs between the introduced sound and the frequencies used by the species, communication is not expected to be disrupted. Also, if the introduced sound is present only infrequently, communication is not expected to be disrupted much, if at all. In addition to the frequency and duration of the masking sound, the strength, temporal pattern, and location of the introduced sound also play a role in the extent of the masking (Branstetter et al. 2013; Finneran and Branstetter 2013; Branstetter et al. 2016; Sills et al. 2017). Loss of listening area or communication space could impact foraging success or result in the inability to locate conspecifics. The biological repercussions of these potential outcomes are largely unknown but given the operating frequencies and source levels of the HRG equipment, significant impacts from masking are not expected.

Some of the HRG survey equipment proposed for use during the site characterization surveys produces sounds with frequency ranges similar to those of marine mammal hearing and vocalizations and thus could result in masking of some biologically important sounds. The impulsive nature of these sounds, limited duration of the survey activities, and short distances over which they would be audible suggest that any masking experience by marine mammals would be highly localized and short term.

7.2 Behavioral Disturbance

Behavioral disturbance includes a variety of effects, ranging from subtle to conspicuous changes in behavior, movement, and respiration patterns as well as displacement (Southall et al. 2007a). In some cases, behavioral responses to sound may result in a reduction of the overall exposure to that sound (Finneran et al. 2015; Wensveen et al. 2015).

Detailed data on reactions of marine mammals to anthropogenic sounds are limited to relatively few species and situations (see reviews by (Richardson et al. 1995; Gordon et al. 2004; Nowacek et al. 2007; Southall et al. 2007a). Behavioral reactions of marine mammals to sound are difficult to predict in the absence of site- and context-specific data. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, exposure level, spectral content and directionality of the sound, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007a; Weilgart 2007b; Ellison et al. 2012). If a marine mammal reacts 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 (New et al. 2013a). 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 (Lusseau and Bejder 2007; Weilgart 2007a; New et al. 2013b; Nowacek et al. 2015; Forney et al. 2017).

Given the many uncertainties in predicting the quantity and types of impacts of sound on marine mammals, it is common practice to estimate how many animals would be present within a particular distance of human activities and/or exposed to a particular level of anthropogenic sound (see Section 6). In most cases, this approach likely overestimates the numbers of marine mammals that would be affected in some biologically important manner. One of the reasons for this is that the selected distances/isopleths are based on limited studies indicating that some animals exhibited short-term reactions at this distance or sound level, whereas the calculation assumes that all animals exposed to this level would react in a biologically significant manner.

The most likely behavioral change exhibited by marine mammals as a result of HRG survey activities would be displacement or moving away from the sound. Hastie et al. (2014) reported behavioral responses by gray seals to echosounders with frequencies of 200 and 375 kHz. Short-finned pilot whales increased their heading variance in response to an EK60 echosounder with a resonant frequency of 38 kHz (Quick et al. 2017), and significantly fewer beaked whale vocalizations were detected while an EK60 echosounder was active vs. passive (Cholewiak et al. 2017). It is presumed that displacement, if it were to occur, would be limited to the area surrounding the sound source that is ensonified to above the Level B thresholds of 160 dB SPL_{rms} for impulsive sounds, and would only last for the duration that the sound source is active, with animals resuming regular behavior once the sound source ceases.

7.3 Hearing Impairment

To experience any potential hearing impairment from HRG sources, marine mammals would have to occur in very close proximity (within 131.7 m for high-frequency cetaceans and less than 1 m for all other marine mammals, Table 8) to the survey equipment. This is because the relatively high frequency sounds produced by the survey equipment attenuate rapidly in water. With the implementation of planned monitoring and mitigation measures like pre-start watches and shutdown zones, hearing impairment caused by HRG sources is extremely unlikely to occur.

8 Anticipated Impacts on Subsistence Uses

The TerraSond Survey Area is located in the Atlantic Ocean off the east coast of the United States from Delaware to North Carolina. There are no traditional subsistence hunting areas in the region and thus no subsistence uses of marine mammals may be impacted by this action.

9 Anticipated Impacts on Habitat

The altered soundscape resulting from sounds produced during HRG survey activities would be short term, localized, and would not permanently alter marine mammal acoustic habitat.

Collection of vibracore and seabed CPT grab samples during geotechnical surveys would disturb benthic habitat where samples are taken and could impact water quality via sediment resuspension and dispersion. These impacts would be short term and localized to the immediate vicinity around sample sites within a large area of similar habitat. Permanent impacts to marine mammal habitat are not anticipated.

10 Anticipated Effects of Habitat Impacts on Marine Mammals

The altered soundscape in the vicinity of HRG survey activities could result in masking of sounds important to marine mammals or temporary displacement of individuals from the survey area. Masking would only occur within relatively short distances while survey activities are underway and thus would be temporary and localized to the vicinity of the survey activities. It is expected that any displacement of marine mammals from the survey area would also be temporary and localized. Displaced individuals would be able to access areas of similar habitat near the area impacted by the survey activity.

11 Mitigation Measures to Protect Marine Mammals and their Habitat

The following monitoring and mitigation measures will be implemented on the vessel(s) conducting the geophysical surveys as described in Section 1.1 for which takes have been requested in Section 6. Takes are not anticipated for vessels when they are conducting geotechnical surveys, so the monitoring and mitigation measures described here will not apply during those activities.

11.1 Protected Species Observers

PSOs will be used to undertake visual watches, implement mitigation measures, and conduct data collection and reporting in accordance with the monitoring plan, the requirements in the IHA, and stipulations in the BOEM leases for OCS-A 0539, 0541, and 0542, as applicable. Except where noted, all PSOs will have completed a NMFS and BOEM accepted PSO training program. TerraSond will provide PSO resumes to NMFS for approval in advance of survey activities. Upon completion of the project, TerraSond will provide a final report and data to NMFS.

PSOs will coordinate to ensure 360-degree visual coverage around the vessel from an appropriate vantage point without interfering with navigation or operation of the vessel. It will be the responsibility of all PSOs on duty to communicate the presence of marine mammals as well as to communicate and request the action(s) that are necessary to ensure mitigation requirements are implemented as appropriate.

11.2 Number of Protected Species Observers

Since the survey vessel will be conducting HRG surveys on a 24-hr per day basis (i.e. including during darkness) it will have four (4) PSOs on board to carry out the necessary monitoring.

11.3 PSO Watch Guidelines

One PSO will be on watch during all daylight HRG and geotechnical operations. Two PSOs will be on watch at all times during all nighttime HRG surveys. No additional duties will be assigned to PSOs during their visual observation watches. PSOs will work in shifts such that no one observer works more than 4 consecutive hours without a 2-hour break or longer than 12 hours during any 24-hour period.

11.4 Day-time Visual Monitoring Equipment

All PSOs will be supplied with reticle binoculars to assist in making detections and estimating ranges. A digital SLR camera will be provided to record detection events, when possible, and verify species identification.

11.5 Night-time Visual Monitoring Equipment

The PSOs on duty will monitor for marine mammals and other protected species using the most appropriate available technology. This includes night-vision goggles (NVDs) with thermal clip-ons and a hand-held spotlight (one set plus a back-up set), such that PSOs can focus observations in any direction.

11.6 Data Collection and Reporting

PSOs will record all sightings and positions of marine mammals. Position data will be recorded using a hand-held or vessel GPS system. PSOs will collect data in accordance with standard reporting forms, software tools, and electronic data forms. These data will be summarized in a report describing the observation effort, sightings, and the extent and nature of potential takes within 90-days of survey completion. TerraSond will report sightings of injured or dead marine mammals to NMFS, including the NMFS Northeast Region's Stranding Hotline (866-755-6622 or current), within 24 hours of sighting, regardless of whether the injury/death was caused by the vessel. As requested by NMFS, if the survey vessel was responsible for the injury or death, TerraSond will ensure that the vessel assists with any salvage effort.

11.7 Mitigation Measures

Proposed mitigation measures for use during the TerraSond site characterization survey activities are described in the following sub-sections.

11.7.1 Shutdown Zones

Shutdown zones (SZs) will be monitored around the center of the sources for marine mammals. The following SZs will be implemented during all HRG survey activities:

- 500 m (656 ft) for North Atlantic right whales;
- 100 m (328 ft) shutdown zone for all other marine mammal species;

Besides the planned 500 m acoustic shutdown zone for North Atlantic right whales, the implementation of the 500 m separation distance from North Atlantic right whales based on the vessel strike avoidance rules will create an effective acoustic shutdown zone of 500 m for this species.

11.7.2 Pre-Start Observations

PSOs will conduct observations of a 500 m exclusion zone for a minimum of 30 minutes prior to the activation of the sparker sound source and continue until 30 minutes following cessation of sparker use. If a marine mammal, or other protected species, is observed within or approaching the appropriate shutdown zone during the pre-start period, the sparker will not be activated until the animal(s) is confirmed by visual observation to have exited the relevant shutdown zone, or until an additional time period has elapsed with no further sighting of the animal (15 minutes for small delphinids and pinnipeds, 30 minutes for all other marine mammals, and 60 minutes for sea turtles).

11.7.3 Ramp-up

When technically feasible, acoustic sources will be ramped up at the start or re-start of survey activities. Ramp-up will not be initiated during inclement conditions or if the clearance zone cannot be adequately monitored by PSOs using appropriate visual technology for a 30-minute period. Ramp-up will begin with the power of the smallest acoustic source at its lowest practical power output. When technically feasible, the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.

11.7.4 Shutdowns

The PSO will call for an immediate shutdown of the sparker anytime a protected species is sighted within the applicable shutdown zone. The equipment operator will immediately comply with any call for shutdown by the PSO. Any disagreement between the PSO and equipment operator will be discussed only after shutdown has occurred. The sparker may continue to operate if delphinids (e.g., *Delphinus, Langenorhynchus,* or *Tursiops*) or pinnipeds voluntarily approach the vessel (e.g. to bow ride) once the ramp-up has been completed and the sparker is operating at full power. If a species for which authorization has not been granted, or an authorized species' takes have already been met, PSO will call for a shutdown if an individual approaches or enters the relevant shutdown zone.

If the sparker is shutdown for longer than 30 minutes, PSOs will conduct a 30-minute pre-start clearance followed by ramp-up. If another marine mammal enters a shutdown zone during the time the sparker is not operating, the sparker will not restart until that animal is confirmed outside the relevant shutdown zone or until the appropriate time has passed from the last sighting of the marine mammal. After shutdown, ramp-up can be initiated once the shutdown zone is visually clear for the respective pre-start clearance timing. If a PSO is unsure about the identification of a small delphinid, PSOs must use their professional judgement to decide as to whether shutdown should occur.

If the sparker is shut down for less than 30 minutes for reasons other than marine mammal mitigation (e.g., due to mechanical or electronic failure) the sparker may be re-activated as soon as practicable at full operational level if PSOs have maintained constant visual observation during the shutdown and no visual detections of marine mammals occurred within the applicable shutdown zone during that time. For a shutdown of 30 minutes or longer, or if visual observation was not continued diligently during the pause, pre-start clearance observation is required, as described above (Section 11.7.2).

11.8 Vessel Strike Avoidance

A number of measures intended to reduce the chance of vessels striking and injuring marine mammals and other protected species, such as sea turtles and giant manta rays, will be implemented while operating in the region in support of TerraSond's site characterization surveys. These measures include:

- Maintaining a vigilant watch for marine mammals and other protected species and slowing down or stopping vessels to avoid striking protected species, except under extraordinary circumstances when complying with this requirement would jeopardize the safety of the vessel or crew.
- Monitoring for vessel strike avoidance may be performed by PSOs or crew members; however, any crew members responsible for monitoring will be trained to broadly identify protected species and marine mammals, such as the NARW or other whale species.
- Complying with speed restrictions (≤10 knots) in North Atlantic right whale management areas including critical habitat, Seasonal Management Areas (SMAs), and active Dynamic Management Areas (DMAs).
- Reducing speed of vessels ≥65 feet in length to ≤10 knots between November 1 through July 31.
- Monitoring the NMFS North Atlantic Right whale reporting systems year-round.
- Operate vessel at a speed of 10 knots or less in any DMA.
- Reducing vessel speeds to ≤10 knots when mother/calf pairs, pods, or large assemblages of marine mammals are observed near any underway vessel.
- Avoid violating the relevant separation distance when a marine mammal is sighted while a vessel is underway (e.g., attempting to remain parallel to the animal's course, avoiding excessive speed or abrupt changes in direction until the animal has left the area, and reducing speed and shifting the engine to neutral). This does not apply to any vessel towing gear or any vessel that is navigationally constrained.
- Maintaining >500 m distance from North Atlantic right whales or an unidentified large marine mammal.
    - If the vessel comes within 500 m of a NARW, the vessel will steer a course away from the NARW at 10 knots or less until the 500 m minimum separation distance has been established.
    - If the vessel is underway and comes within 100 m of a NARW or large whale, the vessel must reduce speed and shift the engine to neutral, and must not engage the engines until the whale has moved beyond 100 m, at which point the vessel will steer a course away from any NARW or large whale at 10 knots or less until the 500 m minimum separation distance has been established.
    - If a vessel is stationary and within 100 m of a NARW or large whale, the vessel will not engage engines until the NARW or large whale has moved beyond 100 m, at which point the vessel will steer a course away from the whale(s) at 10 knots or less until the 500 m minimum separation distance has been established.
- Maintaining >100 m from all ESA-listed marine mammals.
    - If underway the vessel must reduce speed and shift the engine to neutral and must not engage the engines until the whale has moved beyond 100 m.
    - If stationary, the vessel must not engage engines until the whale has moved beyond 100 m.

- Maintaining >50 m from all other marine mammals, with the exception of delphinids and pinnipeds that approach the vessel, in which case the vessel operator must avoid excessive speed or abrupt changes in direction.
    - If underway, all vessels will remain parallel to a sighted delphinid cetacean's or pinniped's course whenever possible and avoid excessive speed or sudden changes in direction.
    - If a delphinid(s) is visually detected approaching the vessel or towed survey equipment (e.g., to bow ride), the PSOs and crew will use professional judgement in making course and/or speed adjustments.
- Report sightings of all dead or injured marine mammals or sea turtles within 24 hrs.

11.9 Sound Source Verification

In 2019, NMFS expressed concerns with HRG sound source verification measurements previously collected in offshore wind leases in the Northeast and recommended developers requesting incidental take authorization to estimate zones of potential acoustic impact using standard modeling guidance (NMFS 2020a). TerraSond does not plan to collect SSV measurements as part of the planned Carolina Long Bay surveys.

12 Mitigation Measures to Protect Subsistence Uses

Not applicable. There are no subsistence uses of marine mammals impacted by this action.

13 Monitoring and Reporting

Planned monitoring activities have been described in Section 11 along with the associated mitigation measures. A marine mammal sighting and detection report will be provided to NMFS as required by authorization stipulations.

Sightings of any NARW will be reported to the RWSAS as soon as it is practical to do so. Sightings of any injured, distressed, or dead marine mammals will be reported by a PSO to NMFS as soon as it is practical to do so and in accordance with any requirements set forth in the IHA.

14 Suggested Means of Coordination

TerraSond will coordinate the planned marine mammal monitoring program associated with this HRG survey off the U.S. east coast (as summarized in § XI and XIII) with other parties that may have interest in the area and/or be conducting marine mammal studies in the same region during the proposed survey.

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