Bay State Wind LLC

Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals during Site Characterization

Lease OCS-A 0500 and Associated Export Cable Route

July 2024
Finalized August 2024

Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals during Site Characterization Surveys Lease OCS-A 0500

DOCUMENT NO. CSA-Orsted-FL-24-81107-3468-08-REP-01-003

Suggested citation: CSA Ocean Sciences Inc. (CSA). 2024. Application for Incidental Harassment Authorization for the Non-Lethal Taking of Marine Mammals during Site Characterization Surveys Lease OCS-A 0500. Prepared for Bay State Wind LLC. 85 pp.

Contact information: info@csaocean.com

Internal review process					
Version	Date	Description	Prepared by:	Reviewed by:	Approved by:
INT-01	02/27/2024	Science Review	R. Orue	K. Hartigan M. Barkaszi	K. Hartigan
INT-02	2/29/2024	Technical Edit	R. Orue	K. Metzger	K. Hartigan
INT-03	5/29/2024	Updates per Agency comments	K. Hartigan	M. Barkaszi	K. Hartigan

Client deliverable			
Version	Date	Description	Project Manager Approval
01	2/29/2024	Client deliverable	K. Hartigan
02	03/21/2024	Client deliverable	K. Hartigan
03	5/30/2024	Updates per Agency comments	K. Hartigan
04	08/09/2024	Revised final delivery	K. Hartigan

Table of Contents

Page

Table of Contents (Continued)

List of Tables

List of Figures

List of Acronyms and Abbreviations

µPa	micropascal
AA	Applied Acoustics
AMAPPS	Atlantic Marine Assessment Program for Protected Species
AWS	Atlantic white-sided (dolphin)
BA	Biological Assessment
Bay State Wind LLC	Applicant
BOEM	Bureau of Ocean Energy Management
CETAP	Cetacean and Turtles Assessment Program
CFR	Code of Federal Regulations
CHIRP	Compressed High-Intensity Radiated Pulse
dB	decibel
DMA	Dynamic Management Area
DoN	Department of the Navy
DPS	distinct population segment
EA	environmental assessment
EBS	environmental baseline study
ECR	export cable route
ESA	Endangered Species Act
ET	EdgeTech
FR	*Federal Register*
G&G	geophysical and geotechnical
HF	high-frequency
HPAI	highly pathogenic avian influenza
HRG	high-resolution geophysical
IHA	Incidental Harassment Authorization
ISO	International Organization for Standardization
J	joule
LF	low-frequency
Lpk	zero-to-peak sound pressure level
MABS	Mid-Atlantic Baseline Studies/Maryland Baseline Studies
MBES	multibeam echosounder
MF	mid-frequency
MMPA	Marine Mammal Protection Act
NARW	North Atlantic right whale
NJDEP	New Jersey Department of Environmental Protection
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
OCS	Outer Continental Shelf
OPR	Office of Protected Resources
PBR	Potential Biological Removal
PEIS	Programmatic Environmental Impact Statement
PSO	Protected Species Observer
PTS	permanent threshold shift
PW	phocid pinniped in water
re	referenced to
RI – MA	Rhode island – Massachusetts
ROV	remotely operated vehicle

Lyst of Acronyms (Continued)

RWSAS	Right Whale Sighting Advisory System
SAR	Stock Assessment Report
SBP	sub-bottom profiler
SEL_{24h}	sound exposure level over 24-hours
SFV	sound field verification
SL	source level
SMA	Seasonal Management Area
SPL	root-mean-square sound pressure level
SSS	side-scan sonar
TTS	temporary threshold shift
UHD	ultra-high definition
UME	Unusual Mortality Event
USBL	ultra-short baseline
USFWS	U.S. Fish and Wildlife Service
WEA	Wind Energy Area
WFA	weighing factor adjustment

1.0 Description of Proposed Activities

Bay State Wind LLC (Applicant) submits this request for Incidental Harassment Authorization (IHA) pursuant to Section 101(a)(5) of the Marine Mammal Protection Act (MMPA) for the incidental take of small numbers of marine mammals by Level B harassment during site characterization using high resolution geophysical (HRG) equipment conducted to support the development of an offshore wind farm project. The Applicant is proposing to conduct the site characterization surveys within federal and state waters located in the area of the Outer Continental Shelf (OCS) Lease Area OCS-A 0500 (Lease Area) and potential export cable routes (ECRs) to landfall locations in Rhode Island and Massachusetts. The information provided in this document is submitted in response to the requirements of 50 Code of Federal Regulations (CFR) § 216.104 to allow for the incidental harassment of small numbers of marine mammals resulting from site characterization surveys.

1.1 PROJECT DESCRIPTION

Bay State Wind LLC, on its behalf and on behalf of any successors in interest or assignee, submits this Application to the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) requesting the issuance of an IHA to allow for the incidental harassment of small numbers of marine mammals resulting from site characterization surveys using HRG equipment which will be conducted to support the development of an offshore wind farm project. **Figure 1** shows the Project Area comprising the Lease Area and survey boundaries (gray shaded area) for the site characterization surveys, which include the potential ECR corridors.

Geophysical and geotechnical (G&G) surveys are required by BOEM and the Applicant to provide data concerning seabed (geophysical, geotechnical, and geohazard), ecological, and archeological conditions within the footprint of offshore wind facility development. Surveys are also conducted to support engineering design and to map unexploded ordinance (UXO) locations. The IHA is being requested to allow for the incidental harassment of small numbers of marine mammals incidental to the operation of HRG sources with frequencies less than 180 kHz.

An existing renewal IHA (88 FR 69159) that includes the Lease Area, as well as Lease Areas OCS-A 0486 and 0487, and potential ECR, which encompass a larger area extending from New York to Massachusetts than that proposed here (**Figure 1**), is valid through 05 October 2024. The proposed survey included in this Application will encompass **only** Lease Area 0500 and the potential ECR encompassed by the gray shaded area in **Figure 1**. The period of coverage for HRG activities included in this Application is 6 October 2024 through 5 October 2025.

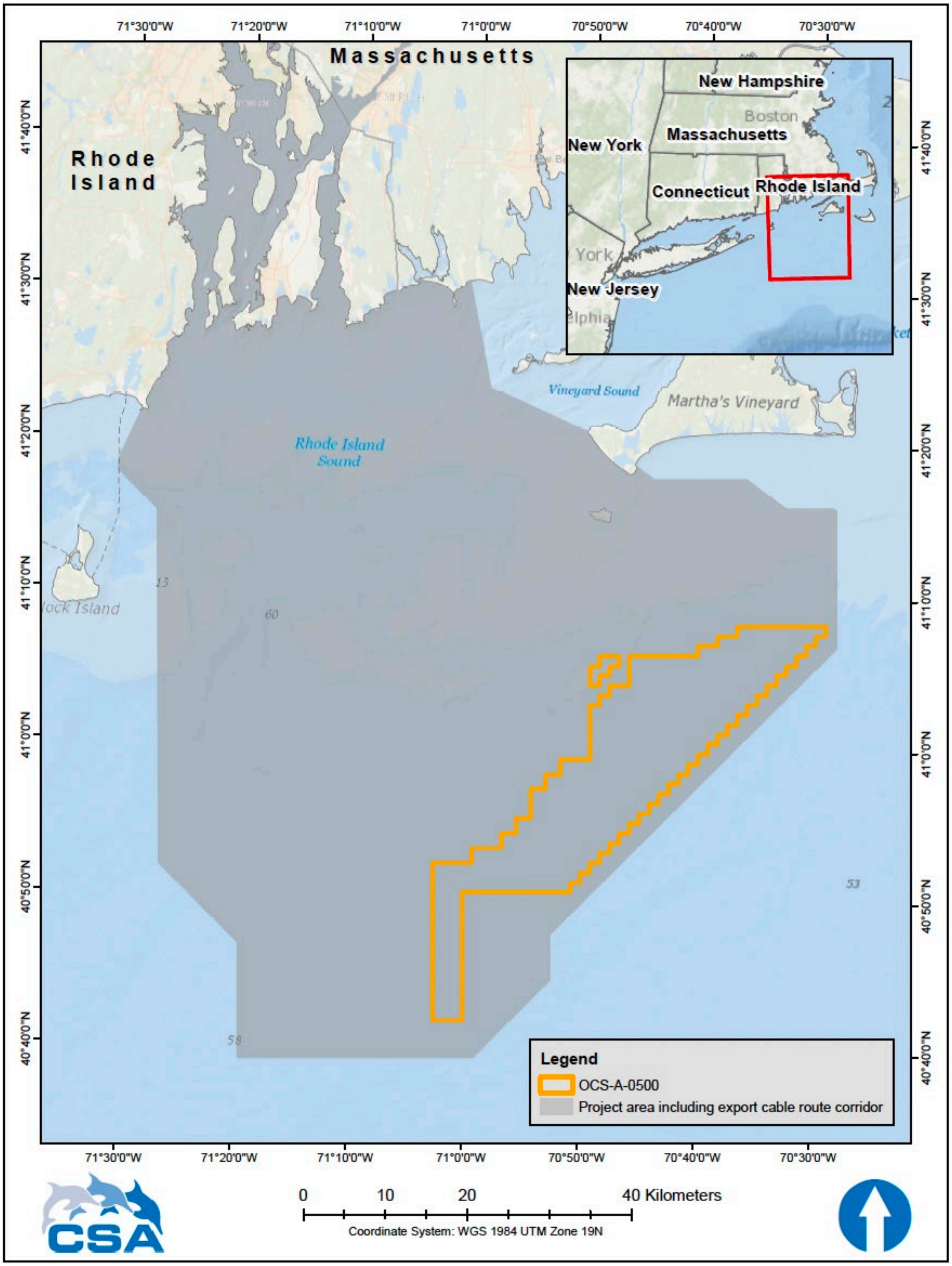

Figure 1. Project Area for the site characterization surveys, indicated in gray, which includes the Lease Area and the potential export cable route area.

1.2 ACTIVITIES CONSIDERED IN THIS APPLICATION

The site characterization surveys described and considered in this Application will include HRG sources with operating frequencies below 180 kHz which are not included in the list of sources unlikely to result in adverse effects by BOEM in their 2021 Biological Assessment (BA; Baker and Howson, 2021) or Tier 4 sources as defined by Ruppel et al. (2022). All sound source categories are described in **Section 1.3**.

1.2.1 Acoustic Analysis of Activities Considered in this Application

1.2.1.1 Acoustic Terminology

This document follows International Organization for Standardization (ISO) 18405:2017 (ISO, 2017) for all acoustic terminology. Underwater acoustic source levels (SLs), exposure levels, and associated measurements are expressed in decibels (dB) referenced to (re) 1 micropascal (μPa). In turn, acoustic metrics can be expressed in several ways depending on the quantity being reported. **Table 1** provides a list of the acoustic units used in this document.

Table 1. Acoustic metric definitions and their units used in this document adapted from International Organization for Standardization (ISO) 18405:2017 (ISO, 2017); abbreviations not provided in ISO (2017) follow Ainslie et al. (2018).

Quantity	Abbreviation	Units
Root-mean-square sound pressure level	SPL	dB re 1 μPa
Zero-to-peak sound pressure level (peak sound pressure level is a synonym)	Lpk	dB re 1 μPa
Sound exposure level over 24-hours	SEL_{24h}	dB re 1 μPa^2 s
Source level	SL	dB re 1 μPa m

μPa = micropascal dB = decibel; re = referenced to.

1.2.1.2 Regulatory Criteria

The included analysis applies the most recent noise exposure criteria utilized by NMFS Office of Protected Resources (OPR) to estimate acoustic harassment (NMFS, 2018a, 2023). The MMPA defines two levels of harassment: Level A harassment is statutorily defined as any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild; Level B harassment is any act of pursuit, torment, or annoyance that has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. In the 2018 acoustic guidance, NMFS establishes acoustic thresholds that, if exceeded, have the potential to cause auditory injury or behavioral disturbance for marine mammals (NMFS, 2018a) which are summarized for all sound sources in NMFS (2023).

NMFS recognizes two main types of sound sources: impulsive (e.g., sparkers, boomers) and non-impulsive (e.g., parametric sonars, compressed high-intensity radiated pulses [CHIRPs]); sources are further broken down into continuous or intermittent categories. Only impulsive and non-impulsive, intermittent sources are included in the list of equipment analyzed for potential acoustic impacts on marine mammals in this Application. After preliminary acoustic analysis of each equipment type based on its operating frequency, source levels, and operational modes (discussed further in **Section 1.3**), some sound sources were deemed to not have impact ranges expected to result in Level A or B take and were therefore not carried through to the take assessment of this Application (**Section 6.0**) due to the low likelihood of acoustic impacts from those sources. Sound source characteristics and acoustic thresholds are used to establish the ensonified area of received zero-to-peak sound pressure level, (Lpk), root-mean-square sound pressure level (SPL) or sound exposure level over 24-hours (SEL_{24h}) depending on the source type and marine mammal hearing group. This ensonified area constitutes the harassment zone, within which impacts and takes of marine mammals are considered.

Hearing Groups

Recognizing that marine mammal species do not have equal hearing capabilities, marine mammals are separated into hearing groups (Southall et al., 2007; NMFS, 2018a, 2023; Southall et al., 2019). Hearing groups are used in acoustic impact assessment through the application of frequency weighting functions. Frequency weighting functions use physiological parameters to scale a species' sensitivity to a propagated sound source depending on the spectral content of the sound source and the hearing acuity of that animal to that spectral content. Sound energy contained within the hearing range of an animal has the potential to affect hearing while sound energy outside an animal's hearing range is unlikely to affect its hearing.

Marine mammal hearing groups, originally identified by Southall et al. (2007) then later modified by Finneran (2016) and adopted by NMFS (2018a), are categorized as low-frequency (LF) cetaceans, mid-frequency (MF) cetaceans, high-frequency (HF) cetaceans, phocid pinnipeds in water (PW), and otariid pinnipeds in water. Each category has a defined auditory weighting function and estimated acoustic threshold for the onset of temporary and injury-level hearing impacts.

More recently, Southall et al. (2019) conducted a broad, structured assessment of the audiometric, physiological, and acoustic output bases for the categorization of these hearing groups using the best available data at that time. Their assessment revealed several important features and distinctions present within the cetaceans that were not reflected in the less robust assessments used in previous categorizations of hearing groups. However, Southall et al. (2019) acknowledged that there is presently insufficient direct data within several groups to explicitly derive distinct thresholds and weighting functions. They thus proposed retaining the thresholds and functions developed by Finneran (2016) and adopted by NMFS (2018a), but with slightly different categorical identifiers. This results in slightly different grouping nomenclature from the NMFS (2018a) designations, but the overall conclusions of Southall (2019) remain congruent with the current MMPA guidance (NMFS, 2018a, 2023).

The four hearing groups of marine mammals, based on the NMFS (2018a) nomenclature, that potentially occur in the Project Area include:

- LF cetaceans – baleen whales with a collective generalized hearing range of approximately 7 Hz to 35 kHz;
- MF cetaceans – most dolphins, all toothed whales except for *Kogia* spp., and all beaked and bottlenose whales with a generalized hearing range of approximately 150 Hz to 160 kHz;
- HF cetaceans – all true porpoises and *Kogia* spp. with a generalized hearing range of approximately 275 Hz to 160 kHz; and
- PW – all true seals with a generalized hearing range of 50 Hz to 86 kHz.

Impact Levels

Level A auditory impacts under the MMPA include permanent threshold shifts (PTS), which is a condition that occurs when sound intensity is sufficiently high and/or of sufficient duration that the result is a permanent loss of hearing sensitivity which is an irreversible auditory tissue injury (Southall et al., 2007). Level A acoustic thresholds are defined as sound exposures that potentially elicit the onset of a PTS in marine mammal hearing. The acoustic thresholds are used to establish the ensonified area of received Lpk or SEL_{24h} depending on the source type and marine mammal hearing group.

For non-impulsive, intermittent sources, only the SEL_{24h} metric is used to assess potential injury-level impacts. For impulsive sources, both Lpk and SEL_{24h} criteria are identified to account for the intensity of impulsive sounds and the duration required to elicit PTS.

Level B harassment impacts include temporary threshold shifts (TTS) and behavioral responses. Compared to PTS, TTS is a lesser impact to hearing. TTS results when sounds of sufficient loudness or duration cause a transient condition in which an animal's hearing sensitivity over the frequency band of exposure is impaired for a period of time (minutes to days). TTS does not cause permanent damage and is not considered a tissue injury (Richardson et al., 1995; Southall et al., 2007). Similarly, underwater sound may elicit a behavioral response from marine mammals that may or may not be biologically significant. In principle, behavioral thresholds are lower than TTS thresholds. TTS thresholds are defined in the 2018 criteria; however, TTS thresholds and behavioral response thresholds have not yet been separated within a regulatory framework and are all considered Level B harassment. Currently, the regulatory framework uses interim guidance to define Level B thresholds provided as unweighted SPL to assess Level B behavioral impacts (NMFS, 2023).

The corresponding Level A and Level B acoustic threshold criteria are summarized in **Table 2**. While the Level B threshold for non-impulsive sources is an SPL of 120 dB re 1 µPa, an SPL of 160 dB re 1 µPa is considered more appropriate for intermittent sources such as those assessed in this Application.

Table 2. Summary of National Marine Fisheries Service acoustic criteria for Level A and Level B acoustic exposure from impulsive and non-impulsive, intermittent sources (NMFS, 2023).

Hearing Group	Non-Impulsive, Intermittent		Impulsive		
	Level B[1]	Level A[2]	Level B[1]	Level A[3]	Level A[2]
Low-frequency Cetacean	160	199	160	219	183
Mid-frequency Cetacean	160	198	160	230	185
High-frequency Cetacean	160	173	160	202	155
Phocid Pinniped (in water)	160	201	160	218	185

µPa = micropascal; dB = decibel; re = referenced to; Lpk = zero-to-peak sound pressure level; SEL_{24h} = sound exposure level over 24-hours; SPL = root-mean-square sound pressure level.
[1]Units expressed as SPL in dB re 1 µPa (unweighted). Level B criteria are the same for all intermittent sources, both non-impulsive and impulsive, which are considered in this Application.
[2]Units expressed as SEL_{24h} in dB re 1 μPa^2 s (weighted).
[3]Units expressed as Lpk in dB re 1 µPa.

1.3 SURVEY EQUIPMENT

Survey equipment discussed in this Application is either towed, pole mounted, hull-mounted on the vessel, or equipment mounted on the source itself or on a remotely operated vehicle (ROV). Survey equipment will be deployed from multiple vessels or ROVs during the HRG surveys conducted within the Project Area, however only one vessel would operate at a time within the Lease Area and ECR area. Typically, a survey ROV used for the proposed activities is a tethered platform that carries additional HRG equipment to increase the swath of the survey or the depth at which the equipment can be operated. The equipment deployed from an ROV is identical to the sources deployed from the survey vessel; however, sparker systems (described further in **Section 1.3**) are not normally deployed from an ROV due to the power supply required. HRG surveys will include the use of seafloor mapping equipment with operating frequencies above 180 kHz (e.g., side-scan sonar [SSS], multibeam echosounder [MBES]); magnetometers and gradiometers that have no acoustic output; and shallow- to medium-penetration sub-bottom profiling (SBP) equipment (e.g., parametric sonars, CHIRPs, boomers, sparkers) with operating frequencies below 180 kHz. No deep-penetration SBP equipment (e.g., airgun, bubble gun) will be utilized during the proposed surveys.

Typically, field-measured data is considered the best available science for HRG sources due to the high site- and operations-specific variables that direct frequency content, power, beamwidths, and other user-defined parameters. There are no accepted sound field verification reports for the proposed survey equipment operating in the Project Area; therefore, source information and associated analysis provided in Crocker and Fratantonio (2016), Baker and Howson (2021), and Ruppel et al. (2022) are used for this Application.

In the analysis conducted by Ruppel et al. (2022), acoustic survey sources were categorized based on their potential to produce and propagate sound levels that may exceed marine mammal acoustic impact thresholds (NMFS, 2023). All Project equipment fall within the Tier 3 or Tier 4 categories, defined by Ruppel et al. (2022) as follows:

- **Tier 3** covers most non-airgun seismic sources, which either have characteristics that do not meet the *de minimis* category (e.g., some sparkers) or could not be fully evaluated in the analysis (e.g., bubble guns, some boomers).
- **Tier 4** includes most HRG, oceanographic, and communication/tracking sources, which are considered unlikely to result in incidental take of marine mammals and therefore termed *de minimis*.

Not every make and model of acoustic source that may be used in the Project were analyzed in the three main references (Crocker and Fratantonio [2016]; Baker and Howson [2021]; and Ruppel et al. [2022]) used for source parameter information in this Application. However, the operational parameters (e.g., operating frequency, SL, pulse duration, ping rate) for each piece of equipment, as well as the output parameters (e.g., SPLs, propagation distance, frequency content) are generally similar within each category; and therefore, the overall magnitude of impact radii can often be predicted based on the equipment category as described in Baker and Howson (2021) and Ruppel et al. (2022). Some source parameters, including SLs, described in Ruppel et al. (2022) are derived from data collected in Crocker and Fratantonio (2016); and are therefore congruent with the hierarchy used to select input parameters for the for the NMFS User Spreadsheet Tool (NMFS, 2018b) and transmission loss equations used in this Application as follows:

1. For equipment that was measured by Crocker and Fratantonio (2016) and assessed in Baker and Howson (2021) or Ruppel et al. (2022), the reported SL for the most likely operational parameters was selected; and
2. For equipment not measured by Crocker and Fratantonio (2016) and/or not provided in Baker and Howson (2021) or Ruppel et al. (2022), the best available manufacturer specifications were selected. Use of manufacturer specifications represent the absolute maximum output of any source and do not adequately represent the operational source. Therefore, they should be considered an overestimate of the sound propagation range for that equipment.

The operational characteristics and supplemental source information considered in the analyses for this Application, as well as justification for selected proxy equipment, and categories excluded from analysis, are provided below.

Equipment categories carried forward in take analysis

Medium penetration, impulsive SBPs (boomers) are used to map deeper subsurface stratigraphy as needed. A boomer is a broad-band sound source operating in the 3.5 Hz to 10 kHz frequency range. This system is commonly mounted on a sled and towed behind the vessel. The sound levels produced by these types of equipment could result in Level B exposures, and therefore these types of equipment were included in the take analysis of this Application (**Section 6.0**).

Medium penetration, impulsive SBPs (sparkers) are used to map deeper subsurface stratigraphy as needed. Sparkers create acoustic pulses from 50 Hz to 4 kHz omnidirectionally from the source. Sparkers are typically towed behind the vessel with adjacent hydrophone arrays to receive the return signals. The sound levels produced by these types of equipment could result in Level B exposures, and therefore these types of equipment were included in the take analysis of this Application (**Section 6.0**).

Sparker equipment source levels were obtained from Crocker and Fratantonio (2016) as noted above which were shown to vary based on both the power level and number of tips selected for operations. If sparker power is operated over a higher number of tips, this reduces the sound levels produced compared to comparable power levels operated over fewer tips. For example, source level measurement of the Dura-spark provided in Crocker and Fratantonio (2016) show that source settings using 500 Joules (J) with 240 tips can produce and SPL source level of 209 dB re 1 µPa m whereas source settings using 500 J with 400 tips produce a lower SPL source level of 203 dB re 1 µPa m. Based on the operational characteristics of the Dura-spark equipment, this was identified as the best available proxy for the GeoMarine sparker equipment which were not measured in Crocker and Fratantonio (2016). The equipment list in **Table 3** show multiple sparker sources and configurations that could be used during the proposed surveys, but the Joule-to-tip ratio would remain comparable for all equipment and is therefore adequately covered by the proxy source level obtained from Crocker and Fratantonio (2016). Furthermore, the take assessment in Section 6.0 assumes that all 350 survey days would utilize the sparker or boomer sources, but in reality CHIRP sources would also be utilized which present a lower risk of exposure for marine mammals (**Section 1.4**). This assumption ensures flexibility for the project survey as well as the greatest level of protection for marine mammals by ensuring all potential for exposures are covered under this IHA application.

Shallow penetration SBPs (CHIRPs) are used to map the near-surface stratigraphy (top 0 to 10 m) of sediment below seabed. These systems emit sonar pulses that increase in frequency from approximately 2 to 20 kHz over time. The pulse length frequency range can be adjusted to meet project variables. These shallow penetration SPBs are typically mounted on a pole, either over the side of the vessel or through a moon pool in the bottom of the hull; however, they can be used in several types of towed configurations. The sound levels produced by some models of CHIRP equipment could result in Level B exposures; and therefore, these types of equipment were included in the take analysis of this Application (**Section 6.0**). However, the operational configuration and relatively narrow beamwidth of these sources help to reduce the likelihood of the beam intersecting an animal.

Equipment not carried forward in take analysis

Parametric SBPs and Sub-bottom Imagers (SBIs), also called sediment echosounders, are used for providing high data density in sub-bottom profiles that are typically required for cable routes, very shallow water, and archaeological surveys. There are no relevant information sources or measurement data within the Crocker and Fratantonio (2016) reference for parametric SBPs. Source information is available from the manufacturer; however, no field measurements or propagation characteristics are provided with the manufacturer specifications. Due to the highly specialized nature of these sonars (high frequencies and narrow beamwidths) the source information alone is not sufficient to fully evaluate the expected propagation. Additionally, since the parametric SPBs are typically mounted on a side pole, either over the side of the vessel or through a moon pool in the bottom of the hull; they are typically not towed behind the vessel, the likelihood of the beam intersecting an animal is significantly reduced.

The specific parametric sonar proposed for the HRG work, the Innomar SES-2000 or similar SBP, uses the principle of "parametric" or "nonlinear" acoustics to generate short, very narrow-beam sound pulses at very high frequencies (generally around 85 to100 kHz). The transducer projects a beamwidth of approximately 1° to 3.5°. The narrow beamwidth significantly reduces the impact range of the source while the high frequencies of the source are rapidly attenuated in sea water. Neither high frequency sonar nor narrow beamwidth sources are well-captured in the NOAA User Spreadsheets used to calculate Level A isopleths. Therefore, the manufacturer reported SLs expressed as SPL were converted to sound exposure levels over the pulse duration, then exposure distances were calculated for each hearing group following guidance provided by NMFS OPR (NMFS, 2019a) which considers both the beamwidth and frequency absorption as previously mentioned.

The Pangeo Sub-bottom Imager™ (SBI) or similar SBIs are also included in this category because they are typically deployed 3 to 4 m above the seafloor, the acoustic source associated with this equipment is a linear frequency-modulated sweep with output frequencies from 4.5 to 12.5 kHz, and operational beamwidths range from 49° to 120° depending on frequency (Spencer, 2021; Pangeo Subsea, 2022). Because of the high frequency of the source and narrow bandwidth, parametric SBPs do not produce Level A isopleths beyond 2 m and do not produce Level B isopleths beyond 4 m. No Level A or Level B exposures can be reasonably expected from the operation of these sources; therefore, the Innomar parametric SBPs and Pangeo SBIs were not carried forward in the take analysis in this Application.

Ultra-short baseline (USBL) positioning systems are used to provide high accuracy ranges to survey equipment by measuring the time between the acoustic pulses transmitted by the vessel transceiver and a transponder (or beacon) necessary to produce the acoustic profile. It is a two-component system with a moonpool- or side pole-mounted transceiver and one or several transponders mounted on other survey equipment. There are no relevant information sources or measurement data within the Crocker and Fratantonio (2016) reference for USBLs and only limited manufacturer SL information. USBLs have a wide variety of configurations, source levels, and beamwidths but have been shown to produce extremely small acoustic propagation distances in their typical operating configuration. There are numerous options for make and model of USBLs and of combinations pairing USBL transceivers and beacons.

USBLs fall into the Tier 4 category of equipment in Ruppel et al. (2022). Additionally, geophysical sources have been extensively reviewed in the Gulf of Mexico OCS due to the large amount of ongoing and planned oil and gas G&G surveys. A Programmatic Environmental Impact Statement (PEIS) was issued for G&G surveys in the Gulf of Mexico in 2017 (BOEM, 2017). Within this PEIS, non-airgun HRG sources were considered for potential impacts. Notably, USBLs were not considered in the PEIS assessment. Additionally, in the recent incidental take regulation published for the Gulf of Mexico USBLs were not considered for take requests by NMFS in the final rule published on 19 January 2021 (86 FR 5322) and were considered unlikely to adversely affect marine mammals in the BOEM BA (Baker and Howson, 2021). In both assessments, HRG surveys with equipment comparable to the equipment proposed in these activities were fully evaluated and USBLs were not considered in the take evaluation.

There is, therefore, precedence for not considering USBLs as sound sources likely to propagate sound levels reaching Level A or Level B thresholds. Based on this information, no Level A or Level B exposures can be reasonably expected from the operation of these sources; therefore, the USBLs were not carried forward in the take analysis in this Application.

MBESs are used to determine water depths and general bottom topography. MBES sonar systems project sonar pulses in several angled beams from a transducer mounted to a ship's hull. The beams radiate out from the transducer in a fan-shaped pattern orthogonally to the ship's direction. The proposed MBESs all have operating frequencies >180 kHz; are outside the general hearing range of marine mammals likely to occur in the Project Area and are not likely to affect these species. Therefore, this equipment category will not be discussed further in this Application.

SSS are used for seabed sediment classification purposes and to identify natural and man-made acoustic targets on the seafloor. The sonar device emits conical or fan-shaped pulses down toward the seafloor in multiple beams at a wide angle, perpendicular to the path of the sensor through the water column. The acoustic return of the pulses is recorded in a series of cross-track slices, which can be joined to form an image of the sea bottom within the swath of the beam. SSSs are typically towed beside or behind the vessel or from an autonomous vehicle. The proposed SSSs all have operating frequencies >180 kHz; are outside the general hearing range of marine mammals likely to occur in the Project Area and are not likely to affect these species. Therefore, this equipment category will not be discussed further in this Application.

1.3.1 Equipment Summary

The operational parameters for each piece of equipment are typically provided as a range of options that can be specified by the user. The precise settings are often field-specific depending on each contractor's individual survey methodologies and data needs. The selected parameters will affect the impact analysis for each piece of equipment within each category; therefore, the parameters used in the analysis must be as closely aligned as possible with the expected operation at the time of the survey. This information helps determine the expected acoustic output for this Project by selecting the appropriate measurements reported in Crocker and Fratantonio (2016). As mentioned previously, the BOEM BA (Baker and Howson, 2021) also used information from Crocker and Fratantonio (2016); however, the BA used the highest source operational settings which do not match the source settings proposed by the Applicants to meet the needs of their survey. As previously discussed for equipment that was not measured by Crocker and Fratantonio (2016), manufacturer information was used with the most applicable operational parameters (**Table 3**).

Sound field verification (SFV) measurements on most proposed equipment types were previously conducted by the Applicant on this Lease and on other wind farm areas between 2015 and 2018. However, due to significant variation in SFV methodologies and SFV reporting, NMFS OPR provided supplemental guidance to the Applicant in July 2019 for methods applied in lieu of using SFVs (NMFS, 2019a). Because there are no standardized field measurements for HRG survey equipment, NMFS recommended that the controlled measurements provided in Crocker and Fratantonio (2016) be the primary reference for equipment SLs with manufacturer information supplementing for equipment that was not measured in the Crocker and Fratantonio (2016) study. Where applicable, SFV measurements are provided in equipment descriptions to supplement the data used in the analysis; however, SFV measurements were not used to define SLs or acoustic threshold distances.

Although the final equipment choices will vary depending on the final survey design, vessel availability, make and model updates, and survey contractor selection, all sources that are representative of those that could be employed during the HRG surveys are provided in **Table 3** along with details of the parameters used in acoustic analyses within this Application.

Table 3. List of all representative geophysical sound sources with operating frequencies below 180 kHz that may be used during the site characterization surveys and were assessed for marine mammal takes. Equipment types not carried through for take analysis are not included in the table. All source information that was used to calculate threshold isopleths are provided in the table[1].

Equipment	Source Type	WFA in User Spreadsheets (kHz)[2]	Reference for SL	Operating Frequency (kHz)	SL (SPL dB re 1 µPa m)	SL (SEL dB re $1\ \mu Pa^2\ m^2\ s$)	SL (PK dB re 1 µPa m)	Pulse Duration (width) (millisecond)	Repetition Rate (Hz)	Beamwidth (degrees)	Deployment Method
Non-impulsive, Non-parametric, Shallow Sub-bottom Profilers (CHIRP Sonars)											
ET 216 (2000DS or 3200 top unit)	Non-impulsive, mobile, intermittent	N/A[3]	MAN	2–16 2–8	195	178	-	20	6	24	PM/T/EM
ET 424 3200-XS	Non-impulsive, mobile, intermittent	N/A[3]	CF	4–24	176	152	-	3.4	2	71	PM/T/EM
ET 512i	Non-impulsive, mobile, intermittent	N/A[3]	CF	0.7–12	179	158	-	9	8	80	PM/T/EM
GeoPulse 5430A	Non-impulsive, mobile, intermittent	N/A[3]	MAN	2–17	196	183	-	50	10	55	PM/T/EM
Teledyne Benthos Chirp III - TTV 170	Non-impulsive, mobile, intermittent	N/A[3]	MAN	2–7	197	185	-	60	15	100	PM/T/EM
Pangeo SBI	Non-impulsive, mobile, intermittent	N/A[3]	MAN	4.5–12.5	188.2	165	-	4.5	45	120	T/EM

Table 3. (Continued).

Equipment	Source Type	WFA in User Spreadsheets (kHz)[2]	Reference for SL	Operating Frequency (kHz)	SL (SPL dB re 1 µPa m)	SL (SEL dB re 1 µPa^2 m^2 s)	SL (PK dB re 1 µPa m)	Pulse Duration (width) (millisecond)	Repetition Rate (Hz)	Beamwidth (degrees)	Deployment Method
Impulsive, Medium Sub-bottom Profilers (Sparkers & Boomers)											
AA, Dura-spark UHD Sparker (400 tips, 500 J)[4]	Impulsive, mobile	1	CF	0.3–1.2	203	174	211	1.1	4	Omni	T
AA, Dura-spark UHD Sparker Model 400 × 400[4]	Impulsive, mobile	1	CF	0.3–1.2	203	174	211	1.1	4	Omni	T
GeoMarine, Dual 400 Sparker, Model GeoSource 800[4,5]	Impulsive, mobile	1.5	CF	0.4–5	203	174	211	1.1	2	Omni	T
GeoMarine Sparker, Model GeoSource 200– 400[4,5]	Impulsive, mobile	1	CF	0.3–1.2	203	174	211	1.1	4	Omni	T

Table 3. (Continued).

Equipment	Source Type	WFA in User Spreadsheets (kHz)[2]	Reference for SL	Operating Frequency (kHz)	SL (SPL dB re 1 µPa m)	SL (SEL dB re 1 µPa^2 m^2 s)	SL (PK dB re 1 µPa m)	Pulse Duration (width) (millisecond)	Repetition Rate (Hz)	Beamwidth (degrees)	Deployment Method
GeoMarine Sparker, Model GeoSource 200 Lightweight[4,5]	Impulsive, mobile	1	CF	0.3–1.2	203	174	211	1.1	4	Omni	T
AA, triple plate SBoom (700– 1,000 J)[6]	Impulsive, mobile	3.4	CF	0.1–5	205	172	211	0.6	4	80	T

µPa = micropascal; AA = Applied Acoustics; CF = Crocker and Fratantonio (2016); CHIRP = compressed high-intensity radiated pulses; dB = decibel; EM = equipment mounted; ET = edgetech; J = joule; Omni = omnidirectional source; re = referenced to; Lpk = zero-to-peak sound pressure level; PM = pole mounted; SBI = sub-bottom imager; SL = source level; SPL = root-mean-square sound pressure level; T = towed; TB = Teledyne benthos; UHD = ultra-high definition; WFA = weighting factor adjustment.

[1]Operational parameters listed here differ from those listed in the Bureau of Ocean Energy Management Biological Assessment published in February 2021 (Baker and Howson, 2021).

[2]WFAs were selected in the User Spreadsheet based on estimated hearing sensitivities of marine mammals and the operational frequency of the source.

[3]All CHIRP equipment have operational beamwidths <180° and sweep through a range of frequencies per pulse, so ranges to Level A thresholds were therefore calculated using MATLAB code provided by the National Marine Fisheries Service Office of Protected Resources (NMFS, 2021).

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

[5]The AA Dura-spark (500 J, 400 tips) was used as a proxy source for all proposed sparkers to represent the most likely potential source level anticipated during the Proposed survey. Though the power settings and number of tips may vary among the sparker systems, all systems will operate with a comparable Joule-to-tip ratio which, as discussed above in **Section 1.3** of this Application, influences the source levels more than just power setting. Additionally, the survey would not utilize higher-powered sparker systems operating at ≥2,000 J so Dura-spark (500 J, 400 tips) is considered to best available proxy for source levels for these equipment.

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

1.4 DISTANCES TO REGULATORY ACOUSTIC THRESHOLDS

Because impulsive sources use dual metrics (SEL_{24h} and Lpk) for Level A exposure criteria, the metric resulting in the largest isopleth distance was used for exposure estimation. Weighting factor adjustments (WFAs) for Level A isopleths used to account for differences in marine mammal hearing were determined by examining the frequency range and spectral densities for each source. The selected WFAs were then compared to the Applicable Frequencies Table located in the WFA tab of the NMFS User Spreadsheet Tool (NMFS, 2018b). If the determined frequency was lower than the applicable frequency for all hearing groups, it was entered as the WFA. When the frequency of a source exceeded the applicable frequency for a certain hearing group, an additional worksheet was created that applied the "use" frequency of the exceeded hearing group as indicated by NMFS (2018b). All the non-impulsive sources included in the take assessment of this Application (**Table 3**) have operational beamwidths <180° and sweep through multiple frequencies within a single pulse, so ranges to Level A exposure criteria were therefore calculated using MATLAB code provided by NMFS OPR (NMFS, 2021).

The User Spreadsheet does not calculate distances to Level B thresholds; the ranges to the Level B thresholds for omnidirectional sources (beamwidths >180°) were instead determined by applying spherical spreading loss to the SL for that equipment. For directional sources with reported beamwidths <180°, operational depth and directionality can greatly influence how the sound propagates and can influence the resulting isopleth distance, so these parameters were considered for sources that had reported beamwidths. Narrow beamwidths allow geophysical equipment to be highly directional, focusing its energy in the vertical direction and minimizing horizontal propagation, which greatly reduces the possibility of direct path exposure to receivers (i.e., marine mammals) from sounds emitted by these sources. Therefore, isopleth distances were calculated using the NMFS Level B Harassment Isopleth Calculator (NMFS, 2024a) associated with their Recommendation for Sound Source Level and Propagation Analysis for HRG Sources document (NMFS, 2020a) to account for the influence of beamwidth and frequency on the horizontal propagation of these sources.

The estimated distances to Level A and Level B isopleths calculated for each marine mammal hearing group are given in **Table 4**.

Table 4. Maximum distance to weighted Level A and unweighted Level B thresholds for equipment categories included in take analysis for all marine mammal hearing groups[1].

Source	Distance to Level A Threshold (m)					Distance to Level B (m)
	LF (SEL_{24h} threshold)	MF (SEL_{24h} threshold)	HF (SEL_{24h} threshold)	HF (Lpk threshold)	PW (SEL_{24h} threshold)	All (SPL threshold)
Shallow SBP's (CHIRPS)	1.5	<1	18	-	<1	54
Boomers	<1	0	0	4.7	0	76
Sparkers	<1	0	0	2.8	0	141

µPa = micropascal; CHIRP = compressed high-intensity radiated pulses; dB = decibel; HF = high-frequency; LF= low-frequency; MF = mid-frequency; Lpk = zero to peak sound pressure level in dB re 1 µPa; PW = phocids in water; re= referenced to; SBP = sub-bottom profiler; SEL_{24h} = cumulative sound exposure level in dB re 1 μPa^2 s; SPL = root-mean-square sound pressure level.

[1]The Level A and B isopleths were calculated to comprehensively assess the potential impacts of the predicted source operations as required for this Application. However, as described in **Section 5.0**, Level A takes are not expected and not requested.

2.0 Survey Dates, Duration, and Specific Geographic Region

2.1 SURVEY ACTIVITY DATES AND DURATION

Site characterization surveys considered under this Application are expected to occur between 6 October 2023 through 5 October 2024 for a total of 350 survey days. A vessel survey day is defined here as a 24-hour activity period in which the assumed number of line km are surveyed. Vessel days are defined as the number of days any single vessel is in operation regardless of any other vessel operations (i.e., if two vessels are working concurrently within the same 24-hour period, each vessel would be counted as having a vessel day for a total of two vessel days even though the activity occurs within a single 24-hour period). The number of anticipated survey days was calculated as the number of days needed to reach the overall level of effort required to meet survey objectives assuming any single vessel covers, on average 70 line km per 24-hour operations.

During the one-year period covered by this IHA, the Applicant is proposing up to 350 vessel survey days during which HRG surveys will be conducted within Lease Area OCS-A 0500 and the associated ECR area (**Figure 1**).

2.2 SPECIFIC GEOGRAPHIC REGION

The proposed survey activities will occur within the Project Area in federal waters off the coast of Rhode Island and Massachusetts **(Figure 1**). Water depths in the Project Area extend out from shoreline to approximately 90 m.

2.3 SURVEY ACTIVITIES

Site characterization survey activities will include multibeam depth sounding, seafloor imaging, and shallow and medium penetration sub-bottom profiling to meet BOEM requirements as set out in the Guidelines for Providing Archaeological and Historic Property Information Pursuant to 30 CFR Part 585 [March, 2017]; the Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information Pursuant to 30 CFR Part 585 [May 2020],as applicable or amended; and to support engineering design and UXO surveys. All surveys will follow the BOEM Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection (dated 22 November 2021 or as amended; BOEM, 2021).

Up to four concurrent vessels, which may include 24-hour vessels and/or 12-hour vessels, will be used to complete the surveys. Site characterization survey activities considered in this IHA will use combinations of the equipment listed in **Table 3** to collect multiple aspects of geophysical data along each transect. Equipment with operating frequencies above 180 kHz (e.g., SSS, MBES) and equipment that does not have an acoustic output (e.g., magnetometers) will also be used but are not considered in the IHA analysis. Combinations of sources may be used during any single survey and selection of equipment combinations is based on specific survey objectives that may not be known at the time of the Application. Field operation modes of each acoustic equipment source are based on expected survey parameters and as-needed modification due to field conditions and data quality constraints may be applied once operations begin.

3.0 Species and Numbers of Marine Mammals

3.1 PROTECTED POPULATIONS

All marine mammal species are protected under the MMPA. Some marine mammal stocks (defined as a group of nonspecific individuals that are managed separately) (Hayes et al., 2021, 2022; NMFS, 2024b) may be designated as strategic under the MMPA.

A stock is considered strategic if:

- Direct human-caused mortality exceeds its Potential Biological Removal (PBR) level (defined as the maximum number of animals, not including natural mortality, that can be removed from the stock while still allowing the stock to reach or maintain its optimum sustainable population level);
- It is listed under the ESA;
- It is declining and likely to be listed under the ESA; or
- It is designated as depleted under the MMPA.

A depleted species or population stock is defined by the MMPA as any case in which:

- The Secretary, after consultation with the Marine Mammal Commission and the Committee of Scientific Advisors on Marine Mammals established under MMPA Title II, determines that a species or population stock is below its optimum sustainable population;
- A State, to which authority for the conservation and management of a species or population stock is transferred under Section 109 of the MMPA, determines that such species or stock is below its optimum sustainable population; or
- A species or population stock is listed as an Endangered species or a Threatened species under the ESA.

Some species are further protected under the ESA. Under the ESA, a species is considered Endangered if it is "in danger of extinction throughout all or a significant portion of its range." A species is considered Threatened if it "is likely to become an Endangered species within the foreseeable future throughout all or a significant portion of its range" (NMFS, 2020b).

3.2 MARINE MAMMAL SPECIES

There are 36 species (comprising 37 stocks) of marine mammals in the Western North Atlantic OCS Region that are protected by the MMPA (**Table 5**) (Hayes et al., 2021, 2022; NMFS, 2024b). The marine mammal assemblage comprises 31 cetacean species, including 25 members of the suborder Odontoceti (toothed whales, dolphins, and porpoises) and 6 of the suborder Mysticeti (baleen whales). There are five whale species listed as Endangered under the ESA with ranges that include the Project Area:

- Fin whale (*Balaenoptera physalus*);
- Sei whale (*Balaenoptera borealis*);
- Blue whale (*Balaenoptera musculus*);
- North Atlantic right whale (*Eubalaena glacialis*); and
- Sperm whale (*Physeter macrocephalus*).

Along with cetaceans, seals are also protected under the MMPA; four species of phocids (true seals) with ranges that include the Project Area include harbor seals (*Phoca vitulina*), gray seals (*Halichoerus grypus*), harp seals (*Pagophilus groenlandicus*), and hooded seals (*Cystiphora cristata*) (Hayes et al., 2022). Lastly, one species of sirenian, the Florida manatee (*Trichechus manatus latirostris*), is an occasional visitor to the region during summer months (USFWS, 2023). The manatee is listed as Threatened under the ESA and is protected under the MMPA along with the other marine mammals.

The expected occurrence of each species is based on the following criteria and/or on the habitat models (i.e., Best et al., 2012; Roberts et al., 2023) for the Project Area and for species available in the model analyses:

- Common – occurring consistently in moderate to large numbers;
- Regular – occurring in low to moderate numbers on a regular basis or seasonally;
- Uncommon – occurring in low numbers or on an irregular basis;
- Rare – records for some years but limited; and
- Not expected – range includes the Project Area but due to habitat preferences and distribution information, species are not expected to occur in the Project Area although records may exist for adjacent waters.

Survey activities within this Project Area (**Figure 1**) have been ongoing for marine site characterization since 2019; as such, Protected Species Observer (PSO) data are available for these surveys under previous MMPA authorizations. PSO data, in addition to other comprehensive surveys (e.g., Atlantic Marine Assessment Program for Protected Species [AMAPPS]; Palka et al., 2012, 2017), provide information regarding species and occurrence of species that can be expected during the proposed survey.

A summary of the marine mammal species with geographic ranges that include the Project Area, along with stock information, expected occurrence, and PSO detections is provided in **Table 5**. The protection status, stock identification, occurrence, and abundance estimates of the species listed in **Table 5** are discussed in more detail in **Section 4.0**.

Table 5. Marine mammals protected by the Marine Mammal Protection Act with geographic ranges that include the Project Area (NMFS 2024b; USFWS, 2023).

Common Name	Scientific Name	Stock	Federal ESA/MMPA Status	Expected Occurrence in the Region	Population (Best Estimate)[1]	Records in PSO data[2]
Low-frequency Cetaceans						
Fin whale	*Balaenoptera physalus*	Western North Atlantic	ESA Endangered/Depleted and Strategic	Common	6,802	Y
Minke whale	*Balaenoptera acutorostrata*	Canadian East Coast	Non-strategic	Common	21,968	Y
Humpback whale	*Megaptera novaeangliae*	Gulf of Maine	Non-strategic	Common	1,396	Y
North Atlantic right whale	*Eubalaena glacialis*	Western Atlantic	ESA Endangered/Depleted and Strategic	Common	340	Y
Sei whale	*Balaenoptera borealis*	Nova Scotia	ESA Endangered/Depleted and Strategic	Regular	6,292	Y

Table 5. (Continued).

Common Name	Scientific Name	Stock	Federal ESA/MMPA Status	Expected Occurrence in the Region	Population (Best Estimate)[1]	Records in PSO data[2]
Blue whale	*Balaenoptera musculus*	Western North Atlantic	ESA Endangered/Depleted and Strategic	Rare	402	N
Mid-frequency Cetaceans						
Sperm whale	*Physeter macrocephalus*	North Atlantic	ESA Endangered/Depleted and Strategic	Common	5,895	Y
Risso's dolphin	*Grampus griseus*	Western North Atlantic	Non-strategic	Common	44,067	Y
Long-finned pilot whale	*Globicephala melas*	Western North Atlantic	Strategic	Common	39,215	Y
Short-finned pilot whale	*Globicephala macrorhynchus*	Western North Atlantic	Strategic	Rare	18,726	N
Atlantic white-sided dolphin	*Lagenorhynchus acutus*	Western North Atlantic	Non-strategic	Common	93,233	Y
Common dolphin	*Delphinus delphis*	Western North Atlantic	Non-strategic	Common	93,100	Y
Atlantic spotted dolphin	*Stenella frontalis*	Western North Atlantic	Non-strategic	Uncommon	31,506	Y
Common bottlenose dolphin[3]	*Tursiops truncatus*	Western North Atlantic, Offshore	Non-strategic	Common	64,587	Y
Common bottlenose dolphin[3]	*Tursiops truncatus*	Western North Atlantic, northern migratory coastal	Strategic	Rare	6,639	No distinction in stocks made by PSOs.
Dwarf sperm whale	*Kogia sima*	Western North Atlantic	Non-strategic	Rare	9,474	N
Pygmy sperm whale	*Kogia breviceps*	Western North Atlantic	Non-strategic	Rare	9,474	N
Killer whale	*Orcinus orca*	Western North Atlantic	Non-strategic	Rare	Unknown	N
Pygmy killer whale	*Feresa attenuata*	Western North Atlantic	Non-strategic	Not Expected	Unknown	N
False killer whale	*Pseudorca crassidens*	Western North Atlantic	Non-strategic	Rare	1,298	N
Northern bottlenose whale	*Hyperoodon ampullatus*	Western North Atlantic	Non-strategic	Not Expected	Unknown	N
Cuvier's beaked whale	*Ziphius cavirostris*	Western North Atlantic	Non-strategic	Rare	2,936	N
Blainville's beaked whale	*Mesoplodon densirostris*	Western North Atlantic	Depleted	Rare	2,936	N
Gervais beaked whale	*Mesoplodon europaeus*	Western North Atlantic	Depleted	Rare	8,595	N
Sowerby's beaked whale	*Mesoplodon bidens*	Western North Atlantic	Depleted	Rare	492	N
True's beaked whale	*Mesoplodon mirus*	Western North Atlantic	Depleted	Rare	4,480	N

Table 5. (Continued).

Common Name	Scientific Name	Stock	Federal ESA/MMPA Status	Expected Occurrence in the Region	Population (Best Estimate)[1]	Records in PSO data[2]
Melon-headed whale	*Peponocephala electra*	Western North Atlantic	Non-strategic	Not Expected	Unknown	N
White-beaked dolphin	*Lagenorhynchus albirostris*	Western North Atlantic	Non-strategic	Rare	536,016	Y
Pantropical spotted dolphin	*Stenella attenuata*	Western North Atlantic	Non-strategic	Rare	2,757	N
Striped dolphin	*Stenella coeruleoalba*	Western North Atlantic	Non-strategic	Uncommon	48,274	Y
Fraser's dolphin	*Lagenodelphis hosei*	Western North Atlantic	Non-strategic	Rare	Unknown	N
Rough toothed dolphin	*Steno bredanensis*	Western North Atlantic	Non-strategic	Rare	Unknown	N
Clymene dolphin	*Stenella clymene*	Western North Atlantic	Non-strategic	Not Expected	21,778	N
Spinner dolphin	*Stenella longirostris*	Western North Atlantic	Non-strategic	Rare	3,181	N
High-frequency Cetaceans						
Harbor porpoise	*Phocoena phocoena*	Gulf of Maine/Bay of Fundy	Non-strategic	Common	85,765	Y
Phocid Pinnipeds in Water						
Harbor seal	*Phoca vitulina*	Western North Atlantic	Non-strategic	Regular	61,336	Y
Gray seal	*Halichoerus grypus*	Western North Atlantic	Non-strategic	Regular	27,911	Y
Harp seal	*Pagophilus groenlandica*	Western North Atlantic	Non-strategic	Rare	7,600,000	N
Hooded seal	*Cystophora cristata*	Western North Atlantic	Non-strategic	Rare	Unknown	N
Sirenians						
Florida manatee	*Trichechus manatus latirostris*	-	ESA Threatened/ Depleted and Strategic	Rare	8,810[4]	N

- = not applicable for this species; ESA = Endangered Species Act; MMPA = Marine Mammal Protection Act; NMFS = National Marine Fisheries Service; PSO = Protected Species Observer; USFWS = U.S. Fish and Wildlife Service.

[1]Best abundance estimate from the most recently published National Oceanic and Atmospheric Administration Stock Assessment Reports (Hayes et al., 2021, 2022) or draft Stock Assessment Report (NMFS 2024b were used.

[2]Prelimary data from PSO reports, does not represent final data sets or all final survey reports.

[3]Bottlenose dolphins likely to occur in this area belong to two distinct stocks.

[4]Current range-wide estimate from the SAR 200 published by USFWS (2023).

4.0 Affected Species Status and Distribution

Of the 36 marine mammal species with geographic ranges that include the Project Area (**Table 5**), 17 species can be reasonably expected to reside, traverse, or occasionally visit the Project Area and may be considered affected. Species information is based on NMFS stock assessment reports (SARs) (Waring et al., 2010, 2014, 2015. 2016; Hayes et al., 2019, 2020, 2021, 2022, 2023; NMFS, 2024b); regional survey records (e.g., Cetacean and Turtle Assessment Program [CETAP], 1982; Atlantic Marine Assessment Program for Protected Species [AMAPPS], 2010 to 2014 [Palka et al, 2017]; North Atlantic Right Whale Sighting Survey and Right Whale Sighting Advisory System (RWSAS); BOEM Mid-Atlantic Environmental Assessment [EA; BOEM, 2012]; the Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles [Kraus et al., 2016]); modeling studies (Pace, 2021); species working group reports (Pettis et al., 2021).

Affected species are those that have a common, regular, or uncommon relative occurrence in Project Area (**Table 5**) or have a very wide distribution with limited distribution or abundance details. Species that are rare or not expected are not carried forward in this Application however, an exception was made for one rare species, the white-beaked dolphin [*Lagenorhynchus albirostris*]) that has been reported, although not confirmed, in PSO data from the Project Area. Therefore, the Applicant requests an IHA for Level B disturbance for the 17 species (one of which comprises two stocks) listed below and described in the following sections.

- North Atlantic right whale (*Eubalaena glacialis*)
- Humpback whale (*Megaptera novaeangliae*)
- Fin whale (*Balaenoptera physalus*)
- Sei whale (*Balaenoptera borealis*)
- Minke whale (*Balaenoptera acutorostrata*)
- Sperm whale (*Physeter microcephalus*)
- Risso's dolphin (*Grampus griseus*)
- Long-finned pilot whale (*Globicephala melas*)
- Atlantic white-sided dolphin (*Lagenorhynchus acutus*)
- Common dolphin (*Delphinus delphis*)
- Atlantic spotted dolphin (*Stenella frontalis*)
- Common bottlenose dolphin (*Tursiops truncatus*) - Western North Atlantic offshore stock
- Striped dolphin (*Stenella coeruleoalba*)
- White-beaked dolphin (*Lagenorhynchus albirostris*)
- Harbor porpoise (*Phocoena phocoena*)
- Harbor seal (*Phoca vitulina*)
- Gray seal (*Halichoerus grypus*)

Species will not be equally affected by the proposed activities due to individual exposure patterns, the context in which noise is received, and, most prominently, individual hearing sensitivities. To account for acoustic sensitivity, marine mammal species are categorized into hearing groups that are designated to better predict and quantify impacts of noise (NMFS, 2018a, 2023; Southall et al., 2007, 2019). These functional hearing groups are described below with associated reference frequencies. While all these species likely hear beyond these bounds, primary sensitivities fall within the listed frequencies (**Section 1.2.1.1**).

The following information summarizes data on the status and trends, distribution and habitat preferences, behavior and life history, and auditory capabilities of marine mammals found in the Project Area as available in published literature and reports, including NMFS marine mammal SARs (Waring et al., 2007, 2010, 2015; Hayes et al., 2019, 2020, 2021, 2022; NMFS, 2024b).

4.1 MYSTICETES

4.1.1 North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale (NARW) is the only member of the mysticete family Balaenidae found in North Atlantic waters. They are skim feeders that primarily consume zooplankton including copepods, euphausiids, and cyprids. The NARW is listed as Endangered and is considered one of the most Endangered large whale species in the world (Jefferson et al., 2011; Hayes et al., 2022; Pettis et al., 2021). The most recent draft NMFS SAR estimated a population size for the Western North Atlantic stock of only 340 individuals based on a published state-space model of the sighting histories of individual whales using photo identification techniques which included information up through 31 December 2021 (NMFS, 2024b).

The most recent draft NMFS SAR (NMFS, 2024b) identified areas where Western North Atlantic NARW aggregate seasonally: the coastal waters of the southeastern U.S., the Great South Channel, Jordan Basin, Georges Basin along the northeastern edge of Georges Bank, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Roseway Basin on the Scotian Shelf (Brown et al., 2001; Cole et al., 2013). Several of these congregation areas correlate with seasonally high copepod concentrations (Pendleton et al., 2009). New England waters are a primary feeding habitat for NARWs during late winter through spring, with feeding moving into deeper and more northerly waters during summer and fall. Less is known regarding winter distributions; however, it is understood that calving takes place during this time in coastal waters of the Southeastern U.S.

The most recent density data from Roberts et al. (2023) indicate that NARWs are expected to occur in the Project Area in relatively moderate to high densities from December through May and in low densities in June through October (Roberts et al., 2023). Although NARWs have been detected acoustically in all seasons, detections outside of the December to May time are brief, transitory events by individuals, and the species is not expected to occur for any significant periods or regularity between July and November (Roberts et al., 2023).

NARWs are consistently observed from aerial survey efforts that include the Project Area (Kraus et al., 2016; Leiter et al., 2017; Stone et al., 2017; O'Brien et al., 2021a, b; O'Brien et al., 2022b). Sighting rates for the Project Area generally show similar patterns between the various survey efforts: NARW occurrence is the highest in the winter, followed by spring; summer and fall months typically have the lowest sightings rates (Kraus et al., 2016; Leiter et al., 2017; Stone et al., 2017; O'Brien et al., 2021a, b; O'Brien et al., 2022a,b). The most recent report of the Right Whale Sighting Advisory System within the Northeast region additionally indicates the presence of NARWs in the Project Area (Johnson et al., 2021). Reports from the RWSAS show 394 visual records and 668 acoustic detections off the coast of Rhode Island (NOAA, 2024).

To identify areas with statistically higher animal clustering than surrounding regions, a hot spot analysis was performed for the Rhode Island (RI) – Massachusetts (MA) Lease Areas (Kraus et al., 2016). Hot spot analysis provides a relative measure of presence in the survey area per unit effort, not actual numbers of whales in an area. The main persistent hot spot was primarily concentrated in the area east of the Project Area over Nantucket Shoals (90 to 99% confidence level; Kraus et al., 2016a). Although O'Brien et al. (2021a, 2021b, 2022b; **Figure 2**) did not conduct a hot spot analysis and presents unweighted detection data, sightings of NARW during these surveys indicate a similar distribution around the RI – MA Lease Areas.

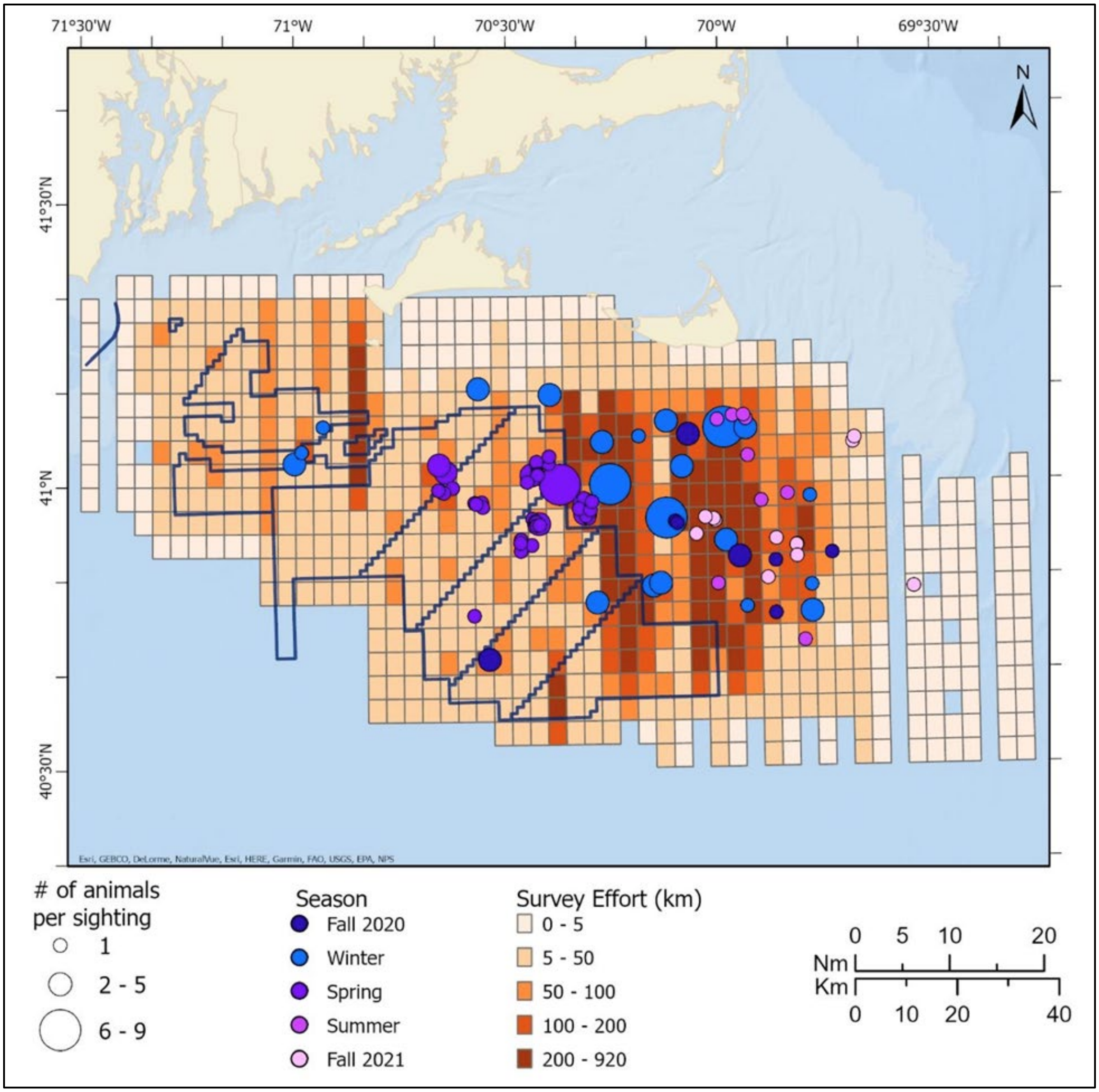

Figure 2. Sightings of North Atlantic Right Whales during the Massachusetts Clean Energy Center and New England Aquarium Surveys in the Rhode Island/Massachusetts Lease Areas (from: O'Brien et al., 2022b).

The major threat to the NARW stock is human-caused mortality through incidental fishery entanglement that averaged 5.7 incidents per year and ship strikes that averaged 2.4 incident records per year based on data from 2016 through 2020 (NMFS, 2024b). In June 2017, NMFS declared an Unusual Mortality Event (UME) following an increase in NARW mortalities in the U.S. and Canada. As of 25 February 2024, a total of 123 dead or seriously injured stranded whales have been reported under the UME. A total of 38 confirmed dead whales, with an additional 34 serious injuries and 51 with signs of morbidity (sublethal injury or illness) have been documented as of February 2024 (NMFS, 2024c). The preliminary cause of death for most of these cases was determined to be due to vessel strike or entanglement (NMFS, 2024c). The draft SAR for NARW sets the PBR level at 0.7; therefore, any mortality or serious injury for this stock can be considered significant (NMFS, 2024b).

The Western Atlantic stock is considered strategic by NMFS because the average annual human-related mortality and serious injury exceeds PBR, and because the NARW is an Endangered species. The NARW underwent a NMFS 5-year review in 2022 (NMFS, 2022a), which resulted in no change to its listing status. In 2009, NMFS received a petition to expand the critical habitat, and the agency considered this petition in the rulemaking process. In January 2016, two additional units comprising over 102,000 km^2 of marine habitat were designated as critical habitat to encompass the northeast feeding area in the Gulf of Maine/Georges Bank and the southeast calving grounds from North Carolina to Florida. No critical habitat overlaps with the Project Area. Seasonal Management Areas (SMAs) for reducing ship strikes of the NARW have also been designated in the U.S. and Canada. All vessels greater than 19.8 m in overall length must operate at speeds of 10 knots or less within these areas during specified time periods (NMFS, 2024d). A proposed modification to this rule was published in October 2022 (87 FR 46921) which would reduce the size of vessel requirement to 10.6 m and adjust the geographic ranges of the SMAs (**Figure 2**) (NMFS, 2024d). Based on the 2022 rule modifications, the entire Project Area would be under an SMA from 1 November to 30 April (**Figure 3**).

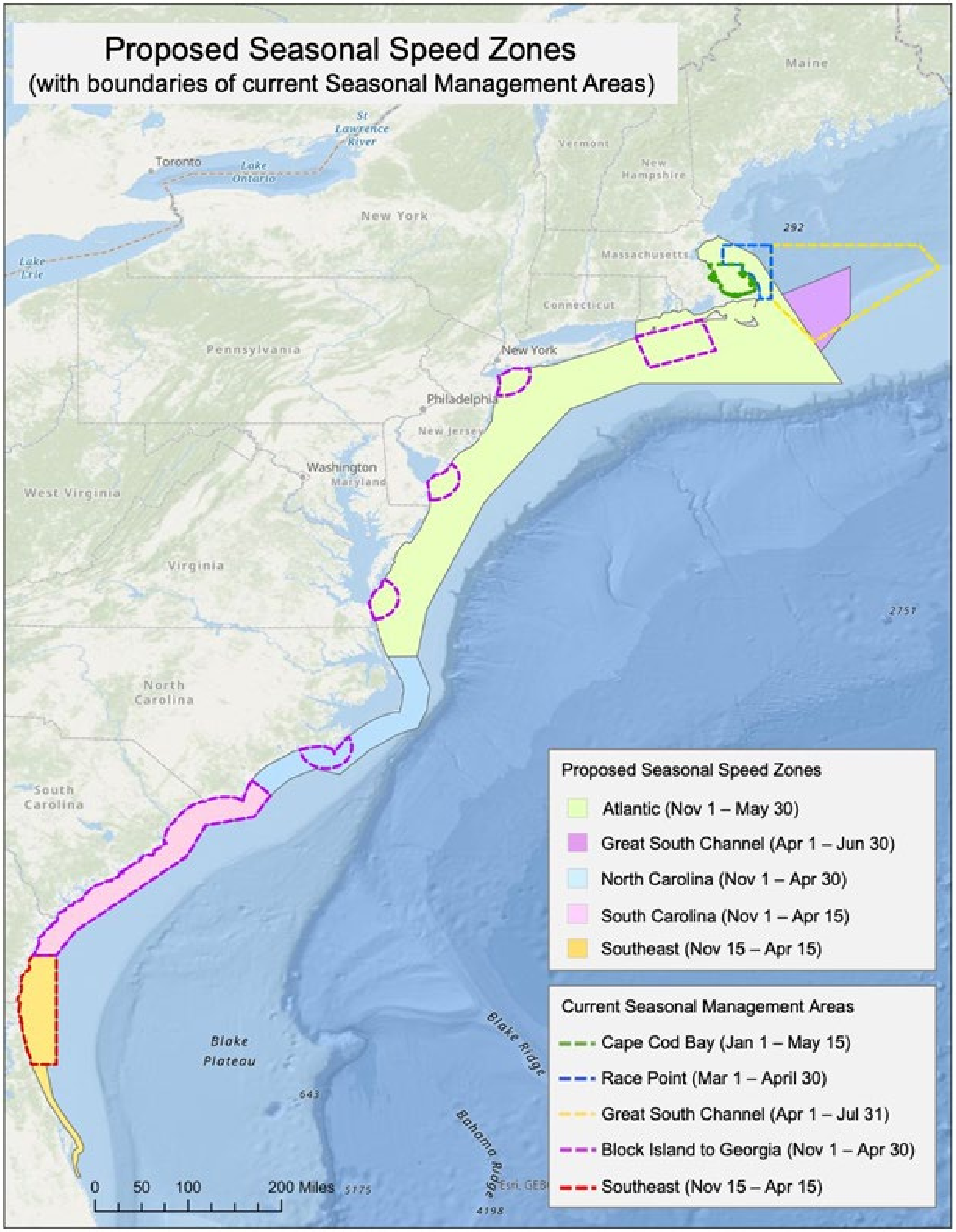

Figure 3. Proposed Seasonal Management Areas for North Atlantic right whales (*Eubalaena glacialis*). (NMFS, 2024d).

The following final rules notices are associated with the NARW:

- Critical Habitat Designation: 59 FR 28805, June 3, 1994;
- Atlantic Large Whale Take Reduction Plan: 62 FR 39157, July 22, 1997;
- Federal Regulations Governing the Approach to North Atlantic right whales: 69 FR 69536, November 30, 2004;
- Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic right whales: 73 FR 60173, October 10, 2008;
- Findings on Petition to Revise Critical Habitat: 75 FR 61690, October 6, 2010;
- Final Rule to Remove the Sunset Provision of the Final Rule Implementing Vessel Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic right whales 78 FR 73726 December 9, 2013; and
- Final Rule for North Atlantic right whale (*Eubalaena glacialis*) Critical Habitat 81 FR 4838, January 27, 2016.
- Amendments to the North Atlantic Right Whale Vessel Strike Reduction Rule 87 FR 46921, August 1, 2022.

NARWs are LF cetaceans that vocalize using a number of distinctive call types, most of which have peak acoustic energy below 500 Hz. Most vocalizations do not go above 4 kHz (Matthews et al., 2014). One typical NARW vocalization is the "up call"; a short sweep that rises from roughly 50 to 440 Hz over a period of 2 seconds. These up calls are characteristic of NARWs and are used by research and monitoring programs for indication of species presence. A characteristic "gunshot" call is believed to be produced by male NARWs. These pulses can have SLs of 174 to 192 dB re 1 µPa m with frequency range from 50 to 2,000 Hz (Parks et al., 2005; Parks and Tyack, 2005). Other tonal calls range from 20 to 1,000 Hz and have SLs between 137 and 162 dB re 1 µPa m.

4.1.2 Humpback Whale (*Megaptera novaeangliae*)

The humpback whale is a robust and medium-sized mysticete. It is distinguished from all other cetaceans by its long flippers, which are approximately one-third the length of the body (Jefferson et al., 2008). One species of the humpback whale is currently recognized (Committee on Taxonomy, 2023). Humpback whales are largely piscivorous, feeding primarily on herring (*Clupea* spp.), sand lance (*Ammodytes* spp.), and other small fishes as well as euphausiids in the Gulf of Maine (Hayes et al., 2019). Humpbacks show fidelity to feeding sites; however, local distribution is driven by prey availability and bathymetry, resulting in the whales transiting widely throughout their feeding habitat between spring and fall in search of prey. Feeding is the principal activity of humpback whales in New England waters, and their distribution in this region has been largely correlated to prey species and abundance (Payne et al., 1986, 1990).

The humpback whales occurring within the Project Area are believed to be mainly part of the Gulf of Maine stock (Hayes et al., 2021). Humpback whales have a global distribution and follow a migratory pattern of feeding in the high latitudes during summers and spending winters in the lower latitudes for calving and mating. The Gulf of Maine stock follows this pattern with winters spent in the Caribbean and West Indies, although acoustic recordings show a small number of males persisting in Stellwagen Bank throughout the year (Vu et al., 2012). The Gulf of Maine stock is comprised of an estimated 1,396 individuals (Hayes et al., 2021).

Sightings of humpback whales in the northeast are common (Kenney and Vigness-Raposa, 2010; Kraus et al., 2016). Surveys in the RI – MA Wind Energy Area (WEA) reported humpback whale sightings in all seasons with peak abundance during the spring and summer, but their presence within the region varies between years (Kraus et al., 2016). Stocks of sand lance appear to correlate with the years in which the most abundant whales are observed, suggesting that humpback whale distribution and occurrences could largely be influenced by prey availability (Kenney and Vigness-Raposa, 2010). The greatest number of sightings of humpbacks in the WEA occurred during April (33 sightings); their presence increased starting in March and continuing through July. Acoustic detections within the WEA were also primarily during the summer months (Kraus et al., 2016).

Primary threats to humpback whales are fishing gear entanglements and ship strikes. Mortality and serious injury records for large whales in the Western North Atlantic over a 40-year period (1970 to 2009) were reviewed to assess the magnitude of human related mortalities (van der Hoop et al., 2013). Results showed that roughly 27% of mortalities and serious injuries were humpback whale records. Of the humpback records where a cause could be determined (203 records), 57% of mortalities were caused by entanglements in fishing gear and 15% were attributable to vessel strikes. Glass et al. (2009) reported that between 2002 and 2006, humpback whales belonging to the Gulf of Maine stock were involved in 77 confirmed fishing gear entanglements and nine confirmed ship strikes. For the period of 2013 through 2017, the minimum annual rate of human-caused mortality and serious injury to the Gulf of Maine stock was 12.15 animals per year (Hayes et al., 2021). This total includes an estimated 7.75 incidental fishery interactions per year, and 4.4 vessel strikes per year (Hayes et al., 2021).

In 2016, a high number of humpback mortalities prompted NMFS to declare a UME starting in January 2016. As of 25 February 2024, a total of 212 humpback whales have been found dead between Maine and Florida. The number of strandings in Rhode Island, New York, and Massachusetts combined totaled 97 (NMFS, 2024d). Of the carcasses examined, approximately 50% had evidence of human interaction such as vessel strike or entanglement (NMFS, 2024e).

On 8 September 2016 NMFS published a final decision changing the status of humpback whales under the ESA (81 FR 62259), effective as of 11 October 2016. Previously, humpback whales were listed under the ESA as an Endangered species worldwide. In the 2016 decision, NMFS recognized the existence of 14 distinct population segments (DPSs), of which four were listed as Endangered, one was listed as Threatened, and the remaining nine did not warrant protection under the ESA. A status review of the humpback whale was undertaken by NMFS in 2015 (Bettridge et al., 2015) to identify taxonomic units such as DPSs and assess the extinction risk of these units. To be considered a DPS, a population or group of populations must be "discrete" from the remainder of the taxon to which it belongs, and "significant" to the taxon to which it belongs. Information on distribution, ecological situation, genetics, and other factors is used to evaluate a population's discreteness and significance. This review process resulted in the identification of a West Indies DPS, which includes the Gulf of Maine stock. The West Indies DPS was considered not to be at risk of extinction. Subsequently, the Gulf of Maine stock is not a strategic stock, and no critical habitat has been designated for the humpback whale (Hayes et al., 2021).

Like other large whales, increases in noise levels may affect this species' ability to transmit and access acoustic cues in the environment. For example, Clark et al. (2009) predicted an 8% reduction in communication space due to shipping for singing humpback whales in the northeast. Humpbacks are an LF species but have one of the most varied vocal repertoires of the baleen whales. Male humpbacks will arrange vocalizations into a complex, repetitive sequence to produce a characteristic "song." Songs are variable, but typically occupy in frequency bands between 300 and 3,000 Hz and last upwards of 10 minutes. Songs are predominately produced while on breeding grounds; however, they have been recorded on feeding grounds throughout the year (Clark and Clapham, 2004; Vu et al., 2012). Typical feeding calls are centered at 500 Hz with some other calls and songs reaching 20 kHz. Common humpback calls also contain series of grunts between 25 and 1,900 Hz as well as strong, LF pulses (with SLs up to 176 dB re 1 µPa m) between 25 and 90 Hz (Clark and Clapham, 2004; Vu et al., 2012).

4.1.3 Fin Whale (*Balaenoptera physalus*)

Fin whales are a widely distributed species found in all oceans of the world. The fin whale is listed as Endangered under the ESA and a Final Recovery Plan for fin whales is available (NMFS, 2010). Fin whales transit between summer feeding grounds in the high latitudes and their wintering, calving, or mating habitats in low latitudes or offshore. However, acoustic records indicate that fin whale populations may be less migratory than other mysticetes whose populations make distinct annual migrations (Watkins et al., 2000). Fin whales typically feed on sand lance, capelin (*Mallotus villosus*), euphausiids, herring, copepods, and cephalopods (i.e., squid) in deeper waters near the edge of the continental shelf (90 to 180 m) but will migrate towards coastal areas following prey distribution.

The fin whales that occur within the Project Area are part of the Western North Atlantic stock of fin whales. This is considered a strategic stock because fin whales are listed as Endangered throughout their range. In February 2019, NMFS undertook a 5-year status review (NMFS, 2019b) of the fin whale and determined that there should be no change in its listing status. The best population abundance estimate is 6,802 individuals (NMFS, 2024b).

Along the Atlantic seaboard, they are mainly found from Cape Hatteras northward with a distribution in both continental shelf and deep-water habitats (NMFS, 2024b). The Northern fin whale subspecies is found within the Project Area. Fin whales accounted for 46% of the large whales sighted during aerial surveys along the continental shelf (CETAP, 1982) between Cape Hatteras and Nova Scotia from 1978 to 1982. Two well-known feeding grounds for fin whales are present near the Project Area in the Great South Channel and Jeffrey's Ledge and in waters directly east of Montauk, New York (Kenney and Vigness-Raposa, 2010; NMFS, 2024b). The highest occurrences are identified south of Montauk Point to south of Nantucket (Kenney and Vigness-Raposa, 2010). Surveys conducted in the RI – MA WEA indicate fin whales may be present year-round, but sightings were the highest during the spring and summer (Kraus et al., 2019).

Threats to fin whales are entanglements in fishing gear and ship strikes. For the period between 2017 through 2021, the minimum annual rate of human-caused mortality and serious injury to fin whales was 2.05 individuals per year. This value includes 1.45 fishery entanglement records per year and 0.6 vessel strike records per year (NMFS, 2024b). The total human-caused mortality and serious injury is less than the calculated PBR of 11; however, it cannot be considered insignificant due to uncertainties regarding these estimates and the current Endangered status of this population which make this a strategic stock under the MMPA. There is no designated critical habitat for this stock (NMFS, 2024b).

Fin whales are LF cetaceans that produce short-duration, down sweep calls between 15 and 30 Hz, typically termed "20-Hz pulses" as well as tonal calls up to 150 Hz. The SL of the fin whale vocalizations can reach 186 dB re 1 µPa m, making it one of the most powerful biological sounds in the ocean (Charif et al., 2002).

4.1.4 Sei Whale (*Balaenoptera borealis*)

Sei whales are a widespread species throughout the world's temperate, subpolar, subtropical, and tropical oceans (NMFS, 2024b). They are very similar in appearance to fin and Bryde's whales (*Balaenoptera edeni*). Two subspecies of sei whales are currently recognized (Committee on Taxonomy, 2023) one of which the Northern sei whale (*B. b. borealis*) is known to occur within the Project Area. The sei whales occurring in the Project Area are part of the Nova Scotia stock (formerly the Western North Atlantic stock). Sei whales are most common in deeper waters along the continental shelf edge (NMFS, 2024b) but will forage occasionally in shallower, inshore waters. The average spring abundance estimate for surveys conducted between 2010 and 2013 is 6,292 individuals, which is considered the best available abundance estimate for the Nova Scotia stock because these surveys covered the largest portion of its range (NMFS, 2024b).

Sei whales are most abundant in Northeastern U.S. waters during the spring, with sightings concentrated along the eastern and southwestern margins of Georges Bank in the area of Hydrographer Canyon (CETAP, 1982). Small groups of sei whales have also been reported south of Montauk Point, New York and Block Island, Rhode Island (Kenney and Vigness-Raposa, 2010). The sei whale feeds primarily on euphausiids and copepods, but will also prey upon fish, and local abundance is largely driven by prey availability. The occurrence and abundance of sei whales on feeding grounds may shift dramatically from one year to the next. CETAP surveys observed sei whales along the continental shelf edge only during the spring and summer (CETAP, 1982). This agrees with sightings in the RI – MA WEA where sei whales were also only observed during the spring (eight sightings) and summer (13 sightings). No sightings were reported in the WEA during the fall and winter (Kraus et al., 2016).

From 2017 through 2021, the minimum rate of confirmed human-caused serious injury and mortality to the Nova Scotia stock was 0.6 individuals per year, which was attributed to 0.4 fisheries entanglements, and 0.2 other human-caused mortalities per year (NMFS, 2024b). No records of vessel strikes were reported for the period between 2017-2021. The Nova Scotia stock is strategic because the species is listed as Endangered under the ESA and the average human-related mortality and serious injury exceeds the PBR. There is no designated critical habitat for this species (NMFS, 2024b).

There are limited confirmed sei whale vocalizations; however, studies indicate that this species produces several, mainly LF (<1,000 Hz) vocalizations. Several calls attributed to sei whales include pulse trains up to 3 kHz, broadband "growl" and "whoosh" sounds between 100 and 600 Hz, tonal calls and upsweeps between 200 and 600 Hz, and down sweeps between 34 and 100 Hz (McDonald et al., 2005; Rankin and Barlow, 2007; Baumgartner et al., 2008).

4.1.5 Minke Whale (*Balaenoptera acutorostrata*)

The minke whale is a small mysticete that is divided into two species: the common minke whale and the Antarctic minke whale. The common minke whale is further divided into three subspecies (Committee on Taxonomy, 2023). The subspecies *B. a. acutorostrata* occurs throughout the North Atlantic. Generally, minke whales occupy warmer waters during the winter and travel north to colder regions in the summer, with some animals migrating as far as the ice edge. Minke whales are frequently observed in coastal or shelf waters along with humpback and fin whales owing to their piscivorous feeding habitats where prey includes sand lance and herring (NMFS, 2024b). The current best abundance estimate for the Canadian East Coast stock is 21,968 individuals (NMFS, 2024b).

The minke whales that occur within the Project Area are part of the Canadian East Coast stock, which is one of four stocks in the North Atlantic. Little is known about their specific migratory behavior compared to other large whale species; however, acoustic detections show that minke whales migrate south in mid-October to early November and return from wintering grounds starting in March through early April (Risch et al., 2014). Northward migration appears to track the warmer waters of the Gulf Stream along the continental shelf, while southward migration is made farther offshore (Risch et al., 2014). Surveys conducted in the RI – MA WEA, reported 103 minke whale sightings within the area, predominantly in the spring (76) followed by summer (26) and fall (1) (Kraus et al., 2016).

Like other baleen whales, threats to minke whales include ship strikes and fisheries interactions. However, unlike the larger whales, minke whales are more susceptible to bycatch threats from bottom trawls, lobster trap/pot, gillnet, and purse seine fisheries. During the period from 2017-2021, the average annual minimum detected human-caused mortality and serious injury was 9.4 minke whales per year. This number was composed of 8.60 whales per year from fishery entanglement records and 0.8 whale per year from vessel strikes (NMFS, 2024b). There was no reported bycatch from U.S fisheries observer data for the period of 2017-2021. Estimated rates of serious injury and mortality are less than the calculated PBR, but it cannot be considered insignificant or approaching zero (NMFS, 2024b). Vessel strikes have been documented from Maine to South Carolina (NMFS, 2024b).

In January 2017, a UME was declared due to minke whale mortalities occurring between Maine and South Carolina. As of 25 February 2024, a total of 164 strandings have been reported with 25 of those occurring in New York and 14 in New Jersey. Examinations for several of the whales showed evidence of human interactions such as vessel strike or entanglement, or infectious disease (NMFS, 2024f). Additionally, minke whales continue to be hunted as part of an ongoing whaling industry in the northeastern North Atlantic, the North Pacific, and Antarctic (Reeves et al., 2012; NMFS, 2022b).

Minke whale recordings have resulted in some of the most variable and unique vocalizations of any marine mammal. Common calls for minke whales found in the North Atlantic include repetitive, LF (100 to 500 Hz) pulse trains that may consist of either grunt-like pulses or thump-like pulses. The thumps are very short in duration (50 to 70 milliseconds) with peak energy between 100 and 200 Hz. The grunts are slightly longer in duration (165 to 320 milliseconds) with most energy between 80 and 140 Hz. In addition, minke whales will repeat a 6 to 14-minute pattern of 40 to 60 second pulse trains over several hours (Risch et al., 2014). Minke whales produce a unique sound called the “boing” which consists of a short pulse at 1.3 kHz followed by an undulating tonal call around 1.4 kHz. This call was widely recorded but remained unidentified for many years and scientists widely speculated as to its source (Rankin and Barlow, 2005). The call frequency of minke whales suggests a hearing sensitivity higher than that of other baleen whales.

4.2 ODONTOCETES

4.2.1 Sperm Whale (*Physeter macrocephalus*)

Sperm whales can easily be distinguished in visual surveys by their large, blunt head; narrow underslung jaw; and characteristic blow shape resulting from the S-shaped blowhole set at the front-left of the head (Jefferson et al., 2008). They can be found throughout the world’s oceans; they have been observed near the edge of the ice packs in both hemispheres and are also common along the equator. The North Atlantic stock is distributed mainly along the continental shelf edge, over the continental slope, and mid-ocean regions, where they prefer water depths of 600 m or more. Sperm whales are uncommon in waters <300 m deep (Waring et al., 2015). Sperm whales are listed as Endangered under the ESA and are considered a strategic stock by NMFS (Waring et al., 2015). Data are insufficient to assess population trends and the current abundance estimate was based on only a fraction of the known stock range (Waring et al., 2015). The best recent abundance estimate for sperm whales is the sum of the estimates from 2021 surveys totaling 5,895 (NMFS, 2024b).

In winter, sperm whales concentrate east and northeast of Cape Hatteras. In spring, distribution shifts northward to east of Delaware and Virginia, and is widespread throughout the central Mid-Atlantic Bight and the southern part of Georges Bank. In the fall, sperm whale occurrence on the continental shelf south of New England reaches peak levels, and there remains a continental shelf edge occurrence in the Mid-Atlantic Bight (Waring et al., 2015). No sperm whales were recorded during the MABS surveys or the NJDEP EBS. CETAP and NMFS Northeast Fisheries Science Center sightings in shelf-edge and off-shelf waters included many social groups with calves/juveniles (CETAP, 1982). Sperm whales were usually seen at the tops of seamounts and rises and did not generally occur over slopes. Sperm whales were recorded over depths varying from 800 to 3,500 m.

Kraus et al. (2016) reported sightings of sperm whales in the RI – MA WEA during the summer and fall months, with five individuals in August, one in September, and three in June. There have also been occasional strandings in Massachusetts and Long Island (Kenney and Vigness-Raposa, 2010). Although the likelihood of occurrence within the Project Area remains very low, the sperm whale was included as an affected species because of its high seasonal densities east of the Project Area.

Historically, thousands of sperm whales were killed during the early 18th Century. Presently, no hunting is allowed for any purposes in the North Atlantic. Occasionally, sperm whales become entangled in fishing gear or 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 annual average human-caused mortality for 2017-2021 was estimated to be 0.2 based on one reported stranding in Florida which was attributed to plastic ingestion (NMFS, 2024b). There were no reported cases of fisheries entanglements or vessel strikes during this period. During the same reporting period, there were 10 sperm whales strandings documented along the U.S. Atlantic coast within the EEZ, but only two were classified as human interactions due to plastic ingestion (NMFS, 2024b). This stock is considered strategic under the MMPA due to its Endangered status, but since human-caused mortality and serious injury is less than PBR, it is not considered significant (NMFS, 2024b).

Sperm whales are in the MF hearing group with an estimated auditory range of 150 Hz to 160 kHz (Southall et al., 2007). Sperm whales produce short-duration, repetitive broadband clicks used for communication and echolocation. These clicks range in frequency from 0.1 to 30 kHz, with dominant frequencies between the 2 to 4 kHz and 10 to 16 kHz ranges (Department of the Navy [DoN], 2008). Echolocation clicks from adult sperm whales are highly directional and have an estimated SL of up to 236 dB re 1 µPa m.

4.2.2 Risso's Dolphin (*Grampus griseus*)

Risso's dolphins are large dolphins with a characteristic blunt head and light coloration, often with extensive scarring. They are widely distributed in tropical and temperate seas. In the Western North Atlantic they occur from Florida to eastern Newfoundland (Leatherwood et al., 1976; Baird and Stacey, 1991). Off the U.S. Northeast Coast, Risso's dolphins are primarily distributed along the continental shelf, but can also be found swimming in shallower waters to the mid-shelf (NMFS, 2024b).

The status of the Western North Atlantic stock of the Risso's dolphin in the U.S. Atlantic Exclusive Economic Zone is not well documented. An abundance estimate of 44,067 individuals in this stock from a 2021 survey (NMFS, 2024b). Risso's dolphins are not listed as Threatened or Endangered under the ESA and the Western North Atlantic stock is not considered strategic under the MMPA (NMFS, 2024b).

Risso's dolphins occur along the continental shelf edge from Cape Hatteras to Georges Bank during spring, summer, and autumn. In winter, they are distributed in the Mid-Atlantic from the continental shelf edge outward (NMFS, 2024b). The majority of sightings during the 2011 surveys occurred along the continental shelf break with generally lower sighting rates over the continental slope (Palka, 2012). Offshore Rhode Island, Risso's dolphin have been observed year-round, with a peak abundance during the summer. This species is primarily observed along the continental shelf break, with few individuals seen in waters shallower than 100 m (Kenney and Vigness-Raposa, 2010). Only two Risso's dolphins were observed in the RI – MA WEA during spring (Kraus et al., 2016).

Entanglement and fisheries interactions are the primary threats to Risso's dolphins in the U.S. Atlantic. Estimated annual rates of serious injury and mortality from 2017-2021 were 18 annual mortalities reported from U.S. fisheries using observer data, and no mortalities from non-fishery-related strandings (NMFS, 2024b). Total human-related mortality does not exceed the calculated PBR but is not considered to be insignificant or approaching zero for this population (NMFS, 2024b).

Risso's dolphins are in the MF functional hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). Vocalizations range from 400 Hz to 65 kHz (DoN, 2008).

4.2.3 Long-finned Pilot Whale (*Globicephala melas*)

There are two species of pilot whale in the Western North Atlantic: long-finned (*G. melas*) and short-finned (*G. macrorhynchus*). The species overlap, are difficult to tell apart, and parameters that define their distributions are not well differentiated. The best distinguishing characteristic of the long-finned pilot whale are the long, slender flippers, which are typically not visible during aerial or shipboard surveys (Jefferson et al., 2011). However, it is generally accepted that pilot whale sightings above approximately 42° N are most likely long-finned pilot whales (Waring et al., 2015). Short-finned pilot whales prefer warmer or tropical waters and are considered rare in New England. In the Northeastern U.S., they are typically sighted in deeper waters offshore near the Gulf Stream, but given the limited observations of this species in New England, they are not expected to occur in the Project Area and will not be discussed further (Kenney and Vigness-Raposa, 2010; NMFS, 2024b).

Long-finned pilot whales occur over the continental slope in high densities during winter and spring, then move inshore and into shelf waters during summer and autumn following prey populations of cephalopods (i.e., squid) and mackerel (*Scomber* spp.) (Reeves et al., 2012). They will also readily feed on other fish, cephalopods, and crustaceans. Pilot whales are common in central and northern Georges Bank, Great South Channel, Stellwagen Bank, and in the Gulf of Maine during the summer and early fall (May and October) (NMFS, 2024b). Long-finned pilot whales are highly social, vocal, and are typically observed in groups of 10 to 20 surface-active individuals. Long-finned pilot whales are not listed as Threatened or Endangered, and the Western North Atlantic stock is not considered strategic under the MMPA. The best population estimate for the Western North Atlantic stock of long-finned pilot whales is 39,215 individuals (NMFS, 2024b).

Pilot whales are distributed along the continental shelf waters off the Northeastern U.S. coast in the winter and early spring. By late spring, pilot whales migrate into more northern waters including Georges Bank and the Gulf of Maine and will remain there until fall (NMFS, 2024b). Long-finned pilot whales concentrate along the Northeast U.S. shelf edge between the 100 m and 1,000 m isobaths during mid-winter and early spring (CETAP, 1982). In late spring, pilot whales move from the mid-Atlantic region onto Georges Bank and the Scotian Shelf, and into the Gulf of Mexico, where they remain through late autumn (CETAP, 1982). Pilot whales generally occur in areas of high relief or submerged banks and are also associated with the Gulf Stream wall and thermal fronts along the continental shelf edge (Hamazaki, 2002). Pilot whales are highly social and vocal and are typically observed in groups of 10 to 20. Pilot whales are highly social and vocal and are typically observed in groups of 10 to 20 surface-active individuals. Within the RI – MA WEA, no sightings of pilot whales were observed during the summer, fall, or winter (Kraus et al., 2016).

A source of mortality and injury to long-finned pilot whales is bycatch during gillnet fishing, pelagic trawling, longline fishing, and purse seine fishing. For the period between 2017-2021, the human-caused mortality or serious injury was a total of 5.7 individuals per year, with 5.5 attributed to U.S. commercial fisheries interactions using observer data, and 0.2 attributed to non-fishery human-caused stranding mortalities (NMFS, 2024b). The highest observed bycatch rate for all pilot whales occurred in the northeast bottom trawl. Other fisheries mortalities (e.g., mid-water trawls, gillnets) are more frequently observed north of 40° N; therefore, these fisheries likely have a higher proportional impact on long-finned pilot whales (NMFS, 2024b). Mean human-caused annual mortality and serious injury does not exceed the calculated PBR for this stock; however, it is not considered insignificant or approaching zero. There is no designated critical habitat for this species (NMFS, 2024b).

Long-finned pilot whales also demonstrate a propensity to mass strand; however, the role that human activities play in these strandings is not known. From 2017-2021, 11 long-finned pilot whale strandings were reported between Maine and Florida (NMFS, 2024b). Polychlorinated biphenyls and chlorinated pesticides (e.g., DDT, DDE, dieldrin) have been found in pilot whale blubber (Muir et al., 1988; Weisbrod et al., 2000) and bioaccumulation levels of these toxins were more similar in whales from the same stranding group than from animals within the same sex or age category (Weisbrod et al., 2000).

Long-finned pilot whales are part of the MF hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). All pilot whales echolocate and produce tonal calls. Long-finned pilot whales produce burst-pulses which ranged from 100 to 22,000 Hz. The primary tonal calls of the long-finned pilot whale range from 1 to 8 kHz with a mean duration of about 1 second. The calls can be varied with seven categories identified (level, falling, rising, up-down, down-up, waver, and multi-hump) and are likely associated with specific social activities (Vester et al., 2014).

4.2.4 Atlantic White-Sided Dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided (AWS) dolphin is a robust animal characterized by a strongly "keeled" tail stock and distinctive color pattern (Jefferson et al., 2008; Waring et al., 2015). The AWS dolphin occurs primarily along the 100-m depth contour within temperate and subpolar waters of the North Atlantic. Seasonally, AWS dolphins occupy northern, inshore waters during summer and southern, offshore waters in the winter. AWS dolphins that potentially occur in the Project Area are all part of the Western North Atlantic stock, which inhabit waters from central West Greenland to North Carolina (about 35° N) (Waring et al., 2015). There is some evidence supporting the division of the Western Atlantic population into three separate stocks; however, this has not been clearly established (Hayes et al., 2022). The estimated average annual human-related mortality does not exceed the PBR for this stock and the AWS dolphin is not listed as Threatened or Endangered; therefore, the stock is not considered strategic under the MMPA. The best abundance estimate for the Western North Atlantic AWS dolphin stock is 93,233 individuals (NMFS, 2024b).

AWS dolphins feed on a variety of fish such as herring, hake (*Merluccius* spp.), smelt (*Osmerus* spp.), capelin, and cod (*Gadus* spp.) as well as cephalopods and crustaceans (i.e., squid and shrimp). Like many dolphins, this species is highly gregarious and will often travel in groups of 100 or more and is highly vocal when in these aggregations. Breeding takes place between May and August with most calves born in June and July (Rasmussen and Miller, 2002).

Prior to the 1970s, AWS dolphins in U.S. waters were found primarily offshore on the continental slope, while white-beaked dolphins (*L. albirostris*) were found on the continental shelf. During the 1970s, there was an apparent switch in habitat use between these two species. This shift may have been a result of the decrease in herring and increase in sand lance in the continental shelf waters (Katona et al., 1993; Kenney et al., 1996). AWS dolphins are opportunistic feeders and their diet is based on available prey (Craddock et al., 2009). AWS dolphins primarily inhabit continental shelf waters, shoreward of the 100-m depth contour (CETAP, 1982; NMFS, 2024b). Most of the sightings during CETAP surveys were seen in depths ranging from approximately 38 to 271 m. Sightings were concentrated in coastal waters near Cape May and in shallow waters within the Gulf of Maine (CETAP, 1982). The Gulf of Maine population is commonly seen from the Hudson Canyon to Georges Bank. Sightings south of Georges Bank and Hudson Canyon occur year-round; however, at lower densities (NMFS, 2024b). Offshore Rhode Island, AWS dolphins were common in continental shelf waters, with a slight tendency to occur in shallower waters in the spring (Kenney and Vigness-Raposa, 2010). Records indicate that there is an aggregation of sightings southeast of Montauk Point during the spring and summer. In the RI – MA WEA, 185 individual AWS dolphins were sighted primarily during summer (112 individuals) followed by fall (70 individuals) (Kraus et al., 2016).

For the period from 2017 to 2021, 28.2 mortalities and serious injuries per year were estimated for AWS This number was comprised of 28 annual estimated recorded mortality or serious injury from U.S. fisheries observer data, and 0.2 possible non-fishery human-caused mortalities (NMFS, 2024b). There was also a total of 142 documented strandings of this species in the U.S. Atlantic during this period, 16 of which were released alive, and 7 of which were indicated as human interactions (NMFS 2024b). The total human-caused annual mortality and serious injury is less than the calculated PBR but is not considered insignificant or approaching zero (NMFS, 2024b).

AWS dolphins are in the MF hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). Their vocalizations range from 6 to 15 kHz (DoN, 2008).

4.2.5 Common Dolphin (*Delphinus delphis*)

The common dolphin may be one of the most widely distributed species of cetaceans, as it is found worldwide in temperate, tropical, and subtropical seas (Waring et al., 2015). Two species were previously recognized: the long-beaked common dolphin (*D. capensis*) and the short-beaked common dolphin; however, 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. This taxonomic convention is used by the Society for Marine Mammalogy. The best population estimate for this stock is 93,100 individuals (NMFS, 2024b). The species is not listed as Threatened or Endangered under the ESA, and the stock is not classified as a strategic or depleted stock (NMFS, 2024b).

Common dolphins are distributed in waters off the U.S. East Coast from Cape Hatteras to Georges Bank (35° N to 42° N) during mid-January to May and move as far north as the Scotian Shelf from mid-summer to autumn (CETAP, 1982; Hamazaki, 2002; Hayes et al., 2022; Selzer and Payne, 1988). Common dolphins are primarily found at the shelf and shelf break along the Gulf Stream, however, common dolphins are known to occur in both nearshore and deep offshore waters (Perrin, 2002). Common dolphins aggregate in large schools numbering in the hundreds, although the typical group size is 30 or fewer (Reeves et al., 2012). Kraus et al. (2016) observed 3,896 individual common dolphins within the RI – MA WEA. Summer surveys observed the most individuals (1,964) followed by fall (725), winter (132), then spring (75).

The common dolphin feeds on small schooling fish and squid; as such, common dolphins are subject to bycatch in gillnets, pelagic trawls, and longline fisheries (Reeves et al., 2012; NMFS, 2024b). During the period from 2017 to 2021, the estimated annual average of mortalities and serious injuries was 413 common dolphins attributed to interactions with U.S. fisheries based on observer data, 0.2 individuals per year attributed to research takes, and 0.6 individuals per year attributed to non-fishery stranding mortalities (NMFS, 2024b). Also during this period, 752 common dolphins were reported stranded between Maine and Florida, 272 of which were either released or last seen alive. Signs of human interaction were confirmed for 36 of these strandings from activities such as fishery interaction, vessel strike, or public harassment (NMFS, 2024b). The total annual mortality and serious injury does not exceed the calculated PBR, but it cannot be considered insignificant or approaching zero for this population. There is no designated critical habitat for this species (NMFS, 2024b).

Common dolphins are in the MF hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). Their vocalizations range widely from 200 Hz to 150 kHz (DoN, 2008).

4.2.6 Atlantic Spotted Dolphin (*Stenella frontalis*)

Atlantic spotted dolphins are widely distributed in tropical and warm temperate waters of the Western North Atlantic (Leatherwood et al., 1976). They range from southern New England south through the Gulf of Mexico, and from the Caribbean to Venezuela (Leatherwood et al., 1976; Perrin et al., 1994). Atlantic spotted dolphins are not listed as Threatened or Endangered under the ESA. Atlantic species of spotted dolphins were not differentiated during surveys, resulting in insufficient data to determine the population trends. The stock status is also unknown (Waring et al., 2014). The best estimate of abundance derived from 2021 surveys for the Western North Atlantic stock of Atlantic spotted dolphins is 31,506 individuals (NMFS, 2024b).

There are few reported occurrences of spotted dolphins (*Stenella* spp.) in the Project Area. CETAP reported 126 spotted dolphin sightings over the course of a 3-year study. The CETAP data for 1982 observed 40 individuals south of Block Island (CETAP, 1982). NMFS shipboard surveys conducted during June-August between central Virginia and the Lower Bay of Fundy reported 542 to 860 individual sightings from two separate visual teams (Palka et al., 2017).

During the period from 2017 to 2021, the reported annual human-caused mortality and serious injury was presumed to be zero (NMFS, 2024b). There were also no reports of injury or mortality due to fisheries interactions during this period; therefore, fisheries interactions are considered insignificant for this population. There is no designated critical habitat for this population (NMFS, 2024b). Between 2017-2021, 21 Atlantic spotted dolphins were reported stranded in the U.S. Atlantic. Four strandings showed evidence of human interaction, where members of the public pushed the animals out to sea. Seven strandings exhibited no signs of human interaction, while for the remaining ten, it remained uncertain whether there was any evidence of human involvement (NMFS, 2024b).

Atlantic spotted dolphins are in the MF hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). Vocalizations typically range from 100 Hz to 130 kHz (DoN, 2008).

4.2.7 Common Bottlenose Dolphin (*Tursiops truncatus*)

The common bottlenose dolphin occupies a wide variety of habitats, occurring in both peripheral seas and oceans in tropical and temperate climates (Stewart et al., 2002). They are common all along the U.S. East Coast year-round (Hayes et al., 2020, 2021). Within the Western North Atlantic, there are two distinct common bottlenose dolphin forms: coastal and offshore. The two forms are genetically and morphologically distinct although regionally variable (Jefferson et al., 2008; Waring et al., 2015). Both inhabit waters in the Western North Atlantic Ocean (Hersh and Duffield, 1989; Mead and Potter, 1995; Curry and Smith, 1997) along the U.S. Atlantic Coast. The common bottlenose dolphin is not listed as Threatened or Endangered under the ESA. Common bottlenose dolphins occurring within the Project Area are likely to come from the offshore population, as the genetic analysis of seasonal stranding records match the temporal patterns of the offshore stock than the coastal stock (Kenney and Vigness-Raposa, 2010). While stranding data does not indicate species distribution, the results of genetic samples taken from strandings Project Area indicate only the offshore stock have been collected there. Additionally, this is consistent with the distribution of the northern migratory coastal stock provided in the most recent stock assessment reports (Hayes et al. 2021). Therefore, the northern migratory coastal stock is not likely to occur in the Project Area and will not be discussed further.

The Western North Atlantic offshore stock expected to occur in the Project Area is not listed as depleted under the MMPA. The offshore stock is distributed primarily along the outer continental shelf and slope, from Georges Bank to Cape Hatteras during the spring and summer (CETAP, 1982; Kenney, 1990). Stock status within U.S. Atlantic waters is unknown and data are insufficient to determine population trends. The best available abundance estimate for the offshore morphotype of common bottlenose dolphins in the Western North Atlantic is 64,587 individuals (NMFS, 2024b).

Common bottlenose dolphins were observed in the RI – MA WEA in all seasons with the highest seasonal abundance estimates during the fall, summer, and spring. The greatest concentrations of bottlenose dolphins were observed in the southernmost portion of the RI – MA WEA (Kraus et al., 2016).

For the offshore stock, the estimated annual fishery-caused mortality and serious injury for the period between 2017 and 2021 was estimated to be 28 individuals due to interactions with large pelagic longlines, northeast sink gillnet, northeast bottom trawl, and mid-Atlantic bottom trawl commercial fisheries (NMFS, 2024b). Total human-caused mortality and serious injury for this stock is considered insignificant, and this stock is not strategic under the MMPA. There is no designated critical habitat for this species (NMFS, 2024b). Between 2017 and 2021, a total of 1,764 common bottlenose dolphins were found stranded along the U.S. East Coast (NMFS, 2024b). Of these, 264 showed signs of huma interactions such as gear entanglement, mutilation, and vessel strike, but none were identified as belonging to the offshore stock (NMFS, 2024b). The vast majority of these stranded dolphins were assumed to belong to one of the coastal stocks or to bay, sound, and estuary stocks (NMFS, 2024b), none of which are expected in the Project Area.

Coastal and offshore stocks of bottlenose dolphins are in the MF hearing group, with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). Bottlenose dolphin vocalization frequencies range from 3.4 to 130 kHz (DoN, 2008).

4.2.8 Striped Dolphin (*Stenella coeruleoalba*)

Striped dolphins are widely distributed in tropical and warm temperate waters of the Western North Atlantic ranging from Nova Scotia to the Caribbean and Gulf of Mexico (NMFS, 2024b). Striped dolphins prefer offshore waters from the continental slope to the Gulf Stream although there is limited information regarding the stock structure (NMFS, 2024b). Western North Atlantic striped dolphins are not a strategic stock and are not listed as Threatened or Endangered under the ESA. The best estimate of abundance derived from 2021 surveys for the Western North Atlantic stock of striped dolphins is 48,274 individuals (NMFS, 2024b).

There are few reported occurrences of striped dolphins in the Project Area. All CETAP records reported striped dolphins in waters greater than 900m; although it was noted that the most northern sightings aligned with warm core rings of the Gulf Stream (CETAP, 1982; NMFS, 2024b). Striped dolphins would not typically be associated with shelf waters off New York and Massachusetts; however, preliminary data from site investigation surveys for offshore wind have a very small number of probable striped dolphin sightings (**Section 3.2**); therefore, they have been included in this assessment.

Between 2017 and 2021, the total annual estimated average fishery-related mortality was zero for this stock (NMFS, 2024b). During this same period, there were also 22 strandings reported along the U.S. Atlantic Coast; including 1 in Rhode Island, 2 in Massachusetts, and 4 in New York (NMFS, 2024b). There is no designated critical habitat for this population (NMFS, 2024b).

Striped dolphins are in the MF hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007). Vocalizations typically range from 100 Hz to 130 kHz (DoN, 2008).

4.2.9 White-beaked Dolphin (*Lagenorhynchus albirostris*)

The white-beaked dolphin is considered rare in the Project Area, but as previously indicated there was a single detection of this species reported by PSOs during site characterization surveys conducted in 2022 within the Project Area (**Section 3.2**) so it is being included for consideration in this take assessment. White-beaked dolphins are primarily found in cold temperate and subpolar waters (Hayes et al., 2020). The white-beaked dolphin is considered very rare in waters south of Cape Cod and individuals occurring in any US waters are likely opportunistically feeding (Hayes et al., 2020). The current estimated white-beaked dolphin abundance is 536,016 individuals derived from Canadian surveys (Hayes et al., 2020), and there are only five stranding records in the U.S.; four from Massachusetts and one from North Carolina (Hayes et al., 2020). The North Carolina report further indicates that movement of white-beaked dolphins south of Cape Cod waters, while rare, does occur. Threats to the population are not fully understood due to lack of information; however, two strandings reported in the U.S. were attributed to human interaction including one from plastic ingestion (Hayes et al. 2020).

White-beaked dolphins are in the MF hearing group with an estimated auditory bandwidth of 150 Hz to 160 kHz (Southall et al., 2007).

4.2.10 Harbor Porpoise (*Phocoena phocoena*)

The harbor porpoise is the only porpoise species found in the Atlantic. It is a small, stocky cetacean with a blunt, short-beaked head. There are four subspecies, with *P. phocoena* residing in the North Atlantic (Committee on Taxonomy, 2023). The harbor porpoises that occur in the Project Area comprise the

Gulf of Maine/Bay of Fundy stock. This stock is not considered strategic under the MMPA because it is not listed as Threatened or Endangered. In 2001, NMFS conducted a status review for the stock, mainly due to the level of bycatch in fisheries (66 FR 53195). The determination from the review was that listing the harbor porpoise under the ESA was not warranted and the species was removed from the candidate list. Population trends for this species are unknown. The best, and most recent, abundance estimate for harbor porpoise in the Gulf of Maine/Bay of Fundy stock is 85,765 individuals (NMFS, 2024b).

Harbor porpoises commonly occur throughout Massachusetts Bay from September through April. During the fall and spring, harbor porpoises are widely distributed along the U.S. East Coast from New Jersey to Maine. During the summer, the porpoises are concentrated in the Northern Gulf of Maine and Southern Bay of Fundy in water depths <150 m. In winter, densities increase in the waters off New Jersey to North Carolina and decrease in the waters from New York to New Brunswick; however, specific migratory timing or routes are not apparent.

Harbor porpoise occurrence offshore Rhode Island is highly seasonal with most sightings occurring predominantly in winter and spring and relatively few in summer and fall (Kenney and Vigness-Raposa, 2010). They are most commonly reported in eastern Long Island Sound, Gardiner's Bay, and Peconic Bay during the winter. They have the greatest abundance on the continental shelf offshore Rhode Island during the spring when they are known to migrate from their offshore wintering habitat in the mid-Atlantic to their summer feeding grounds in the Gulf of Maine (Kenney and Vigness-Raposa, 2010). Within the RI – MA WEA, Kraus et al. (2016) observed 121 individual harbor porpoises throughout the course of the study. Fall observations included the most individuals (49) followed by winter (35), spring (36), and summer (1). Vertical camera detections of all small cetaceans showed that the most commonly detected species over time was the harbor porpoise (Kraus et al., 2016).

Harbor porpoises feed on small schooling fish such as mackerel, herring, and cod, as well as worms, cephalopods, and sand eels (*Hyperoplus* spp.). Their foraging habits and habitats make this species particularly susceptible to mortality in bottom-set gill nets (Waring et al., 2015). The average estimated annual human-caused mortality or serious injury for this stock for the period between 2017 and 2021 was 145.4 harbor porpoises per year, with 145 attributed to U.S. commercial fisheries interactions based on observer data; 0.2 attributed to research takes; and 0.2 attributed to non-fishery caused stranding mortalities (NMFS, 2024b). In 2010, a final rule was published for the existing Harbor Porpoise Take Reduction Plan in the *Federal Register* (75 FR 7383) to address closure areas and timing based on bycatch rates. A total of 305 harbor porpoises were stranded in the U.S. between 2017 and 2021, 18 of which showed evidence for human interaction; 2 of them were deemed fishery interaction, and 1 was attributed to vessel strike (NMFS, 2024b). The total annual human-related mortality rates do not exceed the PBR but cannot be considered insignificant or approaching zero. There is no designated critical habitat for this species (NMFS, 2024b).

The harbor porpoise is the only potentially affected species in the Project Area within the HF hearing group that uses ultrasonic echolocation clicks to navigate and hunt prey. The click frequency is between 110 and 150 kHz, which is consistent with harbor porpoise hearing sensitivity centered between 100 and 120 kHz (Thompson et al., 2013). Click trains can have very short inter-click intervals when close to a prey item, which results in a "feeding buzz" due to the rapid succession of individual clicks, making them highly identifiable in acoustic surveys.

4.3 PHOCIDS

4.3.1 Harbor Seal (*Phoca vitulina*)

The harbor seal is found in all nearshore waters of the Atlantic Ocean and adjoining seas north of 30° N (Hayes et al., 2022). In the Western North Atlantic, they are distributed from Eastern Canada to southern New England and New York, and occasionally to the Carolinas (Payne and Selzer, 1989). Harbor seals are the most abundant seals in the Eastern U.S.; they are not listed as Threatened or Endangered. The harbor seals within the Project Area are part of the single Western North Atlantic stock, which is not considered strategic under the MMPA. The best population estimate of harbor seals for this stock is 61,336 (Hayes et al., 2022).

Harbor seals exploit a variety of available food sources and feed both in shallow coastal habitats and offshore (Waring, 2015). Typical prey items include cephalopods (i.e., squid) and small schooling fish (i.e., herring, alewife [*Alosa pseudoharengus*], flounder [*Paralichthys* spp. and *Pseudopleuronectes* spp.], redfish [*Sciaenops ocellatus*], cod, yellowtail flounder [*Pleuronectes ferruginea*], sand eel, hake) and spend up to 85% of the day diving, presumably foraging.

Harbor seals are the most abundant seals in the Northeastern U.S. They can be found year-round in the coastal waters of Eastern Canada and Maine (Hayes et al., 2022). Harbor seals occur seasonally along the southern New England and New York coasts from September through late May although evidence suggests they may remain in this region over longer time period (Schneider and Payne, 1983; deHart, 2002). Survey data collected from NMFS and the Provincetown Center for Coastal Research reported 151 harbor seal sightings in this region, a large concentration of which were observed near the coast from eastern Long Island to Buzzards Bay and Vineyard Sound. There were occurrences of harbor seals offshore; however, abundances offshore were lower than what was observed near haul-out sites (Kenney and Vigness-Raposa, 2010). No pupping areas have been identified in southern New England, but there are several haul-out sites on Block Island and six haul-out sites have been identified in Narragansett Bay (Barlas, 1999; Kenney and Vigness-Raposa, 2010). They are most commonly observed at the Dumplings off Jamestown at Rome Point in North Kingstown. Nearly all the haul-outs within Narragansett Bay are rocky ledges or isolated rocks with the exception of Spar Island which is a man-made dredge spoil (Kenney and Vigness-Raposa, 2010).

Fisheries interactions are common, and harbor seals are legally killed in Canada, Norway, and the United Kingdom to protect fish farms or local fisheries (Reeves et al., 2013). Harbor seals are also susceptible to bycatch in gillnets, trawls, and purse seines. For the period from 2015 to 2019, the average human-caused mortality and serious injury to harbor seals was 339 individuals per year, of which 334 occurred in fisheries interactions. Other causes of mortality for this population include human interactions such as vessel strikes, pollution, and harassment; storms; abandonment by the mother; disease; and predation (Hayes et al., 2022).

In July 2018, a UME was declared for both the harbor seal and gray seal due to mortalities throughout the Northeast U.S. Based on results of preliminary examinations, the 3,152 strandings (which include both species) reported through 13 March 2020 were determined to be the result of phocine distemper virus (NMFS, 2022c). This UME is currently inactive and pending closure. In June 2022, a separate pinniped UME was declared for harbor and gray seals along the Maine coast; this UME was closed in January 2024 There have been 143 confirmed harbor seal strandings reported under this UME between 1 June 2022 and closure (NMFS, 2024g). Preliminary testing has found some harbor and gray seals positive for highly pathogenic avian influenza (HPAI) H5N1; this UME is ongoing and continues to be researched (NMFS, 2024g). The total human-caused mortality and serious injury does not exceed the PBR but cannot be considered insignificant for this population (Hayes et al., 2022).

Harbor seals are part of the PW hearing group. Male harbor seals produce underwater vocalizations during mating season to attract females and defend territories (Sabinsky et al., 2012). These calls are comprised of “growls” or “roars” with a peak energy at 1.2 kHz (Sabinsky et al., 2012). Captive studies have shown that harbor seals have good (>50%) sound detection thresholds between 0.1 and 80 kHz, with primary sound detection between 0.5 and 40 kHz (Kastelein et al., 2009).

4.3.2 Gray Seal (*Halichoerus grypus*)

Gray seals within the Project Area are part of the Western North Atlantic stock. They are not listed as Threatened or Endangered and the stock is not considered strategic under the MMPA There is a lack of understanding about the exchange of individuals between the gray seals in the U.S. and Canada; therefore, population from each country is calculated separately. The Canadian gray seal population was estimated to be 366,400 individuals in 2021 (NMFS, 2024b). The best population estimate of gray seals for the U.S. stock is 27,911 individuals (NMFS, 2024b). The U.S. population estimate relies on pup numbers, utilizing the pup-to-adult ratio observed in the Canadian population.

Gray seals will aggregate in large numbers to breed, molt, and rest. Gray seals will exploit a variety of available food sources and will feed both in shallow coastal habitats and offshore (Waring et al., 2015). Typical prey items include cephalopods, sessile organisms, small schooling fish (i.e., herring, alewife, flounder, redfish, cod, yellowtail flounder, sand eel, hake), and crustaceans. Gray seals will go on extensive dives to depths of up to 475 m to capture food (Waring et al., 2015).

The gray seal has a year-round range from Canada to Massachusetts and may seasonally migrate further south to northern parts of New Jersey between September and May (NMFS, 2024b). Stranding records extend as far south as Cape Hatteras, North Carolina (Gilbert et al., 2005). Historically, gray seals were relatively absent from Rhode Island and nearby waters. However, with the recent recovery of the Massachusetts and Canadian populations, their occurrence has increased in southern New England waters (Kenney and Vigness-Raposa, 2010). In New York, gray seals are typically seen alongside harbor seal haul-outs. Two frequent sighting locations include Great Gull Island and Fisher’s Island (Kenney and Vigness-Raposa, 2010). Two breeding and pupping grounds have also been identified near the Project Area in Nantucket Sound at Monomoy and Muskeget Island (NMFS, 2024b). Gray seals have been observed using the historic pupping site on Muskeget Island in Massachusetts since 1990 (Wood LaFond, 2009).

Gray seals are susceptible to bycatch and fisheries interactions and, like the harbor seal, are legally killed in some countries to protect fisheries resources. The gray seal is also taken commercially outside the U.S. The average estimated human-caused mortality and serious injury of gray seals between 2017 and 2021 was 4,570 seals per year for both the U.S. (1,388 per year) and Canada (3,182 per year) (NMFS, 2024b). As with the harbor seal, the total annual human-caused mortality and serious injury does not exceed the PBR, but it cannot be considered insignificant (NMFS, 2024b).

In July 2018, a UME was declared for both the harbor seal and gray seal due to mortalities throughout the Northeast U.S. Based on results of preliminary examinations, the 3,152 strandings (which include both species) reported through 13 March 2020 were determined to be the result of phocine distemper virus (NMFS, 2022c). This UME is currently inactive and pending closure. In June 2022, a separate pinniped UME was declared for harbor and gray seals along the Maine coast; this UME was closed in January 2024. There have been 28 confirmed gray seal strandings reported under this UME between 1 June 2022 and the closure of the UME (NMFS, 2024g). Preliminary testing has found some harbor and gray seals positive for highly pathogenic avian influenza (HPAI) H5N1; this UME is ongoing and continues to be researched (NMFS, 2024g). The total human-caused mortality and serious injury does not exceed the PBR but cannot be considered insignificant for this population (NMFS, 2024b).

Gray seals, like harbor seals, belong to the PW hearing group. As with all pinnipeds, they are assigned to hearing groups based on the medium (air or water) through which they are detecting the sounds, for an estimated underwater auditory bandwidth of 75 Hz to 75 kHz (Southall et al., 2007). Vocalizations range from 100 Hz to 3 kHz (DoN, 2008).

5.0 Type of Incidental Take Requested

The Applicant requests an IHA pursuant to Section 101 (a)(5)(D) of the MMPA for incidental take of small numbers of marine mammals by Level B harassment during geophysical surveys conducted as part of site characterization activities within the Project Area. Proposed activities, as outlined in **Section 1.0**, have the potential to impact marine mammals within the Project Area from sounds generated by survey equipment. The maximum range to a Level A threshold is <18 m and Level A take is not anticipated during HRG surveys. No PTS, physiological damage, or injury is expected to occur to marine mammals from the noise generated by the survey equipment or vessels during proposed surveys; therefore, no Level A takes are calculated or requested.

The calculations for Level B take assumed that all 350 vessel days of geophysical surveys conducted during the survey window will use the source producing the largest Level B acoustic isopleths of 141 m (**Table 4**). Vessel days are defined as the number of days any single vessel is in operation regardless of any other vessel operations (i.e., if two vessels are working concurrently within the same 24-hour period, each vessel would be counted as having a vessel day for a total of two vessel days even though the activity occurs within a single 24-hour period). This assumption provides a conservative approach to predicting potential impacts on marine mammal species from active survey operations while also providing a realistic representation of anticipated survey effort.

The most likely Level B take is expected to result from minor behavioral reactions such as avoidance and temporary displacement for some individuals or groups of marine mammals near the proposed activities. It is expected that the severity of behavioral effects will vary with the duration of operations, the behavior of the animal at the time of reception of the sound, and the distance and received SPL of the sound. The Level B take is unlikely to manifest as TTS (Southall et al., 2007) and no TTS exposures are anticipated.

Potential impacts will be mitigated through following the BOEM *Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection* dated 22 November 2021 (BOEM PDC's; BOEM, 2021), or as amended in any updated versions; implementing a visual monitoring program and an associated vessel activity management program, all of which are described in **Section 11.0**.

6.0 Take Estimates for Marine Mammals

The Applicant is seeking authorization for potential "taking" of small numbers of marine mammals under the jurisdiction of NMFS in the proposed region of activity, as described in **Section 2.0**. The 17 species listed below are described in **Section 4.0**. Each species has a geographic distribution that encompasses the Project Area and has at least a minimal potential to be "taken" during the proposed surveys.

Authorization for Level B harassment is sought for the following 17 species:

- North Atlantic right whale;
- Humpback whale;
- Fin whale;
- Sei whale;
- Minke whale;
- Sperm whale;
- Risso's dolphin;
- Long-finned pilot whale;
- Atlantic white-sided dolphin;
- Common dolphin;
- Atlantic spotted dolphin;
- Common bottlenose dolphin;
- Striped dolphin;
- White-beaked dolphin;
- Harbor porpoise;
- Harbor seal; and
- Gray seal.

The only anticipated impacts to marine mammals are associated with noise and are limited to the use of HRG survey equipment operating sources less than 180 kHz and have the potential to result in Level B exposures as described in **Section 1.3**. The potential activities are not expected to take more than a small number of marine mammals or have more than a negligible effect on their populations based on their seasonal density and distribution and known reactions to underwater sound exposure. The source activity is described in **Section 1.2**, survey equipment is listed in **Section 1.3**, and species status and distributions in **Section 4.0**.

6.1 BASIS FOR ESTIMATING NUMBERS OF MARINE MAMMALS THAT MIGHT BE TAKEN BY HARASSMENT

Estimating exposures of marine mammal species assumes that exposure of an animal to a specified noise level within a region of ensonification will result in a take of that animal. The ensonified area is calculated based on the SL and operational mode of the equipment (**Table 3**). Potential Level B take exposures are estimated within the ensonified area as an SPL exceeding 160 dB re 1 µPa for impulsive sources (e.g., sparkers, boomers) within an average day of activity. The potential number of exposed animals is estimated from the mean monthly densities (animals km^{-2}) of a given species expected within the Project Area. These densities are then multiplied by the maximum number of survey days. These calculations result in unmitigated take estimates for each affected species over the entire survey period.

6.1.1 Harassment Zone Calculations

The harassment zone is a representation of the maximum extent of the ensonified area around a sound source over a 24-hour period. The harassment zone for each piece of equipment operating below 180 kHz was calculated per the following formulae:

- Stationary Source: Harassment Zone = πr^2
- Mobile Source: Harassment Zone = (Distance/day × 2r) + πr^2

Where r is the linear distance from the source to the isopleth for Level A or Level B thresholds and day = 1 (i.e., 24 hours).

The estimated potential daily active survey distance of 70 km was used as the estimated areal coverage over a 24-hour period. This distance accounts for the vessel traveling at roughly 4 knots and only for periods during which equipment <180 kHz is in operation. A vessel traveling 4 knots can cover approximately 110 km per day; however, based on data from 2017, 2018, and 2019 surveys, survey coverage over a 24-hour period is closer to 70 km per day. For daylight only vessels, the distance is reduced to 35 km per day; however, to maintain the potential for 24-hour surveys, the corresponding Level B harassment zones provided in **Table 6** were calculated for each source category based on the Level B threshold distances in **Table 4** with a 24-hour (70 km) operational period.

Table 6. Calculated harassment zones Level B thresholds for each sound source or comparable sound source category.

Source	Level B Harassment Zone (km^2)
Shallow SBP's (CHIRPS)	7.6
Boomers	10.7
Sparkers	19.8

CHIRP = compressed high intensity radiated pulses; SBP = sub-bottom profile.

A conservative approach to estimate the Level B take distances for the survey was implemented by using the equipment that produced the greatest Level B isopleth distance from apparent or measured SL to define the impact radii of all proposed equipment within that group. The maximum estimated distance from a geophysical source to the Level B threshold (SPL of 160 dB re 1 µPa) were for the sparkers at 141 m and subsequent 19.8 km^2 harassment zone. (**Table 4**).

6.1.2 Marine Mammal Density Calculation

The density calculation methodology applied to take estimates for this Application is derived from the model results produced by Roberts et al. (2016) and then updated by Roberts et al. (2023) for the entire U.S. East Coast region. To determine cetacean densities for take estimates, only those density blocks which overlapped with any portion of the Project Area were selected for this assessment (**Figure 4**). These files were retrieved as raster files from the website https://seamap.env.duke.edu/models/Duke/EC/ (Roberts et al., 2016, 2023). These estimates are considered the best information currently available for calculating marine mammal densities in the U.S. Atlantic by NMFS.

6.1.2.1 Marine Mammal Guild Densities

Due to limited data availability and difficulties identifying individuals to species level during visual surveys, individual densities are not available for all species and they are instead grouped into "guilds" (Roberts et al., 2023). These guilds include pilot whales, common bottlenose dolphins, and seals.

Long- and short-finned pilot whales are difficult to distinguish during shipboard surveys so individual habitat models were not able to be developed. However, as discussed in **Section 4.2.3**, all pilot whales in the Project Area are assumed to be long-finned pilot whales, so the densities and subsequent takes would apply only to this species.

The density models do not distinguish between common bottlenose dolphin stocks due to limited data regarding distributions of these stocks. As discussed in **Section 4.2.7**, only the Western North Atlantic offshore stock is expected to occur in the Project Area. Therefore, the densities in **Table 7** and subsequent take calculations would only apply to this stock of bottlenose dolphins.

Gray seals and harbor seals are reasonably identifiable during shipboard visual surveys; therefore, it is expected that some sightings will be assigned to species rather than to the generalized seal guild. Additionally, seals tend to occur in very small numbers when away from haul out areas; therefore, sighting events are not likely to constitute large numbers of animals. For these reasons, the seal guild density was split evenly between both gray and harbor seal species.

All density squares intersecting the Project Area (**Figure 4**) across all months for all species were averaged to provide an annual density for each species (**Table 7).**

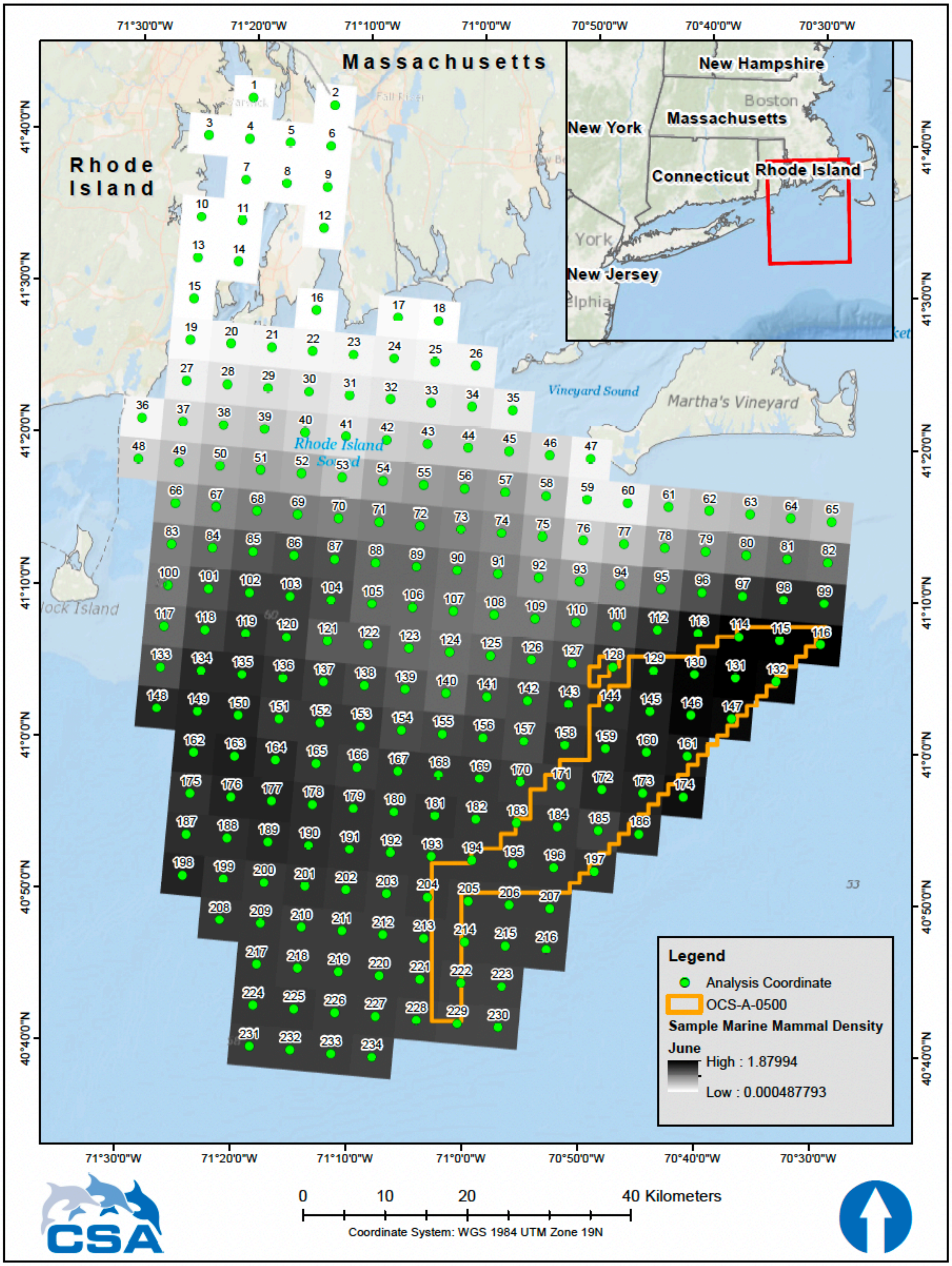

Figure 4. Sample density blocks (Roberts et al. 2023) from models used to determine monthly marine mammal densities within the Project Area.

Table 7. Estimated monthly and average annual density (animals km^{-2}) of potentially affected marine mammals within the Project Area based on monthly habitat density models (Roberts et al., 2023)[1].

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	**Average Annual Density (km^{-2})**
Low-frequency Cetaceans													
Fin whale	0.0026	0.0019	0.0012	0.0022	0.0029	0.0025	0.0041	0.0034	0.0020	0.0006	0.0007	0.0019	**0.0022**
Sei whale	0.0004	0.0002	0.0004	0.0013	0.0018	0.0004	0.0001	0.0001	0.0002	0.0003	0.0009	0.0008	**0.0006**
Minke whale	0.0014	0.0015	0.0014	0.0092	0.0210	0.0141	0.0059	0.0038	0.0038	0.0038	0.0006	0.0010	**0.0056**
Humpback whale	0.0006	0.0004	0.0004	0.0015	0.0029	0.0025	0.0014	0.0011	0.0016	0.0019	0.0020	0.0005	**0.0014**
North Atlantic right whale	0.0041	0.0052	0.0053	0.0048	0.0021	0.0004	0.0002	0.0002	0.0003	0.0005	0.0007	0.0023	**0.0022**
Mid-frequency Cetaceans													
Sperm whale	0.0002	0.0001	0.0001	0.0000	0.0001	0.0002	0.0002	0.0007	0.0003	0.0002	0.0002	0.0002	**0.0002**
Atlantic white-sided dolphin	0.0157	0.0097	0.0069	0.0110	0.0276	0.0234	0.0099	0.0048	0.0128	0.0170	0.0147	0.0186	**0.0143**
Atlantic spotted dolphin	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0002	0.0003	0.0015	0.0038	0.0015	0.0002	**0.0006**
Common bottlenose dolphin (Offshore)	0.0049	0.0012	0.0006	0.0016	0.0080	0.0134	0.0161	0.0162	0.0139	0.0127	0.0124	0.0109	**0.0093**
Long-finned pilot whale	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	0.0016	**0.0016**
Risso's dolphin	0.0005	0.0000	0.0000	0.0001	0.0007	0.0003	0.0005	0.0006	0.0009	0.0006	0.0011	0.0021	**0.0006**
Common dolphin	0.0736	0.0250	0.0163	0.0323	0.0534	0.1058	0.0730	0.0916	0.1640	0.1632	0.1042	0.1130	**0.0846**
Striped dolphin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
White-beaked dolphin	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	**0.0000**
High-frequency Cetaceans													
Harbor porpoise	0.0949	0.0999	0.0923	0.0811	0.0552	0.0038	0.0035	0.0034	0.0030	0.0038	0.0050	0.0618	**0.0423**
Pinnipeds[3]													
Gray seal	0.1544	0.1357	0.1029	0.0709	0.1483	0.0959	0.0182	0.0136	0.0219	0.0659	0.0607	0.1255	**0.0845**
Harbor seal	0.1544	0.1357	0.1029	0.0709	0.1483	0.0959	0.0182	0.0136	0.0219	0.0659	0.0607	0.1255	**0.0845**

[1]See Section 6.1.2.1. for density discussion regarding bottlenose dolphin, pilot whale, pinniped guilds.

6.1.3 Take Calculation

Based on the average annual densities for each species in the Project Area (**bolded** numbers in **Table 7**) and the harassment zones (**Table 6**), the estimated number of Level A takes per equipment type was determined, and the estimated number of Level B takes for the sparker sources was determined. Calculations were based on vessel-towed geophysical survey equipment operating 350 vessel days in the Project Area, with the sources producing the largest threshold distances (i.e., sparkers) operating during 100% of vessel days.

Estimates of take are calculated according to the following formula:

- Estimated Take = D × Harassment Zone × # of Survey Days

Where: D = average species density (km^{-2}); and Harassment Zone = maximum ensonified area that equates to NMFS thresholds for noise impact criteria. To estimate take, the density of marine mammals within the Project Area (animals km^{-2}) was multiplied by the daily ensonified harassment zone (km^2). That result is then multiplied by the number of survey days (rounded to the nearest whole number) to arrive at the estimated take. This final number equals the instances of take for the entire operational period. The result is an estimate of the maximum potential number of instances that marine mammals could be exposed to sounds above the Level A or Level B harassment thresholds over the duration of survey activities. The Applicant has proposed mitigation measures to reduce potential Level B harassment and eliminate the possibility of any Level A harassment (**Section 11.0**).

6.2 ESTIMATED NUMBERS OF MARINE MAMMALS THAT MIGHT BE TAKEN BY HARASSMENT

The Applicant is requesting approval for the incidental harassment takes of marine mammals associated with geophysical surveys. Take estimates were projected based on marine mammal presence, calculated density estimates, and activity-specific noise source propagation characteristics.

6.2.1 Estimated Level B Harassment of Marine Mammals

Level B exposures were estimated by multiplying the average annual density of each species (**Table 7**) (Roberts et al. 2023) by the daily harassment zone that was estimated to be ensonified to an SPL exceeding 160 dB re 1 µPa (**Table 6**), times the number of operating days expected for the survey in each area assessed. In this Application, it was assumed the sparker systems were operating all 350 survey days in the Project Area as it is the sound source expected to produce the largest harassment zone.

Table 8 summarizes the Level B take estimates for the Project Area for all species for which take is requested (**Section 6.0**).

Table 8. Summary of maximum potential Level B take exposures resulting from 100% usage of the sparker systems during all 350 survey days in the Project Area.

Species	Density	Total Calculated Takes
North Atlantic right whale	**0.0022**	15
Humpback whale	**0.0014**	10
Fin whale	**0.0022**	15
Sei whale	**0.0006**	4
Minke whale	**0.0056**	39
Sperm whale	**0.0002**	2
Atlantic white-sided dolphin	**0.0143**	99
Atlantic spotted dolphin	**0.0006**	4
Common bottlenose dolphin (offshore stock)	**0.0093**	65
Long-finned pilot whale	**0.0016**	11
Risso's dolphin	**0.0006**	4
Common dolphin	**0.0846**	586
Striped dolphin	**0.0000**	0
White-beaked dolphin	**0.0000**	0
Harbor porpoise	**0.0423**	293
Gray seal	**0.0845**	586
Harbor seal	**0.0845**	586

6.2.2 Requested Level B Takes

The estimated Level B exposures in **Table 9** are based on the operation of the sparker sources that produced the largest threshold isopleth (141 m) during 100% of the proposed vessel days. All non-sparker sources were estimated to produce Level B isopleths less than 54 m. This method provides conservative estimates of the potential Level B exposures to any of the species or stocks expected to occur within the Project Area because maximum isopleths for each of the equipment groups were used.

The following adjustments were made to the calculated takes (**Table 8**) to provide the requested takes in **Table 9**:

- Atlantic spotted dolphin: 4 takes were calculated but based on reported detections of this species in PSO monitoring reports for projects in the RI-MA WEA where this Project Lease Area is located (Smultea Environmental Sciences, 2020), 1 group of 24 (Palka et al. 2017, 2021) was added to the requested takes.
- Common dolphin: requested takes were increased to 1,471. This is based on the maximum number of individuals reported within the individual Level B harassment zones in PSO monitoring reports published for HRG surveys for leases within the RI-MA WEA (where the Lease Area for this Project is located; **Figure 1**) available on NMFS website (NMFS, 2024h). However, the maximum number of common dolphins detected by PSOs in the Level B harassment zone was based on a survey encompassing a total of 1,300 survey days (Smultea Environmental Sciences, 2020). The proposed survey in this Application would occur over 350 survey days which is approximately 1/3 of the survey days from that PSO report. Therefore, the requested take of common dolphins reflects 1/3 of the maximum number of detections from Smultea Environmental Sciences (2020) (4,457) for a total of 1,471.

- Striped dolphin: no takes were calculated for this species (**Table 8**), but data from AMAPPS indicate this species was commonly observed species in the RI-MA WEA (Palka et al. 2017) where this Project Lease Area is located. Therefore, 1 group of 46 (Palka et al. 2017, 2021) was added to the requested takes.
- Risso's dolphin: only four takes were calculated but based on reported detections of this species in two PSO monitoring reports for projects in the RI-MA WEA where this Project Lease Area is located (Bay State Wind, 2019; Smultea Environmental Sciences, 2020), 1group of 7 (Palka et al. 2017, 2021 were added to the requested takes.
- White-beaked dolphin: no takes were calculated but based on reported detections of this species in two PSO monitoring reports for projects in the RI-MA WEA where this Project Lease Area is located (EPI Group, 2021; RPS, 2021), 1 group of 12 (Palka et al. 2017, 2021) was added to the requested takes.

Table 9. Summary of requested Level B takes for this Project.

Species		Requested Takes[1]
North Atlantic Right Whale	*Eubalaena glacialis*	15
Humpback Whale	*Megaptera novaeangliae*	10
Fin Whale	*Balaenoptera physalus*	15
Sei Whale	*Balaenoptera borealis*	4
Minke Whale	*Balaenoptera acutorostrata*	39
Sperm Whale	*Physeter macrocephalus*	2
Atlantic White-sided Dolphin	*Lagenorhynchus acutus*	99
Atlantic Spotted Dolphin	*Stenella frontalis*	4 (24)
Common Bottlenose Dolphin	*Tursiops truncatus*	65
Long-finned Pilot Whale	*Globicephala melas*	11
Risso's Dolphin	*Grampus griseus*	4 (7)
Common Dolphin	*Delphinus delphis*	586 (1,471)
Striped Dolphin	*Stenella coeruleoalba*	0 (46)
White-Beaked Dolphin	*Lagenorhynchus albirostris*	0 (12)
Harbor Porpoise	*Phocoena phocoena*	293
Harbor Seal[2]	*Phoca vitulina*	586
Gray Seal[2]	*Halichoerus grypus*	586

[1]Parenthesis denotes changes from calculated take estimates.

- For species with few or no modeled exposures, requested takes for HRG surveys are based on mean group sizes derived from the AMAPPS (Palka et al. 2017, 2021).
- For humpback whales, the requested takes were updated to be consistent with the total number of individuals reported within the Level B harassment zones defined in PSO monitoring reports for all available HRG surveys from 2018 – 2022 available from NMFS (2024h) in the Rhode Island-Massachusetts Wind Energy Area (where the Project Area is located).
- For common dolphins, 1/3 of the maximum number of individuals detected by PSOs within the Level B harassment zones defined in the monitoring reports available for HRG surveys from 2018 – 2022 from NMFS (2024h) for projects in the Rhode Island-Massachusetts Wind Energy Area (where the Project Area is located) was used for the requested take numbers. Because the maximum number of reported individuals was in Smultea Environmental Sciences (2020) which was for a survey occurring over 3x the number of survey days proposed in this Application, only 1/3 of that maximum number was used for this take request.

[2]Roberts et al. (2023) only provides density estimates for "generic" seals; therefore, densities were split evenly between the two species and used to estimated potential take.

7.0 Effects on Marine Mammal Species or Stocks

Marine mammals exposed to natural or man-made sound may experience non-auditory and auditory impacts which range in severity (Southall et al., 2007; 2019; NMFS, 2018a; Wood et al., 2012). The potential exists for small numbers of marine mammals to be exposed to underwater sound associated with survey activities. These impacts are likely to affect individual species but have only negligible effects on the marine mammal stocks, and therefore will not adversely affect the population of any species. Mitigation is not considered in the take estimates; inclusion of mitigation would likely reduce the take estimates.

7.1 MULTIPLE EXPOSURES AND SEASONALITY

Level B exposures likely include the same individuals across multiple days and not exposures to the entire stock; therefore, they can be considered instances of exposure rather than a discrete count of individuals that have received regulatory-level sound exposures. The acoustic metric used to establish Level B isopleths (SPL) does not consider a duration of exposure (SEL_{24h}) in its calculations. The SPL assumes that an animal within the Level B isopleth, regardless of the length of time, is taken by exposure. The take estimates assume that an animal will only be taken once over a 24-hour period; however, an activity may result in multiple takes of the same animal during this period resulting in an inflated percent of the population taken which is not realized during actual events.

Additionally, estimates using the habitat density data (Roberts et al., 2023) may not fully reflect the actual observations in the field. In the case of the NARW, seasonal, patchy densities increase the average annual densities across an entire lease area for only a short period of time, resulting in much fewer detections during the surveys when compared to the calculated exposure estimates. Population percentages represent the maximum potential take numbers, whereas in actuality, a limited number of marine mammals may realize behavioral modification.

7.2 NEGLIGIBLE IMPACTS

Animals in an area of exposure may move location depending on their acoustic sensitivity, life stage, and acclimation (Wood et al., 2012), and may or may not demonstrate behavioral responses. Therefore, while the number of takes and the affected population percentages represent the maximum potential take numbers, in actuality, a limited number of marine mammals may realize behavioral modification.

Under the requirements of 50 CFR § 216.104, NMFS has defined negligible impact as an impact that is not reasonably expected to adversely affect a species or stock through effects on annual rates of recruitment or survival. The negligible impact determination is not based on take estimates alone; rather, for NMFS to make a negligible impact determination, small numbers must denote that the portion of a marine mammal species or stock in the take estimates will have a negligible impact on that species or stock.

As discussed in **Sections 9.0** and **10.0**, physical auditory effects, vessel strikes, PTS or TTS, and long-term impacts to habitat or prey species are not expected to occur. Temporary masking may occur in localized areas for short periods of time when an animal is in proximity to the survey. Masking occurs when an animal's acoustic "space" (i.e., auditory perception and discrimination) is covered up by noise of similar frequency, but at higher amplitudes of biologically important sounds. However, due to movement of the sources, masking effects are expected to be negligible and will not contribute significantly to other noise sources operating in the region.

The primary potential impact on marine mammals from exposure to survey-related underwater sound is behavioral response, which will not necessarily constitute significant changes in biologically important behaviors. The National Research Council (2005) noted that an action or activity becomes biologically significant to an individual animal when it affects the ability of the animal to grow, survive, and reproduce, wherein an impact on individuals can lead to population-level consequences and affect the viability of the species. The reasonably expected impacts from the proposed activities are based on noise exposure thresholds that can potentially elicit a behavioral response and are categorized as Level B takes under the MMPA. Here, due to the variability in species reaction to sound sources, short time period of the survey operations, and use of mitigation measures, any behavioral reactions are expected to be minor, localized, short-term, and have negligible effects on individuals and stocks. It is expected that behavioral reactions will mainly comprise a temporary shift in spatial use. No long-term or population effects are expected from the behavioral reactions to the proposed surveys.

8.0 Minimization of Adverse Effects to Subsistence Uses

This section addresses NFMS' requirement to identify methods to minimize adverse effects of the proposed activity on subsistence uses.

There are no current subsistence hunting areas in the vicinity of the proposed Project Area and there are no activities related to the proposed surveys that may affect the availability of a species or stock of marine mammals for subsistence uses. Consequently, there are no available methods to minimize potentially adverse effects to subsistence uses.

9.0 Anticipated Impacts on Habitat

This section addresses NFMS' requirement to characterize the short- and long-term impacts of the proposed activity on marine mammals associated with the predicted loss or modification of habitat and to address available methods and likelihood of restoration of lost or modified habitat.

9.1 SHORT-TERM IMPACTS

The proposed activity has the potential to affect marine mammal habitat primarily through short-term impacts from increases in ambient noise levels from survey equipment that may result in masking of acoustic habitat. Auditory masking occurs when sound signals used by marine mammal overlap in time, space, and frequency with another sound source (Richardson et al., 1995). Masking can reduce communication space, limit the detection of relevant biological cues, and reduce echolocation effectiveness. A growing body of literature is focused on improving the framework for assessing the potential for masking of animal communication by anthropogenic noise and understand the resulting effects. More research is needed to understand the process of masking, the risk of masking by anthropogenic activities, the ecological significance of masking, and what anti-masking strategies are used by marine animals and their degree of effectiveness before masking can be incorporated into regulation strategies or mitigation approaches (Erbe et al., 2016).

The expected short-term impacts to the acoustic habitat are highly localized and transient during the survey; and therefore, have the potential to only temporarily affect marine mammals.

9.2 LONG-TERM IMPACTS

Due to the short duration of the potential activities and the minimal acoustic disturbance expected, no long-term, permanent impacts associated with loss or modification of habitat are anticipated.

10.0 Anticipated Effects of Habitat Impacts on Marine Mammals

This section addresses NFMS' requirement to characterize the short- and long-term impacts of the proposed activity on predicted habitat loss or modification. The predicted impacts to marine mammal habitat have been summarized in **Sections 10.1** and **10.2**.

10.1 SHORT-TERM IMPACTS

Marine mammals use sound to navigate, communicate, find open water, avoid predators, and find food. Acoustic acuity within the habitat must be available for species to conduct these ecological processes. If noise levels within critical frequency bands preclude animals from accessing the acoustic properties of that habitat, then availability and quality of that habitat has been diminished. The sounds that marine mammals hear and generate will vary in terms of dominant frequency, bandwidth, energy, temporal pattern, and directionality. The same variables in ambient noise will therefore determine a marine mammal's acoustic resource availability. In the case of marine mammals, anthropogenic noise can be viewed as a form of habitat fragmentation resulting in a loss of acoustic space that could otherwise be occupied by vocalizations or other acoustic cues (Rice et al., 2014). Primary acoustic habitat for a species will be focused within the vocal ranges for that species; therefore, habitat impact assessment should be conducted within those vocal ranges. The functional extent of the ensonified space around operations employing HRG sources will require an understanding of the distribution of SPLs by their spectral probability density and knowledge of received exposure levels with coordinated species densities. Therefore, marine mammals may experience some short-term loss of acoustic habitat, but the nature and duration of this loss is not expected to represent a significant loss of habitat.

Masking Effects

Masking of LFC communications is considered more likely due to the overlap of vessel noise and survey frequencies with lower-frequency signals produced by these species compared to other hearing groups. However, as the HRG source levels are typically higher in frequency than the predominate ship noise, effects of masking would be generated primarily by the vessel and not the HRG equipment.

A comprehensive review of the literature (Richardson et al., 1995; Erbe et al., 2019) revealed that most of the reported adverse effects of vessel noise and presence are changes in behavior, though the specific behavioral changes vary widely across species. Physical behavioral responses include changes to dive patterns (Finley et al., 1990), disruption to resting behavior (Mikkelsen et al., 2019), increases in swim velocities (Finley et al., 1990; Sprogis et al., 2020; Williams et al., 2022), and changes in respiration patterns (Hastie et al., 2003; Nowacek et al., 2007; Sprogis et al., 2020). These responses have, in certain cases, been correlated with numbers of vessels and their proximity, speed, and directional changes. Responses have been shown to vary by gender and by individual. The energetic consequences of any avoidance behavior or masking effects foraging are not expected affect any individual's ability to successfully obtain enough food to maintain their health or impact the ability of any individual to make seasonal migrations or participate in breeding or calving.

Reduction of Prey Availability

Reduction of prey availability could affect marine mammals if rising sound levels alter prey abundance, behavior, and/or distribution (McCauley et al., 2000; Popper and Hastings, 2009; Slabbekoorn et al., 2010). Prey species may show responses to noise; however, there are limited data on hearing mechanisms and potential effects of noise on common prey species (i.e., crustaceans, cephalopods, fish) that would result in loss of availability to marine mammals. These species have been increasingly researched as concern has grown related to noise impacts on the food web. Invertebrates appear to be able to detect sounds and particle motion (Budelmann, 1992; André et al., 2016; Solé et al., 2016, 2017) and are most sensitive to low-frequency sounds (Packard et al., 1990; Budelmann and Williamson, 1994; Lovell et al., 2005a,b; Mooney et al., 2010).

Squid and other cephalopods are an extremely important food chain component for many higher order marine predators. Cephalopods (i.e., octopus, squid) and decapods (i.e., lobsters, shrimps, crabs) are capable of sensing low-frequency sound. Packard et al. (1990) showed that three species of cephalopod were sensitive to particle motion, not sound pressure, with the lowest particle acceleration thresholds reported as 0.002 to 0.003 m s^{-2} at 1 to 2 Hz. Solé et al. (2017) showed that SPL ranging from 139 to 142 dB re 1 μPa at one-third octave bands centered at 315 Hz and 400 Hz may be suitable threshold values for trauma onset in cephalopods. Cephalopods have exhibited behavioral responses to low frequency sounds under 1,000 Hz, including inking, locomotor responses, body pattern changes, and changes in respiratory rates (Kaifu et al., 2008; Hu et al., 2009). In squid, Mooney et al. (2010) measured acceleration thresholds of -26 dB re 1 m s^{-2} between 100 and 300 Hz and an SPL threshold of 110 dB re 1 μPa at 200 Hz. Lovell et al. (2005b) found a similar sensitivity for prawn (*Palaemon serratus*), SPL of 106 dB re 1 μPa at 100 Hz, noting that this was the lowest frequency at which they tested and that the prawns might be more sensitive at frequencies below this. Hearing thresholds at higher frequencies have been reported, such as 134 and 139 dB re 1 μPa at 1,000 Hz for the oval squid (*Sepioteuthis lessoniana*) and the common octopus (*Octopus vulgaris*), respectively (Hu et al., 2009). McCauley et al. (2000) reported that caged squid exposed to seismic airguns showed behavioral responses such as inking. Wilson et al. (2007) exposed two groups of squid (*Loligo pealeii*) in a tank to killer whale echolocation clicks at SPL from 199 to 226 dB re 1 μPa, which resulted in no apparent behavioral effects or any acoustic debilitation. However, both the McCauley et al. (2000) and Wilson et al. (2007) experiments used caged squid, so it is unclear how unconfined animals would react. André et al. (2011) exposed four cephalopod species (European squid [*Loligo vulgaris*], cuttlefish [*Sepia officinalis*], octopus, and Southern shortfin squid [*Ilex coindetii*]) to 2 hours of continuous noise from 50 to 400 Hz at received SPL of 157 dB re 1 μPa ± 5 dB and reported lesions occurring on the statocyst's sensory hair cells of the exposed animals that increased in severity with time, suggesting that cephalopods are particularly sensitive to low-frequency sound. Similar to André et al. (2011), Solé et al. (2013) conducted a low-frequency (50 to 400 Hz) controlled exposure experiment on two deep-diving squid species (Southern shortfin squid and European squid), which resulted in lesions on the statocyst epithelia. Sóle et al. (2013) described their findings as "morphological and ultrastructural evidence of a massive acoustic trauma induced by…low-frequency sound exposure." In experiments conducted by Samson et al. (2014), cuttlefish exhibited escape responses (i.e., inking, jetting) when exposed to sound frequencies between 80 and 300 Hz with SPL above 140 dB re 1 μPa and particle acceleration of 0.01 m s^{-2}; the cuttlefish habituated to repeated 200 Hz sounds. The intensity of the cuttlefish response with the amplitude and frequency of the sound stimulus suggest that cuttlefish possess loudness perception with a maximum sensitivity of approximately 150 Hz (Samson et al., 2014).

Several species of aquatic decapod crustaceans are also known to produce sounds. Popper et al. (2001) concluded that many are able to detect substratum vibrations at sensitivities sufficient to tell the proximity of mates, competitors, or predators. Popper et al. (2001) reviewed behavioral, physiological, anatomical, and ecological aspects of sound and vibration detection by decapod crustaceans and noted that many decapods also have an array of hair-like receptors within and upon the body surface that potentially respond to water- or substrate-borne displacements as well as proprioceptive organs that could serve secondarily to perceive vibrations. However, the acoustic sensory system of decapod crustaceans remains poorly studied (Popper et al., 2001). Lovell et al. (2005a,b, 2006) reported potential auditory-evoked responses from prawns (*Palaemon serratus*) showing auditory sensitivity of sounds from 100 to 3,000 Hz, and Filiciotto et al. (2016) reported behavioral responses to vessel noise within this frequency range.

Marine fish are typically sensitive to the 100 to 500 Hz range, which is below most HRG sources. However, several studies have demonstrated that seismic airguns and impulsive sources might affect the behavior of at least some species of fish. For example, field studies by Engås et al. (1996) and Løkkeborg et al. (2012) showed that the catch rate of haddock (*Melanogrammus aeglefinus*) and Atlantic cod (*Gadus morhua*) significantly declined over the 5 days immediately following seismic surveys, after which the catch rate returned to normal. Other studies found only minor responses by fish to noise created during or following seismic surveys, such as a small decline in lesser sand eel (*Ammodytes marinus*) abundance that quickly returned to pre-seismic levels (Hassel et al., 2004) or no permanent changes in the behavior of marine reef fishes (Wardle et al., 2001). However, both Hassel et al. (2004) and Wardle et al. (2001) noted that when fish sensed the airgun firing, they performed a startle response and sometimes fled. Squid (*Sepioteuthis australis*) are an extremely important food chain component for many higher order marine predators, including sperm whales (*Physeter macrocephalus*). McCauley et al. (2000) recorded caged squid responding to airgun signals. Given the generally low sound levels produced by HRG sources in comparison to airgun sources, no short-term impacts to potential prey items (fishes, cephalopods, crustaceans) are expected from the proposed survey activities.

Minimal data are available for zooplankton responses to HRG sounds or other disturbance. A 2022 study (Guihen et al., 2022) found a noted avoidance of Antarctic krill species to the presence of an autonomous glider carrying a single-beam echosounder. However, these disturbances had small ranges (approximately 40 m) and did not show a large-scale movement in krill. It is expected that although reactionary behavior to acoustic disturbance by zooplankton is likely, the localized, temporary nature of the movement would not cause significant loss in the availability of the species to marine mammals.

10.2 LONG-TERM IMPACTS

Due to the short duration of the potential activities and the minimal disturbance expected, no long-term impacts to marine mammals associated with loss or modification habitat are anticipated.

11.0 Mitigation Measures

This section addresses NMFS' IHA requirement to assess the availability and feasibility (economic and technological), methods, and manner of conducting this survey activity that has the least practicable impact upon affected species or stock, its habitat, and its availability for subsistence uses, paying particular attention to rookeries, mating grounds, and areas of similar significance.

The Applicant has demonstrated a commitment to minimizing impacts to marine mammal species through a comprehensive and progressive mitigation and monitoring program, described here. The Applicant has committed to engaging in ongoing consultations with NMFS and following a comprehensive set of mitigation measures during site characterization surveys. These measures include the following components which are described in detail below:

- Vessel strike avoidance procedures;
- Establishment of pre-start clearance and shutdown zones;
- Visual monitoring, including low visibility monitoring tools;
- Area clearance;
- Ramp-up procedures;
- Operational shutdowns and delays;
- Communication of sightings between vessels; and
- Maintaining situational awareness across Project vessels and personnel.

The mitigation protocols have been designed to provide protection to marine mammals, both individuals and, by extension, species' stocks where designated, by minimizing exposure to potentially disruptive noise levels during site characterization activities. The mitigation measures will also reduce the likelihood of ship strikes to large whales in the area.

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

11.1 VESSEL STRIKE AVOIDANCE PROCEDURES

The Applicant will ensure that vessel operators and crew maintain a vigilant watch for cetaceans and pinnipeds, and change course, slow down, or switch the engines to neutral, as safely as applicable, to avoid striking these protected species. The Applicant will follow speed guidance and regulated approach requirements provided by NMFS (50 CFR § 224.103 and 224.105); and all requirements in amended proposed rule (87 FR 46921; 1 August 2022) should they go into effect by the time of the survey.

Survey vessel crew members responsible for navigation duties will receive site-specific training on marine mammal detection and identification, sighting/reporting, and vessel strike avoidance measures. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify that the crew members understand and will comply with the necessary requirements throughout the survey event.

Vessel strike avoidance measures will include, but are not limited to, the following except under extraordinary circumstances when complying with these requirements would put the safety of the vessel or crew at risk, or if the vessel is restricted in its ability to maneuver:

- All vessel operators will comply with 10 knot speed restrictions in any Seasonal Management Area (SMA) or visually triggered Dynamic Management Area (DMA) or slow zone where NARW are expected to occur;
- All vessel operators will reduce vessel speed to 10 knots or less when larger assemblages of non-delphinid cetaceans (particularly for ESA-listed species), mother/calf pairs, or pods are observed near an underway vessel;
- All vessels will maintain the following minimum separation distance between marine mammal:
    - 500 m for NARW;
    - 100 m for all other large whales (baleen whales and sperm whales); and
    - 50 m for dolphins, porpoises, and seals
- If underway, vessels must steer a course away from any sighted NARW at 10 knots or less until the 500-m minimum separation distance has been established. If a NARW is sighted in a vessel's path, the underway vessel must reduce speed and/or shift the engine to neutral. Engines will not be engaged until the NARW has moved outside of the vessel's path and beyond 500 m. If the whale is stationary, the vessel must not engage engines until the NARW has moved beyond 500 m;
- All vessels will maintain a separation distance of 100 m or greater from any sighted large whale (other than a NARW). If sighted within 100 m, the vessel underway must reduce speed and/or shift the engine to neutral and must not engage the engines until the non-delphinid cetacean has moved outside of the vessel's path and beyond 100 m. If a survey vessel is stationary, the vessel will not engage engines until the non-delphinid cetacean has moved out of the vessel's path and beyond 100 m; and
- All vessels will maintain a separation distance of 50 m or greater from any sighted dolphin, porpoise, or seal. Any vessel underway should remain parallel to the animal's course whenever possible and avoid excessive speed or abrupt changes in direction.

11.2 RIGHT WHALE OPERATING REQUIREMENTS

Members of the monitoring team will consult NMFS' NARW reporting system and Whale Alert, as able, for the presence of NARWs throughout survey operations, and for the establishment of a SMA, DMA, or slow zones. If NMFS should establish a DMA in the Lease Areas during the survey, the vessels will abide by speed restrictions in the DMA per the lease conditions.

11.3 CLEARANCE, SHUTDOWN, AND LEVEL B HARASSMENT ZONES

Three distinct zones are defined to better describe the monitoring activities and mitigation actions associated with the detection of marine mammals during the survey. Visual monitoring will be conducted around the sound source and the vessel at all times. All marine mammals seen during monitoring will be recorded regardless of the distance at which the animal is observed. The Applicant will employ the following zones and conditions during all site characterization survey activities using boomers, sparkers and CHIRP sources that operate below 180kHz.

Level B Zones for All Marine Mammals:

- 141 m around active sparker or boomer sound sources; and
- 48 m around active CHIRP sources operating below 180 kHz.

Pre-start Clearance Zones:

- 500 m for NARWs and all other ESA-listed whales;
- 100 m for non-ESA listed large whales; and
- 50 m for dolphins, seals, and porpoises.

Shutdown Zones:

- 500 m for NARWs;
- 100 m for all other whales;
- 50 m for all dolphins, seals, and porpoises; however, shutdown requirements will be waived for all dolphin, seal, and porpoise species for which take is authorized; and
- The shutdown zone may or may not encompass the Level B zone. A marine mammal's entry into the shutdown zone does not necessarily represent a take.

11.4 VISUAL MONITORING

Visual monitoring of the established zones and monitoring zone will be performed by the NMFS-approved PSOs (Protected Species Observers).

PSOs will be stationed on all survey vessels and will work in shifts such that observers obtain adequate rest periods between active watch periods. For all HRG survey activities, PSOs will work in shifts as stipulated above such that one PSO will be on watch during all daylight hours and two PSOs equipped with nighttime monitoring devices will be on watch during all hours of reduced visibility, including hours of darkness. One PSO on active watch at all times during daytime operations and two PSOs on active watch during nighttime operations will be sufficient to monitoring during the proposed survey activities. On a case-by-case basis, and upon approval from NMFS, changes in the PSO numbers, schedule, or 3rd party status may be adjusted during the Project. During PSO observations the following guidelines shall be followed:

- Other than brief alerts to bridge of personnel of maritime hazards and the collection of ancillary wildlife data, no additional duties may be assigned to the PSO during his/her visual observation watch.
- No PSO will be allowed more than four consecutive hours on watch before being allocated a break from visual watch.
- No PSO will be assigned a combined watch schedule of more than 12 hours in a 24-hour period.
- The PSOs will stand watch in a suitable location that will not interfere with the navigation or operation of the vessel and affords an optimal view of the sea surface.
- Position data will be recorded using hand-held or vessel GPS units for each sighting.
- The PSOs will be responsible for visually monitoring and identifying marine mammals approaching or entering the established zones during survey activities. It will be the responsibility of the Lead PSO on duty to communicate to the vessel operator the presence of marine mammals as well as to communicate and enforce the action(s) that are necessary to ensure mitigation and monitoring requirements are implemented as appropriate.
- PSOs will share sighting data between Project survey vessels, as able, in near real-time via computer, radio, phone, or other methods.
- Each PSO on watch will be equipped with reticle binoculars that have an internal compass in order to estimate range and bearing to detected marine mammals. Digital, single-lens reflex camera equipment will be used to record sightings and assist in subsequent verification of species identification.

11.4.1 Nighttime and Low Visibility Monitoring

To address surveying efforts during nighttime and periods of low visibility, the Applicant will provide an Alternative Monitoring Plan to BOEM. This plan will outline alternative monitoring methods such night vision equipment (night vision goggles with thermal clip-ons) and/or infrared/thermal imaging technology . Recent studies have concluded that the use of infrared/thermal imaging technology allows for the detection of marine mammals at night (Verfuss et al., 2018; Guazzo et al., 2019). Guazzo et al (2019) showed that the probability of detecting a large whale blow by a commercially available infrared camera was similar at night to during the day; camera monitoring distance was 2.1 km from an elevated vantage point at night versus 3 km for daylight visual monitoring from the same location. The maximum monitoring distance required for the proposed activities would be up to 500 m (Section 11.3). The Applicant presents that the use of thermal camera systems for mitigation purposes warrants additional application in the field as both a standalone tool and in conjunction with other alternative monitoring methods (e.g., night vision binoculars).

11.4.2 Data Recording

PSOs will record all sightings of marine mammals while monitoring during day or night. Data on all PSO observations will be recorded based on standard PSO collection requirements. This will include dates and locations of construction operations; time of observation, location and weather; details of the sightings (e.g., species, age classification [if known], numbers, behavior); and details of any observed behavioral disturbances or injury/mortality. Visual detections will be shared between vessels in near-real time, to the extent possible via computer, radio, phone, or other methods, thus increasing situational awareness.

11.5 PRE-START CLEARANCE OF THE EXCLUSION ZONE

The Applicant will implement a 30-minute clearance period of the pre-start clearance zones prior to the initiation of ramp-up (**Section 11.6**). After 30 minutes of monitoring, if any marine mammal has entered their respective clearance zone, ramp-up will not be initiated until the animal is confirmed outside the clearance zones or until the following time has elapsed since the last sighting of the animal in their respective clearance zone:

- 30 minutes for whales, including the NARW; and
- 15 minutes for dolphins, porpoises, and seals.

After the clearance period survey activities may commence, unless a marine mammal is detected within or entering the applicable shutdown zone. After the clearance period and once surveys have commenced, surveys can continue into darkness or inclement weather even if the shutdown zones, Level B Zones, and/or monitoring zone are not fully visible to PSOs.

11.6 RAMP-UP PROCEDURES

A ramp-up procedure will be used, to the extent practicable, at the beginning of HRG survey activities in order to provide additional protection to marine mammals near the survey by allowing them to vacate the area prior to the commencement of survey equipment use. Where technically feasible, a ramp-up procedure will be used for HRG survey equipment capable of adjusting energy levels at the start or restart of HRG survey activities. A ramp-up would begin with powering up of the HRG equipment that has the lowest source level output and starting it at its lowest practical power appropriate for the survey. The ramp-up will proceed by either adding equipment with higher source levels, increasing the power output of the operating equipment, or a combination of both.

The ramp-up procedure will not be initiated (i.e., equipment will not be started) during periods of inclement conditions when the marine mammal pre-start clearance zone cannot be adequately monitored by the PSOs for a 30-minute period using the appropriate visual technology. If any marine mammal enters the clearance zone, ramp-up will not be initiated until the animal is confirmed outside the marine mammal clearance zone, or until the appropriate time (30 minutes for whales, 15 minutes for dolphins, porpoises, and seals) has elapsed since the last sighting of the animal in the clearance zone.

11.7 Shutdown Procedures

An immediate shutdown of sparkers, boomers or CHIRP sources operating below 180 kHz will be required if a whale is sighted at or within the corresponding marine mammal shutdown zones. The shutdown requirement is waived for small delphinids (individual belonging to the following genera of the Family Delphinidae: *Steno, Delphinus, Lagenorhynchus, Stenella,* and *Tursiops*) and pinnipeds. If a small delphinid or pinniped is visually detected within the shutdown zone, no shutdown is required unless the PSO confirms the individual to be of a genus other than those listed, in which case a shutdown is required.There is no shutdown requirement for any fauna group for categorical sources not listed in **Table 4** (i.e., parametric SBPs [Innomars], acoustic corers, USBL, MBES, SSS) which were scanned out as discussed in **Section 1.3**.

The vessel operator must comply immediately with any call for shutdown by the Lead PSO. Any disagreement between the Lead PSO and vessel operator should be discussed only after shutdown has occurred. Subsequent restart of the survey equipment can be initiated if the animal has been observed exiting its respective shutdown zones or has not been re-sighted within their respective shutdown zone for the appropriate time period (30 minutes for whales). If a marine mammal enters the respective clearance or shutdown zone during a shutdown period, the equipment may not restart until that animal is confirmed outside the clearance zone as stated previously in the pre-start clearance procedures (**Section 11.5**), or until the appropriate time listed below has elapsed since the last sighting of the animal within the zone.

11.8 SURVEY COMMUNICATION AND COORDINATION FOR SIGHTINGS

The Applicant will utilize radios and available software to communicate sightings between all vessels. This will allow all PSOs and vessel crew to maintain awareness of marine mammal observations and adjust activities accordingly. The Applicant will also utilize the Whale Alert application to report all NARW detections and monitor for SMAs, DMAs, and slow zones. Whale Alert will be checked at least once every 4 hours by the PSOs on the vessel while underway.

12.0 Arctic Plan of Cooperation

This requirement is applicable only for activities that occur in Alaskan waters north of 60° N latitude. The proposed survey activities will not take place within the designated region and, therefore, will not have an adverse effect on the availability of marine mammals for subsistence uses. As such, there is no need to form such a plan.

13.0 Monitoring and Reporting

As required in the conditions of Lease OCS-A0500 , the Applicant will comply with the marine mammal reporting requirements for site characterization activities detailed below.

Reporting Injured or Dead Species. The Applicant will ensure that sightings of any injured or dead marine mammals are reported to the Greater Atlantic (Northeast) Region Marine Mammal and Sea Turtle Stranding & Entanglement Hotline (866-755-NOAA [6622]) within 24 hours of a sighting, regardless of whether the injury or death is caused by a vessel. In addition, if the injury or death was caused by a collision with a Project-related vessel, the Applicant will ensure that BOEM is notified of the strike within 24 hours. The notification of such a strike will include the date and location (latitude/longitude) of the strike, the name of the vessel involved, and the species identification or a description of the animal, if possible. If the Project activity is responsible for the injury or death, the Applicant will supply a vessel to assist in any salvage effort as requested by NMFS.

Reporting of Observed Impacts to Species. The observers will report any observations concerning impacts on marine mammals to BOEM and NMFS within 48 hours. Any observed takes of listed marine mammals resulting in injury or mortality must be reported within 24 hours to BOEM and NMFS.

Final Report. The Applicant will provide BOEM and NMFS with a report within 90 calendar days following the completion of survey activities, including a summary of the survey activities and an estimate of the number of marine mammals taken during these survey activities. Data on all marine mammal observations will be recorded and based on standards of observer collection data by the PSOs. This information will include dates, times, and locations of survey operations; time of observation, location, and weather; details of marine mammal sightings (e.g., species, numbers, behavior); and details of any observed taking (e.g., behavioral disturbances, injury/mortality).

14.0 Suggested Means of Coordinated Research

This section addresses the IHA requirement to suggest means of learning, encouraging, and coordinating research opportunities, plans, and activities related to reducing incidental take and evaluating its effects.

While no direct research on marine mammals or marine mammal stocks is expected from the Project, there is the opportunity for the proposed activity to contribute greatly to the noise characterization in the region and to specific sound source measurements.

Data acquired during the mitigation and monitoring may provide valuable information to direct or refine future research on marine mammal species present in the area. Sightings data (e.g., date, time, weather conditions, species identification, approximate sighting distance, direction, heading in relation to sound sources, behavioral observations) may be useful in designing the location and scope of future marine mammal survey and monitoring programs.

The Applicant will immediately share all NARW sightings with NOAA.

All marine mammal data collected by the Applicant during marine characterization survey activities will be provided to NMFS and BOEM through the reporting processes. In addition, the data may be made available to educational institutions and environmental groups upon request.

15.0 List of Preparers

CSA Ocean Sciences Inc.

- Mary Jo Barkaszi: Marine Mammal Programs Manager
- Kayla Hartigan: Project Scientist
- Rebeca Orue: Project Scientist

Bay State Wind LLC

- Sharon Whitesell, Senior Biologist, Biological Science Group (BSG), Region Americas
- Jessica Davis: Permit Manager, Offshore Surveys, Technical & Social Sciences Group (TSG), Region Americas

50 CFR § 224.103. 1999. Special prohibitions for endangered marine mammals.

50 CFR § 224.105. 1999. Speed restrictions to protect North Atlantic Right Whales.

59 *Federal Register* (FR) 28805. 1994. Designated Critical Habitat; Northern Atlantic Right Whale. June 3, 1994.

62 *Federal Register* (FR) 39157. 1997. Taking of Marine Mammals Incidental to Commercial Fishing Operations; Atlantic Large Whale Take Reduction Plan Regulations. July 22, 1997.

66 *Federal Register* (FR) 53195. 2001. Threatened Fish and Wildlife; Status Review of the Gulf of Maine/Bay of Fundy Population of Harbor Porpoise Under the Endangered Species Act (ESA). October 19, 2001.

69 *Federal Register* (FR) 69536. 2004. Regulations Governing the Approach to North Atlantic Right Whales. November 30, 2004.

73 *Federal Register* (FR) 60173. 2008. Endangered Fish and Wildlife; Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales. October 10, 2008.

75 *Federal Register* (FR) 61690. 2010. Endangered and Threatened Wildlife and Designating Critical Habitat for the Endangered North Atlantic Right Whale. October 6, 2010.

75 *Federal Register* (FR) 7383. 2010. Taking of Marine Mammals Incidental to Commercial Fishing Operations; Harbor Porpoise Take Reduction Plan Regulations. February 19, 2010.

78 *Federal Register* (FR) 73726. 2013. Endangered Fish and Wildlife; Final Rule to Remove the Sunset Provision of the Final Rule Implementing Vessel Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales. December 9, 2013.

81 *Federal Register* (FR) 4838. 2016. Endangered and Threatened Species; Critical Habitat for Endangered North Atlantic Right Whale. January 27, 2016.

81 *Federal Register* (FR) 62259. 2016. Endangered and threatened species; Identification of 14 distinct population segments of the humpback whale (*Megaptera novaengliae*) and revision of species-wide listing. September 8, 2016.

86 *Federal Register* (FR) 5322. 2021. Taking and Importing Marine Mammals; Taking Marine Mammals Incidental to Geophysical Surveys Related to Oil and Gas Activities in the Gulf of Mexico. 19 January 2021.

87 *Federal Register* (FR) 46921. 2022. Amendments to the North Atlantic Right Whale Vessel Strike Reduction Rule. 1 August 2022.

88 *Federal Register* (FR) 69159. 202. Takes of Marine Mammals Incidental to Specified Activities; Taking Marine Mammals Incidental to Marine Site Characterization Surveys in the Area of Commercial Lease of Submerged Lands for Renewable Energy Development on the Outer Continental Shelf Lease Areas OCS-A 0486, 0487, and 0500. 05 October 2023

Ainslie MA, Miksis-Olds JL, Martin B, Heaney K, de Jong CAF, von Benda-Beckmann AM, Lyons AP. 2018. ADEON Underwater Soundscape and Modeling Metadata Standard. Version 1.0. Technical report by JASCO Applied Sciences for ADEON Prime Contract No. M16PC00003.

André M, Kaifu K, Solé M, van der Schaar M, Akamatsu T, Balastegui A, Sánchez AM, Castell JV. 2016. Contribution to the understanding of particle motion perception in marine invertebrates. In: AN Popper, A Hawkins (Eds.), The Effects of Noise on Aquatic Life II. New York, NY: Springer New York. pp. 47-55.

Baird RW, Stacey PJ. 1991. Status of the Risso's dolphin, *Grampus griseus*, in Canada. Canadian Field-Naturalist 105:233-242.

Baker K, Howson U. 2021. Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf. Biological Assessment. U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs. October 2018, Revised February 2021. 152 pp.

Barlas ME. 1999. The distribution and abundance of harbor seals, *Phoca vitulina concolor*, and gray seals, *Halichoerus grypus*, in southern New England, winter 1998 - summer 1999. Ph.D. dissertation, Boston University, Graduate School of Arts and Sciences, Boston, MA. pp.

Baumgartner MF, Van Parijs SM, Wenzel FW, Tremblay CJ, Esch HC, Warde AM. 2008. Low frequency vocalizations attributed to sei whales (*Balaenoptera borealis*). Journal of the Acoustical Society of America 124(2):1339-1349.

Bay State Wind. 2019. Bay State Wind Offshore Wind Farm Combined PSO Reports – 2018/2019 Geophysical Survey Plan July 19, 2019. 29 pp.

Best BD, Halpin PN, Read AJ, Fujioka E, Good CP, Labrecque EA, Schick RS, Roberts JJ, Hazen LJ, Qian SS, Palka DL, Garrison LP, McLellan WA. 2012. Online Cetacean Habitat Modeling System for the U.S. East Coast and Gulf of Mexico. Endangered Species Research 18:1-15.

Bettridge S, Baker CS, Barlow J, Clapham PJ, Ford M, Gouveia D, Mattila DK, Pace III RM, Rosel PE, Silber GK, Wade PR. 2015. Status Review of the Humpback Whale (*Megaptera novaeangliae*) Under the Endangered Species Act. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS Southwest Fisheries Science Center-540. 263 pp.

Brown MW, Hamilton PK, Kenney RD, Knowlton AR, Marx MK, Mayo CA, Slay CK, Kraus SD, Brault S. 2001. Sighting heterogeneity of right whales in the western North Atlantic: 1980-1992. Journal of Cetacean Research and Management (Special Issue) 2:245-250.

Budelmann, BU, Williamson R. 1994. Directional sensitivity of hair cell afferents in the Octopus statocyst. The Journal of Experimental Biology 187(1):245.

Budelmann, BU. 1992. Hearing in Nonarthropod Invertebrates. In: DB Webster, AN Popper, RR Fay (Eds.), The Evolutionary Biology of Hearing. New York, NY: Springer New York. pp. 141-155.

Bureau of Ocean Energy Management (BOEM). 2012. Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia. Final Environmental Assessment. U.S. Department of the Interior, BOEM Office of Renewable Energy Programs. OCS EIS/EA BOEM 2012-003. 366 pp.

Bureau of Ocean Energy Management (BOEM). 2017. Gulf of Mexico OCS Proposed Geological and Geophysical Activities. Final Programmatic Environmental Impact Statement. Prepared by CSA Ocean Sciences Inc. for U.S. Department of the Interior, BOEM Gulf of Mexico OCS Region. OCS EIS/EIA BOEM 2017-051. 792 pp.

Bureau of Ocean Energy Management (BOEM). 2021. Project Design Criteria and Best Management Practices for Protected Species Associated with Offshore Wind Data Collection. https://www.boem.gov/pdcs-and-bmps-atlantic-data-collection-11222021 Accessed 22 November 2021.

Cetacean and Turtle Assessment Program (CETAP). 1982. A Characterization of Marine Mammals and Turtles in the Mid- and North-Atlantic Areas of the U.S. Outer Continental Shelf. Kingston, Rhode Island: University of Rhode Island, Sponsored by the U.S. Department of the Interior, Bureau of Land Management. Contract #AA552-CT8-48. 576 pp.

Charif RA, Mellinger DK, Dunsmore KJ, Fristrup KM, Clark CW. 2002. Estimated source levels of fin whale (*Balaenoptera physalus*) vocalizations: Adjustments for surface interference. Marine Mammal Science 18(1):81-98.

Clark CW, Clapham PJ. 2004. Acoustic monitoring on a humpback whale (*Megaptera novaeangliae*) feeding ground shows continual singing into late spring. Proceedings of the Royal Society B: Biological Sciences 271:1051-1057.

Clark CW, Ellison WT, Southall BL, Hatch L, Van Parijs SM, Frankel AS, Ponirakis D. 2009. Acoustic masking in marine ecosystems: Intuitions, analysis, and implication. Marine Ecology Progress Series 395:201-222.

Cole TVN, Hamilton P, Henry AG, Duley P, Pace III RM, White BN, Frasier T. 2013. Evidence of a North Atlantic right whale *Eubalaena glacialis* mating ground. Endangered Species Research 21(1):55-64.

Committee on Taxonomy. 2023. List of marine mammal species and subspecies. Society for Marine Mammalogy. Internet website: https://www.marinemammalscience.org/species-information/list-marine-mammal-species-subspecies/. Accessed 12 June 2024.

Craddock JE, Polloni PT, Hayward B, Wenzel FW. 2009. Food habits of Atlantic white-sided dolphins (*Lagenorhynchus acutus*). Fishery Bulletin 107:384-394.

Crocker SE, Fratantonio FD. 2016. Characteristics of Sounds Emitted During High-Resolution Marine Geophysical Surveys. Naval Undersea Warfare Center Division, Newport, RI. For U.S. Department of the Interior, Bureau of Ocean Energy Management, Environmental Assessment Division and U.S. Geological Survey. OCS Study BOEM 2016-044. NUWC-NPT Technical Report 12,203, 24 March 2016. 266 pp.

Cunha HA, de Castra ER, Secchi ER, Crespo EA, Lailson-Brito J, Azevedo AF, Lazoski C, Solé-Cava AM. 2015. Correction: molecular and morphological differentiation of common dolphins (Delphinus sp.) in the southwestern Atlantic: testing the two species hypothesis in sympatry. PLOS ONE 10(11):e0140251.

Curry BE, Smith J. 1997. Phylogeographic structure of the bottlenose dolphin (*Tursiops truncatus*): Stock identification and implications for management. Molecular Genetics of Marine Mammals Special Publication 3:327-347.

deHart, PAP. 2002. The Distribution and Abundance of Harbor Seals (*Phoca vitulina concolor*) in the Woods Hole region. Ph.D. dissertation, Boston University.

Department of the Navy (DoN). 2008. Request for Letter of Authorization for the incidental harassment of marine mammals resulting from Navy training activities conducted within the northwest training range complex. Prepared by Commander, U.S. Pacific Fleet for U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service Office of Protected Resources. September 2008. 322 pp.

Engås A, Løkkeborg S, Ona E, Soldal AV. 1996. Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*). Canadian Journal of Fisheries and Aquatic Sciences 53(10):2238-2249.

EPI Group. 2021. Protected Species Observation Report Massachusetts Survey/Vineyard Wind LLC EPI Report No. 10282 – Ventus, Striker, Odyssey. Prepared for Vineyard Wind LLC. 306 pp.

Erbe C, Reichmuth C, Cunningham K, Lucke K, Dooling R. 2016. Communication masking in marine mammals: A review and research strategy. Marine Pollution Bulletin 103(1-2):15-38.

Erbe, C, Marley SA, Schoeman RP, Smith JN, Trigg LE, Embling CB. 2019. The effects of ship noise on marine mammals - a review. Frontiers in Marine Science 6(606):1-21.

Filiciotto, F, Vazzana M, Celi M, Maccarrone V, Ceraulo M, Buffa G, Arizza V, de Vincenzi G, Grammauta R, Mazzola S, Buscaino G. 2016. Underwater noise from boats: Measurement of its influence on the behaviour and biochemistry of the common prawn (*Palaemon serratus*, Pennant 1777). Journal of Experimental Marine Biology and Ecology 478:24-33.

Finley, KJ, Miller GW, Davis RA, Greene CR. 1990. Reactions of belugas, *Delphinapterus leucas*, and narwhals, *Monodon monoceros*, to ice-breaking ships in the Canadian high arctic. Canadian Bulletin of Fisheries and Aquatic Sciences 224:97-117.

Finneran JJ. 2016. Auditory Weighting Functions and TTS/PTS Exposure Functions for Marine Mammals Exposed to Underwater Noise. Marine Mammal Scientific and Vet Support Branch of the Biosciences Division, Space and Naval Warfare Systems Center, San Diego, CA. Technical Report 3026. 134 pp.

Gilbert JR, Waring GT, Wynne KM, Guldager N. 2005. Changes in abundance and distribution of harbor seals in Maine, 1981-2001. Marine Mammal Science 21:519-535.

Glass AH, Cole TVN, Geron M. 2009. Mortality and Serious Injury Determinations for Baleen Whale Stocks along the United States Eastern Seaboard and Adjacent Canadian Maritimes, 2003–2007. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Northeast Fisheries Science Center. Document 09-04. 18 pp.

Guazzo RA, Weller DW, Europe HM, Durban JW, D'Spain GL, Hildebrand JA. 2019. Migrating eastern North Pacific gray whale call and blow rates estimated from acoustic recordings, infrared camera video, and visual sightings. Scientific Reports 9(1): 12617.

Guihen, D, Brearley JA, Fielding S. 2022. Antarctic krill likely avoid underwater gliders. Deep Sea Research Part I: Oceanographic Research Papers 179:103680.

Hamazaki T. 2002. Spatiotemporal prediction models of cetacean habitats in the mid-western North Atlantic Ocean (from Cape Hatteras, North Carolina, U.S.A. to Nova Scotia, Canada). Marine Mammal Science 18:920-939.

Hassel A, Knutsen T, Dalen J, Skaar K, Løkkeborg S, Misund OA, Østensen Ø, Fonn M, Haugland EK. 2004. Influence of seismic shooting on the lesser sandeel (*Ammodytes marinus*). ICES Journal of Marine Science 61(7):1165-1173.

Hastie GD, Wilson B, Tufft LH, Thompson PM. 2003. Bottlenose dolphins increase breathing synchrony in response to boat traffic. Marine Mammal Science 19(1):74-84.

Hayes SA, Josephson E, Maze-Foley K, Rosel PE (Eds). 2019. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2018. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. NOAA Technical Memorandum NMFS-NE-258. 306 pp.

Hayes SA, Josephson E, Maze-Foley K, Rosel PE, Byrd B, Chavez-Rosales S, Cole TVN, Garrison LP, Hatch J, Henry A, Horstman SC, Litz J, Lyssikatos MC, Mullin KD, Orphanides C, Pace RM, Palka DL, Powell J, Wenzel FW. 2020. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2019 U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. NOAA Technical Memorandum NMFS-NE-264, July 2020. 479 pp.

Hayes SA, Josephson E, Maze-Foley K, Rosel PE, Turek J. 2021. US Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2020. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts. NOAA Technical Memorandum NMFS-NE-271. 403 pp.

Hayes, SA, Josephson E, Maze-Foley K, Rosel PE, McCordic J, Wallace JE. 2023. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports 2022. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-NE-288. 262 pp.

Hayes, SA, Josephson E, Maze-Foley K, Rosel PE, Wallace JE. 2022. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports 2021. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Memorandum NMFS-NE-304. 380 pp.

Hersh SL, Duffield DA. 1989. Distinction between northwest Atlantic offshore and coastal bottlenose dolphins based on hemoglobin profile and morphometry. In: S Leatherwood, RR Reeves (Eds.), The Bottlenose Dolphin. San Diego, CA: Academic Press. pp. 129-140.

Hu MY, Yan HY, Chung W-S, Shiao J-C, Hwang P-P. 2009. Acoustically evoked potentials in two cephalopods inferred using the auditory brainstem response (ABR) approach. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 153(3):278-283.

International Organization for Standardization (ISO). 2017. ISO 18405 Underwater Acoustics – Terminology. International Organization for Standardization, Geneva, Switzerland. 62 pp.

Jefferson TA, Webber MA, Pitman RL. 2008. Marine Mammals of the World: A Comprehensive Guide to their Identification. London, UK: Elsevier. 573 pp.

Jefferson TA, Webber MA, Pitman RL. 2011. Marine Mammals of the World: A Comprehensive Guide to their Identification. London, UK: Elsevier. 576 pp.

Johnson H, Morrison D, Taggart C. 2021. WhaleMap: a tool to collate and display whale survey results in near real-time. Journal of Open-Source Software 6(62):3094.

Kaifu K, Akamatsu T, Segawa S. (2008). Underwater sound detection by cephalopod statocyst. Fisheries Science 74:781-786.

Kastelein RA, Wensveen PJ, Hoek L, Verboom WC, Terhune JM. 2009. Underwater detection of tonal signals between 0.125 and 100 kHz by harbor seals (*Phoca vitulina*). Journal of the Acoustical Society of America 125(2):1222-1229.

Katona SK, Rough V, Richardson DT. 1993. A Field Guide to Whales, Porpoises, and Seals from Cape Cod to Newfoundland. Washington, DC: Smithsonian Institution Press. 336 pp.

Kenney RD, Payne PM, Heinemann DW, Winn HE. 1996. Shifts in Northeast Shelf cetacean distributions relative to trends in Gulf of Maine/Georges Bank finfish abundance. In: K Sherman, NA Jaworski, TJ Smayda (Eds.), The Northeast Shelf Ecosystem: Assessment, Sustainability, and Management. Cambridge, MA: Blackwell Science, Inc. pp. 169-196.

Kenney RD, Vigness-Raposa KJ. 2010. Marine Mammals and Sea Turtles of Narragansett Bay, Block Island Sound, Rhode Island Sound, and Nearby Waters: An Analysis of Existing Data for the Rhode Island Ocean Special Area Management Plan. University of Rhode Island. Ocean Special Area Management Plan Technical Report #10. 337 pp.

Kenney RD. 1990. Bottlenose dolphins off the Northeastern United States. In: S Leatherwood, RR Reeves (Eds.), The Bottlenose Dolphin. San Diego, CA: Academic Press. pp. 369-386.

Kraus SD, Leiter S, Stone K, Wikgren B, Mayo C, Hughes P, Kenney RD, Clark CW, Rice AN, Estabrook B, Tielens J. 2016. Northeast Large Pelagic Survey Collaborative Aerial and Acoustic Surveys for Large Whales and Sea Turtles. Sterling, Virginia: U.S. Department of the Interior, Bureau of Ocean Energy Management. OCS Study BOEM 2016-054. 117 pp.

Leatherwood S, Caldwell DK, Winn HE, Schevill WE, Caldwell MC. 1976. Whales, Dolphins, and Porpoises of the Western North Atlantic: a Guide to their Identification. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. NOAA Technical Report NMFS Circular 396. 183 pp.

Leiter SM., Stone KM, Thompson JL, Accardo CM, Wikgren BC, Zani MA, Cole TVN, Kenney RD, Mayo CA, Kraus SD. 2017. North Atlantic right whale *Eubalaena glacialis* occurrence in offshore wind energy areas near Massachusetts and Rhode Island, USA. Endangered Species Research 34:45–59

Løkkeborg S, Ona E, Vold A, Salthaug A. 2012. Sounds from seismic air guns: gear- and species-specific effects on catch rates and fish distribution. Canadian Journal of Fisheries and Aquatic Sciences 69(8):1278-1291.

Lovell, JM, Findlay MM, Moate RM, Nedwell JR, Pegg MA. 2005a. The inner ear morphology and hearing abilities of the Paddlefish (*Polyodon spathula*) and the Lake Sturgeon (*Acipenser fulvescens*). Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 142(3):286-296.

Lovell, JM, Findlay MM, Moate RM, Yan HY. 2005b. The hearing abilities of the prawn *Palaemon serratus*. Comparative Biochemistry and Physiology Part A: Molecular & Integrative Physiology 140(1):89-100.

Lovell, JM, Moate RM, Christiansen L, Findlay MM. 2006. The relationship between body size and evoked potentials from the statocysts of the prawn *Palaemon serratus*. Journal of Experimental Biology 209(13):2480.

Matthews LP, McCordic JA, Parks SE. 2014. Remote acoustic monitoring of North Atlantic right whales (*Eubalaena glacialis*) reveals seasonal and diel variations in acoustic behavior. PLOS ONE 9(3):e91367.

McCauley RD, Fewtrell J, Duncan AJ, Jenner C, Jenner MN, Penrose JD, Prince RIT, Adhitya A, Murdoch J, McCabe K. 2000. Marine seismic surveys—a study of environmental implications. APPEA Journal 40(1):692-708.

McDonald MA, Hildebrand JA, Wiggins SM, Thiele D, Glasgow D, Moore SE. 2005. Sei whale sounds recorded in the Antarctic. Journal of the Acoustical Society of America 188(6):3941-3945.

Mead JG, Potter CW. 1995. Recognizing two populations of the bottlenose dolphin (*Tursiops truncatus*) of the Atlantic coast of North America-morphologic and ecologic considerations. IBI Reports 5:31-44.

Mikkelsen,L, Johnson M, Wisniewska DM, van Neer A, Siebert U, Madsen PT, Teilmann J. 2019. Long-term sound and movement recording tags to study natural behavior and reaction to ship noise of seals. Ecology and Evolution 9(5):2588-2601.

Mooney TA, Hanlon RT, Christensen-Dalsgaard J, Madsen PT, Ketten DR, Nachtigall PE. 2010. Sound detection by the longfin squid (*Loligo pealeii*) studied with auditory evoked potentials: sensitivity to low-frequency particle motion and not pressure. The Journal of Experimental Biology 213(21):3748.

Muir DCG, Wagemann R, Grift NP, Nortstrom RJ, Simon MA, Lien J. 1988. Organochlorine chemical and heavy metal contaminants in white-beaked dolphins (*Lagenorhynchus albirostris*) and pilot whales (*Globicephala melaena*) from the coast of Newfoundland, Canada. Archives of Environmental Contamination and Toxicology 17(5):613-629.

National Marine Fisheries Service (NMFS). 2010. Recovery plan for the fin whale (*Balaenoptera physalus*). U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. Silver Spring, MD. 121 pp.

National Marine Fisheries Service (NMFS). 2018a. 2018 Revisions to: Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Department of Commerce, National Oceanic and Atmospheric Administration. NOAA Technical Memorandum NMFS-OPR-59. 167 pp.

National Marine Fisheries Service (NMFS). 2018b. Manual for Optional User Spreadsheet Tool (Version 2.0) for: 2018 Technical Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing (Version 2.0): Underwater Thresholds for Onset of Permanent and Temporary Threshold Shifts. Silver Spring, MD: U.S. Department of Commerce, National Oceanic and Atmospheric Administration. Silver Spring, MD. 109 pp.

National Marine Fisheries Service (NMFS). 2019a. Interim Recommendations For Sound Source Level And Propagation Analysis For High Resolution Geophysical Sources. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. 19 September 2019. 3 pp.

National Marine Fisheries Service (NMFS). 2019b. Fin Whale (*Balaenoptera physalus*) 5-Year Review: Summary and Evaluation. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. February 2019. 40 pp.

National Marine Fisheries Service (NMFS). 2020a. Recommendation for Sound Source Level and Propagation Analysis for HRG Sources. https://www.fisheries.noaa.gov/s3/2023-05/RecommendationsforSoundHRGSourceandTLAnalysis-Final-508V4-OPR1.pdf. Accessed 28 February 2024.

National Marine Fisheries Service (NMFS). 2020b. Endangered Species Act. https://www.fisheries.noaa.gov/national/endangered-species-conservation/endangered-species-act#section-3.-definitions. Accessed 11 April 2023.

National Marine Fisheries Service (NMFS). 2021. MATLAB code to calculate the ensonified distance from sonar. Code received with permission for use 6 July 2021.

National Marine Fisheries Service (NMFS). 2022a. North Atlantic Right Whale (*Eubalaena glacialis*) 5-Year Review: Summary and Evaluation. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Office of Protected Resources. November 2022. 55 pp.

National Marine Fisheries Service (NMFS). 2022b. Minke Whale Species Overview. https://www.fisheries.noaa.gov/species/minke-whale. Accessed 11 April 2023.

National Marine Fisheries Service (NMFS). 2022c. 2018–2020 Pinniped Unusual Mortality Event Along the Northeast Coast https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/2018-2020-pinniped-unusual-mortality-event-along. Accessed 4 April 2023.

National Marine Fisheries Service (NMFS). 2023. Summary of Marine Mammal Protection Act Acoustic Thresholds. https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance. Accessed 25 February 2024.

National Marine Fisheries Service (NMFS). 2024a. Associated Level B Harassment Isopleth Calculator. https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance. Accessed 28 February 2024.

National Marine Fisheries Service (NMFS). 2024b. Draft U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment Reports 2023. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service. January 2024. https://www.fisheries.noaa.gov/s3/2024-01/Draft-2023-MMSARs-Public-Comment.pdf. Accessed 25 February 2024.

National Marine Fisheries Service (NMFS). 2024c. 2017-2024 North Atlantic Right Whale Unusual Mortality Event. https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2023-north-atlantic-right-whale-unusual-mortality-event. Accessed 25 February 2024.

National Marine Fisheries Service (NMFS). 2024d. Reducing Ship Strikes to North Atlantic Right Whales. https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-ship-strikes-north-atlantic-right-whales. Accessed 4 April 2024.

National Marine Fisheries Service (NMFS). 2024e. 2016-2023 Humpback whale unusual mortality event along the Atlantic coast. https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2019-humpback-whale-unusual-mortality-event-along-atlantic-coast. Accessed 11 April 2024.

National Marine Fisheries Service (NMFS). 2024f. 2017–2023 Minke Whale Unusual Mortality Event along the Atlantic Coast. https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2019-minke-whale-unusual-mortality-event-along-atlantic-coast. Accessed 11 April 2024.

National Marine Fisheries Service (NMFS). 2024g. 2022 Pinniped Unusual Mortality Event along the Maine Coast. https://www.fisheries.noaa.gov/marine-life-distress/2022-2023-pinniped-unusual-mortality-event-along-maine-coast. Accessed 25 February 2024.

National Marine Fisheries Service (NMFS). 2024h. Incidental Take Authorizations for Other Energy Activities (Renewable/LNG). https://www.fisheries.noaa.gov/national/marine-mammal-protection/incidental-take-authorizations-other-energy-activities-renewable#active-authorizations. Accessed 29 May 2024.

National Oceanographic and Atmospheric Administration (NOAA). 2024. NOAA Right Whale Sighting Advisory System Interactive Mapper. https://www.nefsc.noaa.gov/psb/surveys/MapperiframeWithText.html. Accessed 25 February 2024.

National Research Council. 2005. Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects. Committee on Characterizing Biologically Significant Marine Mammal Behavior. Washington, D.C.: The National Academies Press. 142 pp.

Nowacek DP, Thorne LH, Johnston DW, Tyack PL. 2007. Responses of cetaceans to anthropogenic noise. Mammal Review 37(2):81-115.

O'Brien O, McKenna K, Hodge B, Pendleton D, Baumgartner M, Redfern J. 2021a. Megafauna aerial surveys in the wind energy areas of Massachusetts and Rhode Island with emphasis on large whales: Summary Report Campaign 5, 2018-2019. US Department of the Interior, Bureau of Ocean Energy Management, Sterling (VA). OCS Study BOEM 2021-033.

O'Brien O, McKenna K, Pendleton D, Redfern J. 2021b. Megafauna aerial surveys in the wind energy areas of Massachusetts and Rhode Island with emphasis on large whales: Interim Report Campaign 6A, 2020. US Department of the Interior, Bureau of Ocean Energy Management, Sterling (VA). OCS Study BOEM 2021-054.

O'Brien O, McKenna K, Pendleton D, Redfern J. 2022a. Megafauna aerial surveys in the wind energy areas of Massachusetts and Rhode Island with emphasis on large whales: Final Report Campaign 6B, 2020-2021. Massachusetts Clean Energy Center, Boston (MA). 40 pp.

O'Brien OO, Pendleton DE, Ganley LC, McKenna KR, Kenney RD, Quintana-Rizzo E, Mayo CA, Kraus SD, Redfern JV. 2022b. Repatriation of a historical North Atlantic right whale habitat during an era of rapid climate change. Scientific Reports 12: 12407.

Pace RM. 2021. Revisions and further evaluations of the right whale abundance model: improvements for hypothesis testing. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. NEFSC. NOAA Technical Memorandum NMFS-NE-269. April 2021. 54 pp.

Packard A, Karlsen HE, Sand O. 1990. Low frequency hearing in cephalopods. Journal of Comparative Physiology A 166(4):501-505.

Palka D. 2012. Cetacean Abundance Estimates in US Northwestern Atlantic Ocean Waters from Summer 2011 Line Transect Survey. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. NEFSC Reference Document 12-29. 43 pp.

Palka DL, Chavez-Rosales S, Josephson E, Cholewiak D, Haas HL, Garrison L, Jones M, Sigourney D, Waring G, Jech M, Broughton E, Soldevilla M, Davis G, DeAngelis A, Sasso CR, Winton MV, Smolowitz RJ, Fay G, LaBrecque E, Leiness JB, Dettloff, Warden M, Murray K, Orphanides C. 2017. Atlantic Marine Assessment Program for Protected Species: 2010-2014. Washington, DC: U.S. Department of the Interior, Bureau of Ocean Energy Management, Atlantic OCS Region. OCS Study BOEM 2017-071. 211 pp.

Palka D, L. Aichinger Dias, E. Broughton, S. Chavez-Rosales, D. Cholewiak, G. Davis, A. DeAngelis, L. Garrison, H. Haas, J. Hatch, K. Hyde, M. Jech, E. Josephson, L. MuellerBrennan, C. Orphanides, N. Pegg, C. Sasso, D. Sigourney, M. Soldevilla, and H. Walsh. 2021. Atlantic Marine Assessment Program for Protected Species: FY15 – FY19. Washington DC: US.

Pangeo Subsea. 2022. Sub-bottom Imager™. https://www.pangeosubsea.com/sub-bottom-imager/. Accessed 12 June 2024.

Parks SE, Hamilton PK, Kraus SD, Tyack PL. 2005. The gunshot sound produced by male North Atlantic right whales (*Eubalaena glacialis*) and its potential function in reproductive advertisement. Marine Mammal Science 21(3):458-475.

Parks SE, Tyack PL. 2005. Sound production by North Atlantic right whales (*Eubalaena glacialis*) in surface active groups. Journal of the Acoustical Society of America 117(5):3297-3306.

Payne PM, Heinemann DW, Selzer LA. 1990. A Distributional Assessment of Cetaceans in the Shelf and Shelf Edge Waters of the Northeastern United States Based on Aerial And Shipboard Surveys, 1978-1988. Report to U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. 253 pp.

Payne PM, Nicholas JR, O'Brien L, Powers KD. 1986. The distribution of the humpback whale, *Megaptera novaeangliae*, on Georges Bank and in the Gulf of Maine in relation to densities of the sand eel, *Ammodytes americanus*. Fishery Bulletin 84:271-277.

Payne PM, Selzer LA. 1989. The Distribution, abundance and selected prey of the Harbor Seal, *Phoca vitulina concolor*, in southern New England. Marine Mammal Science 5:173-192.

Pendleton DE, Pershing A, Brown MW, Mayo CA, Kenney RD, Record NR, Cole TV. 2009. Regional-scale mean copepod concentration indicates relative abundance of North Atlantic right whale. Marine Ecology Progress Series 378:211.

Perrin W. 2002. Common Dolphins. In: W Perrin, B Wursig, J Thewissen (Eds.), Encyclopedia of Marine Mammals. San Diego, CA: Academic Press. pp. 4.

Perrin WF, Caldwell DK, Caldwell MC. 1994. Atlantic spotted dolphin *Stenella frontalis* (G. Cuvier, 1829). Handbook of Marine Mammals London UK: Academic Press. 5:173-190.

Pettis HM, Pace RM III, Hamilton PK. 2021. North Atlantic Right Whale Consortium 2020 Annual Report Card. Report to the North Atlantic Right Whale Consortium. 22 pp.

Popper AN, Hastings MC. 2009. The effects of human-generated sound on fish. Integrative Zoology 4(1):43-52.

Popper AN, Salmon M, Horch KW. 2001. Acoustic detection and communication by decapod crustaceans. Journal of Comparative Physiology A 187(2):83-89.

Rankin S, Barlow J. 2005. Source of the North Pacific "boing" sound attributed to minke whales. Journal of the Acoustical Society of America 118(5):3346-3351.

Rankin S, Barlow J. 2007. Vocalizations of the sei whale (*Balaenoptera borealis*) off the Hawaiian Islands. Bioacoustics 16:137-145.

Rasmussen MH, Miller LA. 2002. Whistles and clicks from white-beaked dolphins, *Lagenorhynchus albirostris*, recorded in Faxaflói Bay, Iceland. Aquatic Mammals 28(1):78-89.

Reeves RR, McClellan K, Werner TB. 2013. Marine mammal bycatch in gillnet and other entangling net fisheries, 1990 to 2011. Endangered Species Research 20(1):71-97.

Reeves RR, Rosa C, George JC, Sheffield G, Moore M. 2012. Implications of Arctic industrial growth and strategies to mitigate future vessel and fishing gear impacts on bowhead whales. Marine Policy 36(2):454-462.

Rice AN, Tielens JT, Estabrook BJ, Muirhead CA, Rahaman A, Guerra M, Clark CW. 2014. Variation of ocean acoustic environments along the western north Atlantic coast: a case study in context of the right whale migration route. Ecological Informatics 21:89-99.

Richardson W, Greene Jr. C, Malme C, Thomson D. 1995. Marine Mammals and Noise. San Diego, CA: Academic Press. 575 pp.

Risch D, Castellote M, Clark CW, Davis GE, Dugan PJ, Hodge LEW, Kumar A, Lucke K, Mellinger DK, Nieukirk S, Popescu CM, Ramp C, Read AJ, Rice AN, Silva MA, Siebert U, Stafford KM, Verdaat H, Van Parijs SM. 2014. Seasonal migrations of North Atlantic minke whales: novel insights from large-scale passive acoustic monitoring networks. Movement Ecology 2(24):1-17.

Roberts JJ, Best BD, Mannocci L, Fujioka E, Halpin PN, Palka DL, Garrison LP, Mullin KD, Cole TVN, Khan CB, McLellan WM, Pabst DA, Lockhart GG. 2016. Habitat-based cetacean density models for the U.S. Atlantic and Gulf of Mexico. Scientific Reports 6:22615.

Roberts JJ, Yack T, Halpin PN. 2023. Marine mammal density models for the U.S. Navy Atlantic Fleet Training and Testing (AFTT) study area for the Phase IV Navy Marine Species Density Database (NMSDD). Document version 1.3. Report prepared for Naval Facilities Engineering Systems Command, Atlantic by the Duke University Marine Geospatial Ecology Lab, Durham, North Carolina. https://seamap.env.duke.edu/seamap-models-files/Duke/Reports/AFTT_Marine_Mammal_Density_Models_2022_v1.3.pdf. Accessed 25 February 2024.

RPS. 2021. Mayflower Fugro Geophysical Survey 2020, IHA Final Protected Species Observer Report. 248 pp.

Ruppel CD, Weber TC, Staaterman ER, Labak SJ, Hart PE. 2022. Categorizing Active Marine Acoustic Sources Based on Their Potential to Affect Marine Animals. Journal of Marine Science and Engineering 10(9):1-46.

Sabinsky PF, Tougaard J, Wahlberg M, Larsen ON. 2012. Seasonal, Diel, Tidal, And Geographical Variation In Male Harbour Seal (*Phoca Vitulina*) Vocalizations In Southern Scandinavia. In: 26th Annual Conference of the European Cetacean Society. 26-28 March 2012, Galway, Ireland.

Samson,JE, Mooney TA, Gussekloo SWS, Hanlon RT. 2014. Graded behavioral responses and habituation to sound in the common cuttlefish *Sepia officinalis*. The Journal of Experimental Biology 217(24):4347.Selzer LA, Payne PM. 1988. The distribution of white-sided, *Lagenorhynchus acutus* and common dolphins, *Delphinus delphis* vs. environmental features of the continental shelf of the northeastern United States. Marine Mammal Science 4(2):141-153.

Schneider DC, Payne PM. 1983. Factors affecting haul-out of harbor seals at a site in southeastern Massachusetts. Journal of Mammalogy 64(3): 518-520.

Selzer LA, Payne PM. 1988. The distribution of white-sided, *Lagenorhynchus acutus* and common dolphins, *Delphinus delphis* vs. environmental features of the continental shelf of the northeastern United States. Marine Mammal Science 4(2): 141-153.

Slabbekoorn H, Bouton N, van Opzeeland I, Coers A, ten Cate C, Popper AN. 2010. A noisy spring: the impact of globally rising underwater sound levels on fish. Trends in Ecology and Evolution 25(7):419-427.

Smultea Environmental Sciences. 2020. Protected Species Observer Technical Report for the Ørsted New England IHA, BOEM Lease Areas OCS-A 0486, OCS-A 0487, and OCS-A 0500; 2019–2020. 26 September 2019–25 September 2020. Prepared for Ørsted. 124 pp.

Solé M, Lenoir M, Durfort M, López-Bejar M, Lombarte A, André M. 2013. Ultrastructural Damage of *Loligo vulgaris* and *Illex coindetii* statocysts after Low Frequency Sound Exposure. PLOS ONE 8(10):e78825.

Solé M, Lenoir M, Fortuño JM, Durfort M, van der Schaar M, André M. 2016. Evidence of Cnidarians sensitivity to sound after exposure to low frequency underwater sources. Scientific Reports 6:37979.

Solé M, Sigray P, Lenoir M, van der Schaar M, Lalander E, André M. 2017. Offshore exposure experiments on cuttlefish indicate received sound pressure and particle motion levels associated with acoustic trauma. Scientific Reports 7:45899.

Southall BJ, Bowles AE, Ellison WT, Finneran JJ, Gentry RL, Greene Jr. CR, Kastak D, Ketten DR, Miller JH, Nachtigall PE, Richardson WJ, Thomas JA, Tyack PL. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(44):411-521.

Southall BL, Finneran JJ, Reichmuth C, Nachtigall PE, Ketten DR, Bowles AE, Ellison WT, Nowacek DP, Tyack PL. 2019. Marine mammal noise exposure criteria: Updated scientific recommendations for residual hearing effects. Aquatic Mammals 45(2):125-232. Sprogis, KR, Videsen S, Madsen PT. 2020. Vessel noise levels drive behavioural responses of humpback whales with implications for whale-watching. Elife 9:e56760.

Spencer N. 2021. Personal Communication. Pangeo Subsea, VP Americas.

Sprogis KR, Videsen S, Madsen PT. 2020. Vessel noise levels drive behavioural responses of humpback whales with implications for whale-watching. Elife 9: e56760.

Stewart BS, Clapham PJ, Powell JA. 2002. National Audubon Society Guide to Marine Mammals of the World. New York, NY: Knopf. 528 pp.

Stone KM, Leiter SM, Kenney RD, Wikgren BC, Thompson JL, Taylor JKD, Kraus SD. 2017. Distribution and abundance of cetaceans in a wind energy development area offshore of Massachusetts and Rhode Island. Journal of Coastal Conservation 21(4): 527-543.

Thompson PM, Hastie GD, Nedwell J, Barham R, Brookes KL, Cordes LS, Bailey H, McLean N. 2013. Framework for assessing impacts of pile-driving noise from offshore wind farm construction on a harbour seal population. Environmental Impact Assessment Review 43:73-85.

U.S. Fish and Wildlife Service (USFWS). 2023. West Indian manatee *Trichechus manatus*. https://www.fws.gov/southeast/wildlife/mammals/manatee/. Accessed 15 September 2021.

van der Hoop JM, Moore MJ, Barco SG, Cole TVN, Daoust PY, Henry AG, McAlpine DF, McLellan WA, Wimmer T, Solow AR. 2013. Assessment of management to mitigate anthropogenic effects on large whales. Conservation Biology 27(1):121-133.

Verfuss UK, Gillespie D, Gordon J, Marques TA, Miller B, Plunkett R, Theriault JA, Tollit DJ, Zitterbart DP, Hubert P, Thomas L. 2018. Comparing methods suitable for monitoring marine mammals in low visibility conditions during seismic surveys. Marine Pollution Bulletin 126: 1-18.

Vester H, Hammerschmidt K, Timme M, Hallerberg S. 2014. Bag-of-calls analysis reveals group specific vocal repertoire in long-finned pilot whales. Quantitative Methods arXiv:1410.4711.

Vu E, Risch D, Clark C, Gaylord S, Hatch L, Thompson M, Wiley D, Van Parijs S. 2012. Humpback whale song occurs extensively on feeding grounds in the western North Atlantic Ocean. Aquatic Biology 14(2):175-183.

Wardle CS, Carter TJ, Urquhart GG, Johnstone ADF, Ziolkowski AM, Hampson G, Mackie D. 2001. Effects of seismic air guns on marine fish. Continental Shelf Research 21(8):1005-1027.

Waring GT, Josephson E, Fairfield CP, Maze-Foley K, (eds.). 2007. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments -- 2006. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Wood Hole, MA. NOAA Technical Memorandum NMFS-NE-201.

Waring GT, Josephson E, Maze-Foley K, Rosel PE, (Eds.). 2010. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2010. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Wood Hole, MA. NOAA Technical Memorandum NMFS-NE-219. 609 pp.

Waring GT, Josephson E, Maze-Foley K, Rosel PE, (Eds.). 2014. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2013. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Wood Hole, MA. NOAA Technical Memorandum NMFS-NE-228. 475 pp.

Waring GT, Josephson E, Maze-Foley K, Rosel PE, (Eds.). 2015. U.S. Atlantic and Gulf of Mexico marine mammal stock assessments – 2014. U.S. Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, MA. NOAA Technical Memorandum NMFS-NE-231. 370 pp.

Waring GT, Josephson E, Maze-Foley K, Rosel PE, (Eds.). 2016. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments - 2015. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Northeast Fisheries Science Center, Wood Hole, MA. NOAA Technical Memorandum NMFS-NE-238. 512 pp.

Watkins WA, Daher MA, Reppucci GM, George JE, Martin DL, DiMarzio NA, Gannon DP. 2000. Seasonality and distribution of whale calls in the North Pacific. Oceanography 13:62-67.

Weisbrod AV, Shea D, Moore MJ, Stegemann JJ. 2000. Organochlorine exposure and bioaccumulation in the endangered Northwest Atlantic right whale (*Eubalaena glacialis*) population. Environmental Toxicology and Chemistry 19(3):654-666.

Williams, TM, Blackwell SB, Tervo O, Garde E, Sinding MHS, Richter B, Heide-Jørgensen MP. 2022. Physiological responses of narwhals to anthropogenic noise: A case study with seismic airguns and vessel traffic in the Arctic. Functional Ecology 36(9):2251-2266.

Wilson M, Hanlon RT, Tyack PL, Madsen PT. 2007. Intense ultrasonic clicks from echolocating toothed whales do not elicit anti–predator responses or debilitate the squid *Loligo pealeii*. Biology Letters 3(3):225-227.

Wood J, Southall BL, Tollit DJ. 2012. PG&E offshore 3-D Seismic Survey Project EIR – Marine Mammal Technical Draft Report. SMRU Ltd. SMRUL-NA0611ERM. 124 pp.

Wood LaFond S. 2009. Dynamics of Recolonization: a Study of the Gray Seal (*Halichoerus grypus*) in the Northeast U.S. Ph.D. dissertation, University of Massachusetts, Boston, MA. 83 pp.