Wind Energy Commercial Lease on the Atlantic Outer Continental Shelf Offshore Maine Final Biological Assessment

For the National Marine Fisheries Service

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U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

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List of Acronyms

Acronym	Definition
AIM	Acoustic Integration Model
AIS	Automatic Identification System
ALWTRP	Atlantic Large Whale Take Reduction Plan
AMAPPS	Atlantic Marine Assessment Program for Protected Species
ANSI	American National Standards Institute
ASMFC	Atlantic States Marine Fisheries Council
ASSRT	Atlantic Sturgeon Status Review Team
AUV	autonomous underwater vehicle
BIA	biologically important area
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement
BRI	Biodiversity Research Institute
BSEE	Bureau of Safety and Environmental Enforcement
CAA	Clean Air Act
CETAP	Cetacean and Turtle Assessment Program
CFR	Code of Federal Regulations
COP	construction and operations plan
CSA	CSA Ocean Sciences Inc.
CWA	Clean Water Act
DFO	Fisheries and Oceans Canada
DMA	Dynamic Management Area
DMR	Maine Department of Marine Resources
DNREC	Department of Natural Resources and Environmental Control
DOI	Department of the Interior
DPS	Distinct Population Segment
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	environmental impact statement
EMF	electromagnetic field
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FDR	Facility Design Report
FHWA	Federal Highway Administration

Acronym	Definition
FHWG	Fisheries Hydroacoustic Working Group
FIR	Fabrication and Installation Reports
GAR	Greater Atlantic Region
GARFO	Greater Atlantic Regional Fisheries Office
GMRI	Gulf of Maine Research Institute
GP	General Permit
GPS	global positioning system
HDD	horizontal directional drilling
HRG	high-resolution geophysical
IHA	Incidental Harassment Authorization
IPF	impact-producing factor
ITA	Incidental Take Authorization
IUCN	International Union for Conservation of Nature
LAA	likely to adversely affect
LFC	low-frequency cetacean
LOA	letter of authorization
MBES	multibeam echosounder
MFC	mid-frequency cetacean
MMPA	Marine Mammal Protection Act
MOA	memorandum of agreement
MOTUS	MOTUS Wildlife Tracking System
NARW	North Atlantic right whale
NASA	National Aeronautics and Space Administration
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NPS	National Park Service
NROC	Northeast Regional Ocean Council
OCS	Outer Continental Shelf
OPR	Office of Protected Resources
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic

Acronym	Definition
OSS	offshore substation
PAM	passive acoustic monitoring
PATON	Private Aids to Navigation
PBR	potential biological removal
PIT	passive integrated transponder
PRD	Protected Species Division
PSO	protected species observer
PTS	permanent threshold shift
RAP	Research Activities Plan
RHA	Rivers and Harbors Act
ROD	Record of Decision
SAG	surface active group
SAR	stock assessment report
SBP	sub-bottom profiler
SEFSC	Southeast Fisheries Science Center
SEL	sound exposure level
SMA	Seasonal Management Area
SPL	sound pressure level
SSS	side scan sonar
TBD	to be determined
TEWG	Turtle Expert Working Group
TIMS	Technical Information Management System
TSS	total suspended solids
TTS	temporary threshold shift
UME	Unusual Mortality Event
USACE	U.S. Army Corps of Engineers
USC	United States Code
USCG	U.S Coast Guard
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UXO	unexploded ordnance
WHOI	Woods Hole Oceanographic Institution
WTG	wind turbine generator

1 Introduction

In accordance with Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 United States Code [U.S.C.] §§ 1531 et seq.), this document transmits the Bureau of Ocean Energy Management's (BOEM's) Biological Assessment (BA) of the effects of the Proposed Action on ESA-listed species and designated critical habitat that occur within the Action Area.

The Proposed Action for this BA is the issuance of commercial leases within the Wind Energy Area (WEA) in the Gulf of Maine and to grant rights-of-way (ROWs) and rights-of-use and easement (RUEs) in the region of the outer continental shelf (OCS) of the Gulf of Maine. BOEM's issuance of these leases and grants is needed to (1) confer the exclusive right to submit plans to BOEM for potential development, such that the lessees and grantees develop plans for BOEM's review and will commit to site characterization and site assessment activities necessary to determine the suitability of their leases and grants for commercial offshore wind production or transmission, and (2) impose terms and conditions intended to ensure that site assessment (i.e. met buoy and PAM buoy operations) and characterization (i.e. geophysical, geotechnical surveys, benthic surveys, physical oceanographic monitoring, and biological surveys) activities are conducted in a safe and environmentally responsible manner. The issuance of a lease by BOEM to the lessee conveys no right to proceed with development of a wind energy facility; the lessee acquires only the exclusive right to submit one or more plans to conduct this activity.

Under the Proposed Action, BOEM would potentially issue leases that may cover the entirety of the WEA, easements associated with each lease, and grants for subsea cable corridors and associated offshore collector/converter platforms. The ROWs, RUEs, and potential easements would all be located within the OCS offshore Maine, Massachusetts, and New Hampshire and may include corridors that extend from the WEA to the onshore energy grid. This BA analyzes the reasonably foreseeable effects to ESA-listed species and designated critical habitat from activities that are anticipated to occur from the Proposed Action, including site assessment activities on leases and site characterization activities on the leases, grants, and potential easements. Site assessment activities would most likely include the temporary placement of meteorological (met) buoys and oceanographic devices, but does not include the construction or installation of any commercial-scale offshore wind energy facility structures used to generate or transmit electricity (e.g., wind turbine generator foundations, electrical service platforms, and cables). **Section 3** describes the activities included in the Proposed Action.

The timing of lease issuance, as well as weather and sea conditions, would be the primary factors influencing timing of site characterization and site assessment activities. It is assumed that lessees would begin survey activities as soon as possible after receiving a lease and preparing plans for submission to BOEM, and when sea states and weather conditions allow for site characterization and site assessment activities. The most suitable sea states and weather conditions would occur during late spring and summer months. Lessees have up to 5 years to perform site characterization activities before they must submit a construction and operations plan (COP) (30 CFR § 585.235(a)(2))[1]. Lease sales[2] in the Gulf of Maine are anticipated to occur in two phases:

> Leasing Phase 1: Under the reasonably foreseeable site characterization scenario, the sale date for up to 10 leases is planned for October 29, 2024, and the FSN is to be published 45 days prior. BOEM could issue leases as early as late 2024 and continue through mid-2025. For leases issued in October through December 2024, the earliest surveys would likely begin no sooner than April 2025. Lessee's surveys for leases issued in October through December 2024 could continue through August 2029 prior to submitting their COPs.

> Leasing Phase 2: Under the reasonably foreseeable site characterization scenario, a second lease sale would be held in 2027. BOEM could issue leases as early as early 2027 and continue through late 2027. For leases issued after July 2027, the earliest surveys would likely begin no sooner than April 2028. Lessee's surveys for leases issued in 2027 could continue through 2032 prior to submitting their COPs.

BOEM is the lead federal agency for purposes of Section 7 consultation (50 Code of Federal Regulations [CFR] 402.07). The draft BA was shared with Agencies cooperating on the environmental assessment under National Environmental Policy Act including the Bureau of Safety and Environmental Enforcement (BSEE); the U.S. Coast Guard (USCG); the National Marine Fisheries Service's Office of Protected Resources (NMFS OPR); the U.S. Army Corps of Engineers (USACE); and the Federal Communications Commissions (FCC). BSEE, USACE, and NMFS OPR have been identified as co-action agencies for the proposed action. It is not expected that Lessees would require an OCS Air Permit or NPDES permit for the Proposed Action and no federal actions from the U.S. Environmental Protection Agency (USEPA) are expected for the Proposed Action. Therefore, the USEPA is not considered an action agency. Although not subject to ESA section 7 consultation requirements two state agencies will also be issuing permits or authorizations on the Proposed Action: the Maine Bureau of Parks and Lands, and Maine Department of Marine Resources. **Section 2.2** provides a description of the co-action agency regulatory authorities.

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[1]BOEM regulations previously required lessees to submit a SAP prior to deployment of met buoys. BOEM and BSEE's final Renewable Energy Modernization Rule[1], published on May 15, 2024 (89 FR 42602), eliminated the SAP requirement for met buoys because the SAP process is duplicative with USACE's long-standing permitting process under Section 404(e) of the Clean Water Act (33 USC 1344(e)) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 401 et seq.) for the installation of met buoys, which are categorized by the USACE as scientific measurement devices. The final rule is effective on July 15, 2024 and will apply to all commercial lease sales in the Gulf of Maine WEA. The final rule can be found at https://www.federalregister.gov/documents/2024/05/15/2024-08791/renewable-energy-modernization-rule.
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[2] For the purposes of impact assessment, BOEM is assuming lease areas of approximately 80,000 acres each, with up to 15 lease areas across two phases of leasing within the WEA.

2 Consultation History and Regulatory Authorities

The Energy Policy Act of 2005, Public Law 109-58, added Section 8(p)(1)(c) to the Outer Continental Shelf Lands Act. This section authorized the Secretary of the Interior to issue leases, easements, and ROWs in the OCS for renewable energy development, including wind energy. The Secretary delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing this authority (30 CFR part 585) were promulgated on April 22, 2009.

2.1 Consultation History

On March 15, 2024, BOEM released the Announcement of the Area Identification (Area ID) memorandum (BOEM 2024a). The Area ID memorandum documents the analysis and rationale used to develop the WEA in the Gulf of Maine. The Gulf of Maine is an area offshore the states of Maine, New Hampshire, and the commonwealth of Massachusetts. In partnership with the National Centers for Coastal Ocean Science (NCCOS), BOEM compiled best available data and developed spatial models to identify suitable areas for offshore wind energy in the region (NOAA NCCOS 2024). BOEM identified one WEA in the Gulf of Maine.

Based on the process described in the Area ID memorandum (BOEM 2024a), the WEA considered in this BA is described in **Section 3**. For the purposes of the effects analysis, BOEM is assuming lease areas of approximately 80,000 acres each, with up to 15 lease areas within the WEA. BOEM may decide to issue leases within all of, a portion of, or no part of the WEA analyzed in the EA, and communicates this decision through issuance of a proposed sale notice (PSN) and final sale notice (FSN). On April 30, 2024, BOEM published a PSN[3], proposing the lease areas within the WEA. The EA and associated consultations will inform development of the FSN.

BOEM issued the draft BA on June 12, 2024. The BA was revised in response to comments received from USACE, BSEE and NMFS GARFO. The Federal action[4] that is the subject of this request for Section 7 consultation is BOEM's issuance of commercial leases within the WEA and granting of ROWs and RUEs in the region of the outer continental shelf (OCS) of the Gulf of Maine, and the resulting site characterization and site assessment activities that would be carried out by lessess in these areas. BOEM will ensure that the final BA has been reviewed by the other action agencies, is based on the best available scientific information, and it includes all the information required by 50 CFR 402.14(c).

[3] Federal Register :: Atlantic Wind Lease Sale 11 (ATLW-11) for Commercial Leasing for Wind Power Development on the U.S. Gulf of Maine Outer Continental Shelf-Proposed Sale Notice
https://www.federalregister.gov/documents/2024/05/01/2024-09390/atlantic-wind-lease-sale-11-atlw-11-for-commercial-leasing-for-wind-power-development-on-the-us-gulf

[4] Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the U.S. or upon the high seas (50 CFR 402.02).

2.2 Other Regulatory Authorities

2.2.1 Bureau of Safety and Environmental Enforcement

BSEE's mission is to enforce safety, environmental, and conservation compliance with any associated legal and regulatory requirements during the proposed surveys and future activities. BSEE is responsible for verifying and enforcing compliance with any avoidance, minimization, and monitoring measures from this consultation for activities conducted on the OCS through 30 CFR 285/585, lease stipulations and required mitigations associated with consultation. Additionally, BSEE will be involved with enforcement and compliance, as-placed anchor plats, protected species observer (PSO) reporting, and decommissioning and site clearance reviews for any buoys installed under the Proposed Action.

2.2.2 United States Army Corps of Engineers

The USACE issues permits for the discharge of dredged or fill material into waters of the United States under Section 404 of the Clean Water Act (33 CFR 323). Under Section 10 of the Rivers and Harbors Act (RHA) USACE issues permits for structures and/or work in or affecting navigable waters of the United States and for devices affixed to the seabed on the Outer Continental Shelf (33 CFR 322). USACE New England District has developed a set of regional general permits (GPs) for each state in New England to streamline the evaluation and approval process for certain types of activities that have only minimal adverse impacts both individually and cumulatively on the aquatic environment. Most site characterization and site assessment activities under the Proposed Action would be covered by GPs, in particular those for scientific measurement devices and survey activities. Massachusetts General Permit (MA GP) 14, New Hampshire General Permit (NH GP) 14, and Maine General Permit (ME GP) 17 all cover the placement of scientific measurement devices, including tide gages, water recording devices, water quality testing and improvement devices, meteorological stations (which would include met buoys), and similar structures. MA GP 15, NH GP 15, and ME GP 18 all cover a variety of survey activities, including soil borings, core sampling, seismic exploratory operations, plugging of seismic shot holes and other exploratory type bore holes, exploratory trenching, soil surveys, sampling, and historic resources surveys. USACE indicated that site characterization and site assessment activities that may require USACE authorization, such as met buoys and jurisdictional survey work, would likely qualify for these USACE general permits. An individual permit may be required from USACE if the proposed activities do not meet the terms and conditions of the GPs or if USACE determines that the activities would result in more than minimal adverse effects on the aquatic environment. In addition, Section 408 permission, pursuant to Section 14 of the RHA (33 USC 408), may be required for any proposed alterations that have the potential to modify, alter, or occupy any federally authorized civil works projects including federal navigation projects. At the time of permit request submittal by a lessee, the USACE will review the proposed activities in accordance with permit application review procedures and per the conditions of the General Permits. Under the Proposed Action a self-verification notification and/or a preconstruction notification to USACE is anticipated prior to installation of the met buoys and prior to starting any jurisdictional survey activities.

2.2.3 National Marine Fisheries Service

The MMPA, as amended, and its implementing regulations (50 CFR part 216) allow, upon request, the incidental take of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region. Incidental take[5] is an unintentional, but not unexpected, "take.” The “take” largely arises due to activities incidental to planned marine construction activities, such as underwater sound, and may include behavioral avoidance. Upon receipt and review of an adequate and complete application, NMFS OPR may authorize the incidental take of marine mammals incidental to the marine site characterization surveys pursuant to the MMPA, if the required findings are made. Proponents of some survey activities considered here may be required to obtain Incidental Take Authorizations (ITAs) under the MMPA. Therefore, the Federal actions considered in this consultation include the issuance of ITAs for survey activities described herein. Those ITAs may or may not provide MMPA take authorization for marine mammal species that are also listed under the ESA. On December 21, 2016, NMFS issued interim guidance[6] on the term “harass,” under the ESA, defining it as to “create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.” The NMFS interim ESA definition of “harass” is not equivalent to MMPA Level B harassment. Due to the differences in the definition of “harass” under the MMPA and ESA, there may be activities that result in effects to a marine mammal that would meet the threshold for harassment under both the MMPA and the ESA, while other activities may result in effects that would meet the threshold for harassment under the MMPA but not under the ESA. For this consultation, we considered NMFS’ interim guidance on the term “harass” under the ESA when evaluating whether the proposed activities are likely to harass ESA-listed species, and we considered the available scientific evidence to determine the likely nature of the behavioral responses and their potential fitness consequences.

[5] Incidental take is defined under the MMPA (50 CFR 216.3) as, “harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal.” Harassment is defined under the MMPA as any act of pursuit, torment, or annoyance which: has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment). As defined in the MMPA, Level B harassment does not include an act that has the potential to injure a marine mammal or marine mammal stock in the wild. (16 U.S.C. §1361 et seq.)

[6] NMFS Policy Directive 02-110-19; available at https://media.fisheries.noaa.gov/dam-migration/02-110-19.pdf; last accessed March 25, 2021.

3 Description of the Proposed Action

The Proposed Action[7] is the issuance of wind energy commercial leases within all or some of the Gulf of Maine WEA and granting of ROWs and RUEs in support of wind energy development in the WEA and the resulting site characterization and site assessment activities that would be carried out by lessess in these areas. Under the Proposed Action, BOEM proposes to issue leases that may cover the entirety of the WEA, easements associated with each lease, and grants for subsea cable corridors and associated offshore collector/converter platforms. The ROWs, RUEs, and potential easements would all be located within the OCS offshore Maine, Massachusetts, and New Hampshire and may include corridors that extend from the WEA to the onshore energy grid. The WEA totals approximately 2.0 million acres (8,094 square kilometers) and is located between 20 and 76 nautical miles (37 and 141 kilometers) from shore. For the purposes of impact assessment, BOEM is assuming lease areas of approximately 80,000 acres (324 square kilometers) each, with a maximum of 15 lease areas. A complete description of the Action Area is provided in **Section 3.2**.

The Proposed Action that BOEM is requesting ESA section 7 consultation on includes site assessment activities (**Section 3.1.1**) and site characterization activities (**Section 3.1.2**) in the Action Area (**Section 3.2**). Site assessment activities include the temporary placement (i.e., deployment, maintenance, and decommissioning) of a meteorological ocean buoy. Site characterization activities include geophysical, geotechnical, biological, and archaeological surveys and monitoring activities.

The issuance of a lease by BOEM to the lessee conveys no right to proceed with development of a wind energy facility; the lessee acquires only the exclusive right to submit one or more plans[8] to BOEM to conduct site characterization surveys (**Section 3.1.2**) and site assessment activities (**Section 3.1.1)** that could be conducted as a result of the Proposed Action. A commercial and research renewable energy lease gives the lessee an exclusive right to apply for subsequent approvals that are necessary to advance to the next stage of the renewable energy development process. After the lessee has collected sufficient site characterization and assessment data the lessee may submit a COP, approval of which would authorize the actual construction and operation of a renewable energy facility (30 CFR 285.620-621). Although BOEM does not permit site characterization activities i.e., geotechnical and geophysical surveys), a lessee must submit the results of such survey before BOEM can consider approving its COP (30 CFR 285.626). Therefore, site characterization surveys are a reasonably foreseeable result of lease issuance. This document is a BA of the proposed lease issuance, associated site characterization, and subsequent site assessment activities for siting of wind energy facilities. The construction, O&M, and decommissioning of individual wind projects will be analyzed as part of a separate analysis process if a lessee submits a COP, and may require project-specific consultation associated with the issuance of Marine Mammal Protection Act Incidental Harassment Authorizations or Letters of Authorization (16 USC §1371(a)(5)(A) & (D)).Under the Proposed Action, BOEM would require each lessee to avoid or minimize potential impacts on the environment by complying with various requirements. These requirements are summarized in **Section 3.3** of this BA (referenced in **Appendix H** of the EA) and will be documented in lessees' lease stipulations.

[7] Under the ESA, "action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies in the U.S. or upon the high seas (50 CFR 402.02).
[8] Plans are based on the requirements of the renewable energy regulations at 30 Code of Federal Regulations (CFR) Part 585, BOEM's guidance for lessees, previous lease applications and plans that have been submitted to BOEM. If a lessee proposes to construct a commercial wind energy facility, the lessee would be required to submit a Construction and Operation Plan (COP) to BOEM for review and approval. BOEM would then conduct a project-specific NEPA review and would initiate project-specific ESA consultation with NMFS.

The assumptions for the Proposed Action (the issuance of a lease and grants within the WEAs in the Gulf of Maine and associated site characterization and site assessment activities), are included in the analysis in **Section 6**. Though site characterization activities that extend into state waters and onshore to evaluate potential export cable (transmission) routes are a reasonably foreseeable result of a wind energy lease issued in the Gulf of Maine, BOEM is not authorizing any activities in state waters and/or onshore areas and does not have regulatory authority to apply mitigating measures outside of the OCS. The Proposed Action does not include construction, operation, or decommissioning of any wind farm infrastructure (e.g., turbines, substations, cable routes). Those activities (i.e., transmission lines, turbines, substations, and cables) will be evaluated in future regulatory processes.

Additionally, BOEM will include a condition in the proposed Gulf of Maine WEA leases to require lessee compliance with the Project Design Criteria (PDC) and Best Management Practices (BMP) of the NMFS June 29, 2021, informal programmatic ESA consultation and the NMFS June 29, 2021 letter of concurrence (Data Collection and Site Survey Activities Programmatic Informal Consultation). As such, BOEM has determined all related activities are ***not likely to adversely affect*** any ESA-listed species (**Section 6**) or critical habitat (**Section 7**). BOEM will conduct individual reviews consistent with the steps detailed in the NMFS 2021 informal programmatic consultation in coordination with NMFS to determine consistency with the Gulf of Maine informal consultation.

Furthermore, BOEM has concluded that fisheries surveys, extractive fisheries surveys especially, that may be conducted in association with Gulf of Maine lease issuance are not “effects of the action” as defined in 50 CFR 402.02, “Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action”. In 2023 BOEM updated its survey guidelines to include non extractive methodologies to include baited remote underwater video stations, drop cameras, gliders, and eDNA as methodologies that could be employed to characterize fishery resources in a project area. BOEM acknowledges that while an individual Gulf of Maine lessee may opt to carry out such biological surveys to characterize resources in their lease area to inform their COP development, there is not an affirmative requirement to carry out any fisheries surveys, and no fisheries survey plans have been developed. Thus, any such extractive fisheries surveys are not reasonably certain to occur and effects at this time are unknowable. A condition of the proposed lease would require appropriate consultation prior to carrying out any such fisheries surveys. BOEM has included in this assessment a description of vessel trips and the impact of those transits to ESA-listed species that could occur supporting biological surveys broadly. As described in this paragraph the assessment does not include an analysis of sampling methodologies that could effect ESA-listed species, especially effects from extractive fishing.

3.1 Description of Activities

The Proposed Action is the issuance of a up to 15 leases by BOEM within the WEA (80,000 acres each) and associated Federal authorizations and permits proposed by USACE, NMFS OPR, USCG, FCC; and includes the resultant site assessment activities and site characterization activities that would occur on each of the leases and potential Project easements. BOEM has submitted this section 7 consultation with the proposed action covering leasing and proposed site assessment activities include the temporary placement of up to two met buoys per lease area (n=30), and up to four PAM bouys per lease (n=60), andproposed site characterization activities that could include geophysical, geotechnical, biological, and archeological surveys and monitoring activities. An overview of the different survey types and equipment are provided in **Table 3-1** and Appendix C, and the following subsections provide more detail regarding the activities considered in this BA.

Table 3-1. Typical equipment that would be used for surveys associated with the Proposed Action

Survey Type	Survey Equipment or Method	Resource Surveyed or Information Used to Inform
High-resolution geophysical surveys	Sub-bottom profiler, side-scan sonar, multibeam echosounder, or magnetometer—towed from vessel or mounted on an AUV within the water column	Shallow hazards,[a] archaeological,[b] bathymetric charting, benthic habitat
Geotechnical/ seafloor sampling[c]	Vibracores, deep borings, cone penetration tests	Geological and geotechnical[c]
Biological[d]	Grab sampling, benthic sled, underwater imagery/sediment profile imaging	Benthic habitat
Biological[d]	Aerial digital imaging, visual observation from boat, airplane, or remote-operated flying drone	Avian
Biological[d]	Ultrasonic detectors installed on survey vessels used for other surveys	Bat
Biological[d]	Visual observation from boat, airplane, or remote-operated drone; passive acoustic monitors mounted on AUVs, drones, or vessels	Marine fauna (marine mammals and sea turtles)

[a] 30 CFR § 585.610(b)(2), 30 CFR § 585.626(a)(1), and 30 CFR § 585.645(a)(2).
[b] 30 CFR § 585.626(a), 30 CFR § 585.610–585.611, and 30 CFR § 585.645(a)(3).
[c] 30 CFR § 585.610(b)(1,4), 30 CFR § 585.626(a)(2,4), and 30 CFR § 585.645(a)(1,4).
[d] 30 CFR § 585.610(b)(5), 30 CFR § 585.626(a)(3), and 30 CFR § 585.645(a)(5).
AUV = autonomous underwater vehicle

It is assumed that lessees would begin survey activities as soon as possible after receiving a lease and preparing plans for submission to BOEM, and when sea states and weather conditions allow for site characterization and site assessment activities. The most suitable sea states and weather conditions typically occur between April and August. Lessees have up to 5 years to perform site characterization activities before they must submit a COP (30 CFR § 585.235(a)(2))[9]. Lease sales in the Gulf of Maine are anticipated to occur in two phases:

> Leasing Phase 1: Under the reasonably foreseeable site characterization scenario, the sale date for up to ten leases is planned for October 2024, and the FSN is to be published 45 days prior. BOEM could issue leases as early as late 2024 and continue through mid-2025. For leases issued in October through December 2024, the earliest surveys would likely begin no sooner than April 2025. Lessee's surveys for leases issued in October through December 2024 could continue through August 2029 prior to submitting their COPs.

> Leasing Phase 2: Under the reasonably foreseeable site characterization scenario, a second lease sale would be held in 2028. BOEM could issue leases as early as early 2028 and continue through late 2028. For leases issued after July 2028, the earliest surveys would likely begin no sooner than

[9]BOEM regulations previously required lessees to submit a SAP prior to deployment of met buoys. BOEM and BSEE's final Renewable Energy Modernization Rule[9], published on May 15, 2024 (89 FR 42602), eliminated the SAP requirement for met buoys because the SAP process is duplicative with USACE's long-standing permitting process under Section 404(e) of the Clean Water Act (33 USC 1344(e)) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 401 et seq.) for the installation of met buoys, which are categorized by the USACE as scientific measurement devices. The final rule is effective on July 15, 2024 and will apply to all commercial lease sales in the Gulf of Maine WEA. The final rule can be found at https://www.federalregister.gov/documents/2024/05/15/2024-08791/renewable-energy-modernization-rule .

April 2029. Lessee's surveys for leases issued in 2029 could continue through 2034[10] prior to submitting their COPs.

Geophysical reconnaissance surveys would likely begin within 1 year following execution of the lease, along with any additional surveys that may be required prior to installing a met buoy. Site characterization surveys would then continue in a phased approach for up to 5 years leading up to the preparation and submittal of the COP. Lessees would likely survey the entire proposed lease area during the 5-year site assessment term to collect required geophysical and geotechnical information for siting of commercial facilities (wind turbines and offshore export cables). The surveys are typically completed in phases. For the purposes of this assessment, BOEM assumes that up to 10 separate lease holders could conduct various aspects of the Proposed Action (site assessment and site characterization surveys) concurrently throughout the WEA. Additional geophysical surveying may be performed after COP approval to support a facility design report and a fabrication and installation report. The following subsections provide more detail regarding the proposed survey activities considered in this BA.

3.1.1 Consistency Review Process

Issuing leases or grants allows for site characterization activities, including surveys, to gather data and information to support submittal of a Construction and Operations Plan (COP) for BOEM's consideration and approval. Therefore, this environmental analysis focuses on the effects of site characterization and site assessment activities expected to occur after the issuance of commercial wind energy leases. The purpose is to allow lessees access to the WEAs to gather the physical and biological data required to submit a COP. BOEM will conduct individual reviews consistent with the steps detailed in the NMFS 2021 informal programmatic consultation in coordination with NMFS to determine consistency with the Gulf of Maine informal consultation.

If the lessee intends to design and conduct biological or other surveys to support offshore renewable energy plans that could interact with ESA-listed species, the surveys must be within the scope of activities described in forthcoming ESA consultations, or the lessee must consult further with BOEM and the Services (NMFS and USFWS). Additional time should be allowed for consultation and/or permits authorizing proposed activities which are outside of the scope of existing consultations/authorizations.

BOEM expects the Proposed Action of lease issuance to be followed by site characterization and assessment activities on the OCS and state waters. However, until BOEM receives survey plans, which does not occur until after a lease is issued, information in this section focuses on the most common activities and equipment used offshore the U.S. East Coast or in similar ocean conditions.

The timing of lease issuance, as well as weather, and sea conditions, would be the primary factors influencing the timing of site characterization surveys and site assessment activities. BOEM could begin issuing leases as early as late 2024. Lessees have a preliminary term of up to 1 year to begin site characterization surveys and submit a site assessment plan (SAP). BOEM will decide whether to approve or disapprove a SAP or COP in accordance with the applicable regulations in 30 CFR Part 585.

Per requirements of the lease, lessees must submit a survey plan to BOEM at least 90 days prior to commencement of any survey activities described in the survey plan. Within 30 days from receipt, BOEM may request the Lessee modify the survey plan to address any comments BOEM submits to the Lessee on the contents of the survey plan. Comments must be addressed in a manner deemed satisfactory prior to commencement of the survey activities.

[10] Lessees have up to 5 years to perform site characterization activities before they must submit a construction and operations plan (COP) (30 CFR § 585.235(a)(2))1.

3.1.2 Site Assessment Activities

Site assessment activities under the Proposed Action will include the deployment of meteorological and PAM buoys and associated vessel activity for its installation, maintenance, and decommissioning as described in the following subsections. BOEM regulations previously required lessees to submit a SAP prior to deployment of met buoys. BOEM and BSEE's final Renewable Energy Modernization Rule[11], published on May 15, 2024 (89 FR 42602), eliminated the SAP requirement for met buoys because the SAP process may duplicate USACE's long-standing permitting process under Section 404(e) of the Clean Water Act (33 USC 1344(e)) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 401 et seq.) for the installation of met buoys, which are categorized by the USACE as scientific measurement devices.

Reconnaissance site characterization surveys would likely begin within 1 year following execution of the lease, along with any additional surveys that may be required prior to installing a met buoy. Site characterization surveys would then continue in a phased approach for up to 5 years leading up to the preparation and submittal of the COP. Additional geophysical surveying may be performed after COP approval to support a facility design report and a fabrication and installation report. Deployment of met buoys requires USCG PATON approval under 33 CFR part 66 and 14 U.S.C. 545 and USACE permits.Table 3-2. Summary of site assessment buoys[1] for all 15 leases under the Proposed Action

Buoy Type	Total # of buoys (for all 15 leases)
Met Buoys	30
PAM Buoys	60

[1] Four PAM buoys will be installed within each Lease area (estimated 60 total). Two met buoys will be installed within each Lease area (estimated 30 total). Installation methodologies will be close to the same techniques and equipment for Met and PAM buoys.

3.1.2.1 Meteorological Buoys—Installation, Operation, and Decommissioning

Installation, operation and maintenance, and decommissioning of met buoys for characterizing wind conditions are part of the assumptions/scenario for the Proposed Action. Met buoys are anchored to the seafloor at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. This Draft BA assumes that a maximum of two buoys per lease would be installed; thus, with an assumed 15 leases within the WEA, a total of 30 buoys are considered (based on an estimated two buoys per lease area during the 5-year site assessment term). The type of buoy chosen usually depends on its intended installation location and measurement requirements. For example, a smaller buoy in shallow coastal waters may be moored using an all-chain mooring. On the OCS, a larger discus-type or boat-shaped hull buoy may require a combination of a chain, nylon, and buoyant polypropylene materials encased in a rubber sleeve or different material designed to endure many years of ocean service. Buoy types that are typically deployed are also described by the National Data Buoy Center (NDBC 2012).

[11] The final rule is effective on July 15, 2024 and will apply to all commercial lease sales in the Gulf of Maine WEA. The final rule can be found at https://www.federalregister.gov/documents/2024/05/15/2024-08791/renewable-energy-modernization-rule.

Buoys are towed or carried aboard a vessel to the installation location and either lowered to the ocean surface from the deck of the vessel or placed over the final location and the mooring anchor is dropped. Based on previous proposals, anchors for boat-shaped or discus-shaped buoys would weigh about 2,721 kilograms to 4,536 kilograms, with a footprint of about 0.5 square meter and an anchor chain sweep of about 34,398 square meters (BOEM 2014; Fugro Marine GeoServices Inc. 2017). The anchor for the met buoy is estimated to weigh about 1,234.2 to 2,057.5 pounds (2,721 to 4,536 kilograms) and is not expected to exceed a footprint of 5.4 square feet (0.5 square meters) with 8.5 acres (34,398 square meters) of disturbance related to anchor chain sweep scour per buoy. The total areal impact within each WEA lease would be 17 acres (68,796 square meters) for two discus- or boat-shaped buoys. The total impact area for all 30 met buoy sites would be approximately 255 acres (1 square kilometer). If a spar-type met buoy is used, the maximum area of disturbance is expected to be 1,270 square feet (118 square meters) per buoy (38,100 square feet [3,540 square meters] for all 30 buoys). The scour impact caused by a single met or PAM buoy system would occur during the 5- year residence of the buoys within each Lease Area. The scour impacts would occur within a staggered deployment and operation time frame of over a 5-year period.

Transport and installation vessel anchoring for 1 day is anticipated for these types of buoys. For spar-type buoys, installation would occur in two phases: Phase one would occur over 1 day, and the clump anchor would be transported and deployed to the seabed. In phase two, which would take place over 2 days, the sparbuoy would be similarly transported and then lifted by crane into the water. Divers would secure it to the clump anchor (which weighs a minimum of 100 tons). Previous proposals have indicated that the maximum area of disturbance related to deployment of a spar-buoy occurs during anchor deployment/removal, resulting in a maximum area of disturbance of 118 square meters of seafloor between its clump anchor and mooring chain (BOEM 2014a).

For met buoys, on-site inspections and preventive maintenance (i.e., marine fouling, wear, or lens cleaning) are expected to occur on a monthly or quarterly basis. Periodic inspections for specialized components (i.e., buoy, hull, anchor chain, or anchor scour) would occur at different intervals but would likely coincide with the monthly or quarterly inspection to minimize the need for additional boat trips to the site.

Decommissioning is basically the reverse of the installation process. Equipment recovery would be performed with the support of a vessel (or vessels) equivalent in size and capability to that used for installation. For small buoys, a crane-lifting hook would be secured to the buoy. A water or air pump system would de-ballast the buoy, causing it to tip into the horizontal position. The mooring chain and anchor would be recovered to the deck using a winching system. The buoy would then be transported to shore. Buoy decommissioning is expected to be completed within 1 to 2 days, depending on buoy type.

Decommissioning and site clearance activities are also a part of decommissioning obligations and requirements pursuant to 30 CFR 285 Subpart I—Decommissioning. A lessee must provide evidence that the area used for site assessment facilities (i.e., met buoys) has been returned to its original state within 60 days following removal of the facilities. The lessee must remove any trash or bottom debris introduced as a result of operations and document that the lease area is clear; such evidence may consist of one or more of the following: photographic bottom survey, high-resolution side-scan survey, or sector-scanning sonar survey.

Stressors associated with met buoy installation operation and maintenance and with met buoy decommissioning (including site clearance) may include vessel traffic, noise, lighting, air emissions, and routine vessel discharges. Bottom disturbance and habitat degradation may also occur as a result of met buoy anchoring and installation. Each met buoy may act as a fish aggregating device, attracting fish and other species (e.g., birds) to the buoy location. Entanglement of any ESA listed species in buoy or anchor components is considered extremely unlikely to occur with implementation of the required BMPs/PDCs **(Appendix B)**.

3.1.2.2 PAM Buoys

Installation, operation and maintenance, and decommissioning of PAM buoys for studying marine mammals are a part of the assumptions/scenario for the Proposed Action. This BA assumes that a maximum of four PAM buoys per lease would be installed in each of the 15 leases within the WEA; therefore, installation, operation, and decommissioning of a total of 60 PAM buoys are included in the analysis. Installation methodologies will be close to the same techniques and equipment as described for Met buoy deployment systems. The met buoy and PAM buoy systems will be towed or carried aboard a service vessel to the installation location. Once in position the buoys would be lowered to the seafloor from the deck of the vessel or placed over the final location where the mooring anchor is lowered. Geophysical survey data will be used as a pre-clearance methodology to avoid sensitive habitats within the cable corridors and lease areas. PAM Buoy systems are much smaller in size than met buoys and the anchoring systems would result in much smaller impact (additional anchoring details provided in **Section 3.1.2.1**). There would not be a surface expression (no surface buoy) and no line throughout the water column. All deployed buoys will be compliant with the U.S. Coast Guard and federal and state regulations regarding marking and lighting. An autonomous underwater vehicle (AUV) (e.g., underwater glider) may be used with a PAM recorder or PAM array placed inside or strapped to the exterior of the vehicle[12].

The Lessee must collect a minimum of 3 years of PAM data for monitoring the presence of large whales in the Gulf of Maine North Atlantic Right Whale Critical Habitat within their lease area to support the submission and review of the COP. The Lessee must follow the Regional Wildlife Science Collaborative (RWSC) best practices for data processing and archiving to ensure data comparability and transparency. All raw data must be sent to the National Centers for Environmental Information (NCEI) Passive Acoustic Data archive on an annual basis and the Lessee must follow NCEI guidance for packaging the data. Confirmation of this submission may be provided as part of the certification of compliance statement submitted pursuant to 30 CFR 285.633(a).

Decommissioning is basically the reverse of the installation process. Equipment recovery would be performed with the support of a vessel (or vessels) equivalent in size and capability to that used for installation. For small buoys, a crane-lifting hook would be secured to the buoy. A water or air pump system would de-ballast the buoy, causing it to tip into the horizontal position. The mooring chain and anchor would be recovered to the deck using a winching system. The buoy would then be transported to shore. Buoy decommissioning is expected to be completed within 1 to 2 days, depending on buoy type.

For the analyses in this BA, BOEM has assumed that PAM buoys used would be primarily bottom-mounted systems which would be anchored to the sea floor within a lease area. BOEM has assumed the PAM buoy installation and decommissioning assumptions would be the same as those for met buoys (see **Section 3.1.1.1**), and on-site inspections and maintenance would occur every 6 months. Buoy installation, operation,maintenance, and decommissioning may include vessel traffic, noise, lighting, air emissions, and routine vessel discharges. Bottom disturbance and habitat degradation may also occur as a result of PAM buoy anchoring and installation.

[12] Per Van Parijs et al. 2021. NOAA and BOEM minimum recommendations for use of passive acoustic listening systems in offshore wind energy development monitoring and mitigation programs. *Frontiers in Marine Science*, *8*, p.760840.

3.1.2.3 Vessels and Potential Ports

Installation of the two met buoys per lease (**Section 3.1.1.1**) is expected to occur within one year after lease issuance. Timing for all maintenance and decommissioning trips would be dependent on lessee schedules. An overview of the vessel activities associated with the proposed site assessment activities (i.e., installation, maintenance, and decommissioning of the met buoys) is provided in **Table 3-3**. Estimates of vessel speeds during transiting activities are provided based on available information from BOEM (2021); however, all vessel trips in **Table 3-3** included under the Proposed Action will adhere to the vessel strike avoidance measures provided in **Section 3.3**,.Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (18.5 mph) or less while operating in any Seasonal Management Area (SMA), Dynamic Management Area (DMA)/Slow Zones triggered by visual detection of North Atlantic right whales. Vessel traffic associated with the installation and maintenance of the met buoys would be split between ports in Maine, Massachusetts, and New Hampshire, and no expansion of these ports is expected in support of the Proposed Action. Vessels could use the following general port locations:

- Searsport, ME;
- Portland, ME;
- Portsmouth, NH;
- Boston, MA;
- Salem, MA; and
- New Bedford, MA.

For the purpose of this BA analysis, up to 1,440 vessel round trips to support met buoy and PAM buoy deployment, maintenance, and decommissioning may be conducted during site assessment activities for Phase 1 (10 leases; April 2025–August 2029) and Phase 2 (April 2029–December 2033) under the Proposed Action.

Table 3-3. Summary of the vessel trips expected to occur for the installation, maintenance, and decommissioning of all site assessment buoys for all 15 leases under the Proposed Action[1,2, 3]

Buoy Type	Total # of buoys (for all 15 leases)	Round trips for installation, decommissioning per buoy (range)	Total round trips for installation of all buoys (range)	# of quarterly (4) to monthly (12) maintenance trips over 5 years for all buoys (range)	Total round trips for decommissioning of all buoys (range)	Total estimated round trips (range)
Met Buoys	30	1–2	30–60	300–900	30–60	360–1,020
PAM Buoys	60	1	60	300	60	420
Totals	90	2-3	90-120	600-1,200	90-120	1,440

[1] The numbers presented in this table represent the best estimated number of vessel transits to be conducted for all 15 lease areas in total (i.e., for the entire Gulf of Maine Wind Energy Area) during site assessment activities for Phase 1 (10 leases; April 2025–August 2029) and Phase 2 (5 leases; April 2029–December 2033).
[2] Vessel trips for site characterization surveys and installation, maintenance, and decommissioning of met and PAMbuoys were estimated as one (24-hour) vessel day. For met and PAM buoys, on-site inspections and preventive maintenance (i.e., marine fouling, wear, or lens cleaning) are expected to occur on a monthly or quarterly basis. Periodic inspections for specialized components (i.e., buoy, hull, anchor chain, or anchor scour) would occur at different intervals but would likely coincide with the

monthly or quarterly inspection to minimize the need for additional boat trips to the site. Wherever reasonable, vessel trips will be combined, facilitating the servicing of multiple buoys in a single lease area within the same vessel day.

[3] Assumptions: It is assumed that nearshore work (i.e., portions of the cable route corridor surveys) could use 12-hour vessels (vessels that work for 12 hours per day), but WEA surveys would use 24-hour vessels (vessels that work for 24 hours per day). Vessel round trips for quarterly maintenance visits over the course of 5 years are expected to total 300; 900 vessel round trips are expected if maintenance is performed monthly (over 5 years).

3.1.3 Site Characterization Activities

Site characterization activities that are part of the Proposed Action would occur within each of the Lease Areas, areas immediately surrounding it, and potential cable routes. Site characterization surveys include a variety of activities that assess of construction hazards and characterization of the physical, biological, cultural environment in which the project may take place. Site characterization activities would include geophysical reconnaissance surveys; HRG surveys; geotechnical surveys; benthic surveys; physical oceanographic monitoring; biological surveys; and associated vessel traffic. Individual survey plans of each lessee may vary. BOEM does not have a regulatory requirement for the submittal and approval of site characterization plans; BOEM does not issue permits or approvals[13] for these site characterization activities, but a Lessee must submit the results of site characterization surveys with their plans[14] (e.g., 30 CFR § 585.610, § 585.626, and § 585.645). Therefore, the types of survey activities (i.e., geophysical and geotechnical, biological, and archaeological surveys and monitoring activities) that may occur are considered as part of the Proposed Action associated with lease issuance. BOEM has in the past and is proposing for the Gulf of Maine to include a requirement for the submittal of site characterization plans to be reviewed for consistency with this biological assessment.

3.1.3.1 Geophysical Reconnaissance Surveys

Individual lessees will conduct geophysical reconnaissance surveys of their respective lease area and export cable routes within the WEA. Reconnaissance surveys are designed to cover a broader area and collect relatively lower resolution data than HRG surveys (**Section 3.1.2.2**) in order to identify specific locations for subsequent HRG surveys. These surveys typically utilize hull-mounted multibeam echosounder (MBES) with backscatter measurement (proxy for seafloor hardness) and a sub-bottom profiler (SBP). A summary of the equipment proposed for these surveys is provided in **Section 3.1.2.2**.

Geophysical reconnaissance surveys would be expected to occur for each of the 15 potential leases and within one year after lease sales are finalized and would include both 24-hour (i.e., daytime and nighttime) and 12-hour (i.e., daytime only) operations. All lease areas conducting activities concurrently is not a reasonable assumption due to vessel availability and project demand.

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[13] BOEM regulations previously required lessees to submit a SAP prior to deployment of met buoys. BOEM and BSEE’s final Renewable Energy Modernization Rule published on May 15, 2024 (89 FR 42602), eliminated the SAP requirement for met buoys because the SAP process may duplicate USACE’s long-standing permitting process under Section 404(e) of the Clean Water Act (33 USC 1344(e)) and Section 10 of the Rivers and Harbors Act of 1899 (33 USC 401 et seq.) for the installation of met buoys, which are categorized by the USACE as scientific measurement devices. The final rule is effective on July 15, 2024 and will apply to all commercial lease sales in the Gulf of Maine WEA. The final rule can be found at https://www.federalregister.gov/documents/2024/05/15/2024-08791/renewable-energy-modernization-rule.

[14] Based on the requirements of the renewable energy regulations at 30 Code of Federal Regulations (CFR) Part 585, BOEM’s guidance for lessees, previous lease applications and plans that have been submitted to BOEM, and previous environmental compliance prepared for similar activities.

3.1.3.2 HRG Surveys

HRG survey data provides information on seafloor and subsurface conditions as they pertain to project siting and design, including shallow geologic and anthropogenic hazards like the presence or absence of archaeological resources. BOEM's Guidelines for Providing Geophysical, Geotechnical, and Geohazard Information (BOEM 2023b) require high-frequency sub-bottom profiler data and medium-penetration seismic surveys. A medium-penetration seismic system, such as a boomer, sparker, bubble pulser, or other low-frequency system, can be used to provide information on sedimentary structure that exceeds the depth limitations of compressed high-intensity radiated pulse (CHIRP) systems. Use of AUVs may be part of the HRG survey activities and specifics of those devices and how they will be used will be survey specific. BOEM guidance also recommends collection of sedimentary structure data 10 meters beyond the depth of disturbance, which may be conducted using sub-bottom profiler systems.

AUVs may be used for some site characterization activities including HRG and PAM surveys. Instead of mounted on vessel hulls, or towed behind vessels, HRG equipment could be deployed on AUVs to conduct site characterization surveys. These surveys may or may not make use of underwater transponder positioning (UTP) systems. An AUV can run many geophysical sensors at once and typically consists of a multibeam echosounder, sidescan sonar, magnetometer, and a sub-bottom profiler. Typical survey speeds for AUVs are not expected to exceed 2.5 knots. Additionally, Lessees must discuss AUV deployment with BOEM prior to contracting to understand what measures may be necessary to minimize interactions with protected species for the AUV system under consideration. Acoustic effects from AUVs would be consistent with the analysis below for HRG data collective devices.

HRG data acquisition instrumentation used during surveys could add noise to the underwater environment. The types of equipment that may be used during these surveys are described in **Table 3-3**;Equivalent technologies to those listed in the table[15] could be used if potential impacts are similar to those analyzed for the equipment described in this BA and are reviewed by BOEM to determine consistency with this assessment prior to the surveys being conducted.. Acoustic information presented is representative of the types of equipment that may be used during characterization and site surveys, for which sound characteristics are known from field measurements at various distances from the source; these measurements were then back-calculated to 1 meter to estimate the source levels shown in **Table** 3-3 (Crocker and Fratantonio 2016). This information is based on the highest reported power settings and source levels, but the actual equipment and settings used could have frequencies and source levels that differ from those indicated. The line spacing for HRG surveys would vary depending on the data collection requirements of the different HRG survey types. The HRG survey equipment has numerous configurations (e.g., towed, pole mounted, hull mounted or mounted on autonomous underwater vehicles [AUVs]) but is typically deployed as a single source element, unlike other geophysical survey operations (e.g., oil and gas deep penetrating seismic exploration and mid-frequency active sonar military exercises), which use source arrays with multiple units or elements operating in unison. More information on the technical specifications of the representative sources presented here can be found in Crocker and Fratantonio (2016).

Each lessee would be expected to begin surveys within their respective lease areas and prospective cable routes within a few years lease sales (lessee dependent). Surveys would then continue in a phased approach for up to 5 years leading up to the preparation and submittal of the individual COPs. These surveys would include both 24-hour (i.e., daytime and nighttime) and 12-hour (i.e., daylight only)

[15] BOEM Center for Marine Acoustics maintains a list of HRG equipment, found here: Sound Source List https://www.boem.gov/sites/default/files/documents/environment/center-marine-acoustics/Sound Source List_Mar2023.pdf

operations). in The surveys would collect bathymetrical (seafloor depth), morphological (topography), and geological data to inform various charting, interpretation, analyses, and reporting efforts, including assessment of archeological resources. The HRG surveys specifically may utilize boomer, MBES, side-scan sonar (SSS), ultra-short baseline (USBL) equipment, parametric SBP, non-parametric SBP (i.e., CHIRPs), and sparker sources. A summary of representative equipment HRG surveys is provided in **Table 3-3**.

BOEM assumes that, during site characterization, a lessee would survey potential offshore export cable routes (for connecting future wind turbines to an onshore power substation) from the WEA to shore using HRG survey methods. BOEM assumes that the HRG survey grids for a proposed offshore export cable route to shore would likely occur over a 1,000-meter-wide corridor, centered on the potential offshore export cable location, to allow for anticipated physical disturbances and movement of the proposed cable, if necessary. Because it is not yet possible to predict precisely where an onshore electrical substation may ultimately be installed or to know the route that any potential future export cable would take across the seafloor from the WEA to shore, this Draft BA uses direct routes from the far side of the WEA to hypothetical potential interconnection points onshore in Maine, Massachusetts, and New Hampshire. The hypothetical points were selected based on proximity from onshore points of interconnection to the WEA to conservatively approximate the level of surveys that may be conducted and the number of geotechnical and benthic samples (S**ections 3.1.2.3 and 3.1.2.4**) that would be collected to characterize an offshore export cable route. The hypothetical points of interconnection used to approximate the level of surveys for the WEA in no way represents proposed export cable routes.

Table 3-3. Representative geophysical survey equipment for the geophysical reconnaissance and HRG surveys[1]

HRG Equipment Categories		SL PK (dB re 1 μPa m)	SL SPL (dB re 1 μPa m)	SL SEL (dB re 1 μPa m)	Main Pulse Frequency (kHz)	Pulse Duration (seconds)	PPS	Beamwidth (degrees)
Medium-penetration SBP	Boomers (proxy: AA251 boomer plate)	216	207	176	4.3	0.0008	1	Omni
	Sparkers (proxy: AA Dura-Spark)	225	214	188	2.7	0.0022	6	Omni
	Bubble guns	204	198	173	1.1	0.0033	8	Omni
Shallow-penetration, non-parametric SBP (CHIRPs)	SBP (proxy: EdgeTech 512i)	186	180	159	6.3	0.0087	8	80
	SBP (proxy: Knudsen 3202)	214	209	193	3.3	0.0217	4	83
Parametric SBP	Innomar medium-100 (SES-2000)	N/A	240	N/A	85	0.00007	40	2
Echosounders	Reson Seabat 7111 multibeam echosounder	228	224	185	100	0.00015	20	160
	Reson Seabat T20P multibeam echosounder	223	220	184	>200	0.000254	50	160
	Echotrac CV100 single-beam echosounder	197	194	163	>200	0.000711	20	7
Side-scan sonar	Klein 3900 side-scan sonar	226	220	179	>200	0.000084	unreported	1.3
USBL positioning	AA, Fatboy Beacons 1160 Series	N/A	206	N/A	21	0.3	1	15
	Edgetech 4380	N/A	197	N/A	21	0.3	1	90

[1] Source information for HRG equipment categories was obtained from the 2021 information programmatic Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf (Baker and Howson 2021) which based their assessment on the reported source characteristics in Crocker and Fratantonio (2016). However, revisions were made to this table as follows based on new information published since the 2021 assessment was conducted:

Parametric SBP were not evaluated in Crocker and Fratantonio (2016) or the 2021 information programmatic (Baker and Howson 2021), but have been used and/or proposed in more recent site characterization surveys associated with offshore wind development in the U.S. Atlantic. Therefore, this equipment was added to the table using information from BOEM (2023c).

The 2021 programmatic (Baker and Howson 2021) did not provide beamwidths for the sources analyzed; therefore, beamwidths for each equipment type were obtained from Crocker and Fratantonio (2016) or BOEM (2023c), depending on the source.

USBLs were not evaluated in Crocker and Fratantonio (2016) or the 2021 information programmatic (Baker and Howson 2021), but are known to be used during site characterization surveys associated with offshore wind development in the U.S. Atlantic. Therefore, this equipment was added to the table using information from BOEM (2023c).

μPa = micropascal; CHIRP = compressed high-intensity radiated pulse; dB = decibels; HRG = high-resolution geophysical; kHz = kilohertz; m = meter; N/A = not applicable; PK = zero-to-peak sound pressure level; PPS = pulses per second; re = referenced to; SBP = sub-bottom profiler; SEL = sound exposure level; SL = source level; SPL = root-mean-square sound pressure level; USBL = ultra-short baseline.

3.1.3.3 Geotechnical Surveys

Geotechnical surveys are performed to assess the suitability of substrate for installation of infrastructure including WTGs (wind turbine generators) and substation foundations and cables. Geotechnical samples are also used to evaluate shallow sediment characteristics for water quality and sediment dispersion modeling. Samples for geotechnical evaluation are typically collected using a combination of boring and in situ methods taken from a survey vessel or drilling vessel. Likely methods to obtain samples to analyze physical and chemical properties of surface sediments are described in **Table 3-4**. These methods may result in bottom disturbance as a result of physical seafloor sampling.

Within 1 year of lease sale, lessees would conduct geotechnical surveys of their respective lease areas and potential export cable routes to sample or test seabed characteristics to inform design specifications of and locations suitable for placement of anchors for future floating wind turbine foundations and cable infrastructure. Up to 15 individual lessees could be surveying within the WEA at any time after lease sales have been completed. All lease areas conducting activities concurrently is not a reasonable assumption, based on vessel availability and project demand. Equipment used for these surveys within each individual lease area may include shallow geotechnical coring (piston or vibracores) (**Table 3-4**). Individual lessees would be responsible for preparing a full G&G survey plan which would further define this information and would be reviewed by BOEM, in coordination with NMFS GARFO, for ensuring consistency with this BA prior to the start of these surveys.

Geotechnical sampling of the WEA would require one sample at every potential wind turbine location (which would only occur in the portion of the WEA where structural placement, including fixed foundations, floating turbine anchors, etc., is allowed) and one sample per kilometer of offshore export cable corridor. It is estimated that a total of 3,645geotechnical samples will be collected at the WTG and substation locations (three geotechnical samples are expected at every potential WTG and transmission station location) and 6,149along the cable routes (one geotechnical sample is expected every kilometer along the transmission cable corridor) for all 15 leases. There are 33 total expected vessel trips associated with geotechnical sampling efforts. The area of seabed disturbed by individual sampling events (e.g., collection of a core or grab sample) is estimated to range from 1 square meter to 10 square meters (BOEM 2014a; Fugro Marine GeoServices Inc. 2017). Geotechnical sampling methods expected to disrupt the seafloor include vibracoring, CPT and/or deep borings. The amount of effort and number of vessel trips required to collect the geotechnical samples vary greatly by the type of technology used to retrieve the sample. Some vessels require anchoring for brief periods using small anchors; however, approximately 50 percent of deployments for this sampling work could involve a boat having dynamic positioning capability (i.e., no seafloor anchoring impacts) (BOEM 2014a). These surveys would include both 24-hour (i.e., daytime and nighttime) and 12-hour (i.e., daylight only) operations, occurring concurrently with benthic sampling.

There are residual risks of encountering munitions and explosives of concern (MEC)/unexploded ordnance (UXO) during surveying, and in the event that a MEC/UXO is encountered, lessees should follow the National Guidance for Industry on Responding to Munitions and Explosives of Concern in U.S. Federal Waters[16]. As with HRG surveys, increased vessel presence and traffic during geotechnical surveys may result in exposure to several stressors, including noise, air emissions, routine vessel discharges, and lighting from vessels. Additionally, bottom disturbance may occur as a result of geotechnical surveys due to physical sampling methods.

[16] See: National Guidance for Responding to Munitions and Explosives of Concern in Federal Waters (bts.gov)

Table 3-4. Geotechnical/benthic sampling survey methods and equipment

Survey Method	Use	Description of the Equipment and Methods
Bottom-sampling devices	Penetrating depths from a few centimeters to several meters	A piston core or gravity core is often used to obtain samples of soft surficial sediments. Unlike a gravity core, which is essentially a weighted core barrel that is allowed to free-fall into the water, piston cores have a piston mechanism that triggers when the corer hits the seafloor. The main advantage of a piston core over a gravity core is that the piston allows the best possible sediment sample to be obtained by avoiding disturbance of the sample (MMS 2007b). Shallow-bottom coring employs a rotary drill that penetrates through several feet of consolidated rock. Drilling produces low-intensity, low-frequency sound through the drill string. The above sampling methods do not use high-energy sound sources (Continental Shelf Associates Inc. 2004; MMS 2007a).
Vibracores	Obtaining samples of unconsolidated sediment; in some cases, may also be used to gather information to inform the archaeological interpretation of features identified through the HRG survey (BOEM 2023b)	Vibracore samplers typically consist of a core barrel and an oscillating driving mechanism that propels the core barrel into the sub-bottom. Once the core barrel is driven to its full length, the core barrel is retracted from the sediment and returned to the deck of the vessel. Typically, cores up to 6 m long with 8 cm diameters are obtained, although some devices have been modified to obtain samples up to 12 m long (MMS 2007a; USACE 1987).
Deep borings	Sampling and characterizing geotechnical properties to provide relevant data for facility design, to a minimum depth of 10 m below the maximum depth of seafloor disturbance, or depth of cable or structure (BOEM 2023b)	A drill rig is used to obtain deep borings. The drill rig is mounted on a jack-up barge supported by four “spuds” that are lowered to the seafloor. Geologic borings can generally reach depths of 30 to 61 m within a few days (based on weather conditions). The acoustic levels from deep borings can be expected to be in the low-frequency bands and below the 160 dB threshold established by NMFS to protect marine mammals (Erbe and McPherson 2017).
CPT	Supplement or use in place of deep borings (BOEM 2023b)	A CPT rig would be mounted on a jack-up barge similar to that used for the deep borings. The top of a CPT drill probe is typically up to 8 cm in diameter, with connecting rods less than 15 cm in diameter.

cm = centimeter; CPT = cone penetration test; dB = decibels; HRG = high-resolution geophysical; m = meter; NMFS = National Marine Fisheries Service.

3.1.3.4 Benthic Surveys

Lessees will conduct detailed benthic surveys to characterize seafloor habitats of each of the individual leases including export cable routes. Benthic sampling could also include nearshore, estuarine, and SAV habitats along the cable corridors. Individual surveys (within each lease) may utilize benthic grabs (e.g., Hamon grab or Van Veen grab), frame-mounted sediment profile imaging/plan view cameras, and underwater video. Underwater video data would be used to meet the same survey goals of the geophysical reconnaissance survey scope (**Section 3.1.2.1**) and would be deployed with the benthic grabs and sediment profile imaging/plan view cameras during the benthic surveys.

The exact scope of these surveys has not yet been determined but it is anticipated that, throughout the during the 5-year survey period for each lease. , one benthic sample will be taken per kilometer of transmission cable corridor for a total of 6,149samples. Additional benthic sampling will occur at each met buoy and PAM buoy site, for a total of 90 samples.There are 16 total expected vessel trips associated with benthic sampling efforts. Samples would result in minimal seafloor disturbance, on the order of several square meters in disturbance area. Lessees would be responsible for preparing detailed G&G survey plan which define this information and reviewed by BOEM, in coordination with NMFS GARFO, for ensuring consistency with this BA prior to the start of these surveys. These surveys would include both 24-hour (i.e., daytime and nighttime) and 12-hour (i.e., daylight only) operations, occurring concurrently with geotechnical sampling.

3.1.3.5 Physical Oceanographic Monitoring

To measure the speed and direction of ocean currents, Acoustic Doppler Current Profilers (ADCPs) would likely be installed on met buoys or the ocean floor within all 15 commercial leases. The ADCP is a remote sensing technology that transmits sound waves at a constant frequency and measures the ricochet of the sound wave off fine particles or zooplankton suspended in the water column. The ADCPs may be mounted independently on the seafloor or attached to a buoy. Two types of ADCPs could be applied for measuring bottom currents, either down-looking (buoy-mounted) or up-looking (bottom-mounted) ADCPs. For bottom-mounted ADCPs that could be deployed at depths within the Gulf of Maine WEA (min = 120 m, max = 277 m, mean = 197 m), it is unlikely that wire cables will be used. A more likely scenario would be to use a standalone device housed in a TRBM (trawl resistant bottom mount) with acoustic releases that release marker buoys for retrieval.A seafloor mounted ADCP would likely be located near the met buoy (within approximately 500 feet [152 meters]). In the highly unlikely scenario that a bottom-mounted ADCP requires wiring in the Gulf of Maine WEA, the wire would be hand-buried adjacent to the mooring of met-ocean equipment. Trenching or scour protection of the ADCP wire is not part of the proposed action. The anticipated footprint for a bottom-mounted ADCP and TRBM are in the 4-6 ft by 2-4 ft range. A typical ADCP has 3 to 4 acoustic transducers that emit and receive acoustical pulses from different directions, with frequencies ranging from 300 to 600 kilohertz (kHz) and a sampling rate of 1 to 60 minutes. A typical ADCP is about 1 to 2 feet tall and 1 to 2 feet wide. Its mooring, base, or cage (surrounding frame) would be several feet wider.

3.1.3.6 Biological Surveys

Lessees may conduct high-definition digital aerial surveys throughout the Action Area to sample and map seasonal occurrence and activity of birds, bats, marine mammals, sea turtles, and large fish. Surveys would also document the number of individuals, distribution, behaviors (e.g., foraging, traveling/flying, resting), and flight height and direction (if applicable). The surveys may use high-resolution digital video cameras mounted on a fixed-wing aircraft.

Vessel-based visual wildlife surveys may be conducted by the Lessees to assess marine mammal, bird, and sea turtle species utilization of the WEA, with emphasis on endangered and threatened species listed under the ESA. The surveys would also assess information variability and uncertainty associated with baseline surveys. All observers would document species ID, location, group size, distance and bearing from vessel, flight height for birds, and behavior for each sighting as well as sea state, time of day, glare, and fishing activity in the area. Additionally, passive acoustic monitors (PAM) may be mounted on and conducted from AUVs, drones, or vessels to monitor for the presence of vocalizing marine mammals.

Met buoys could also accommodate environmental monitoring equipment such as avian monitoring equipment (e.g., thermal imaging cameras, Motus receivers), acoustic monitoring for marine mammals, data logging computers, visibility sensors, water measurements (e.g., temperature, conductivity salinity), and communications equipment.

3.1.3.7 Vessels and Potential Ports

The potential types, number of transits, and potential speeds for vessel activities associated with the proposed site characterization activities is summarized in **Table 3-5**. Vessels could use the following general port locations: Searsport, ME; Portland, ME; Portsmouth, NH; Boston, MA; Salem, MA; and New Bedford, MA. No vessel transits from ports outside of this region are considered under the Proposed Action. Estimates of vessel speeds during transiting and survey activities are provided based on available information from BOEM (2021b) or based on the type of survey activities proposed for each vessel; however, all vessels in **Table 3-5** included under the Proposed Action will adhere to the vessel strike avoidance measures provided in **Section 3.3**, so actual vessel speeds may differ based on mitigation requirements during the surveys.

For the analyses in this BA, it is assumed that each of the 15 leases would require a single vessel type for each survey type and that the timing of the surveys would occur within 1 year of lease approval and could continue for 5 years leading up to submittal of the COP.

Reconnaissance and HRG surveys could be conducted from up to 2 vessels concurrently per lease: one for the 24-hour operations and one for the 12-hour operations. It is anticipated that the 24-hour survey operations would require monthly port calls depending on many factors, including weather downtime, vessel replenishment, and crew changes throughout a 4-month survey period for each lease. The 12-hour operations will require daily vessel trips back to port during the 4-month survey period. Geophysical HRG 12-hour operations would amount to a total of 757 round trips (for all 15 lease areas) and geophysical HRG 24-hour operations would amount to a total of 94 round trips (**Table 3-5**).

It is anticipated that geotechnical surveys would require 33 round trips (total for all 15 lease areas) that would each last for approximately 30 days per trip, conducted using 24-hour operations (i.e., daytime and nighttime) over a 4-month period after lease sales have been finalized. The full extent of the timing of these surveys are highly dependent on many factors, including weather downtime, vessel replenishment, and crew changes.

Benthic survey vessels conducting 24-hour operations could undergo up to 16 round trips[17] (during a four-month period, one round trip of approximately 30 days would occur).

Up to 36 visual wildlife surveys (marine mammal, sea turtle, and avian) associated with the lease and potential ROW areas are expected to be conducted per lease over the 5-year site characterization period for each lease. It is assumed that each survey would require one vessel round trip, resulting in 36 round trips per lease area, amounting to 540 round trips total for all 15 lease areas (**Table 3-5).**

[17] 24-hour vessels could be used with trips lasting 30 days each.

Seasonal biological surveys could include up to 1,920 vessel trips. these vessel trips are estimated based on potential effort described in BOEM's offshore renewable energy development survey guidelines (BOEM 2023a)..

In total, up to 3,360 vessel round trips[18] may be conducted during site characterization activities for Phase 1 (10 leases; April 2025–August 2029) and Phase 2 (5 leases; April 2029–December 2033) under the Proposed Action. The total includes all vessel types and activities identified for the site characterization activities described in Sections 3.1.2.1 through 3.1.2.6 and summarized below in **Table 3-5**).

[18] Some vessel trips last more than one day (e.g., two days for a round trip or a 24-hour vessel spends 30 days on a single trip), so for consistency in estimating vessel impacts (e.g., from traffic, emissions, and collision risk), the total number of days of vessel activity is used for analyses.

Table 3-5. Representative vessels and vessel trips for the 15 leases in total during site characterization activities for the Proposed Action[1]

Vessel Type	Approx. Vessel Length	Approx. Vessel Draft	Destination	Number of Vessels	Timing	Total Number of Round Trips[2]	Frequency of Transits	Approx. Vessel Transit Speed (knots)[3]	Approx. Vessel Survey Speed (knots)
Geophysical reconnaissance and HRG 24-hour vessel[3]	164 ft (50 m)	11.8 ft (3.6 m)	Individual Lease Area and export cable routes	15	Within 1 year of lease approval	94	Monthly	10	4.5
Geophysical reconnaissance and HRG 12-hour vessel	49 ft (15 m)	10 ft (3 m)	Individual Lease Area and export cable routes	15	Within 1 year of lease approval	757	Daily	10	4.5
Geotechnical survey vessel 24-hour vessel	246–262 ft (75-80 m)	12.8 ft (3.9 m)	Individual Lease Area and export cable routes	15	Within 1 year of lease approval	33	Monthly	11.5	0
Research vessel for 24-hr benthic surveys	164 ft (50 m)	11.8 ft (3.6 m)	Individual Lease Area and export cable routes	15	Withing 1 year of lease approval	16	Monthly	12.5	0
Research vessel for visual wildlife surveys[4]	TBD	TBD	Individual Lease Area and potential ROW areas	15	Within 1 year of lease approval	540	Monthly to Seasonally	10	4.5
Vessels for biological surveys[5]	TBD	TBD	Individual Lease Area	TBD	Within 1 year of lease approval	1,920[6]	Seasonally	12.5	2.5

ft = feet; m = meters; PAM = passive acoustic monitoring; TBD = to be determined
[1] The numbers presented in this table represent the best estimated number of vessel transits to be conducted **for all 15 lease areas in total** (i.e., for the entire Gulf of Maine Wind Energy Area) during site characterization activities for Phase 1 (10 leases; April 2025–August 2029) and Phase 2 (5 leases; April 2029–December 2033), amounting to 3,360 vessel round trips total for site characterization activities.
[2] A round trip was assumed to include the vessel transiting from the home port to the destination (depending on the survey for which the vessel is operating) as well as the vessel transiting from the destination back to the home port.
[3] Vessel speeds during transit were sourced from Appendix A of the EA (BOEM 2024b).
[4] The visual wildlife surveys include surveys for marine mammals, sea turtles, and avian populations, conducted separately from any other vessel-based surveys. These visual wildlife surveys may include up to 36 vessel round trips per lease area.
[5] Biological surveys may include up to 128 vessel days per lease area.
[6] Vessel trips are counted as one vessel trip per vessel day. Some vessel trips last more than one day (e.g., two days for a round trip or a 24-hour vessel spends 30 days on a single trip.

3.2 Action Area

The Action Area is defined by 50 CFR 402.02 as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action." The Action Area for this consultation is a broad region that encompasses the area where all Project activities will occur, inclusive of all site assessment and site characterization surveys (e.g., geophysical reconnaissance, HRG, benthic, biological, fisheries) as well as all vessel transit routes for all Project-related activities. The Action Area includes the entire WEA and the area encompassing all potential cable routes. Vessel traffic associated with the Proposed Action would be split between ports in Maine, Massachusetts, and New Hampshire, and no expansion of these ports is expected in support of the Proposed Action. Vessels could use the following general port locations: Searsport, ME; Portland, ME; Portsmouth, NH; Boston, MA; Salem, MA; and New Bedford, MA. No vessel transits from ports outside of this region are considered under the Proposed Action. Further, no upriver[19] vessel transits or surveys are reasonably foreseeable under the Proposed Action[20].

3.2.1 Environmental Baseline Conditions Within the Action Area

3.2.1.1 Physical and Biological Conditions

The Gulf of Maine is the northernmost component of the Northeast Large Marine Ecosystem. It is considered a semi-enclosed sea encompassing 36,000 mi^2 (93,240 km^2) and is bounded by Maine, New Hampshire, Massachusetts, New Brunswick, and Nova Scotia. Its complex geological, bathymetric, oceanographic, and hydrological features support high levels of primary and secondary productivity, making it one of the most productive regions of all the world's oceans (Thompson 2010). Cold and nutrient-dense Scotian Shelf waters from the Labrador Current enter the Gulf of Maine through the Northeast Channel, which sets up a generalized counterclockwise circulation that is bounded by Georges Bank to the south; Maine Coastal Current waters exit via the Great South Channel (Thompson 2010).

Three major basins comprise the Gulf of Maine: Wilkinson Basin in the southwest, Jordan Basin in the northeast, and Georges Basin in the southeast. Other named geomorphic features include Stellwagen Bank, Cashes Ledge, Jeffreys Bank, and Georges Bank (Randall et al. 2024). Due to its shallow and well-mixed waters, Georges Bank is unique and known for high primary productivity as an offshore region. The high concentrations of chlorophyll-a on Georges Bank are like those found in near-shore regions of the continental shelf (Fogarty and Murkawski 1998) and supports an extensive food web including Atlantic cod (*Gadus morhua*), haddock (*Melanogrammus aeglefinnus*), and sea scallop (*Placopectin magellanicus*) among many others. In addition, the southeastern portion of Georges Bank (Nantucket Shoals) forms an important feeding ground for North Atlantic Right whales (O'Brien et al. 2022; Hayes et al. 2022) and many other species.

Tidal-driven mixing is pronounced in the Gulf of Maine, especially in the Bay of Fundy. Additionally, freshwater influx from 60 rivers enters the Gulf of Maine. Together, these features sustain high levels of biodiversity in the Gulf of Maine, with waters that are used seasonally and year-round by a number of

[19] No vessel transits further upriver from the port (e.g., Portsmouth) are considered under the Proposed Action.
[20] The port of Portsmouth, New Hampshire is located on the Piscataqua River, 4.0 nautical miles (7.4 km) from the mouth of the river. Vessels transits upriver from the port are not expected and therefore are not considered under the Proposed Action.

ESA-listed marine mammals, sea turtles, and fish, as well as other species of commercial, economic, and cultural value; over 3,000 marine species and birds utilize habitat within the Gulf of Maine. However, the Gulf of Maine's biological diversity is particularly vulnerable to rapidly changing physical and chemical conditions as a result of global climate change, as discussed in **Section 3.2.1.9**.

3.2.1.2 Seabed Conditions

The Gulf of Maine is relatively wide and has a relatively flat bottom with water depths ranging from 328 to 984 feet (100 to 300 meters) (Musial et al. 2023). Sediment from the coastline of the Action Area to roughly 295 ft (90 m) water depth is generally rocky with sand and gravel deposits. Muddy sediment deposits are also observed over large areas. High relief features exist beyond 9 nmi (16.7 km) from the coastline (Burgess 2022). The WEA is located within Wilkinson Basin with a maximum depth of 902 feet (275 meters) (Brooks 1992). Greater detail on seabed conditions within the WEA would be expected from the eventual site assessment surveys that would be conducted for the 15 commercial leases after lease sales have occurred.

Generalized mapping conducted by the Maine Coastal Mapping Initiative of the inner continental shelf shows a variation of benthic substrates along the Maine coastline (Maine Geological Survey 2023). the habitats along the coastline may be impacted by the transmission cable corridors or potential landing sites. These corridors will be further detailed once transmission cables are sited. From tidal areas to roughly 9 nautical miles (16.7 kilometers) at water depths of approximately 295 feet (90 meters), the substrate is patchy, with high-relief features observed beyond 9 nautical miles (16.7 kilometers) (Burgess 2022). Patches of gravel are found along the northeast coasts of the Penobscot Bay and Machias.

Nearshore habitats include shallow water estuaries and bays which are mostly soft bottom sediments but also include shellfish beds and submerged aquatic vegetation (SAV). These various habitats provide food and shelter for high trophic species and boost local biodiversity, while also serving as nursery grounds for local fish species (Stevenson et al. 2014; Kritzer et al. 2016). Stevenson et al. (2014) evaluated the importance of these nearshore habitats for 16 of the most common commercially important species and their prey. Their analysis showed that sand and gravel/cobble habitats are used by the majority of species and life stages, followed by mud, eelgrass, macroalgae, boulder, salt marsh channels, and shell (mussel) beds. Shallow water habitats in the Gulf of Maine provide valuable ecological services for a variety of species.

3.2.1.3 Water Column Conditions

The Maine Department of Environmental Protection, Marine Environmental Monitoring Program was established in 1991 to monitor the "extent and effect of industrial contaminants and pollutants on marine and estuarine ecosystems and to determine compliance with and attainment of water quality standards" (38 Maine Revised Statutes 410-F). The State has three water quality classes for marine and estuarine waters—SA, SB, and SC—listed in order from highest to lowest quality (38 Maine Revised Statutes 465-B). Classification is based on monitoring of ambient water quality, nutrients, and eutrophication indicators. The majority of marine and coastal waters are classified as SB (mid-quality), with intermittent areas along less-developed portions of the Gulf of Maine coastline and islands classified as SA (highest quality); and localized areas at the outlets of industrialized or nutrient-rich watersheds classified as SC (lowest quality) (Maine Department of Environmental Protection 2024).

Water quality in the Gulf of Maine is affected by contaminants entering the marine environment through a variety of sources, including runoff, sewage, and industrial discharges. The presence of contaminants in coastal and marine waters acts as a stressor to biological communities and poses health risks to humans from exposure to contaminated shellfish and water. The effects of human activity on water quality in the Gulf of Maine increased after European colonization and subsequent expansion of fishing and logging activity in the late 1700s and were further intensified with growth in coastal populations and development of industries such as logging operations, sawmills, fish processing plants, private septic systems, municipal sewage plants, pulp mills, and agricultural drainage and aquaculture operations. There are an estimated 2,024 active point sources of contaminants in the Gulf of Maine region, including 378 wastewater treatment plants and 93 power plants (Gulf of Maine Association 2023).

The contaminants of greatest concern for the Gulf of Maine region are sewage, nutrients, mercury, and microbial pathogens (bacteria, viruses, and protozoa) (Jones 2011; Harding and Burbidge 2013).

3.2.1.4 Underwater Noise

Ambient noise in the Gulf of Maine based on a recorder deployed offshore Bar Harbor, Maine from August 1 to 31, 2008, was estimated to have some of the lowest overall noise levels compared to the other recording sites along the U.S. East Coast (Rice et al. 2014). The long-term spectral averages showed regular low-frequency pulses throughout the recording period which were thought to be related to tidal flow noise (Rice et al. 2014). The highest sound energy was reported between 10 and 200 Hz with cumulative equivalent sound levels, calculated as the variation in sound levels as a function of time, for the entire recording period exceeded 105 decibels (dB) referenced to (re) 1 micropascal (µ Pa) less than 1 percent of the time, whereas 50 percent of the data throughout the recording period only exceeded a median of 84 dB re 1 µPa (Rice et al. 2014). On average, sound levels in the Gulf of Maine during this one month recording period exceeded 120 dB re 1 µPa, the behavioral disturbance threshold for marine mammals in response to continuous sources (**Section 6.3.1.1**), less than 10 percent of the time (Rice et al. 2014).

NOAA's NEFSC has deployed multiple recorders within the Gulf of Maine including a moored SoundTrap 500 located in 61 m water depth just south of the island of Monhegan, Maine, offshore Muscongus Bay in the northern part of the Action Area which collected data between February and December 2021; multiple marine acoustic recording units (MARU) deployed over Tillies Bank and Jeffreys Ledge just north of Stellwagen Bank National Marine Sanctuary in 60 to 133 m water depth which collected data between December 2007 and March 2010; and multiple MARU deployed within Stellwagen Bank National Marine Sanctuary in 25 to 81 m water depth which collected data between September 2008 and November 2009 (NOAA National Centers for Environmental Information [NCEI] 2023). Most of these studies collected animal detection information and no ambient noise levels were reported from any of these recorders, but raw data files are available that could potentially be mined for ambient noise levels (NOAA NCEI 2023).

Haver et al. (2018) used data from recorders deployed by NOAA and the National Park Service (NPS) around the U.S., one of which was deployed off the Northeastern U.S. along the continental shelf edge (outside of the Action Area) in approximately 2,953 ft (900 m) water depth. Data collected from July 2014 to March 2015 showed sound spectrum levels ranging from approximately 60 dB re 1 $\mu Pa^2/Hz$ at 1,000 Hz to 100 dB re 1 $\mu Pa^2/Hz$ at 18 Hz. The peaks in sound levels observed around 18 Hz were thought to be indicative of fin and blue whale vocalizations in the data (Haver et al. 2018). The patterns in the ambient noise levels at all sites analyzed by Haver et al. (2018) were thought to reflect proximity to populated port cities and shipping lanes which influenced the level of vessel traffic in the region. However, it is worth noting that this analysis focused on data in deep water beyond the shelf edge and outside the Action Area, which cannot be interpreted as representative of ambient noise conditions in the Action Area.

Haver et al. (2019) used data from similar recorders analyzed by Haver et al. (2018) but focused specifically on comparison of underwater soundscapes for U.S. National Parks and Marine Sanctuaries, including Stellwagen Bank National Marine Sanctuary, which falls within the Action Area. Results of this analysis showed sound levels in the 50 Hz to 1.5 kHz frequency band were lower in Stellwagen Bank between June through August compared to November through May, which were thought to be correlated with lower wind speeds during the summer. The data collected in this area also showed numerous, high-noise transient events thought to be vessel passages through the area (Haver et al. 2019). The 90^{th}, 5^{th}, and 10^{th} percentiles of the sound levels all peaked at 20 Hz with sound levels ranging from approximately 70 to 105 dB re 1 μPa^2/Hz at this frequency (Haver et al. 2019).

Haxel et al. (2022) deployed a hydrophone in a free drifting configuration at a 25-kW rated tidal turbine at the University of New Hampshire's Living Bridge Project in Portsmouth, New Hampshire. This project uses existing infrastructure of the Memorial Bridge connecting motor vehicle and pedestrian traffic between Portsmouth, New Hampshire, and Kittery, Maine, over the tidal Piscataqua River in Great Bay Estuary, roughly 4 km upriver from the river mouth. Data were collected between 21 and 23 July 2021 with the hydrophone deployed 1.6 m below the water's surface. The deployment method and timing were selected to align with the large possible range of the tidal turbine's generator outputs (Haxel et al. 2022). SPL ranged from approximately 105 to 125 dB re 1 μP but the authors noted that a comparisons of measured sound levels with proximity to the turbine did not reveal any clear patterns in noise levels associated with the turbine, nor was any repeated, characteristic turbine signal observed above the background ambient acoustic conditions (Haxel et al. 2022). Increases in SPL observed approximately 50 to 60 m downstream of the tidal turbine were thought to be attributed to passing vessels or noise related to the bridge from which the tidal turbine is deployed (Haxel et al. 2022).

3.2.1.5 Electromagnetic Field

The marine environment continuously generates ambient electromagnetic field (EMF) effects. The motion of electrically conductive seawater through Earth's magnetic field induces voltage potential, thereby creating electrical currents. Surface and internal waves, tides, and coastal ocean currents all create weak, induced EMF effects. Their magnitude at a given time and location depends on the strength of the prevailing magnetic field, site, and time-specific ocean conditions. Other external factors such as electrical storms and solar events can also generate variable EMF effects. The strength of Earth's direct current (DC) magnetic field is approximately 517 milligauss (mG) (51.7 microteslas [μT]) in the vicinity of the Lease Area (NOAA n.d.). This is the static magnetic field of Earth oriented to magnetic north at a declination of approximately 15 degrees west (NOAA n.d.). As ocean currents and organisms move through this DC magnetic field, a weak DC electric field is produced. For example, the electric field generated by the movement of the ocean currents through Earth's magnetic field is reported to be approximately 0.075 millivolts per meter (mV/m) or less (CSA Ocean Sciences Inc. and Exponent 2019). Wave action would also induce electrical and magnetic fields at the water surface on the order of 10 to 100 μV/m and 1 to 10 mG (0.1 to 1 μT), respectively, depending on wave height, period, and other factors. Although these effects dissipate with depth, wave action would likely produce detectable EMF effects up to 185 ft (56 m) below the surface (Slater et al. 2010). Petereit et al. (2019) found that tide-induced magnetic fields in the Gulf of Maine varied by approximately 0.68 nanoteslas (nT) between seasons, which was the largest seasonal difference found among the areas studied in this report.

Submarine transmission or communication cables can also contribute to EMF levels in an area. Electrical telecommunications cables are likely to induce a weak EMF in the immediate area along the cable path. Gill et al. (2005) observed electrical fields on the order of 1 to 6.3 μV/m within 3.3 ft (1 m) of a typical cable of this type. The heat effects of communication cables on surrounding sediments are likely to be negligible given the limited transmission power levels involved. Currently, there are two submarine cables which intersect partially with the Action Area (Northeast Regional Ocean Council 2024), installed between 1998 and 2005.

3.2.1.6 Artificial Light

Vessel traffic and navigational safety lights on buoys are the only artificial lighting sources in the open-water portion of the Action Area. Land-based artificial light sources become more predominant approaching the Maine, New Hampshire, and Massachusetts shorelines, especially in the vicinity of larger cities (i.e., Boston, Massachusetts; Portsmouth, New Hampshire; Portland, Maine).

3.2.1.7 Vessel Traffic

Bulk cargo vessels, tank vessels, cruise vessels, container vessels, tugs and tows, and military vessels transit the Gulf of Maine. In addition, commercial fishing vessels, recreational fishing vessels, and other types of pleasure craft share the waterways. Fishing vessels are the most prevalent vessel type in the Gulf of Maine. In 2021, state and federally licensed commercial fishers made 392,000 trips, mostly by lobster license holders, although other fisheries such as groundfish, scallop, and tuna are also active and contribute to the varied and extensive vessel traffic in the Gulf of Maine throughout the year (Burgess 2022). Most commercial vessel traffic, excluding fishing vessels, tend to travel within established vessel traffic routes. Principal ports within the Action Area include Searsport, ME; Portland, ME; Portsmouth, NH; Boston, MA; Salem, MA; and New Bedford, MA.

The WEA is located outside of existing designated routing measures; the southwestern edge of the WEA is located approximately 7.3 nautical miles (13.5 km) east of the Traffic Separation Scheme (TSS) entering and exiting the port of Boston, Massachusetts and adjacent to the Great South Channel Area To Be Avoided (ATBA). Primary routing measures located within the Action Area include:

1. TSSs and Precautionary Areas:
    a. Approaches to Portland, Maine, which consists of three parts: a precautionary area, an eastern approach, and a southern approach TSS (33 CFR 167.50-167.52).
    b. Approach to Boston, Massachusetts, which consists of three parts: two precautionary areas and a single approach TSS (33 CFR 167.75-167.77).
2. Two-Way Routes:
    a. Cape Cod Bay.
    b. Portland Harbor and Casco Bay, through Hussey Sound to Cousins Island and through Broad Sound to Harpswell, Maine.

In addition, the following Seasonal Management Areas (SMAs) with federally established speed regulations overlap with the Action Area; vessels 65 feet or longer must travel at 10 knots or less in these areas during the indicated dates:

1. Cape Cod Bay, January 1 through May 15
2. Off Race Point, March 1 through April 30
3. Great South Channel, April 1 through July 31.

In 2023, USCG completed the Approaches to Maine, New Hampshire, and Massachusetts Port Access Route Study (MNMPARS), which used multiple sources of data, such as the Automated Identification System (AIS), Vessel Monitoring System (VMS) traffic, commercial fishing statistics, public comments, and partner agency submissions to determine if routing measure revisions are necessary to improve navigation safety (USCG 2023). AIS vessel transit[21] counts in 2022 are presented in **Figure 3-1** . **Table 3-6** presents vessel trackline counts in the Action Area and the WEA from 2019 to 2022 and **Table 3-7**

[21] A vessel transit is considered a single one-way vessel passing.

reports the unique vessel counts within the Action Area and WEA from 2019 to 2022. These data provide a broad overview of the amount and type of vessels present in the MNMPARS study area (i.e., the Gulf of Maine), including general vessel traffic volume, patterns, and commonly trafficked routes for the Gulf of Maine. Based on the 4-year average, pleasure craft/sailing traffic, fishing vessels, cargo vessels, and tankers were the most common vessel types transiting through the WEA.

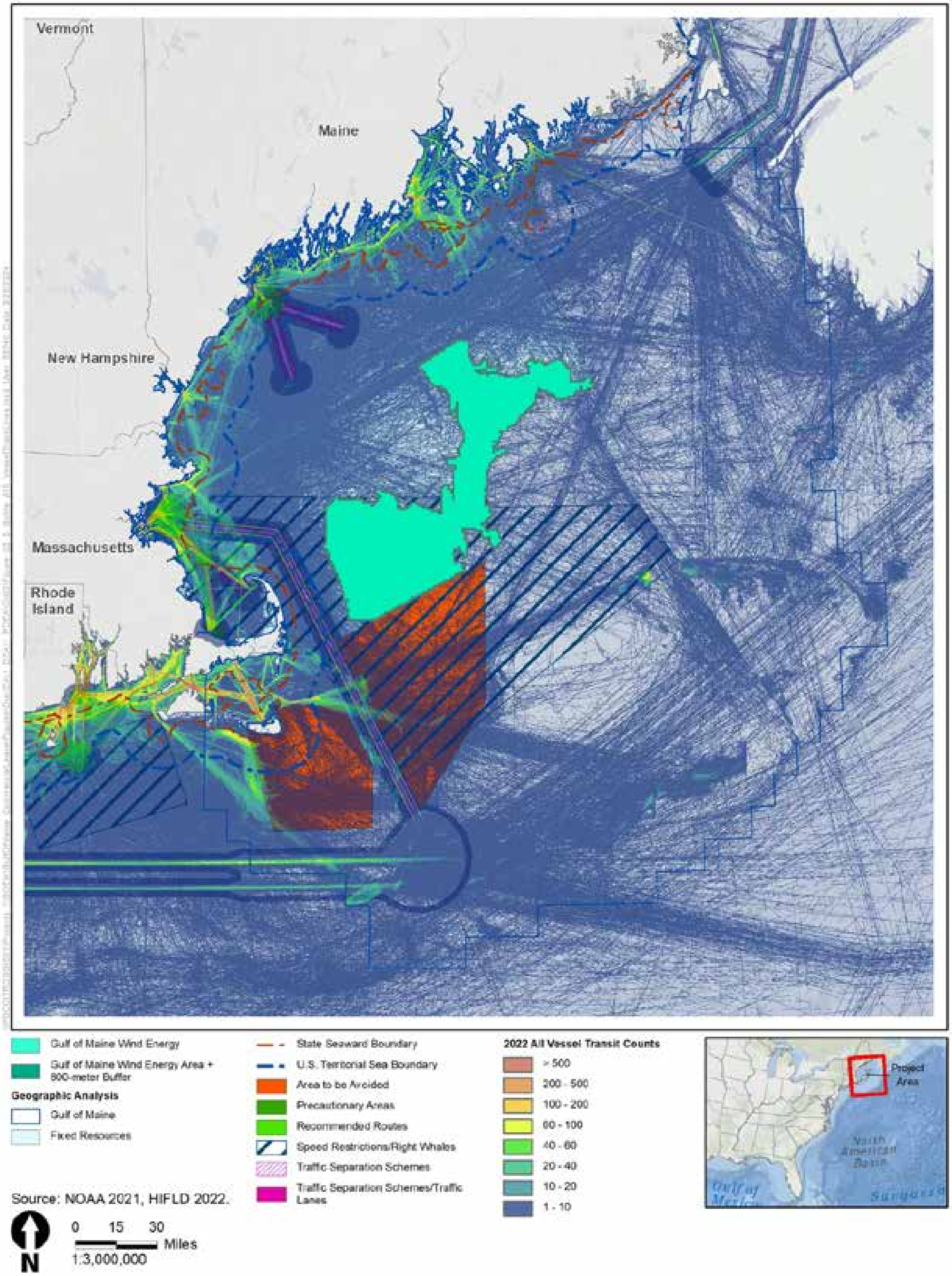


Figure 3-1. Automatic Identification System vessel transit counts for 2022 relative to the Gulf of Maine Wind Energy Area

Table 3-6. Vessel trackline counts by type for the Action Area and Gulf of Maine Wind Energy Area (WEA) (2019–2022)[1]

Vessel Type	Action Area					Wind Energy Area				
	2019	2020	2021	2022	Average	2019	2020	2021	2022	Average
Cargo	953	769	775	925	855	130	92	122	141	121
Fishing	28,090	28,954	30,656	29,123	29,205	1,068	1,357	1,347	1,051	1,206
Passenger	19,931	12,850	17,198	19,634	17,392	75	9	16	87	47
Pleasure Craft/Sailing	50,106	51,718	61,522	64,952	57,074	308	138	114	224	196
Tanker	1,253	1,190	1,307	1,346	1,274	226	259	266	281	258
TowTug	5,550	4,897	5,629	5,390	5,366	31	18	18	11	20
Other	5,654	5,186	7,367	8,561	6,692	69	35	66	96	66
Not Available[2]	3,706	4,112	3,445	2,656	3,479	129	152	37	12	82
Total	115,243	109,676	127,899	132,587	121,351	2,036	2,060	1,986	1,903	1,996

Source: BOEM and NOAA 2024
[1] Vessel trackline counts are not equivalent to USACE trips. The latter represent inbound and outbound passage to and from a port, whereas a trackline is a 24-hour segment (duration) of an AIS signal within the boundaries of the Action Area or the WEA.
[2] An unidentified vessel type within the USCG National Automatic Identification System (NAIS) data.

Table 3-7. Unique vessel counts by type for the Action Area and Gulf of Maine Wind Energy Area (WEA) [1] (2019–2022)

Vessel Type	Action Area					Wind Energy Area				
	2019	2020	2021	2022	Average	2019	2020	2021	2022	Average
Cargo	284	227	247	330	272	62	56	70	84	68
Fishing	740	767	822	833	790	67	76	87	79	77
Passenger	293	192	228	281	248	28	5	8	30	18
Pleasure Craft/Sailing	3,974	3,538	4,593	4,726	4,208	221	92	88	143	136
Tanker	168	149	213	194	181	56	56	77	70	65
TowTug	203	160	170	181	179	8	4	7	8	7
Other	273	207	306	361	287	25	16	39	38	29
Not Available[1]	237	291	306	219	263	45	50	18	8	30
Total	6,172	5,531	6,885	7,125	6,428	512	355	394	460	430

Source: BOEM and NOAA 2024.
[1] An unidentified vessel type within the USCG National Automatic Identification System (NAIS) data.

Overall, the data indicate that the Gulf of Maine is heavily trafficked (**Figure 3-1**). An average of 121,351 annual vessel trackline counts (**Table 3-6**) and 6,428 unique vessel counts (**Table 3-7**) were recorded in the Action Area from 2019 through 2022. Given its smaller area, fewer vessels transit the Gulf of Maine WEA; an average of 1,996 annual vessel trackline counts (**Table 3-6**) and 430 unique vessel counts **(Table 3-7**) were recorded in the WEA from 2019 through 2022. Aside from recreational vessels (pleasure craft/sailing), fishing vessels were generally the most prevalent vessel type within the geographic analysis area from 2019 to 2022. Also, while fishing vessels accounted for only 12 percent of the average annual unique vessel counts (**Table 3-7**), they represented approximately 24 percent of the average annual vessel trackline counts (**Table 3-6**).

An AIS transponder is only required on commercial vessels with a length of 65 feet (19.8 meters) or longer. Although some recreational and commercial fishing vessels smaller than 35 feet (10.7 meters) in length may choose to have a transponder, AIS is not mandatory on these vessels. VMS is also not mandatory on vessels. Therefore, these categories of vessels are underreported within the data presented above. When considering this limitation, the analysis of baseline vessel traffic for the Action Area as presented in this BA is likely an underestimate of actual ongoing vessel traffic associated with smaller vessels.

3.2.1.8 Commercial and Recreational Fishing

Multiple commercial and recreational fishing grounds and banks are located within the Gulf of Maine. Fisheries within the Action Area are managed at both the Federal and regional level. At the Federal level, there are two councils designated by the Magnuson Fishery Conservation and Management Act of 1976 (later renamed the Magnuson-Stevens Fishery Conservation and Management Act): New England Fishery Management Council (NEFMC) for Connecticut, Massachusetts, Maine, New Hampshire, and Rhode Island. The commercial and recreational fishing within the Action Area is located entirely within the jurisdiction of the NEFMC. At the regional level, the 15 Atlantic states form the Atlantic States Marine Fisheries Commission. Species managed at the Federal level include sea scallop, Atlantic salmon, Atlantic herring by the NEFMC and Atlantic bluefish by the Mid-Atlantic Fishery Management Council (MAFMC); both councils jointly manage monkfish and spiny dogfish. Species managed at the regional level include American lobster, black drum, red drum, tautog, and weakfish. Black sea bass, spiny dogfish, scup, and summer flounder are managed at both the Federal and regional level.

NMFS maintains landings data for commercial and recreational fisheries based on year, state, and species. Commercial fisheries that utilize the waters in the potential activity area to the greatest extent include the American lobster, menhaden, and Atlantic sea scallop fisheries. The American lobster fishery accounts for approximately 49.5 percent of the total fishing revenue from Maine, New Hampshire, and Massachusetts waters, and 77.8 percent of revenue when considering Maine alone based on 2021 landings data (NMFS 2021a). Additional fisheries include menhadens, haddock, seaweed/rockweed, shortfin squid, and others.

There are multiple recreational fishing areas located within the Action Area, many of which are along the shoreline (DMR 2023a). There are also numerous charter and head boats available in Maine which target a variety of species including striped bass, bluefin tuna, mackerel, sharks, bluefish, and others (DMR 2023b). In 2022, the fisheries with the highest landings included Atlantic mackerel striped bass, pollock and other cods/hakes, each with over one million pounds landed. Additionally, the Action Area (**Figure 3-1**) overlaps with Lobster Management Areas 1 and 3, and the Outer Cape Lobster Management Area (GARFO 2020), and Fisheries Statistical Areas 512, 513, 514, 515, and 521 (GARFO 2023a).

3.2.1.9 Climate Change

NMFS and USFWS list long-term climate change as a threat for almost all marine species (Hayes et al. 2020, 2022, 2023; NMFS 2022a, USFWS 2023a,b,c,d). Climate change is known to increase temperatures, alter ocean acidity, change ocean circulation patterns, raise sea levels, alter precipitation patterns, increase the frequency and intensity of storms, and increase freshwater runoff, erosion, and sediment deposition. These effects can alter habitat, modify species' use of existing habitats, affect migration and movement patterns, and affect an organisms' physiological condition (Albouy et al. 2020; Lettrich et al. 2023; Love et al. 2013; USEPA 2022a; Gulland et al. 2022; National Aeronautics and Space Administration [NASA] 2023).

An increase in ocean acidity has numerous effects on ecosystems, fundamentally resulting in a reduction in available calcium carbonate that many marine organisms use to build shells (Doney et al. 2009). This could alter the distribution and abundance of marine mammal and sea turtle prey items and result in feeding shifts within food webs (Love et al. 2013; USEPA 2022a; NASA 2023). For example, between 1982 and 2018, the average center of biomass for 140 marine fish and invertebrate species along U.S. coasts shifted approximately 20 mi (32 km) north (USEPA 2022a). These species also migrated an average of 21 ft (6.4 m) deeper (USEPA 2022a). This effect is especially profound off the northeast U.S., where American lobster, red hake, and black sea bass have shifted, on average, 113 mi (182 km) north since 1973 (USEPA 2022a).

Climate change could affect the incidence or prevalence of infection and the frequency, severity, and magnitude of epizootics (Burge et al. 2014). Of the 72 established unusual mortality events identified for marine mammals between 1991 and 2022 in U.S. waters, 14 percent are attributed to infectious disease, though this has not been directly correlated with climate change (Hayes et al. 2023). However, infectious disease outbreaks are predicted to increase as a result of climate change (Burek et al. 2008).

Over time, climate change and coastal development will alter existing habitats, rendering some areas unsuitable for certain species and more suitable for others. For example, shifts in NARW distribution patterns are likely in response to changes in prey densities, driven in part by climate change (Reygondeau and Beaugrand 2011; Meyer-Gutbrod et al. 2015, 2021; O'Brien et al. 2022). These long-term, high-consequence impacts could include increased energetic costs associated with altered migration routes; reduction of suitable breeding habitat, foraging habitat, or both; and reduced individual fitness.

Available data also suggest changing ocean temperatures and sea level rise may lead to changes in the sex ratio of sea turtle populations (e.g., green sea turtle [*Chelonia mydas*] population feminization predicted under Intergovernmental Panel on Climate Change scenarios by 2120; Booth et al. 2020), loss of nesting area, and a decline in population growth due to incubation temperature reaching lethal levels (Patrício et al. 2019; Varela et al. 2019). In addition to affecting nesting activity, increased sea surface temperatures could have physiological effects on sea turtles during migration (Marn et al. 2017). Higher temperatures in migratory corridors would be especially risky for metabolic rates of female sea turtles post-nesting, as they do not generally forage during breeding periods, and their body condition would not be expected to be optimal to withstand unexpected changes in water temperature in their migratory habitat (Hays et al. 2014).

Finfish and invertebrate migration patterns can be influenced by warmer waters, as can the frequency and magnitude of disease (Hare et al. 2016). Regional water temperatures that increasingly exceed the thermal stress threshold may affect recovery of the American lobster fishery off the U.S. East Coast (Rheuban et al. 2017). Ocean acidification driven by climate change is contributing to reduced growth, and, in some cases, decline of invertebrate species with calcareous shells. Increased freshwater input into nearshore estuarine habitats can result in water quality changes and subsequent effects on invertebrate species (Hare et al. 2016). Based on a recent study, marine, estuarine, and riverine habitat types were found to be moderately to highly vulnerable to stressors resulting from climate change (Farr et al. 2021). In general, rocky and mud bottom, intertidal, kelp, coral, and sponge habitats and special areas of conservation were considered the most vulnerable habitats to climate change in marine ecosystems (Farr et al. 2021). Similarly, estuarine habitats considered most vulnerable to climate change include intertidal mud and rocky bottom, shellfish, kelp, submerged aquatic vegetation, and native wetland habitats (Farr et al. 2021). Riverine habitats found to be most vulnerable to climate change include native wetland, sandy bottom, water column, and submerged aquatic vegetation habitats (Farr et al. 2021). As invertebrate habitat, finfish habitat, and Essential Fish Habitat (EFH) may overlap with these habitat types, marine life and habitats could experience dramatic changes and decline over time as impacts from climate change continue (Farr et al. 2021).

The Gulf of Maine Research Institute (GMRI) reported an average sea surface temperature of 53.66°F (12°C) in the Gulf of Maine in 2022, which was the second hottest year on record and an increase of over 3.72°F (2.07°C) above the long-term average from 1982 through 2011 (GMRI 2023). The hottest year on record was 54.14°F (12.3°C) in 2021, which was more than 4°F (1.5°C) above normal (GMRI 2023). Long-term data show that the water temperatures in the Gulf of Maine have been increasing over the last decade at a rate faster than 97 percent of the world's oceans (Pershing et al. 2015; Pershing et al. 2021; Balch et al. 2022; Seidov and Parsons 2021; GMRI 2023). The temperature changes have a cascading effect on all trophic levels. Further, changes in these trophic systems will likely have long term consequences on marine species that may not be recoverable (Pershing et al. 2015; Pershing et al. 2021). The extent of these effects is unknown; however, ESA-listed populations already stressed by other factors likely will be the most affected by the repercussions of climate change, particularly in the Gulf of Maine. The current effects from climate change could result in population-level effects that compromise the viability of some species.

3.3 Avoidance, Minimization, Monitoring, and Reporting Measures

This section outlines the proposed mitigation, monitoring, and reporting conditions intended to minimize or avoid potential effects on ESA-listed species from all activities included under the Proposed Action. The measures considered part of the Proposed Action are those measures proposed by BOEM which will be followed by individual Lessees and any contractors performing the survey activities described in Section 3.1. These measures, to the extent they are known, are described below and in Appendix B.

BOEM will require the implementation of the following conditions related to protected species and habitat. These conditions have been previously considered and approved under the NMFS 2021 programmatic consultation[22] and are thus part of the Proposed Action and apply to site assessment activities and site characterization activities. Additionally, the Lessee must also follow any applicable mitigation requirements included with their MMPA take authorization and USACE permits, if such authorizations are pursued or deemed necessary.

As used herein, the term "protected species" means species of fish, wildlife, or plant that have been determined to be endangered or threatened under Section 4 of the ESA. ESA-listed species are provided in 50 C.F.R. 17.11-12. The term also includes marine mammals protected under the MMPA. Marine debris is defined as any object or fragment of wood, metal, glass, rubber, plastic, cloth, paper, or any other man-made item or material that is lost or discarded in the marine environment.

[22] https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-take-reporting-programmatics-greater-atlantic#offshore-wind-site-assessment-and-site-characterization-activities-programmatic-consultation

3.3.1 Marine Debris Awareness and Elimination

The Lessee must ensure that vessel operators, employees, and contractors engaged in offshore activities as part of all survey activities under the Proposed Action complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at Marine Trash and Debris Program or by contacting BSEE at marinedebris@bsee.gov. The training videos, slides, and related material may be downloaded directly from the website. Operators engaged in marine survey activities must continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that their employees and contractors are trained. The training process must include the following elements:

- Viewing of either a video or slide show by the personnel specified above;
- An explanation from management personnel that emphasizes their commitment to the requirements;
- Attendance measures (initial and annual); and
- Record keeping and the availability of records for inspection by the Department of the Interior (DOI).

By January 31 of each year, the Lessee must submit to DOI an annual report signed by the Lessee that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. The Lessee must send the reports via email to email to renewable_reporting@boem.gov and BSEE (via Technical Information Management System (TIMS) Web Portal and protectedspecies@bsee.gov).

Materials, equipment, tools, containers, and other items used in OCS activities, which are of such shape or configuration that make them likely to snag or damage fishing devices or be lost or discarded overboard, must be clearly marked with the vessel or facility identification number, and properly secured to prevent loss overboard. All markings must clearly identify the owner and must be durable enough to resist the effects of the environmental conditions to which they may be exposed.

The Lessee must recover marine trash and debris that is lost or discarded in the marine environment while performing OCS activities when such incident is likely to (1) cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components, with particular attention to marine trash or debris that could entangle or be ingested by marine protected species; or (2) significantly interfere with OCS uses (e.g., the marine trash or debris that is likely to snag or damage fishing equipment, or present a hazard to navigation). The Lessee must notify DOI within 48 hours of the incident (using the email address listed on DOI's most recent incident reporting guidance) if recovery activities are (a) not possible because conditions are unsafe; or (b) not practicable and warranted because the marine trash and debris released is not likely to result in any of the conditions listed in (1) or (2) above. Notwithstanding this notification, DOI may still order the Lessee to recover the lost or discarded marine trash and debris if DOI finds the reasons provided by the Lessee in the notification unpersuasive. If the marine trash and debris is located within the boundaries of a potential archaeological resource/ avoidance area, or a sensitive ecological/benthic resource area, the Lessee must contact DOI for concurrence before conducting any recovery efforts.

Recovery of the marine trash and debris should be completed as soon as practicable, but no later than 30 calendar days from the date on which the incident occurred. If the Lessee is not able to recover the marine trash or debris within 48 hours of the incident, the Lessee must submit a plan to DOI explaining the activities planned to recover the marine trash or debris (Recovery Plan). The Lessee must submit the Recovery Plan no later than 10 calendar days from the date on which the incident occurred. Unless DOI objects within 48 hours of the filing of the Recovery Plan, the Lessee can proceed with the activities described in the Recovery Plan. The Lessee must request and obtain a time extension if recovery activities cannot be completed within 30 calendar days from the date on which the incident occurred. The Lessee must enact steps to prevent similar incidents and must submit a description of these actions to BOEM and BSEE within 30 calendar days from the date on which the incident occurred.

The Lessee must report to DOI (OSWIncidentReporting@bsee.gov) all lost or discarded marine trash and debris. This report must be made monthly and submitted no later than the fifth day of the following month. The Lessee is not required to submit a report for those months in which no marine trash and debris was lost or discarded. The report must include the following:

Project identification and contact information for the Lessee and for any operators or contractors involved.

The date and time of the incident.

The lease number, OCS area and block, and coordinates of the object's location (latitude and longitude in decimal degrees).

A detailed description of the dropped object, including dimensions (approximate length, width, height, and weight) and composition (e.g., plastic, aluminum, steel, wood, paper, hazardous substances, or defined pollutants).

Pictures, data imagery, data streams, and/or a schematic/illustration of the object, if available.

An indication of whether the lost or discarded item could be detected as a magnetic anomaly of greater than 50 nT, a seafloor target of greater than 1.6 ft (0.5 m), or a sub-bottom anomaly of greater than 1.6 ft (0.5 m) when operating a magnetometer or gradiometer, side scan sonar, or sub-bottom profiler in accordance with DOI's most recent, applicable guidance.

An explanation of how the object was lost.

A description of immediate recovery efforts and results, including photos.

In addition to the foregoing, the Lessee must submit a report within 48 hours of the incident (48-hour Report) if the marine trash or debris could (1) cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components, with particular attention to marine trash or debris that could entangle or be ingested by marine protected species; or (2) significantly interfere with OCS uses (e.g., the marine trash or debris is likely to snag or damage fishing equipment or presents a hazard to navigation). The information in the 48-hour Report must be the same as that listed for the monthly report, but only for the incident that triggered the 48-hour Report. The Lessee must report to DOI (using the email address listed on DOI's most recent incident reporting guidance) if the object is recovered and, as applicable, describe any substantial variance from the activities described in the Recovery Plan that were required during the recovery efforts. The Lessee must include and address information on unrecovered marine trash and debris in the description of the site clearance activities provided in the decommissioning application required under 30 C.F.R. § 585.906.

3.3.2 Minimize Vessel Interactions with Listed Species

The Lessee must ensure all vessels associated with any project activities (transiting or actively surveying) comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. If any such incidents occur, they must be reported as outlined in **Section 3.3.6**.

3.3.2.1 Vessel Crew and Trained Lookout Training

The Lessee must provide Project-specific training to all vessel crew members and trained lookouts on the detection of sea turtles and marine mammals, vessel strike avoidance, reporting protocols, and the associated regulations for avoiding vessel collisions with protected species. Trained lookouts are used when professional, third-party PSOs are not required. Third-party PSO requirements are outlined in **Section 3.3.5**. Trained lookouts must receive additional training in protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. Reference materials for identifying sea turtles and marine mammals must be available aboard all Project vessels. The expectation and process for reporting of protected species sighted during surveys must be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so.

Confirmation of the training and understanding of the requirements must be documented on a training course log sheet, and the Lessee must provide the log sheets to DOI upon request. The Lessee must communicate to all crew members its expectation for them to report sightings of sea turtles and marine mammals to the designated vessel contacts. The Lessee must communicate the process for reporting sea turtles and marine mammals (including live, entangled, and dead individuals) to the designated vessel contact and all crew members. The Lessee must post the reporting instructions, including communication channels, in highly visible locations aboard all Project vessels.

3.3.2.2 Vessel Observation Requirements

Vessel captain and crew must maintain a vigilant watch for all protected species and reduce speed, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any listed species. The presence of a single individual at the surface may indicate the presence of submerged animals in the vicinity; therefore, precautionary measures should always be exercised. If pinnipeds or small delphinids of the following genera: *Delphinus*, *Lagenorhynchus*, *Stenella*, and *Tursiops* are visually detected approaching the vessel (i.e., to bow ride) or towed equipment, vessel speed reduction, course alteration, and shutdown are not required.

Anytime a survey vessel is underway (transiting or surveying), a PSO or trained lookout must monitor for protected species, and the vessel must maintain a minimum separation distance of 1,640 ft (500 m) or greater from any sighted ESA-listed species, or other unidentified large marine mammal visible at the surface, to ensure detection of that animal in time to take necessary measures to avoid striking the animal. If a survey vessel does not require a PSO for the type of survey equipment used, crew may be used as a Trained Lookout to meet this requirement. For monitoring around autonomous surface vehicles (ASVs) controlled from a manned vessel, regardless of the equipment it may be operating, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. A dedicated operator must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing an additional forward view of the craft.

a. Survey plans (see **Section 3.3.6.1** for further details) must include identification of the Project vessel strike avoidance measures, including procedures for equipment shut down and retrieval, communication between PSOs/Trained Lookouts, equipment operators, and the captain, and other measures necessary to avoid vessel strikes while maintaining vessel and crew safety. If any circumstances are anticipated that may preclude the implementation of this measure, they must be clearly identified in the survey plan and alternative procedures outlined in the plan to ensure minimum distances are maintained and vessel strikes can be avoided.

b. All vessel crew members must be briefed in the identification of protected species that may occur in the survey area and in regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all project vessels for identification of listed species. The expectation and process for reporting of protected species sighted during surveys must be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so. Vessel crew members must be provided with an Atlantic reference guide to help identify marine mammals and sea turtles that may be encountered. Vessel personnel must also be provided material regarding NARW SMAs, DMAs, Slow Zones, sightings information, and reporting.

A minimum separation distance of 500 m from all ESA-listed whales (including unidentified large whales) must be maintained around all surface vessels at all times.

a. If a large whale is identified within 500 m of the forward path of any vessel, the vessel operator must steer a course away from the whale at 10 knots (18.5 km/hr) or less until the 500 m minimum separation distance has been established. Vessels may also shift to idle if feasible.

b. If a large whale is sighted within 200 m of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 m.

If a sea turtle or manta ray is sighted at any distance within the operating vessel's forward path, the vessel operator must slow down to 4 knots and steer away (unless unsafe to do so). The vessel may resume normal vessel operations once the vessel has passed the individual.

a. Vessels must avoid, when possible to do so, transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats) that are easily sighted and exceed 50 meters in length or width. In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.

Vessels operating in water depths with less than four feet of clearance between the vessel and the bottom should maintain speeds no greater than 4 knots to minimize risk of vessel strikes on sturgeon and salmon.

a. Vessels underway must not divert their course to approach any protected species.

Any observations of a marine mammal or ESA-listed species by crew members aboard any vessel associated with the survey must be relayed to the PSO on duty and/or captain of the vessel.

To monitor the minimum separation distance, one PSO (or Trained Lookout if PSOs are not required) must be posted during all times a vessel is underway (transiting or surveying) to monitor for listed species within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard).

Visual observers monitoring the minimum separation distance can be either PSOs or Trained Lookouts (if PSOs are not required). If the Trained Lookout is a vessel crew member, this must be their designated role and primary responsibility on shift. Any crew designated as Trained Lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. All observations must be recorded per reporting requirements.

Regardless of monitoring duties, all crew members responsible for navigation duties must receive -site specific training on ESA-listed species sighting/reporting and vessel strike avoidance measures.

Vessels underway must not divert their course to approach any ESA-listed species and marine mammals.

Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (18.5 mph) or less while operating in any Seasonal Management Area (SMA) and Dynamic Management Area (DMA) or Slow Zone triggered by visual and/or acoustic detections of NARWs. An exception to this requirement is for vessels operating in areas within a portion of a visually designated DMA or Slow Zone where it is not reasonable to expect the presence of NARWs (e.g., Long Island Sound, shallow harbors), unless a sighting of a NARW in that area triggered the DMA/Slow Zone.

BOEM encourages increased vigilance through the required mitigation and monitoring measures to minimize vessel interactions with protected species, by reducing speeds to 10 knots or less when operating within an acoustically triggered Slow Zone, and when feasible, avoid operating in or transiting through Slow Zones.

All vessel operators must conduct daily checks for information regarding mandatory or voluntary ship strike avoidance (SMAs, DMAs, Slow Zones) and daily information regarding NARW sighting locations. These media may include, but are not limited to: NOAA weather radio, U.S. Coast Guard NAVTEX and channel 16 broadcasts, Notices to Mariners, the Whale Alert app, or WhaleMap website.

a. NARW Sighting Advisory System info can be accessed at: Whalemap: Latest Right Whale Observations. https://apps-nefsc.fisheries.noaa.gov/psb/surveys/MapperiframeWithText.html

b. Information about active SMAs, DMAs, and Slow Zones can be accessed at: Reducing Vessel Strikes to North Atlantic Right Whales. https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-vessel-strikes-north-atlantic-right-whales

All vessels carrying out the survey activities included under the Proposed Action (**Section 3.1**) must have a trained lookout for NARWs on duty at all times, during which the trained lookout must monitor a vessel strike avoidance zone around the vessel. The trained lookout must maintain a vigilant watch at all times a vessel is underway and, when technically feasible, monitor the 500-meter Vessel Strike Avoidance Zone for ESA-listed species to maintain minimum separation distances.

Alternative monitoring technology (e.g., night vision, thermal cameras) must be available on all survey vessels to maintain a vigilant watch at night and in any other low-visibility conditions such that observers can still effectively detect marine mammals and sea turtles and monitor the vessel strike avoidance zone. All observations must be recorded per reporting requirements. Outside of active watch duty, members of the monitoring team must check NMFS' NARW sightings (North Atlantic Right Whale Sightings) for the presence of NARWs in the Action Area. https://www.fisheries.noaa.gov/resource/map/north-atlantic-right-whale-sightings

The trained lookout must check the Sea Turtle Sighting Hotline (Sea Turtle Sighting Hotline) before each trip and report any detections of sea turtles in the vicinity of the planned transit to all vessel operators or captains and lookouts on duty that day. https://seaturtlesightings.org/

For all vessels operating north of the Virginia/North Carolina border, the Lessee must have a trained lookout posted between June 1 and November 30 on all vessel transits during all phases of the Project to observe for sea turtles. If a vessel is carrying a trained lookout for the purposes of maintaining watch for NARWs, an additional trained lookout for sea turtles is not required, provided that the trained lookout maintains watch for marine mammals and sea turtles. If the trained lookout is a vessel crew member, the lookout obligations as noted above must be that person's designated role and primary responsibility while the vessel is transiting.

3.3.2.3 Vessel Speed Requirements

Vessels of all sizes must operate at 11.5 mph (18.5 kph or 10 kn) or less between October 1 and May 30 and while operating port to port and operating in the lease area, or in the transit area to and from ports in Maine, Massachusetts, and New Hampshire. Regardless of vessel size, vessel operators must reduce vessel speed to 11.5 mph (18.5 kph or 10 kn) or less while operating in any SMA, DMA or Slow Zones. An exception to this requirement is for vessels operating in areas within a portion of a designated DMA or Slow Zone where it is not reasonable to expect the presence of NARWs (e.g., shallow harbors), unless a sighting of a NARW in that area triggered the DMA or Slow Zone. This requirement also does not apply when necessary for the safety of the vessel or crew. Any such events must be reported.

3.3.3 Minimize Interactions with Listed Species during Geophysical Survey Operations

To avoid injury and minimize any potential disturbance to protected species, implement the following measures for all vessels using boomer, sparker, and bubble gunprofiler categories of equipment. Shutdown, pre-start clearance, and ramp-up procedures are not required during HRG survey operations using only other sources (e.g., ultra-short baselines, fathometers, parametric shallow penetration sub-bottom profilers, hull-mounted non-parametric SBP, side-scan sonars, pingers, acoustic releases, echosounders, and instruments attached to submersible vehicles (HOV/AUV/ROVs). In keeping with Ruppel et al. (2022) chirp sub bottom profilers are included in the Tier IV category of HRG sources and thus not likely to result in the incidental take of marine mammals. Thus, BOEM is not proposing that shut down requirements apply to surveys using that sound source. However, pre-clearance and ramp up procedures should still be used with chip sub bottom profilers out of the utmost caution.

1. For situational awareness of marine mammals and ESA-listed species that may be in the survey area, during times third-party protected species observers (PSOs) are on duty, they must monitor to the farthest extent practicable, at least 500 m around geophysical survey vessels (i.e., the Clearance Zone). At all times PSOs are on duty, any observed species must be recorded (see reporting requirements below).
2. Any observations of a marine mammal or ESA-listed species by crew members aboard any vessel associated with the survey must be relayed to the PSO on duty.
3. For autonomous surface vessels (ASV) that require remote PSO monitoring from the mother vessel[23], a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction to provide a field of view ahead of the vessel and around the ASV. PSOs must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft. In addition, night-vision goggles with thermal clip-ons and a handheld spotlight must be provided and used such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.

[23] Lessees must discuss ASV deployment with BOEM prior to contracting to understand what measures may be necessary for the ASV system under consideration.

4. To minimize exposure of ESA-listed species of marine mammal to noise that could be disturbing, a 500 m Shutdown Zone for NARW and unidentified whales, and a 100 m Shutdown Zone for all other ESA-listed species, including other ESA-listed marine mammals visible at the surface must be established around the sound source operating at frequencies <180 kHz (e.g., boomer, sparker, bubble gun equipment). If the Shutdown Zone(s) cannot be adequately monitored for -ESA listed species presence (i.e., PSO discretion determines conditions, including night or other low visibility conditions, are such that listed species cannot be reliably sighted within the Shutdown Zone(s) with the available monitoring equipment, no equipment that requires PSO monitoring can be deployed until such time that the Shutdown Zone(s) can be effectively monitored.
5. The Shutdown Zone(s) must be monitored by third-party PSOs at all times when boomer, sparker, bubble gun, or Chirp sub-bottom profiler categories of equipment are being operated and all observed ESA-listed species must be recorded (see reporting requirements below).
6. A PSO must notify the survey crew that a shutdown of all active boomer, sparker, and bubble gun acoustic sources is immediately required. The vessel operator and crew must comply immediately with any call for a shutdown by the PSO. Any disagreement or discussion must occur only after shutdown.

For all protected species, a Clearance Zones of at least 500 m must be clear of all animals for 30 minutes before ramp-up or any deployed survey equipment is activated.

1. If any protected species is observed within the respective Clearance Zone during the 30-minute pre-clearance period, the relevant acoustic sources must not be initiated until the ESA listed whale (or unidentified whale) is confirmed by visual observation to have exited the relevant zone, or, until 30 minutes have elapsed with no further sighting of the animal.
2. A “ramp up” of the boomer, sparker, or bubble gun survey equipment must occur at the start or re-start of geophysical survey activities when technically feasible. A ramp up must begin with the power of the smallest acoustic equipment for the geophysical survey at its lowest power output. When technically feasible the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.
3. Following a shutdown for any reason, ramp up of the equipment may begin immediately only if: (a) the shutdown is less than 30 minutes, (b) visual monitoring of the Shutdown Zone(s) continued throughout the shutdown, (c) the animal(s) causing the shutdown was visually followed and confirmed by PSOs to be outside of the Shutdown Zone(s) and heading away from the vessel, and (d) the Shutdown Zone(s) remains clear of all ESA-listed species. If all the conditions above are not met, a 500 m distance must be monitored for all ESA-listed species for 30 minutes of pre-clearance observation before noise-producing equipment can be turned back on.
4. No geophysical surveys may be conducted at night or during low-visibility conditions unless PSOs are able to effectively monitor the full extent of the Clearance and Shutdown Zone(s).
5. An Alternative Monitoring Plan (AMP) must be submitted to BOEM (or the federal agency authorizing, funding, or permitting the survey) detailing the monitoring methodology that will be used during nighttime and low-visibility conditions. The AMP must include technologies that have the technical feasibility to detect all ESA-listed species in the Clearance and Shutdown Zone(s). Low-light equipment (i.e., night-vision goggles and/or infrared technology) must be available for use during low visibility (e.g., inclement weather, nighttime) monitoring.
6. PSOs must be trained and experienced with any AMP technology used. The AMP must describe how calibration will be performed, for example, by including observations of known objects at set distances and under various lighting conditions. This calibration should be performed during mobilization and periodically throughout the survey operation.

7. PSOs shall make nighttime observations from a platform with no visual barriers, due to the potential for the reflectivity from bridge windows or other structures to interfere with the use of the night vision optics. Alternative monitoring technology (e.g., night vision, infrared/thermal cameras, etc.) must be available on all survey vessels for monitoring at night and in any other low visibility conditions.
8. To minimize risk to North Atlantic right whales, no surveys may occur in Cape Cod Bay from January 1–May 15 of any year (in an area beginning at 42°04′56.5″ N-070°12′00.0″ W; thence north to 42°12′00.0″ N-070°12′00.0″ W; thence due west to charted mean high-water line; thence along charted mean high water within Cape Cod Bay back to beginning point).
9. During good conditions (e.g., daylight hours; Beaufort scale 3 or less) when survey equipment is not operating, to the maximum extent practicable (accounting for recommended shift schedules and vessel activities), PSOs should conduct observations for listed species for comparison of sighting rates and behavior with and without use of active geophysical survey equipment. Any observed listed species must be recorded regardless of any mitigation actions required.

3.3.4 Minimize Vessel Interactions with Listed Species during use of a Moon Pool

While the final vessel contractors have not yet been selected for the survey activities included under the Proposed Action, vessels equipped with a moon pool for the proposed survey activities. During times of year when sea turtles are known to occur in the survey area and if there is an intention to utilize a moon pool for the required activities, the following BMPs must be followed:

1. General requirements:
    a. Where the moon pools have hull doors, the operator(s) should keep the doors closed as much as reasonably practicable when no activity is occurring within the moon pool, unless the safety of crew or vessel require otherwise. This will prevent protected species from entering the confined area during periods of non-activity.
    b. Use of a moon pool requires regular monitoring while open to the water column and if a vessel is not underway. Regular monitoring means 24-hour video monitoring with hourly recurring checks for at least five minutes of the video feed, or hourly recurring visual checks of the moon pool for at least five minutes by a dedicated crew observer with no other tasks during that short visual check.
    c. If water conditions are such that observers are unable to see within a meter of the surface, operations requiring the lowering or retrieval of equipment through the moon pool must be conducted at a rate that will minimize potential harm to protected species.
2. Movement of the vessel and equipment deployment and/or retrieval (no hull door):
    a. Before movement of the vessel and/or the deployment and/or retrieval of equipment, the moon pool must be monitored continuously for a minimum of 30 minutes, by a dedicated crew observer with no other tasks, to ensure no individual protected species is present in the moon pool area.
    b. If a protected species is observed in the moon pool before movement of the vessel, the vessel must not be moved and equipment must not be deployed or retrieved, except for human safety considerations. If the observed animal leaves the moon pool, the operator may commence activities. If the observed animal remains in the moon pool, contact BSEE before planned movement of the vessel according to reporting requirements (see *Reporting of Observations of Protected Species within an Enclosed Moon Pool* below).
    c. Should a protected species be observed in a moon pool before activity commences (including

lowering or retrieval of equipment), recovery of the animal or other actions specific to the scenario may be required to prevent interaction with the animal. If protected species are observed during activity, only reporting is required (see *Reporting of Observations of Protected Species within an Enclosed Moon Pool* below). Operators must not take such action except at the direction of, and after contact with, NMFS.

3. Closure of the Hull Door:

   a. Should the moon pool have a hull door that can be closed, then prior to and following closure, the moon pool must be monitored continuously by a dedicated crew observer with no other tasks to ensure that no individual protected species is present in the moon pool area. If visibility is not clear to the hull door from above (e.g., turbidity or low light), 30 minutes of monitoring is required prior to hull door closure.

   b. If a protected species is observed in the moon pool prior to closure of the hull door, the hull door must not be closed, to the extent practicable. If the observed animal leaves the moon pool, the operator may commence closure. If the observed animal remains in the moon pool, contact BSEE prior to closure of the hull doors according to reporting requirements (see *Reporting of Observations of Protected Species within an Enclosed Moon Pool* below).

4. Reporting of Observations of Protected Species within an Enclosed Moon Pool:

   a. If a protected species is observed within an enclosed moon pool and does not demonstrate any signs of distress or injury or an inability to leave the moon pool of its own volition, measures described in this section must be followed (only in cases where they do not jeopardize human safety). Although this particular situation may not require immediate assistance and reporting, a protected species could potentially become disoriented with their surroundings and may not be able to leave the enclosed moon pool of their own volition. In order for operations requiring use of a moon pool to continue, the following reporting measures must be followed:

   b. Within 24 hours of any observation, and daily after that for as long as an individual protected species remains within a moon pool (i.e., in cases where an ESA listed species has entered a moon pool but entrapment or injury has not been observed), The following information must be reported to BSEE (protectedspecies@bsee.gov):

      For an initial report, all information described above should be included.

      For subsequent daily reports:

      § Describe the animal's status to include external body condition (e.g., note any injuries or noticeable features), behaviors (e.g., floating at surface, chasing fish, diving, lethargic, etc.), and movement (e.g., has the animal left the moon pool and returned on multiple occasions?);
      § Description of current moon pool activities, if the animal is in the moon pool (e.g., drilling, preparation for demobilization, etc.);
      § Description of planned activities in the immediate future related to vessel movement or deployment of equipment;
      § Any additional photographs or video footage of the animal, if possible;
      § Guidance received and followed from NMFS liaison or stranding hotline that was contacted for assistance;
      § Whether activities in the moon pool were halted or changed upon observation of the animal; and
      § Whether the animal remains in the pool at the time of the report, or if not, the time/date the animal was last observed.

BOEM does not advocate the lowering of crew members into the moon pool to free protected species and NMFS should be contacted if protected species are encountered in the moon pool.

3.3.5 Third-Party PSO Requirements

When surveys or vessels require the use of third-party PSOs (as opposed to Trained Lookouts), such as for HRG surveys for which MMPA take authorization is being requested, the Lessee must use qualified PSOs provided by a third party to observe Clearance and Shutdown Zones, and implement mitigation measures as outlined in the conditions in the previous and following subsections. Additionally:

1. All PSOs must have completed a training program with BOEM-approved PSO training materials. PSOs must also have received NMFS approval to act as a PSO for geophysical surveys. The Lessee must provide to BOEM upon request, documentation of NMFS approval as PSOs for geophysical activities in the Atlantic and copies of the most recent training certificates of individual PSOs' successful completion of a commercial PSO training course with an overall examination score of 80 percent or greater. Instructions and application requirements to become a NMFS- approved PSO can be found at: Protected Species Observers.
2. For situations where Trained Lookouts are used when PSOs are not required, training must include protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.
3. PSOs deployed for mitigation, monitoring, and reporting of geophysical survey activities must be employed by a third-party observer provider. While the vessel is underway, they must have no other tasks other than to conduct observational effort, record data, communicate with and instruct relevant vessel crew to the presence of listed species and implement required mitigation and monitoring measures. PSOs on duty must be clearly listed on daily data logs for each shift.
    a. Non-third-party observers may be approved by NMFS on a case-by-case basis for limited, specific duties in support of approved, third-party PSOs.
4. A minimum of one PSO must be on duty for observing listed species on each vessel at all times, during times of low visibility (e.g., nighttime, fog) two PSOs must be on duty, that noise-producing equipment is operating, or the survey vessel is actively transiting.
    a. The Lessee must include a PSO schedule showing that the number of PSOs used is sufficient to effectively monitor the affected area for the project (e.g., surveys) and record the required data. PSOs must not be on watch for more than 4 consecutive hours, with at least a 2-hour break after a 4-hour watch. PSOs must not work for more than 12 hours in any 24-hour period.
5. Visual monitoring must occur from the most appropriate vantage point on the associated operational platform that allows for maximum possible 360-degree field of view around the sound source and vessel. If 360-degree field of view is not possible from a single vantage point, multiple PSOs must be on watch to ensure such coverage to ensure both geophysical survey and vessel strike avoidance requirements for ESA-listed species can be implemented.
6. The Lessee must ensure that suitable equipment is available to each PSO to adequately observe the full extent of the Clearance and Shutdown Zones prior to and during all geophysical survey activity respectively and meet all reporting requirements. The following equipment must be available.
    a. Visual observations must be conducted using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.
    b. Rangefinders (at least one per PSO, plus backups) or reticle binoculars (e.g., 7 × 50) of appropriate quality (at least one per PSO, plus backups) to estimate distances to listed species located in proximity to the Clearance and Shutdown Zone(s).

c. Digital cameras with a telephoto lens that is at least 300 mm or equivalent on a full-frame single lens reflex (SLR). The camera or lens should also have an image stabilization system. Used to record sightings and verify species identification when possible.

d. A laptop or tablet to collect and record data electronically.

e. Global Positioning Units (GPS) if data collection/reporting software does not have built-in positioning functionality.

f. PSO data must be collected in accordance with standard data reporting, software tools, and electronic data submission standards approved by BOEM and NMFS for the particular activity.

g. Any other tools deemed necessary to adequately perform PSO tasks.

PSOs must have no Project-related tasks other than to observe, collect and report data, and communicate with and instruct relevant vessel crew regarding the presence of protected species and mitigation requirements (including brief alerts regarding maritime hazards). PSOs must have completed a commercial PSO training program for the Atlantic with an overall examination score of 80 percent or greater. The Lessee must provide training certificates for individual PSOs to BOEM upon request. PSOs and PAM operators must be approved by NMFS before the start of a survey.

PSOs must be approved by NMFS prior to the start of a survey, and the Lessee must submit documentation of NMFS' approval upon request to BOEM (at renewable_reporting@boem.gov) and BSEE (via TIMS Web Portal and protectedspecies@bsee.gov). Application requirements to become a NMFS-approved PSO for geological and geophysical surveys can be obtained by sending an inquiry to nmfs.psoreview@noaa.gov.

Lead PSOs must have prior approval from NMFS as an unconditionally approved PSO.

At least one lead PSO must be present on each HRG survey vessel.

a. PSOs on transit vessels must be approved by NMFS but need not be authorized as a lead PSO.

b. All PSOs on duty must be clearly listed and the lead PSO identified on daily data logs for each shift.

c. A sufficient number of PSOs must be deployed to record data in real time and effectively monitor the required clearance, shutdown, or monitoring zone for the Project.

d. Where applicable, the number of PSOs deployed must meet the NARW enhanced seasonal monitoring requirements.

e. A PSO must not be on watch for more than 4 consecutive hours and must be granted a break of no fewer than 2 hours after a 4-hour watch.

f. A PSO must not work for more than 12 hours in any 24-hour period unless an alternative schedule is authorized in writing by BOEM.

g. The Lessee must ensure that suitable equipment is available to PSOs (including binoculars, range-finding equipment, a digital camera, and electronic data recording devices [e.g., a tablet]) to adequately monitor the extent of the clearance and shutdown zones, determine the distance to protected species during surveys, record sightings and verify species identification, and record data. PSO observations must be conducted while free from distractions and in a consistent, systematic, and diligent manner.

3.3.6 Reporting Requirements

To ensure compliance and evaluate effectiveness of mitigation measures, regular reporting of survey activities and information on listed species will be required as follows. Only vessel surveys which require third-party PSOs will be required to meet reporting requirements under Sections **3.3.6.1** through **3.3.6.4**. Reporting requirements listed under **Sections 3.3.6.5** and **3.3.6.6** must be completed if applicable regardless of survey type or type of observer.

3.3.6.1 Survey Reporting

Prior to conducting each physical, biological, or cultural resources survey in support of the submission of a plan, the Lessee must submit to the Lessor a survey plan. Each distinct survey effort (e.g., mobilization) must be addressed by a survey plan, although a single survey plan may cover more than one survey effort and may cover multiple types of activities (e.g., geotechnical and geophysical surveys on lease and along cable routes).

Each survey plan must include details of activities to be conducted and timelines of each survey effort necessary to support the submission of a plan (i.e., necessary to satisfy the information requirements in the applicable regulations, including but not limited to 30 CFR 585.606, 610, 611, 621, 626, 627, et al.). The Lessor will not accept survey plans that do not provide sufficient detail for review, including but not limited to specific description and illustration of the geographic areas to be surveyed, specific discussion of the survey methods and equipment to be employed, and a schedule of survey activities.

The Lessee must demonstrate compliance include any waiver requests in its initial survey plan and the Lessee's intentions to coordinate with the U.S. Coast Guard (USCG) to prepare a Notice to Mariners for the specific survey activities described in the survey plan.

The Lessee must submit a survey plan to the Lessor at least 90 calendar days prior to commencement of any survey activities described in the survey plan. Within 30 calendar days from receipt, the Lessor may request the Lessee modify the survey plan to address any comments the Lessor submits to the Lessee on the contents of the survey plan. Comments must be addressed by the Lessee in a manner deemed satisfactory by the Lessor prior to commencement of the survey activities. If the Lessor does not respond with comments or objections within 30 calendar days of receipt of the survey plan, the Lessee may proceed with the survey activities per the proposed schedule. The lack of Lessor comment or objection to the survey plan does not ensure acceptance of the survey results with the SAP and/or RAP. If the Lessee is proposing a fisheries survey that could result in the take of species listed under the Endangered Species Act, additional time should be allowed for consultation and/or permits authorizing the activity.

3.3.6.2 Monthly Survey Reports

Monthly reporting of raw PSO data collected during geophysical survey activities must be submitted to BOEM (renewable_reporting@boem.gov) and BSEE (via TIMS Web Portal and protectedspecies@bsee.gov) by the PSO provider on the 15th of each month for each vessel conducting survey work. Any editing, review, and quality assurance checks must be completed only by the PSO provider prior to submission to BOEM and ensure use of standard field codes and formats (**Appendix A**). Monthly data reporting from all PSO observations must be recorded based on standard PSO collection and reporting requirements. PSOs must use standardized electronic data forms to record data. The PSOs may record data electronically in data collection software, but the data fields listed below must be recorded and exported to an Excel file for submittal. Alternatively, BOEM has developed an Excel spreadsheet with all the necessary data fields that is available upon request.

3.3.6.3 Final Survey Reports

Final survey reports must be submitted to BOEM in coordination with PSOs within 90 calendar days following completion of a survey. Final reports must contain all survey activity included under each submitted survey plan, but include individual vessel departure and return ports, PSO names and training certifications, the PSO provider contact information, dates of the survey, a vessel track, a summary of all PSO documented sightings of protected species, survey equipment shutdowns that occurred, any vessel strike-avoidance measures taken, takes of protected species that occurred, and any observed injured or dead protected species. The DOI will work with the Lessee to ensure that DOI does not release confidential business information found in the monitoring reports.

3.3.6.4 Instructions for Geophysical Survey Reports

The following data fields for PSO reports of geological and geophysical surveys must be reported in Excel format (.xls file) along with metadata defining all data fields.

Survey Information:

- Project name
- Lease number
- State coastal zones
- Survey contractor
- Survey type
- Reporting start and end dates
- Visual monitoring equipment used (e.g., bionics, magnification, IR cameras);
- Distance finding method used
- PSO names (last, first), training certification, and affiliation
- PSO location and observation height above sea surface

Operations Information:

- Vessel name(s)
- Sound sources including equipment type, power levels, and frequencies used
- Greatest RMS source level
- Dates of departures and returns to port with port name

Monitoring Effort Information:

- Date (YYYY-MM-DD)
- Source status at time of observation (on/off)
- Number of PSOs on duty
- Start time of observations for each shift in UTC (YY-MM-DDT HH:MM)
- End time of observations for each shift in UTC (YY-MM-DDT HH:MM)
- Duration of visual observations of protected species

Weather

Wind speed (knots), direction (cardinal direction)

Beaufort sea state

Water depth (meters)

Visibility (km)

Glare severity related to monitoring area (none, slight, moderate, extreme)

Time pre-clearance visual monitoring began in UTC (YY-MM-DDT HH:MM)

Time pre-clearance monitoring ended in UTC (YY-MM-DDT HH:MM)

Duration of pre-clearance visual monitoring

Time of day of pre-clearance began (day/night)

Time power-up/ramp-up began

Time equipment full power was reached

Duration of power-up/ramp-up (if conducted)

Time survey activity began (equipment on) in UTC

Time survey activity ended (equipment off) in UTC

Survey duration

Did a shutdown/power-down occur?

- Time shutdown was called for (UTC)
- Time equipment was shut down (UTC)

Vessel location (latitude/longitude, decimal degrees) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts; recorded at 30 second intervals if obtainable from data collection software

Habitat or prey observations (narrative)

Marine debris sightings (narrative)

Detection Information (in addition to the Survey, Operation, and Monitoring fields)

Date (YYYY-MM-DD)

Sighting ID (multiple sightings of the same animal or group should use the same ID)

Time at first detection in UTC (YY-MMDDT HH:MM)

Time at last detection in UTC (YY-MM-DDT HH:MM)

PSO name(s) (last, first) on duty

Observer location

Number of observers on duty

Watch status (on effort PSO, off effort PSO, opportunistic, crew, alternate vessel/platform)

Effort (ON=device on; OFF=device off)

Start time of observations

End time of observations

Location of vessel when detection occurs: Latitude and Longitude (decimal degrees)

Compass heading of vessel (degrees)

Beaufort sea state

Wind speed (knots/direction)

Swell height (meters)

Weather/precipitation

Visibility (kilometers)

Cloud coverage (%)

Glare severity related to monitoring area (none, slight, moderate, extreme)

Species (Species Code)

Certainty of identification

Number of adults (high, low, best)

Number of juveniles (high, low, best)

Total number of animals or estimated group size

Sighting cue (Blow, Breach, White water, Flukes, Body)

Bearing to animal(s) when first detected (ship heading in degrees + clock face direction to animal)

Distance determination method (use code)

Distance from vessel at first detection (e.g., reticle distance in meters)

Description of unidentified animals (include features such as overall size; shape of head; color and pattern; size, shape, and position of dorsal fin; height, direction, and shape of blow, etc.)

Detection narrative (note behavior, especially changes in relation to survey activity and distance from source vessel)

Direction of travel/first approach (relative to vessel)

Behaviors observed: indicate behaviors and behavioral changes observed in sequential order (use behavioral codes)

If any bow-riding behavior observed, record total duration during detection (YY-MM-DDT HH:MM)

Initial heading of animal(s) (ship heading in degrees + clock face direction to animal)

Final heading of animal(s) (ship heading in degrees + clock face direction to animal)

Shutdown zone size during detection (meters)

Was the animal inside the shutdown zone? (Y/N)

Closest distance to vessel (reticle distance in meters)

Time at closest approach (UTC YY-MM-DDT HH:MM)

Time animal entered shutdown zone (UTC YY-MM-DDT HH:MM)

Time animal left shutdown zone (UTC YY-MM-DDT HH:MM)

If observed/detected during ramp-up/power-up: first distance (reticle distance in meters), closest distance (reticle distance in meters), last distance (reticle distance in meters), behavior at final detection

Did a shutdown/power-down occur? (Y/N)

Time shutdown was called for (UTC)

Time equipment was shut down (UTC)

3.3.6.5 Protected Species Incident Reporting

Regardless of survey type or the need to provide a dedicated trained watch stander or PSO, any potential take, strikes, or dead/injured protected species caused by Project activities must be reported to the NMFS GARFO Protected Resources Division (nmfs.gar.incidental-take@noaa.gov), NOAA Fisheries 24-hour Stranding Hotline–for marine mammals from Maine-Virginia, report to (866) 755-6622, and from North Carolina-Florida to (877) 942-5343 and for sea turtles from Maine-Virginia, report to (866) 755-6622, and from North Carolina-Florida to (844)732-8785.BOEM (renewable_reporting@boem.gov), and BSEE (via TIMS and protectedspecies@bsee.gov) as soon as practicable, but no later than 24 hours from the time the incident took place (Protected Species Incident Report). The Protected Species Incident Report must include the following information:

Contact info for the person providing the report;

Time, date, and location (latitude/longitude) of the incident;

Species identification (if known) or description of the animal(s) involved;

Condition of the animal(s) (e.g., live, injured, dead);

Observed behaviors of the animal(s), if alive;

If available, photographs or video footage of the animal(s); and

General circumstances (e.g., vessel speed/direction of travel, sound sources in use) under which the animal was impacted.

3.3.6.6 Dead or Injured Protected Species Reporting

All dead or injured protected species must be reported to NMFS, BOEM, and BSEE regardless of whether they were observed during operations or directly due to Lessee activities **(**see **Appendix B)**. In the event that an injured or dead marine mammal or sea turtle is sighted, regardless of the cause, the Lessee must report the incident to the NMFS Protected Resources Division (nmfs.gar.incidental-take@noaa.gov), NMFS 24-hour Stranding Hotline number (866-755-6622), BOEM (renewable_reporting@boem.gov), and BSEE TIMSWeb and (protectedspecies@bsee.gov) as soon as practicable (taking into account crew and vessel safety), but no later than 24 hours from the sighting (Dead or Injured Protected Species Report). Staff responding to the hotline call will provide any instructions for the handling or disposing of any injured or dead protected species by individuals authorized to collect, possess, and transport sea turtles. The Protected Species Incident Report[24] must include the following information:

[24] See also PDCs 8: Reporting Requirements, Appendix B. https://www.boem.gov/sites/default/files/documents/renewable-energy/OSW-surveys-NLAA-programmatic.pdf

Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

Species identification (if known) or description of the animal(s) involved;

Condition of the animal(s) (including carcass condition if the animal is dead);

Observed behaviors of the animal(s), if alive;

If available, photographs or video footage of the animal(s); and

General circumstances under which the animal was discovered.

3.3.6.7 Reporting of All NARW Sightings

The Lessee must immediately report all NARWs observed to BOEM and BSEE; the NOAA Fisheries[25] 24-hour Stranding Hotline number (866-755-6622); the Coast Guard (via telephone at (617) 223-5757 or via Channel 16); and WhaleAlert. The report must include the time, location, and number of animals sighted.

3.3.7 Entanglement Avoidance

Ensure any mooring systems used during data collection activities under the Proposed Action are designed to prevent potential entanglement or entrainment of listed species, and in the unlikely event that entanglement does occur, ensure proper reporting of entanglement events according to the measures specified below:

1. Ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables, or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species.
2. Any survey gear or equipment included under the Proposed Action (described in **Section 3.1**) must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose.
3. When practicable, all survey gear, including buoys, included under the Proposed Action should be lowered and raised slowly to minimize risk to listed species and benthic habitat. No survey gear, including buoys, should be deployed or retrieved if large whales or sea turtles are sighted within 1,640 ft (500 m) of the survey gear/buoy being deployed/retrieved.
4. If a live or dead marine protected species becomes entangled, operators must immediately contact the applicable stranding network coordinator using the reporting contact details (see Reporting Requirements section) and provide any on-water assistance requested.
    a. All buoys must be properly labeled with owner and contact information.

[25] Observations can also be submitted via https://www.fisheries.noaa.gov/resource/document/template-datasheet-real-time-north-atlantic-right-whale-acoustic-and-visual

3.3.8 Benthic Habitat and Ecosystem Monitoring Conditions

All vessel anchoring and any seafloor-sampling activities are restricted from seafloor areas with deep/cold-water coral reefs and shallow/mesophotic reefs. All vessel anchoring and seafloor sampling must also occur at least 492 ft (150 m) from any known locations of threatened or endangered coral species. All sensitive live bottom habitats (eelgrass, cold-water corals, etc.) should be avoided as practicable. All vessels in coastal waters will operate in a manner to minimize propeller wash and seafloor disturbance and transiting vessels should follow deep-water routes (e.g., marked channels), as practicable, to reduce disturbance to sturgeon habitat. Additionally, no geotechnical or bottom disturbing activities will take place during the spawning/rearing season within freshwater reaches of rivers where Atlantic or shortnose sturgeon spawning occurs. Any survey plan that includes geotechnical or other benthic sampling activities in freshwater reaches (salinity 0 to 0.5 ppt) of such rivers will identify a time of year restriction that will avoid such activities during the time of year when Atlantic sturgeon spawning and rearing of early life stages occurs in that river. Time of year restrictions included in the PDCs **(Appendix B)** that are applicable to Atlantic sturgeon spawning and rearing of early life stages only occur in the Hudson and Delaware Rivers, both of which are outside the Action Area and therefore not applicable for the Proposed Action.

4 ESA-listed Species and Critical Habitat in the Action Area

4.1 ESA-listed Species in the Action Area

Table 4-1 presents all ESA-listed species and associated designated critical habitat that occur within the Action Area.

Table 4-1. ESA-listed species and designated critical habitat that that occur within the Action Area.

Species		ESA Status	Critical Habitat	Recovery Plan
Marine Mammals–Cetaceans	Blue whale (*Balaenoptera musculus*)	E–35 *FR* 18319	-- --	FR Not Available 07/1998 11/2020
	Fin whale (*Balaenoptera physalus*)	E–35 *FR* 18319	-- --	75 *FR* 47538 07/2010
	North Atlantic right whale (*Eubalaena glacialis*)	E–73 *FR* 12024	81 *FR* 4837	70 *FR* 32293 08/2004
	Sei whale (*Balaenoptera borealis*)	E–35 *FR* 18319	-- --	FR Not Available 12/2011
	Sperm whale (*Physeter macrocephalus*)	E–35 *FR* 18319	-- --	75 *FR* 81584 12/2010
Sea Turtles	Green turtle (*Chelonia mydas*)–North Atlantic DPS	T–81 *FR* 20057	-- --[1]	FR Not Available 10/1991–U.S. Atlantic
	Kemp's Ridley turtle (*Lepidochelys kempii*)	E–35 *FR* 18319	-- --	FR Not Available 09/1991–U.S. Caribbean, Atlantic, and Gulf of Mexico 09/2011

Species		ESA Status	Critical Habitat	Recovery Plan
	Leatherback turtle (*Dermochelys coriacea*)	E–35 *FR* 8491	-- --[2]	FR Not Available 10/1991–U.S. Caribbean, Atlantic, and Gulf of Mexico
	Loggerhead turtle (*Caretta caretta*)–Northwest Atlantic Ocean DPS	T–76 *FR* 58868	-- --[3]	74 *FR* 2995 10/1991–U.S. Caribbean, Atlantic, and Gulf of Mexico 01/2009–Northwest Atlantic
Fishes	Atlantic salmon (Salmo salar)– Gulf of Maine DPS	E–74 *FR* 29344	74 *FR* 39903	70 *FR* 75473 11/2005 FR Not Available 02/2019
	Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*)– Carolina, Chesapeake, Gulf of Maine, New York Bight, South Atlantic DPSs	E–77 *FR* 5913	82 *FR* 39160	03/2018[4]
	Giant manta ray (*Mobula birostris*)	T–83 *FR* 2916	-- --	12/2019[4]
	Oceanic whitetip shark (*Carcharhinus longimanus*)	T–83 *FR* 4153	-- --	09/2018[4]
	Shortnose sturgeon (*Acipenser brevirostrum*)	E–32 *FR* 4001	-- --	63 *FR* 69613 12/1998

-- -- = not applicable; DPS = distinct population segment; E = endangered; F = foreign; *FR* = *Federal Register*; T = Threatened
[1] Green sea turtle critical habitat (63 *FR* 46693) is established outside of the Action Area.
[2] Leatherback sea turtle critical habitat (44 *FR* 17710 in the Atlantic and 77 *FR* 4169 in the Pacific) is established outside of the Action Area.
[3] Loggerhead sea turtle critical habitat (79 *FR* 39856) is established outside of the Action Area.
[4] No Recovery Plan is available for this species. However, NMFS has developed a Recovery Outline to serve as interim guidance for this species until a full Recovery Plan is developed.

4.2 ESA-listed Species and Critical Habitat Considered but Excluded from Further Analysis

Two ESA-listed species have broad geographic ranges that include portions of the northwest Atlantic but are not expected to occur within the Gulf of Maine with any reasonable certainty. Based on sighting histories and habitat preferences, these species, namely the giant manta ray (*Mobula birostris*) and oceanic whitetip shark (*Carcharhinus longimanus*), are unlikely to be present in the Action Area. Given this, **no effec**t is expected for these species as they would not encounter any project vessels or equipment included under the Proposed Action (**Section 3.1**). Explanations for excluding these species from further analysis are provided in the following subsections.

Critical habitat for Atlantic Salmon – Gulf of Maine DPS exists in the rivers adjacent to the Action Area. However, there is no marine habitat identified as critical habitat for this species. Therefore, the effects of the Proposed Action considered for this BA would have **no effect** on the critical habitat of Atlantic salmon and therefore, critical habitat for this species is excluded from further analyses. Information is provided in the subsections below for excluding this critical habitat from further analysis.

4.2.1 Atlantic Salmon Critical Habitat–Gulf of Maine DPS

Critical habitat for the Atlantic Salmon Gulf of Maine DPS was designated in June 2009 (74 *FR* 29300), with corrections published in August 2009 (74 *FR* 39903). This area is made up of perennial river, stream, estuary, and lake habitats that serve as critical areas for spawning, nursery and feeding grounds, and migration corridors to and from offshore marine waters. The FR determined that the successful return of adult salmon to spawning habitat, spawning, egg incubation and hatching, juvenile survival during the rearing time in freshwater, and smolt migration out of the rivers to the ocean are all essential to the conservation of Atlantic salmon. For the GOM DPS, the physical and biological features (PBFs; also known as primary constituent elements) essential for the conservation of Atlantic salmon are: 1) sites for spawning and rearing, and, 2) sites for migration (excluding marine migration). No marine habitats were identified as critical habitat because marine migration and feeding in these habitats essential for the conservation of Atlantic salmon could not be identified.

This habitat constitutes 12,273 mi (19,751 km) of river, stream, and estuary habitat, as well as 308.5 mi^2 (799 km^2) of lake which lies adjacent to the Action Area. The physical and biological features identified for spawning and rearing include (1) deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall; (2) freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development; (3) freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development, and feeding activities of Atlantic salmon fry; freshwater rearing sites (4) with space to accommodate growth and survival of Atlantic salmon parr; (5) with a combination of river, stream, and lake habitats that accommodate parr's ability to occupy many niches and maximize parr production; (6) with cool, oxygenated water to support growth and survival of Atlantic salmon parr; and (7) with diverse food resources to support growth and survival of Atlantic salmon parr.

The physical and biological features necessary for migration of Atlantic salmon include freshwater and estuary migratory sites (1) free from physical and biological barriers that delay or prevent access of adult salmon seeking spawning grounds needed to support recovered populations; (2) with pool, lake, and instream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult salmon; (3) with abundant, diverse native fish communities to serve as a protective buffer against predation; (4) free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment; (5) with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration; and (6) with water chemistry needed to support sea water adaptation of smolts.

Since there is no marine habitat identified as critical habitat for this species in any areas where any of the activities described as part of the Proposed Action will occur, **no effect** is expected for Atlantic salmon – Gulf of Maine DPS critical habitat resulting from the Proposed Action.

5 Description of Species and Critical Habitat Considered for Further Analysis

5.1 ESA-listed Species Considered for Further Analysis

BOEM has determined that the following ESA-listed species are likely to be present in the Action Area and thus require further analysis: blue whale–North Atlantic stock (*Balaenoptera musculus*); fin whale–Western North Atlantic stock (*Balaenoptera physalus*); North Atlantic right whale (NARW) –Western North Atlantic stock (*Eubalaena glacialis)*; sei whale–Nova Scotia stock (*Balaenoptera borealis*); sperm whale–North Atlantic stock (*Physeter macrocephalus*); green sea turtle–North Atlantic DPS (*Chelonia mydas*); Kemp's ridley sea turtle (*Lepidochelys kempii*); leatherback sea turtle (*Dermochelys coriacea*); loggerhead sea turtle–Northwest Atlantic Ocean DPS (*Caretta caretta*); Atlantic Salmon–Gulf of Maine DPS (*Salmo salar*); Atlantic sturgeon–All DPSs (*Acipenser oxyrinchus oxyrinchus*); and shortnose sturgeon (*Acipenser brevirostrum*). The following subsections discuss the habitat, foraging preferences, acoustic behavior, status, and occurrence of each ESA-listed species considered for further analysis.

5.1.1 Marine Mammals

Five species of ESA-listed marine mammals are carried forward in this assessment. Habitat-based marine mammal density data (Roberts et al. 2023) was analyzed for each species; mean densities for all marine mammal species (in number of animals per square kilometer) within the Action Area are presented in **Table 5-1**. These data (visualized through the heatmap applied to the table) are used to assess seasonal and relative distribution patterns for blue, fin, NARW, sei, and sperm whales within the Action Area in addition to data from other surveys and published reports.

Table 5-1. Monthly marine mammal mean densities (individuals per square kilometer) within the Action Area

Species	January	February	March	April	May	June	July	August	September	October	November	December	Yearly Average
Fin	0.00314	0.00245	0.00225	0.00291	0.00520	0.00724	0.00822	0.00849	0.00664	0.00550	0.00394	0.00358	0.00496
NARW	0.00186	0.00161	0.00158	0.00198	0.00241	0.00138	0.00114	0.00014	0.00011	0.00031	0.00087	0.00108	0.00121
Sei	0.00023	0.00020	0.00050	0.00264	0.00707	0.00626	0.00199	0.00134	0.00186	0.00341	0.00157	0.00046	0.00230
Sperm	0.00060	0.00050	0.00053	0.00030	0.00054	0.00077	0.00087	0.00144	0.00168	0.00106	0.00070	0.00049	0.00079
Blue	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002	0.00002

Data source: Roberts et al. 2023
Note: Table cell colors correspond to relative geographic and temporal densities assessed for from January through December for each species, individually. Warm colors (i.e., red) indicate months of highest relative density whereas cool colors (i.e., green) indicate months of lowest relative density for that species. Blue whale densities are all one color and the same for all months because only annual density data is available for this species from Roberts et al. (2023). Only annual density data is available for the blue whale (Roberts et al. 2023); therefore, all months indicate the same average annual density for blue whales.

5.1.1.1 Blue Whale–North Atlantic Stock (Endangered)

The documented range of blue whales in the North Atlantic extends from the subtropics to the Greenland Sea. As described in the most recent stock assessment report, blue whales have been detected and tracked acoustically in much of the North Atlantic Ocean, with most acoustic detections around the Grand Banks area of Newfoundland and west of the British Isles (Hayes et al. 2020). Photo-identification in eastern Canadian waters indicates blue whales from the St. Lawrence River, Newfoundland, Nova Scotia, Northeast U.S., and Greenland all belong to the same stock, whereas blue whales photographed off Iceland and the Azores appear to be part of a separate population (Cetacean and Turtle Assessment Program [CETAP] 1982; Wenzel et al. 1988; Sears and Calambokidis 2002; Sears and Larsen 2002). The largest concentrations of blue whales are found in the lower St. Lawrence Estuary (Lesage et al. 2007; Comtois et al. 2010), which is outside of the Action Area. Blue whales do not regularly utilize habitat within the U.S. Exclusive Economic Zone (EEZ), typically occurring farther offshore in depths of 328 ft (100 m) or more (Waring et al. 2012). Sightings and strandings data indicate blue whales occur along the U.S. East Coast only rarely because their primary northwest Atlantic habitat is offshore eastern Canada (Reeves et al. 1998; Kraus et al. 2016a; Hayes et al. 2020). Blue whales primarily feed on krill, but fish and copepods may also be part of their diet (NMFS 2023a).

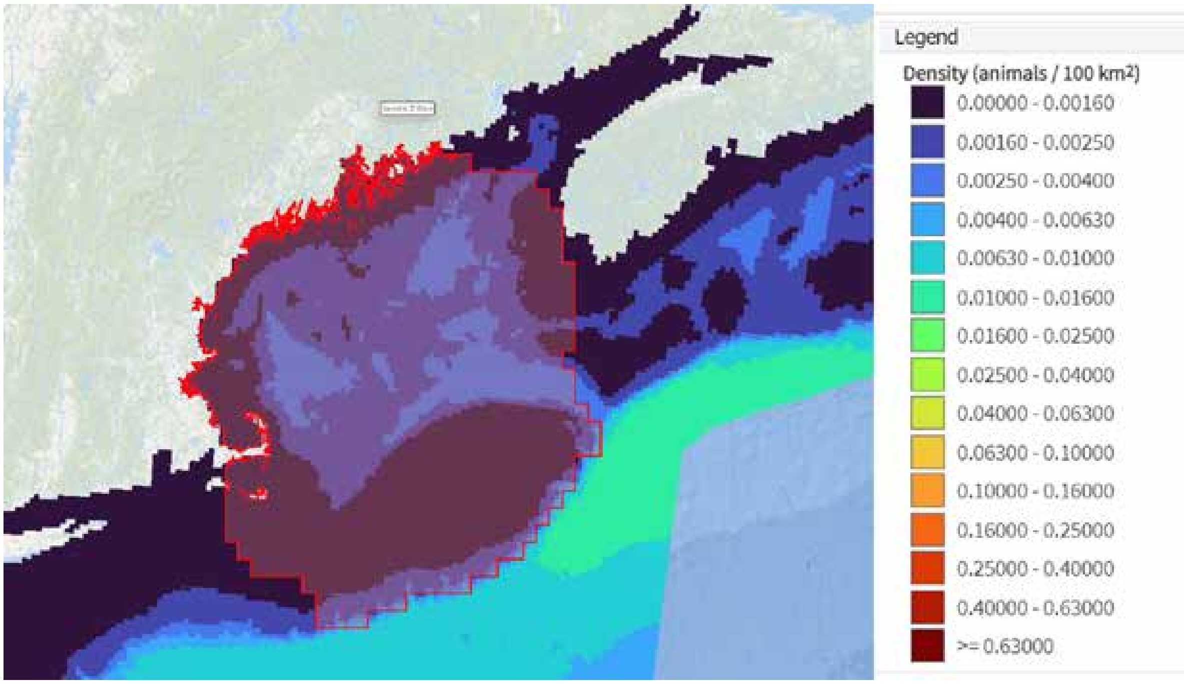
5.1.1.1.1 Current Status

Blue whales have been listed as endangered under the ESA Endangered Species Conservation Act of 1969, with a recovery plan published under 63 *FR* 56911. Blue whales are separated into two major populations (North Pacific and North Atlantic) and further subdivided into stocks[26]. The North Atlantic Stock includes mid-latitude (North Carolina coastal and open ocean) to Arctic waters (Newfoundland and Labrador). The population size of blue whales off the U.S. East Coast is not known; however, a catalogue count of 402 individuals from the Gulf of St. Lawrence establishes the minimum population estimate (Hayes et al. 2020). There are no recent confirmed records of anthropogenic mortality or serious injury to blue whales in the U.S. Atlantic EEZ or in Atlantic Canadian waters (Henry et al. 2020). As a result, the total level of anthropogenic mortality and serious injury is unknown, but it is believed to be insignificant and approaching zero (Hayes et al. 2020). No critical habitat has been designated for the blue whale.

5.1.1.1.2 Potential Occurrence within the Action Area

Historical observations indicate the blue whale has a wide distribution throughout the North Atlantic Ocean, from warm temperate latitudes in the winter months to northern regions in the summer months. Based on limited sighting and standing data, blue whales are only occasional visitors to U.S. Atlantic EEZ waters, exhibiting a more pelagic distribution (Kraus et al. 2016a; Lesage et al. 2017). Blue whales in the North Atlantic appear to target high-latitude feeding areas and may use deep-ocean features such as sea mounts outside the feeding season (Pike et al. 2009; Lesage et al. 2017, 2018). Given their reported occurrence and habitat preferences, their presence in the Action Area is expected to be rare (**Figure 5-1**; Hayes et al. 2020). Blue whales have been reported in the Gulf of Maine and a known individual was resighted between the Gulf of Maine, Scotian Shelf, and Gulf of St. Lawrence (Hayes et al. 2020). Annual density estimates for blue whales were modeled by Roberts et al. (2023) and are represented in **Table 5-1**.

[26] "Stock" is defined by the MMPA as a group of individuals "of the same species or smaller taxa in a common spatial arrangement that interbreed when mature" (16 USC § 1362.11).



Source: Roberts et al. 2023

Figure 5-1. Blue whale mean annual densities within the Action Area and surrounding region

5.1.1.2 Fin Whale–Western North Atlantic Stock (Endangered)

Fin whales are a globally distributed baleen whale species found in temperate to polar regions in all ocean basins (Edwards et al. 2015). The western North Atlantic stock is concentrated in the U.S. and Canadian Atlantic Exclusive Economic Zones from Cape Hatteras to Nova Scotia (Hayes et al. 2020) and is therefore the most likely source of individuals occurring in the Action Area. Fin whales are the most commonly sighted large whale species in this region, accounting for 46 percent of all sightings in aerial surveys conducted from 1978 to 1982 (CETAP 1982; Hayes et al. 2018) and constitute the majority of large whale sightings in recent aerial and shipboard surveys (NEFSC and SEFSC 2018; Kraus et al. 2016a). They have been observed in every season throughout most of their range, though densities do vary seasonally (Edwards et al. 2015). While they prefer the deeper waters of the continental shelf (300 to 600 ft [91 to 183 m]), they are regularly observed anywhere from coastal to abyssal areas (Hayes et al. 2020).

Fin whales are the second largest cetacean, with adults in the North Atlantic reaching lengths up to 78.7 ft (24 m). Fin whales are fast swimmers typically found in social groups of two to seven, often congregating with other whales in large feeding groups (Hayes et al. 2017). The species returns annually to established feeding areas and fasts during migration between feeding and calving grounds. Fin whales in the North Atlantic feed on krill (*Meganyctiphanes norvegica* and *Thysanoessa inermis*) and schooling fish such as capelin (*Mallotus villosus*), herring (*Clupea harengus*), and sand lance (*Ammodytes* spp.), captured by skimming or lunge feeding (Borobia et al. 1995). The Gulf of Maine represents one of the main feeding grounds for fin whales, where they preferentially forage on small schooling fish such as herring, sand lance, young mackerel, and krill (DMR 2022b) Several studies suggest that distribution and movements of fin whales along the east coast of the U.S. are influenced by the availability of sand lance (Kenney and Winn 1986; Payne et al. 1990). Some level of site fidelity among females at their feeding grounds likely exist (Clapham and Seipt 1991; Agler et al. 1993; Schleimer et al. 2019). While fin whales likely migrate into Canadian waters, deep offshore areas, or tropical latitudes, distinct, population-wide large-scale annual migrations are unlikely (Hayes et al. 2022). Data suggests that calving may take place from October through January in the Mid-Atlantic region (Hain et al. 1992), though calving, mating, and wintering patterns for the majority of the population remain unknown. The fin whale's ecological role and influence on ecosystem processes surpasses that of all other cetacean species in the Western North Atlantic due to their large stock size and prey requirements (Hain et al. 1992; Kenney et al. 1997). Within the Action Area, biologically important areas (BIA) for feeding are delineated for the Southern Gulf of Maine year-round and the Northern Gulf of Maine from June to October (LaBrecque et al. 2015).

Fin whales and other baleen whales belong to the low-frequency cetacean (LFC) marine mammal hearing group, which has a generalized hearing range of 7 hertz (Hz) to 35 kHz (NMFS 2018). The predicted best hearing sensitivity of fin whales is believed to range from 20 HZ to 20 kHz (Erbe 2002; Southall et al. 2019).

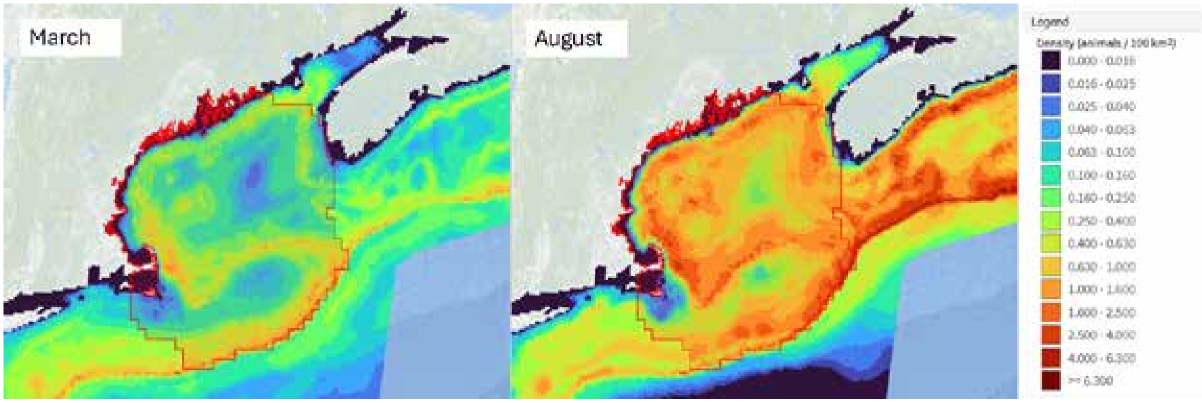
5.1.1.2.1 Current Status

Fin whales have been listed as endangered under the ESA since the act's passage in 1973 (35 *FR* 8491), and critical habitat has not been designated. The best available abundance estimate for the western North Atlantic stock is 6,802 individuals, with a minimum population estimate of 5,573 based on shipboard and aerial surveys conducted in 2016 by NOAA and the 2016 Northeast Fisheries Science Center and Department of Fisheries and Oceans Canada surveys (Hayes et al. 2022). The extents of these two surveys do not overlap; therefore, the survey estimates were added together. NMFS has not conducted a population trend analysis due to insufficient data and irregular survey design (Hayes et al. 2022). The best available information indicates that the gross annual reproduction rate is 8 percent, with a mean calving interval of 2.7 years (Hayes et al. 2022). For 2017 through 2021, the minimum annual rate of human-caused (i.e., vessel strike and entanglement in fishery gear) mortality and serious injury was 2.05 per year (NMFS 2024a). No critical habitat has been designated for fin whales in the Action Area.

5.1.1.2.2 Potential Occurrence Within the Action Area

Fin whales are one of the most commonly sighted large whales in OCS waters from the Mid-Atlantic U.S. coast to Nova Scotia, Canada, principally from Cape Hatteras, North Carolina and northward (Sergeant 1977; Sutcliffe and Brodie 1977; CETAP 1982, Hain et al. 1992; NMFS 2019). The Gulf of Maine, including the Action Area, represents an important foraging area for fin whales; two BIAs for fin whale feeding overlap with the Action Area (LaBrecque et al. 2015). There is also evidence for maternally-directed site fidelity over multiple years in the Gulf of Maine (Clapham and Seipt 1991). All life stages of fin whales could be encountered in the Action Area.

Habitat-based marine mammal density data indicate the highest densities throughout the Action Area would most likely occur in August and the lowest in March (**Figure 5-2**; Roberts et al. 2023). The temporal and geographic distribution of fin whale densities within the Action Area is presented in **Table** 5-1; the data indicate that, while fin whales are widespread throughout the Gulf of Maine throughout the year, they are likely to occur in highest densities during the summer.



Source: Roberts et al. 2023

Figure 5-2. Fin whale minimum (March) and maximum (August) mean densities within the Action Area and surrounding region

5.1.1.3 North Atlantic Right Whale–Western North Atlantic Stock (Endangered)

The NARW is a large baleen whale, ranging from 45 to 55 ft (13.7 to 16.8 m) in length and weighing up to 70 tons at maturity, with females being larger than males. The primary habitat for this species is coastal or OCS waters ranging from calving grounds off the Southeastern U.S. to feeding grounds off the Northeastern U.S. (Hayes et al. 2023). Important feeding habitats include coastal waters off southern New England, Gulf of Maine, Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence.

There are two critical habitat areas for NARWs in Canadian waters (Brown et al. 2009) and two in U.S. waters: all U.S. waters within the Gulf of Maine are designated as a Foraging Area Critical Habitat while waters off the Southeastern U.S. are designated as a Calving Area Critical Habitat (81 *FR* 4837; Hayes et al. 2023). The Mid-Atlantic OCS between the two U.S. critical habitat areas has been identified as a principal migratory corridor and thus an important habitat for NARWs as they travel between breeding and feeding grounds (Hayes et al. 2023; CETAP 1982). This migratory pathway is considered a BIA for the species (LaBrecque et al. 2015). While some individuals undergo yearly migrations between spending summer months at their northern feeding grounds and winter months at their southern breeding grounds, the location of most individuals throughout much of the year is not known. Year-round presence in all habitat areas has been recorded (Bailey et al. 2018; Davis et al. 2017). In addition, long-range movements are also apparent, with some individuals being identified in the eastern North Atlantic and others covering long distances over short time periods (Hayes et al. 2023).

Foraging habits of NARWs show a clear preference for the late juvenile developmental stage of the zooplanktonic copepod, *Calanus finmarchicus* (Mayo et al. 2001). This species occurs in dense patches and demonstrates both diel and seasonal vertical migration patterns (Baumgartner et al. 2011). The NARW distribution and movement patterns within their foraging grounds is highly correlated with concentrations and distributions of their prey, which exhibit high variability within and between years (Pendleton et al. 2012). Due to the heightened energetic requirements of pregnant and nursing females, yearly reproductive success of the population is directly related to foraging success and the abundance of *C. finmarchicus* (Meyer-Gutbrod et al. 2015), which in turn is correlated with decadal-scale variability in climate and ocean patterns (Greene and Pershing 2000).

Skim feeding is an important activity identified in effects assessments because it demonstrates a critical behavior (feeding) that could be disrupted by external stressors. Baumgartner et al. (2017) investigated NARW foraging ecology in the Gulf of Maine and southwestern Scotian Shelf using archival tags; diving behavior was variable but followed distinct patterns correlated with the vertical distribution of forage species in the water column. Importantly, Baumgartner et al. (2017) found that NARWs spent 72 percent of their time within 33 ft (10 m) of the surface. Although NARWs are always at risk of ship strike when breathing, the tendency to forage near but below the surface for extended periods substantially increases this risk (Baumgartner et al. 2017). NARW feeding behavior varies by region in response to different seasonal and prey availability conditions. For example, NARWs may rely more frequently on skim-feeding when in transit between core habitats or when dense concentrations of prey are less available (Whitt et al. 2013). Similarly, right whales spend extended periods of time at the water's surface actively socializing in what are known as surface active groups (SAGs); SAGs have been documented in all habitat regions, during all seasons, involve all age classes, and include mating behaviors, play, and the maintenance of social bonds (Parks et al. 2007). The extensive and biologically critical surface behaviors of NARWs, such as surface skim feeding and SAGs, represent a vulnerable time for right whales as they are exposed to an increased risk for ship strike when active at or near the surface.

The diversity of zooplankton across the Northeast U.S. Continental Shelf is relatively high (greater than 100 species), although seasonal and interannual trends in abundance differ among species (NEFSC n.d.; Johnson et al. 2017; DFO 2017). Seasonal trends in overall zooplankton abundance have been detected over the shelf waters of southern New England, ranging from relatively low densities (0.73 to 1.4 cubic inches per 2.4 cubic mile) in January through February to relatively high densities (greater than 3.36 cubic inches per 2.4 cubic mile) during May through August (NEFSC n.d.). These trends are also present for *C. finmarchicus*, which is also an important food source for many fish species, including NARWs. On average, *C. finmarchicus* has been the most abundant during the spring and summer (March through August), with a peak density in May through June along the Northeast U.S. Shelf (NEFSC n.d.). Overall, average zooplankton densities have been remarkably consistent over the past 20 years, though interannual variability is present. Mean total density for *C. finmarchicus* along the Northeast U.S. Shelf varied greatly from year to year, commonly halving or doubling from one year to the next (NEFSC n.d.). Results from Runge et al. (2015) and Ji et al. (2017) specify that predicting fluctuations in abundance or circumstances for disappearance of *C. finmarchicus* in the northwest Atlantic would require models that address the roles of local production and advection.

NARW distribution and pattern of habitat use has shifted both spatially and temporally beginning in 2010 (Davis et al. 2017). Meyer-Gutbrod et al. (2018) recorded NARW sightings in several traditional feeding habitats beginning to decline in 2012, causing speculation that a shift in NARW habitat usage was occurring (Pettis et al. 2022). An increased presence of NARWs in the Gulf of St. Lawrence beginning in 2015 further supports a shift in habitat use, potentially in response to shifting prey resources as a result of climate change (Crowe et al. 2021; Meyer-Gutbrod et al. 2015, 2021). Additionally, a recent increase in habitat use and year-round presence in the southern New England region, including Nantucket Shoals, indicates that the area is an increasingly important NARW habitat (O'Brien et al. 2022). These data and literature therefore collectively suggest that NARW habitat use, including changes in their distribution patterns linked to prey resources, is dynamic and likely related to climate change processes.

NARW and other baleen whales belong to the LFC marine mammal hearing group, which has a generalized hearing range of 7 Hz to 35 kHz (NMFS 2018). Right whale vocalizations most frequently observed during PAM studies include upsweeps rising from 30 to 450 Hz, often referred to as "upcalls," and broadband (30 to 8,400 Hz) pulses, or "gunshots," with SLs between 172 and 187 dB re 1 µPa m (Erbe et al. 2017a). However, recent studies have shown that mother-calf pairs reduce the amplitude of their calls in the calving grounds, possibly to avoid detection by predators (Parks et al. 2019). Modeling conducted using right whale ear morphology suggest that the best hearing sensitivity for this species is between 16 Hz and 25 kHz (Southall et al. 2019).

5.1.1.3.1 Current Status

NARWs in U.S. waters belong to the Western Atlantic stock. The NARW is listed as endangered under the ESA and critically endangered by the International Union for Conservation of Nature (IUCN) Red List (Cooke 2020; Hayes et al. 2023). Right whales are considered to be one of the most critically endangered large whale species in the world (Hayes et al. 2023). Between 2011 and 2021, overall population abundance declined 29.3 percent, further evidenced by the decreased abundance estimate from 451 individuals in 2018 to the current 2023 estimate of 340 individuals (NMFS 2024a). This decline in abundance follows a previously positive population trend from 1990 to 2011 of a 2.8 percent increase per year from an initial abundance estimate of 270 individuals in 1998 (NMFS 2024a). Over time, there have been periodic swings of per capita birth rates (NMFS 2024a), although current birth rates continue to remain below expectations (Pettis and Hamilton, 2024), with an approximately 40 percent decline in reproductive output for the species since 2010 (Kraus et al. 2016). Twelve new calves were born during the 2023 calving season, down from 15 in 2022 and 20 in 2021; so far, 17 calves have been identified during the 2024 calving season (NMFS 2024b). Although the increasing birth rate is a good sign, it is still significantly below what is expected, and the rate of mortality is still higher than what is sustainable (Pettis and Hamilton, 2024; NMFS 2024a). A reduction in adult female survival rates relative to male survival rates has caused a divergence between male and female abundance. In 1990, there were an estimated 1.15 males per female, and by 2015, estimates indicated 1.46 males per female (Pace et al. 2017).

There have been elevated numbers of NARW mortalities and injuries reported since 2017, which prompted NMFS to designate a UME for NARWs (NMFS, 2024c). These elevated mortalities and injuries have continued into 2024, with a total of 125 individuals reported dead or to have sustained serious or sublethal injuries or illness in U.S. and Canadian waters to date (NMFS, 2024c). This includes 40 confirmed mortalities, 34 live free-swimming whales with serious injuries, and 51 individuals observed with sublethal injuries or illness documented as of April 8, 2024 (NMFS 2024c). Human interactions (e.g., fishery-related entanglements and vessel strikes) are the most likely cause of this ongoing UME; of the 40 mortalities, 15 have been attributed to vessel strikes and 9 to entanglements.

The total annual average detected (i.e., observed) human-caused mortality and serious injury for the NARW is 7.1 individuals per year, averaged over the period between 2017 and 2021, although this likely represents an underestimate as not all mortalities are recorded (NMFS 2024a). Modeling using the 2016 to 2020 estimated annual means to account for undetected mortality and serious injury suggests the mortality rate could be as high as 27.2 animals per year (NMFS 2024a). Importantly, NARW mortalities exceed the species' calculated PBR (0.7 individual per year); and due to its listing as endangered under the ESA, this population is classified as strategic and depleted under the MMPA (NMFS 2024a). The current population estimate for NARWs is at its lowest point in nearly 20 years, with their high mortality rate driven primarily by fishing gear entanglement and vessel strike (NMFS 2024a). When coupled with the species' low fecundity and small population size, all human-caused mortalities have the potential to affect its population status.

While vessel strikes and entanglements in fishing gear represent the most significant threat to NARWs, other risks to the population include acoustic disturbance and masking, climate change, and climate-driven shifts in prey species (NMFS 2024a).

To mitigate the potential for vessel strikes, NMFS designated certain nearshore waters along the U.S. East Coast as Seasonal Management Areas (SMAs) (73 *FR* 60173). These management areas are in effect seasonally and established such that all vessels greater than 65 ft (19.8m) in overall length must operate at speeds of 10 kn or less within these areas. Portions of existing NARW SMAs overlap with the southern portion of the Action Area:

Cape Cod Bay SMA–January 1 to May 15

Off Race Point SMA–March 1 to April 30

Great South Channel SMA–April 1 to July 31

Amendments to the NARW speed rule (Proposed Rule, 87 FR 46921) would decrease the size of vessels required to comply with the 10-knot speed restriction to 35 ft (10.7m) and expand the geographic areas to regional sections rather than immediately surrounding ports and transit corridors. The southern portion of the Action Area would overlap with the proposed Atlantic seasonal speed zone, which would be in effect from November 1 to May 30 if the rule is adopted; the WEA does not overlap with the expanded seasonal speed zone.

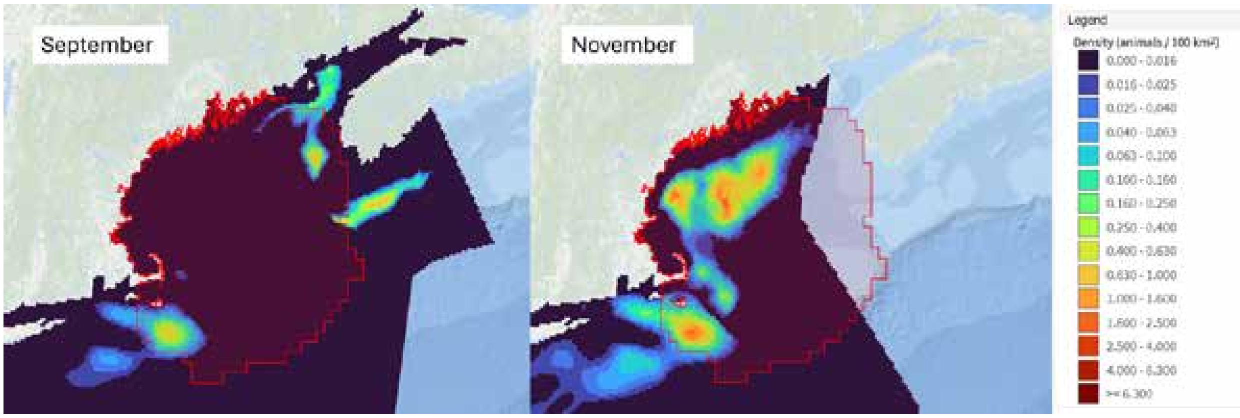
Critical habitat for the NARW within the Action Area (**Section 5.2.1**) comprises the Northeastern U.S. Foraging Area (Unit 1) in the Gulf of Maine, including Cape Cod Bay, Stellwagen Bank, and the Great South Channel (81 *Federal Register* 4837). Additional NARW critical habitat is designated in the species' nearshore calving grounds that stretch from Cape Canaveral, Florida to Cape Fear, North Carolina (Southeastern U.S. Calving Area [Unit 2]); this portion of NARW critical habitat does not overlap with the Action Area.

5.1.1.3.2 Potential Occurrence Within the Action Area

NARWs are common in the Gulf of Maine; visual and acoustic surveys indicate that NARWs may be present year-round in the Gulf of Maine, though the highest abundances occur from mid-fall through early summer (Hayes et al. 2023; MGEL 2022; Davis et al. 2017). The species is less commonly observed in the Action Area during July, August, and September when they are more likely to be in the Bay of Fundy (outside of the Action Area) or in more northern feeding grounds such as the Gulf of St. Lawrence, Canada (Pendleton et al. 2012; Kraus et al. 2016a; Leiter et al. 2017; Crowe et al. 2021). The Gulf of Maine represents an important foraging habitat for the NARW as the unique bathymetric features of the Gulf of Maine support dense aggregations of their preferred prey. NARWs typically arrive in the Gulf of Maine in the early spring and enter Cape Cod Bay, where large, dispersed groups, including mothers with their offspring, are commonly sighted. From mid-spring through early summer, individuals move out of Cape Cod Bay to utilize other areas of the Gulf of Maine, Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence. While these movement patterns are generalized, satellite telemetry data indicate that individuals are highly mobile and can exhibit sporadic large scale movement patterns between sighting events (Mate et al. 1992). Therefore, individuals may occur within the Action Area throughout the year, even when predicted densities are expected to be low.

Habitat-based marine mammal density data indicate the highest densities throughout the Action Area would most likely occur in November and the lowest in September (**Figure 5-3**; Roberts et al. 2023). The temporal and geographic distribution of NARW densities within the Action Area is presented in **Table** 5-1**;** the data indicate that, while NARW may occur year-round in the Gulf of Maine, they are likely to occur in highest densities during the winter and spring.

There continue to be shifts in NARW abundances and feeding activity; and more uncertainty in foraging patterns should be expected throughout the entirety of the Proposed Action (Hudak et al. 2023; Ross et al. 2023). There are several planned and ongoing acoustic studies for NARWs in the Gulf of Maine to better understand shifts in abundances (Passive Acoustic Research in the Northeast).



Source: Roberts et al. 2023

Figure 5-3. NARW minimum (September) and maximum (November) mean densities within the Action Area and surrounding region

5.1.1.4 Sei Whale–Nova Scotia Stock (Endangered)

The sei whale is a large baleen whale species found in subtropical, temperate, and subpolar waters around the globe, most commonly observed in temperate waters at mid-latitudes. Sei whales are often associated with deeper waters and areas along the continental shelf edge (Hain et al. 1985); however, this general offshore pattern of sei whale distribution is disrupted during occasional incursions into more shallow and inshore waters (Waring et al. 2004). Sightings in U.S. Atlantic waters are typically centered on mid-shelf and the shelf edge and slope (Olsen et al. 2009). The species is notable for its unpredictable distribution, concentrating in specific areas in large numbers for a period and then abandoning those habitats for years or even decades. The breeding and calving areas used by this species are unknown (Hayes et al. 2022).

This species is highly mobile, and there is no indication that any population remains in a particular area year-round (NMFS 2011). Sei whale occurrence in any particular feeding ground is considered unpredictable or irregular (Schilling et al. 1992) but may be correlated to incursions of relatively warm waters related to broadscale oceanographic circulation patterns (Hayes et al. 2022). Olsen et al. (2009) also indicated that sei whales' movements appear to be associated with oceanic fronts, thermal boundaries, and specific bathymetric features. NMFS (2011) indicated that climate change may affect sei whale habitat availability and food availability, as migration, feeding, and breeding locations may be affected by ocean currents and water temperature.

Sei whales usually travel alone or in small groups of two to five animals, occasionally in groups as large as 10 (Hayes et al. 2022). Potential species occurrence in the Action Area is likely to be closely tied to feeding behavior and seasonal availability of preferred prey resources. Sei whales in the North Atlantic preferentially prey on calanoid copepods, particularly *C. finmarchicus*, over all other zooplankton species (Christensen et al. 1992; NMFS 2011; Prieto et al. 2014). Data indicate that sei whales have a clear preference for copepods between June and October, with euphausiids constituting a larger part of the diet in May and November (NMFS 2011; Prieto et al. 2014). They also feed on small schooling fish and cephalopods, including squid. Sei whales prefer to feed at dawn and may exhibit unpredictable behavior while foraging and feeding on prey (NMFS 2023e). Their feeding behaviors include gulping, skimming, and lunging at the surface.

Sei whales are occasionally killed in collisions with vessels. Of three sei whales that stranded along the U.S. Atlantic coast between 1975 and 1996, two showed evidence of collisions with ships (Laist et al. 2001). Between 1999 and 2005, there were three reports of sei whales being struck by vessels along the Atlantic coast of the U.S. and the maritime provinces of Canada (Cole et al. 2005; Nelson et al. 2007). Two of these vessel strikes were reported as having resulted in the death of the sei whale.

Sei whales and other baleen whales belong to the LFC hearing group of marine mammals, which has a generalized hearing range of 7 Hz to 35 kHz (NMFS 2018). Peak hearing sensitivity of sei whales is believed to range from 1.5 to 3.5 kHz based on recorded vocalization patterns (Erbe 2002).

5.1.1.4.1 Current Status

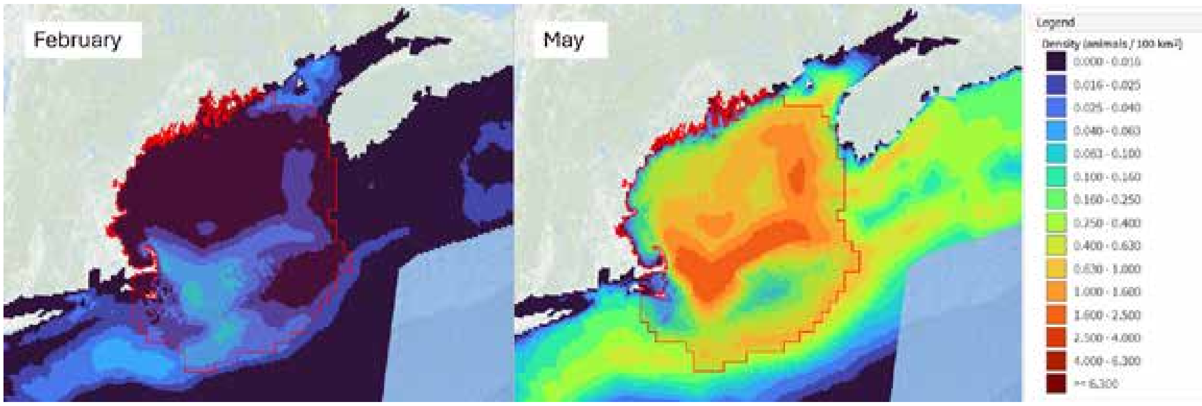
Sei whales have been ESA-listed as endangered since the passage of the act in 1973 (35 *FR* 8491). Sei whales occurring in the U.S. Atlantic EEZ belong to the Nova Scotia stock, which range from the northeast U.S. coast northward to south of Newfoundland throughout continental shelf waters (Hayes et al. 2022). The current best abundance estimate for this stock is 6,292 individuals (Hayes et al. 2022). Between 2017 and 2021, the average annual minimum human-caused mortality and serious injury was 0.6 sei whales per year (NMFS 2024a). The PBR of this stock is 6.2 (NMFS 2024a). Threats to sei whales include vessel strike and entanglement in fisheries gear. A population trend is not available for the Nova Scotia sei whale stock because of insufficient data (Hayes et al. 2022). This stock is listed as strategic and depleted under the MMPA due to its endangered status (Hayes et al. 2022). No critical habitat has been designated for sei whales in the Action Area.

5.1.1.4.2 Potential Occurrence Within the Action Area

Sei whales are typically distributed in deep waters in association with the shelf edge throughout their range, though incursions into shallower OCS waters occurs, generally in response to oceanographic patterns and prey availability (Hain et al. 1985; Hayes et al. 2022). Sei whales are present in the Action Area primarily during spring and summer, though they have been observed year-round near the shelf break (Palka et al. 2021). Available data suggest sei whales primarily occur in deeper shelf waters in the southern and eastern portions of the Action Area near the shelf break, only occasionally traveling closer to shore to feed (Palka et al. 2021; Hayes et al. 2022; Roberts et al. 2023). The Gulf of Maine is primarily used for foraging; however the sei whale preference for cooler waters (less than 10°C) indicate that preferential feeding grounds may be in decline and populations would be in flux (Hayes et al. 2022). Passive acoustic analyses support this with records showing that sei whales had a higher acoustic occurrence after 2010 in the Mid-Atlantic (Davis et al. 2020).

Low numbers of sei whales are expected to be encountered within the Action Area, with highest likelihood in offshore waters beyond the 100-m isobath; however, variable patterns in distribution could result in very high or very low encounter rates for any given year (Hayes et al. 2022).

Habitat-based marine mammal density data indicate the highest densities throughout the Action Area would most likely occur in May and the lowest in February (**Figure 5-4**; Roberts et al. 2023). The temporal and geographic distribution of sei whale densities within the Action Area is presented in **Table** 5-1; the data indicate that, while sei whales may occur year-round in the Gulf of Maine, they are likely to occur in highest densities during the spring and again during the fall.



Source: Roberts et al. 2023

Figure 5-4. Sei whale minimum (February) and maximum (May) mean densities within the Action Area and surrounding region

5.1.1.5 Sperm Whale–North Atlantic Stock (Endangered)

The sperm whale is the largest member of the order Odontocetes, or toothed whales, with adults ranging from 39 to 59 ft (12 to 18 m) in length. Sperm whales occur throughout the world's oceans. They can be found near the edge of the ice pack in both hemispheres and are also common along the equator. The North Atlantic stock is distributed mainly along the OCS-edge, over the continental slope, and mid-ocean regions, where they prefer water depths of 1,969 ft (600 m) or more and are less common in waters less than 984 ft (300 m) deep (Perry et al. 1999; Hayes et al. 2020). The stock exhibits a distinct seasonal cycle in U.S. Atlantic EEZ waters (Perry et al. 1999; Stanistreet et al. 2018). During the winter, sperm whales are observed east and northeast of Cape Hatteras, predominantly past the OCS edge (Hayes et al. 2020). In the spring, sperm whale distribution shifts north and they are more widely distributed throughout the Mid-Atlantic Bight and southern portions of George's Bank (Hayes et al. 2020). Their summer distribution is similar to the spring, but with heightened occurrence inshore of the 328-foot (100-meter) isobath south of New England and in the Mid-Atlantic (Hayes et al. 2020). Sperm whale occurrence on the OCS in areas south of New England is at its highest in the fall, while occurrence in the Mid-Atlantic Bight is along the shelf edge (Hayes et al. 2020). The observed seasonality is likely driven by the distributions of their preferred prey (cephalopods), which may aggregate along distinct oceanographic features such Gulf Stream eddies and temperature fronts in association with bathymetric features of the shelf edge (Waring et al. 1993; Jaquet and Whitehead 1996; Griffin 1999).

While deep water is their typical habitat, sperm whales have been observed near Long Island, New York, in water between 135 and 180 ft (41 and 55 m; Scott and Sadove 1997); and in the Gulf of Maine in 525 ft (160 m) water depths (Tran et al. 2014). When they are found relatively close to shore, sperm whales are usually associated with sharp increases in bottom depth where upwelling occurs and biological production is high, implying the presence of a good food supply (Clarke 1956).

Geographic distribution of sperm whales appears to be linked to social structure. Females and juveniles tend to congregate in matrilineal social groups in subtropical waters, whereas males range widely from the tropics to high latitudes and breed across social groups (Hayes et al. 2020). Sperm whales in the North Atlantic display sufficient genetic isolation from other Atlantic groupings to justify their identification as a breeding stock, but insufficient data are available to determine a definitive population structure (Waring et al. 2015).

Sperm whales are predatory specialists known for hunting prey in deep water. The species is among the deepest diving of all marine mammals. Males have been known to dive 3,936 ft (1,200 m), whereas females dive to at least 3,280 ft (1,000 m); both can continuously dive for more than 1 hour. Sperm whales are also relatively fast swimmers, capable of swimming at speeds of up to 20 miles per hour (9 m per second [m/s]) (Aoki et al. 2007). The species preferentially targets squid, which make up at least 70 percent of the whale's typical diet (Kawakami 1980; Pauly et al. 1998). Sperm whale may also prey on bottom-oriented organisms such as octopus, fish, shrimp, crab, and sharks (Leatherwood et al. 1982; Pauly et al. 1998).

Sperm whales belong to the mid-frequency cetacean (MFC) marine mammal hearing group, which has a generalized hearing range of 150 Hz to 160 kHz (NMFS 2018). Peak hearing sensitivity of sperm whales ranges from 5 to 20 kHz based on auditory brainstem response to recorded stimuli completed on a stranded neonate (Ridgway and Carder 2001). Sperm whales communicate and search for prey using broadband transient signals between 500 and 24 kHz, with most sound energy focused in the 2- and 9-kHz range (Lohrasbipeydeh et al. 2013).

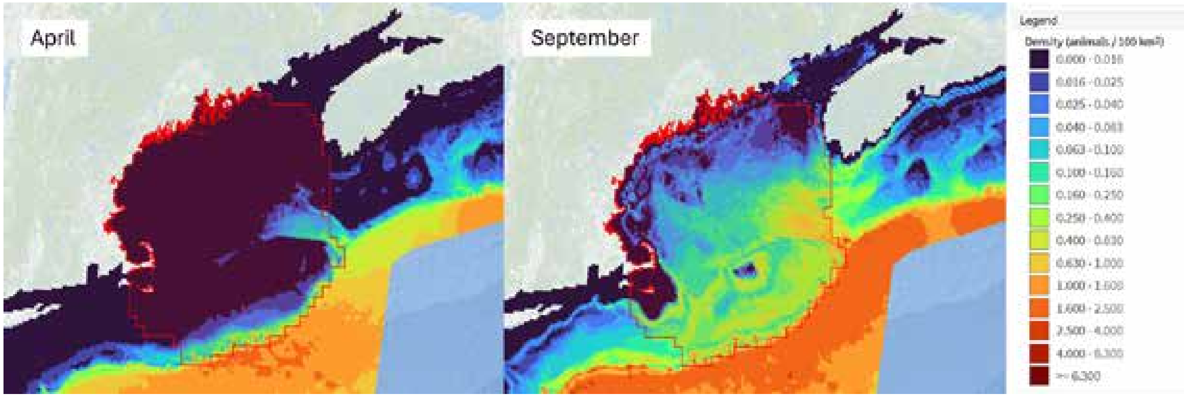
5.1.1.5.1 Current Status

Sperm whales have been listed as endangered under the ESA since the initial passage of the act (35 *FR* 18319). The stock structure of the Atlantic population of sperm whales is poorly understood. It is not clear whether the western North Atlantic population is discrete from the eastern North Atlantic population (NMFS 2024a). However, the portion of the population found within the U.S. EEZ likely belongs to a larger stock in the western North Atlantic. The species was subjected to intense commercial whaling pressure in the 18th, 19th, and early 20th centuries, resulting in a prolonged and severe decline in abundance. Sperm whale populations are rebuilding after the cessation of commercial whaling on the species; the primary threats today are ship collisions and fishing gear entanglement (NMFS 2024a). The most recent abundance estimate for the North Atlantic stock is 5,895 (NMFS 2024a). There were no reports of fishery-related mortality or serious injury between 2017 and 2021, however there was one stranding in 2021, which was attributed to plastic ingestion. The annual human-caused mortality and serious injury is 0.2 for this stock (NMFS 2024a). No critical habitat has been designated for sperm whales in the Action Area.

5.1.1.5.2 Potential Occurrence Within the Action Area

Sperm whales are not common in the Action Area, but are common at the shelf break in water depths of 656 to 3280 ft (200 to 1000 m), particularly in the area of the Northeast Channel with a year-round occurrence. The Gulf of Maine had the lowest abundance estimates for sperm whales during AMAPPS surveys compared to the shelf and offshore habitats along the US east coast (Palka et al. 2021). There were no sperm whale sightings along tracklines encompassing the Action Area during AMAPPS surveys conducted in 2016; and all acoustic detections displayed in the NMFS Passive Acoustic Cetacean Map are outside the Action Area along the shelf. Given their habitat preferences, the sperm whale is considered relatively uncommon in shelf waters in the vicinity of the Action Area.

Habitat-based marine mammal density data indicate the highest densities throughout the Action Area would most likely occur in September and the lowest in April (**Figure 5-5**; Roberts et al. 2023). The temporal and geographic distribution of sperm whale densities within the Action Area is presented in **Table 5-1**; the data indicate that, while sperm whales may occur year-round in the Gulf of Maine, they are likely to occur in highest densities from summer to fall.



Source: Roberts et al. 2023

Figure 5-5. Sperm whale minimum (April) and maximum (September) mean densities within the Action Area and surrounding region

5.1.2 Sea Turtles

Four species of ESA-listed sea turtles are carried forward in this assessment. Habitat-based sea turtle density data (DiMatteo et al. 2023a, 2023b) was analyzed for each species. Mean monthly species densities (number of animals per square kilometer) within the Action Area are presented in **Table 5-2**. The data (visualized through the heatmap applied to the table) are used to assess seasonal and relative distribution patterns for green, Kemp’s Ridley, leatherback, and loggerhead sea turtles within the Action Area in addition to data from other surveys and published reports.

Table 5-2. Monthly sea turtle mean densities (individuals per square kilometer) within the Action Area

Species	January	February	March	April	May	June	July	August	September	October	November	December	Yearly Average
Green	0	0	0	0	0	0.00128	0.01032	0.01542	0.00974	0.00200	0.00053	0	0.00327
Kemp's Ridley	0	0	0	0	0	0.00014	0.00052	0.00051	0.00045	0.00021	0.00002	0	0.00015
Leatherback	0.00025	0.00011	0.00008	0.00011	0.00062	0.00636	0.02678	0.04737	0.06178	0.03521	0.00700	0.00104	0.01556
Loggerhead	0.00131	0.00123	0.00093	0.00102	0.00131	0.00519	0.01069	0.01029	0.01017	0.00949	0.00528	0.00188	0.00490

Data source: DiMatteo et al. 2023a, 2023b
Note: Table cell colors correspond to relative geographic and temporal densities assessed for from January through December for each species, individually. Warm colors (i.e., red) indicate months of highest relative density whereas cool colors (i.e., green) indicate months of lowest relative density for that species.

5.1.2.1 Green Sea Turtle–North Atlantic Distinct Population Segment (Threatened)

Green sea turtles have a worldwide distribution and can be found in both tropical and subtropical waters (NMFS and USFWS 1991; NatureServe 2023). They are the largest of the hard-shelled sea turtles, growing to a maximum length of approximately 4 ft (1.2 m) and weighing up to 440 pounds (200 kilograms [kg]) (NMFS and USFWS 1991). In the Western North Atlantic Ocean, the species can be found from Massachusetts to Texas as well as in waters off Puerto Rico and the U.S. Virgin Islands (NMFS and USFWS 1991). Depending on the life stage, green sea turtles inhabit high-energy oceanic beaches, convergence zones in pelagic habitats, and benthic feeding grounds in shallow protected waters (NMFS and USFWS 1991). They are most commonly observed feeding in shallow waters of reefs, bays, inlets, lagoons, and shoals that are abundant in algae or marine grass, such as eelgrass (NMFS and USFWS 2007a). Green sea turtles are known to make long-distance migrations between their nesting and feeding grounds. Individuals display fidelity for specific nesting habitats, which are concentrated in lower latitudes well south of the Action Area. The primary breeding areas in the U.S. are located in southeast Florida (NMFS and USFWS 1991). Nesting also occurs annually in Georgia, South Carolina, North Carolina, and Texas (NMFS 2023f). Hatchlings occupy pelagic habitats and are omnivorous. Juvenile foraging habitats include coral reefs, emergent rocky bottoms, *Sargassum* spp. mats, lagoons, and bays (USFWS 2023a). Once mature, green sea turtles leave pelagic habitats and enter benthic foraging grounds, primarily feeding on seagrasses and algae (Bjorndal 1997), although they will occasionally feed on sponges and invertebrates (NMFS 2023f).

Green sea turtles spend most of their lives in coastal foraging grounds, including open coastline waters (NMFS and USFWS 2007a). They often return to the same foraging grounds following periodic nesting migrations (Godley et al. 2002). However, some remain in the open ocean habitat for extended periods and possibly never recruit to coastal foraging sites (Pelletier et al. 2003). Once thought to be strictly herbivorous, more recent research indicates that this species also forages on invertebrates, including jellyfish, sponges, sea pens, and pelagic prey while offshore, and sometimes in coastal habitats (Heithaus et al. 2002).

Hatchling green sea turtles occupy pelagic habitats. Juveniles, upon reaching a carapace length of 20 to 25 cm, move to foraging habitats such as coral reefs, emergent rocky bottoms, *Sargassum* spp. mats, lagoons, and bays (Waring et al. 2012; USFWS 2023a). Once adults, green turtles will leave pelagic habitats and enter benthic foraging grounds (Bjorndal 1997). Available tagging and sighting data suggest green turtles generally prefer shallower waters (Palka et al. 2021). Juveniles are found more frequently than adults in the northeast Atlantic, migrating northward and residing in the New England area from May through November (NMFS 2023f).

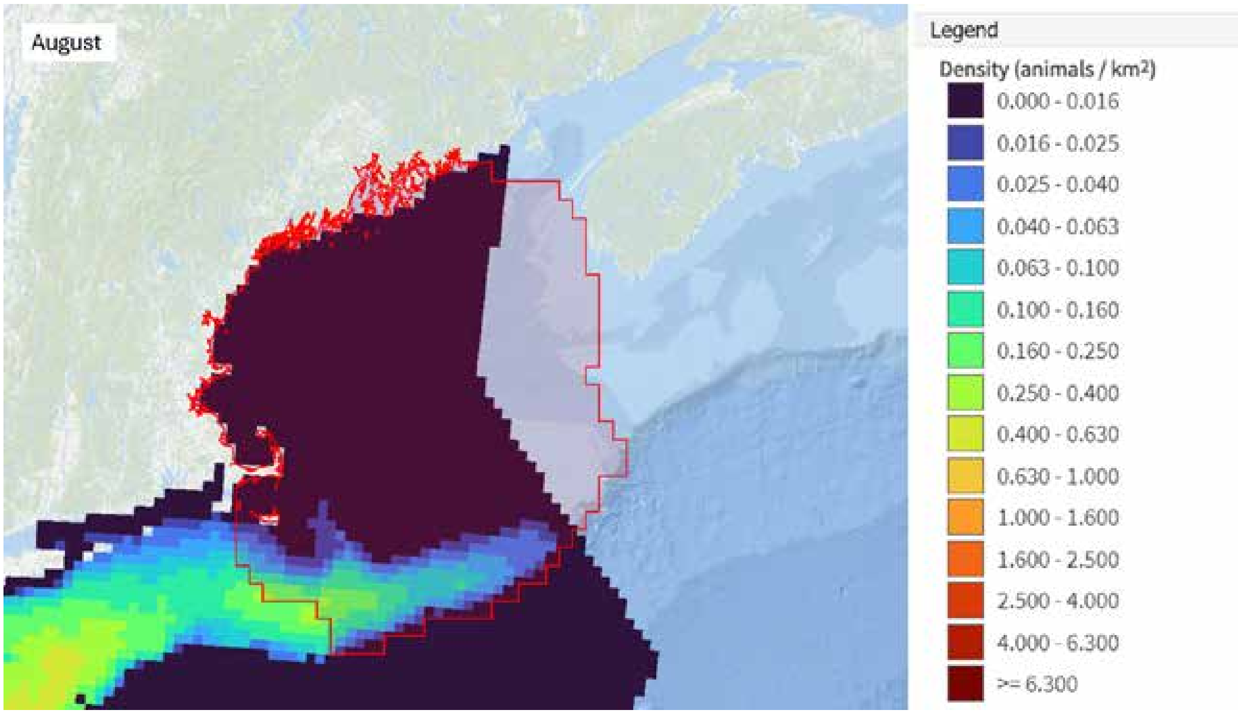
Bartol and Ketten (2006) measured the auditory evoked potentials of two Atlantic green sea turtles and six sub adult Pacific green sea turtles. Sub-adults were found to respond to stimuli between 100 and 500 Hz, with a maximum sensitivity of 200 and 400 Hz. Juveniles responded to stimuli between 100 and 800 Hz, with a maximum sensitivity between 600 and 700 Hz. Piniak et al. (2016) found that the auditory evoked potentials of juvenile green sea turtles were between 50 and 1,600 Hz in water and 50 and 800 Hz in air, with ranges of maximum sensitivity between 50 and 400 Hz in water and 300 and 400 Hz in air.

5.1.2.1.1 Current Status

The green sea turtle was originally listed under the ESA in 1978 as threatened across its range. The listing was subsequently updated in 2016 (81 *FR* 20057), confirming threatened status across the range, with specific breeding populations in Florida and the Pacific Coast of Mexico listed as endangered (Seminoff et al. 2015). Individuals occurring within the Action Area belong to the North Atlantic DPS and is listed as threatened (81 *FR* 20057). The primary nesting beaches for the North Atlantic DPS of green sea turtles are Costa Rica, Mexico, U.S. (Florida), and Cuba. According to Seminoff et al. (2015), nesting trends are generally increasing for this DPS. The most recent status review for the North Atlantic DPS estimates the number of female nesting sea turtles to be approximately 167,424 individuals (NMFS and USFWS 2015a). Critical habitat has not been designated. The species was listed on the basis of significant population declines resulting from egg harvesting, incidental mortality in commercial fisheries, and nesting habitat loss.

5.1.2.1.2 Potential Occurrence Within the Action Area

Green sea turtles may be found as far north as Nova Scotia, and due to the warming of the Gulf of Maine may become more common in the Action Area compared to the last decade (Griffin et al. 2019; NMFS and USFWS 1991). During the summer, the distribution of foraging subadults and adults can expand to include subtropical waters at higher latitudes. Juveniles and subadults are occasionally observed in Atlantic coastal waters as far north as Massachusetts (NMFS and USFWS 1991), including Cape Cod Bay (CETAP 1982), and therefore may occur in the Action Area during the summer months. Data from NOAA Fisheries Sea Turtle Stranding and Salvage Network (STSSN) show two green sea turtle strandings within the Action Area between January 1, 2013 and September 5, 2023 (NMFS 2024d). Nesting has not been reported within the Action Area. Density surface models indicate highest regional green sea turtle occurrences during August, though incursion into the Gulf of Maine is considered rare (**Figure 5-6**; DiMatteo et al. 2023a, 2023b; NMFS 2024d). Green sea turtles occur within the Action Area seasonally, with densities beginning to increase in June with increasing water temperatures; highest densities in the Action Area are in July, August, and September, though their occurrence is mainly limited to southern portions of Georges Bank and the Great South Channel (**Figure 5-6**; DiMatteo 2023a, 2023b). Based on these data and stranding records, green sea turtle occurrence within the Action Area is also considered rare. The temporal and geographic distribution of green sea turtles within the Action Area is presented in **Table 5-2** and **Figure 5-6**.



Source: DiMatteo, et al. 2023a, 2023b

Figure 5-6. Green sea turtle maximum mean density during August within the Action Area and surrounding region

5.1.2.2 Kemp's Ridley Sea Turtle (Endangered)

The Kemp's ridley sea turtle is the smallest of sea turtle species. Adults can weigh between 70.5 and 108 pounds (32 and 49 kg) and reach up to 24 to 28 in (60 to 70 cm) in length (NMFS and USFWS 2007b). This species primarily inhabits the Gulf of Mexico, although large juveniles and adults travel along the U.S. Atlantic coast. Kemp's ridley inhabit coastal waters around Cape Canaveral, Florida up to Cape Hatteras, North Carolina during the winter (Waring et al. 2012).

In late fall, Atlantic juveniles/sub adults travel northward to forage in the coastal waters off Georgia through New England, then return southward for the winter (Stacy et al. 2013; NMFS 2022b). Nesting typically occurs from April to July and, unlike most other sea turtles, the species nests during the daytime. Most nesting areas are in the western Gulf of Mexico, primarily Tamaulipas and Veracruz, Mexico. Some nesting occurs periodically in Texas and few other U.S. states, occasionally extending up the Atlantic coast to North Carolina. Kemp's ridley sea turtles return to beaches, often in groups, to nest every 1 to 3 years and lay an average of two to three clutches per season (NMFS 2022b).

Juvenile and subadult Kemp's ridley sea turtles are known to travel as far north as Cape Cod Bay during summer foraging (NMFS et al. 2011). The species is primarily associated with habitats on the OCS, with preferred habitats consisting of sheltered areas along the coastline, including estuaries, lagoons, and bays (Burke et al. 1994; NMFS 2022b) and nearshore waters less than 120 ft deep (Shaver et al. 2005; Shaver and Rubio 2008), although it can also be found in deeper offshore waters. The species is coastally oriented, rarely venturing into waters deeper than 160 ft (50 m). It is primarily associated with mud sand-bottomed habitats, where primary prey species are found (NMFS and USFWS 2007b).

Kemp's ridley sea turtles are generalist feeders that prey on a variety of species, including crustaceans, mollusks, fish, jellyfish, and tunicates, and forage on aquatic vegetation (Byles 1988; Carr and Caldwell 1956; Schmid 1998). However, the preferred diet of the Kemp's ridley sea turtle is crabs (NMFS and USFWS 2007b). The species is also known to ingest natural and anthropogenic debris (Burke et al. 1993, 1994; Witzell and Schmid 2005).

Dow Piniak et al. (2012) concluded that sea turtle hearing is generally confined to lower frequency ranges below 1.6 kHz, with the greatest hearing sensitivity between 100 and 700 Hz, varying by species. Bartol and Ketten (2006) determined that Kemp's ridley hearing is more limited, ranging from 100 to 500 Hz, with greatest sensitivity between 100 and 200 Hz.

5.1.2.2.1 Current Status

The Kemp's ridley sea turtle was listed as endangered at the species level with the passage of the ESA in 1973 (35 *FR* 18319). All Kemp's ridley sea turtles belong to a single population. The species has experienced large population declines due to egg harvesting, loss of nesting habitat to coastal development and related human activity, bycatch in commercial fisheries, vessel strikes, and other anthropogenic and natural threats. The species began to recover in abundance and nesting productivity since conservation measures were initiated following listing. However, since 2009, the number of successful nests has declined markedly (NMFS and USFWS 2015b). Potential explanations for this trend, including the *Deepwater Horizon* oil spill in 2010, have proven inconclusive, suggesting that the decline in nesting may be due to a combination of natural and anthropogenic stressors (Caillouet et al. 2018). Current threats include incidental fisheries mortality, ingestion, and entanglement in marine debris, and vessel strikes (NMFS and USFWS 2015b).

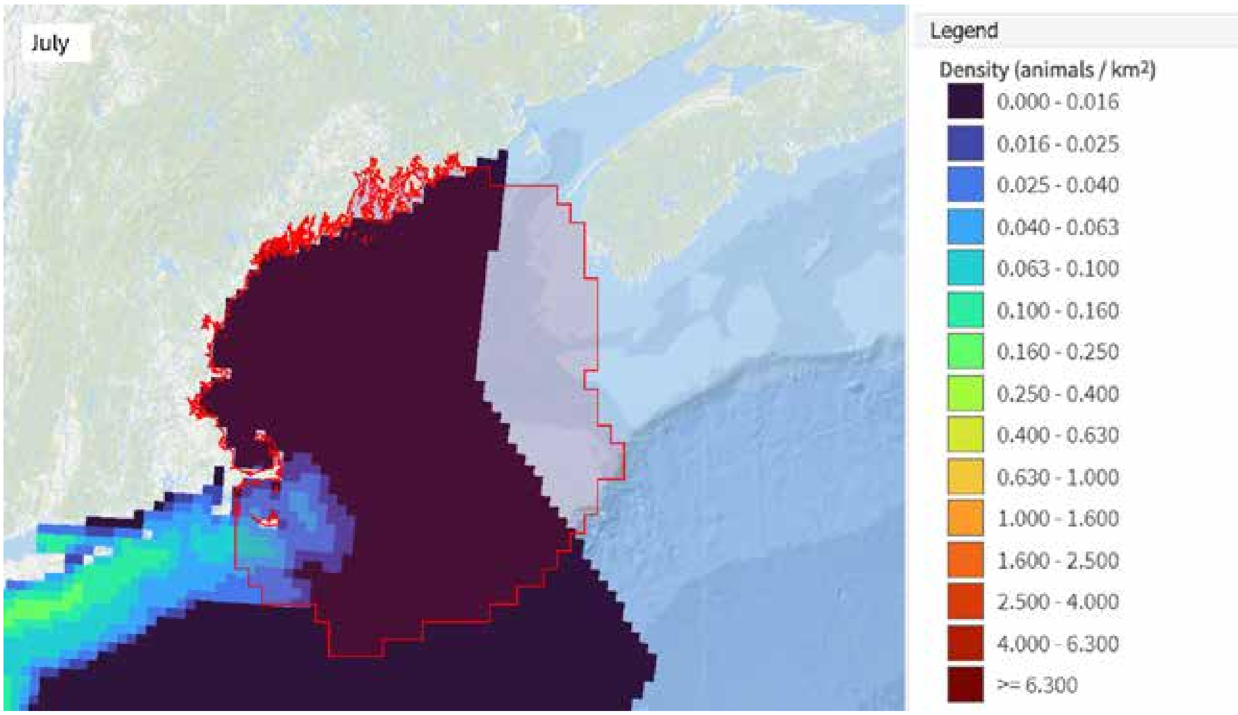
The population was severely reduced by 1985 due to intensive egg collection and fishery bycatch, with a low of 702 nests counted from an estimated 250 nesting females on three primary nesting beaches in Mexico (Bevan et al. 2016; NMFS and USFWS 2015b). Recent estimates of the total population of age 2 years and older is 248,307; however, recent models indicate a persistent reduction in survival or recruitment, or both, in the nesting population, suggesting that the population is not recovering to historical levels (NMFS and USFWS 2015b). A record high number of Kemp's sea turtle nests were recorded in 2017 (24,586 in Mexico and 353 in Texas). In 2019 there were 11,090 nests, a 37.61 percent decrease from 2018, and a 54.89 percent decrease from 2017. This decline is typical due to the reproduction biology of the species, as females nest approximately every 1 to 3 years (National Park Service 2023). Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341; the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019). There is no designated critical habitat for Kemp's ridley sea turtles.

5.1.2.2.2 Potential Occurrence Within the Action Area

Kemp's ridley sea turtles may be found as far north as New England and due to the warming of the Gulf of Maine are increasingly likely to be found there, as they prefer warmer, nearshore coastal waters (Griffin et al. 2019; NMFS 2022b). Adult Kemp's ridley undergo a seasonal migration each year in the Atlantic, starting their journey to northern foraging grounds in spring, reaching New England by June, and traveling back to southern habitat in the fall, reaching the Mid-Atlantic by early November (Waring et al. 2012). Sea surface temperatures in the Gulf of Maine have warmed 97 percent faster (as of 2022) than the global ocean over the last decade, and as such, Kemp's ridley turtles are likely to occur more frequently as evidenced by higher numbers of cold stunned strandings reported from North Atlantic waters during late summer to late fall (Griffin et al. 2019).

STSSN data show 19 Kemp's ridley sea turtle strandings within the Action Area between January 1, 2013 and September 5, 2023 (STSSN 2023). All of these strandings have occurred within Massachusetts.

Nesting has not been reported within the Action Area. The species may be encountered within the Action Area from June through November, but are more likely from July through September (DiMatteo et al., 2023a and 2023b; **Table 5-2**). Density surface models indicate highest regional Kemp's ridley sea turtle occurrences during July (**Figure 5-7**; DiMatteo et al. 2023a and 2023b). Based on these data and stranding reports, occurrence within the Gulf of Maine is considered rare and likely limited to the southern portion of the Action Area near Cape Cod and in Cape Cod Bay.



Source: DiMatteo, et al. 2023a, 2023b

Figure 5-7. Kemp's ridley sea turtle maximum mean density during July within the Action Area and surrounding region

5.1.2.3 Leatherback Sea Turtle (Endangered)

The leatherback sea turtle is primarily a pelagic species and is distributed in temperate and tropical waters worldwide, and are a species that regularly occur in colder waters where they can take advantage of high productivity regions with good foraging opportunities (Okuyama et al., 2021). The leatherback is the largest, deepest diving, most migratory, widest ranging, and most pelagic of the sea turtles (NMFS 2023g). Adults can reach up to 2,000 pounds (900 kg) and can be more than 6 ft (2 m) long (NMFS and USFWS 2013; NMFS 2023g). Adult leatherback sea turtles forage in temperate and subpolar regions in all oceans. Satellite tagged adults reveal migratory patterns in the North Atlantic that can include a circumnavigation of the North Atlantic Ocean basin, following ocean currents that make up the North Atlantic gyre, and preferentially targeting warm-water mesoscale ocean features such as eddies and rings as favored foraging habitats (Hays et al. 2006).

Leatherback sea turtles are dietary specialists, feeding almost exclusively on jellyfish, siphonophores, and salps, and the species' migratory behavior is closely tied to the availability of pelagic prey resources (Eckert et al. 2012; NMFS and USFWS 2020). Unlike other predatory sea turtles with crushing jaws, the leatherback has evolved a sharp-edged jaw for consuming soft-bodied oceanic prey (NMFS 2023g) They are also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed (NMFS 2023g; USFWS 2023b).

James et al. (2006) studied leatherbacks' migratory behavior using satellite tags and observed that the timing of southerly migration ranges widely, extending from mid-August to mid-December, but with a distinct peak in October. The continental slope to the east and south of Cape Cod and the OCS south of Nantucket appear to be hotspots, where several tagged leatherback sea turtles congregated to feed for extended periods. These findings are consistent with Kraus et al. (2016a), who recorded most of their leatherback sightings in the same area. The migratory corridors between breeding and northerly feeding areas appear to vary widely, with some individuals traveling through the OCS and others using the open ocean far from shore (James et al. 2006).

In a study tracking 135 leatherbacks fitted with satellite tracking tags, the species was identified to inhabit waters with sea surface temperatures ranging from 52°F to 89°F (11°C to 32°C) (Bailey et al. 2012). The leatherback sea turtle dives the deepest of all sea turtles to forage and is thought to be more tolerant of cooler oceanic temperatures than other sea turtles. The study also found that oceanographic features such as mesoscale eddies, convergence zones, and areas of upwelling attracted foraging leatherbacks because these features are often associated with aggregations of jellyfish.

Nesting beaches in the U.S. are concentrated in southeastern Florida from Brevard County south to Broward County (NMFS and USFWS 2013, 2020a; USFWS 2023b). Leatherbacks are a pelagically oriented species, but they are often observed in coastal waters along the U.S. continental shelf (NMFS and USFWS 2020). Leatherbacks have been sighted along the entire coast of the eastern U.S. from the Gulf of Maine in the north and south to Puerto Rico, the Gulf of Mexico, and the U.S. Virgin Islands (NMFS and USFWS 2020).

Dow Piniak et al. (2012) determined that the hearing range of leatherback sea turtles extends from approximately 50 to 1,200 Hz in water and 50 and 1,600 Hz in air, which is comparable to the general hearing range of turtles across species groups. Leatherbacks' greatest hearing sensitivity is between 100 and 400 Hz in water and 50 and 400 Hz in air.

5.1.2.3.1 Current Status

Leatherback sea turtles in the Action Area belong to the Northwest Atlantic population, which is one of seven leatherback populations globally. The species was listed as endangered under the ESA in 1970 (35 *FR* 8491), inclusive of all populations[27]. The breeding population (total number of adults) estimated in the North Atlantic is 34,000 to 94,000 (NMFS and USFWS 2013; TEWG 2007). NMFS and USFWS (2020) concluded that the Northwest Atlantic population has a total index of nesting female abundance of 20,659 females with a decreasing nest trend at nesting beaches with the greatest known nesting female abundance.

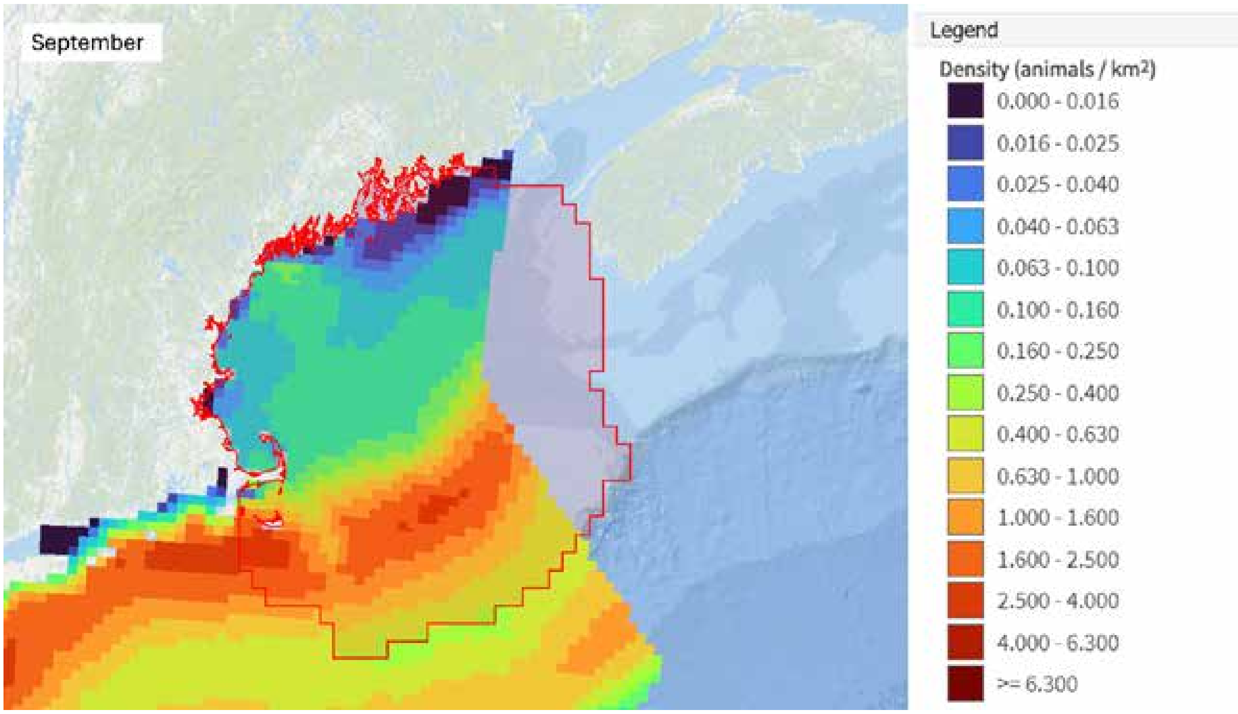
Critical habitat for the Northwest Atlantic population is designated in the U.S. Virgin Islands and does not occur in the Action Area (NMFS and USFWS 2020). Primary threats to the species include illegal harvesting of eggs, nesting habitat loss, and shoreline development. In-water threats include incidental catch and mortality from commercial fisheries, vessel strikes, anthropogenic noise, marine debris, oil pollution, and predation by native and exotic species (NMFS and USFWS 2020).

[27] NMFS and USFWS have not designated DPSs for leatherback sea turtles because the species is listed as endangered throughout its global range (85 *FR* 48332); however, after reviewing the best available information, USFWS and NMFS (2020) identified seven leatherback populations that meet the discreteness and significance criteria of the DPS Policy, including the Northwest Atlantic population.

5.1.2.3.2 Potential Occurrence Within the Action Area

In the Northwest Atlantic, leatherback sea turtles are widely dispersed. They are generally a highly mobile species, inhabiting open ocean environments as hatchlings and adults, although pelagic distribution of hatchling or juvenile leatherback sea turtles is largely unknown (NMFS and USFWS 1992). Adult leatherbacks are highly migratory and are believed to be the most pelagic of all sea turtles (NMFS and USFWS 1992) and would be expected to remain further offshore relative to other sea turtle species, including waters beyond the shelf break. Tagged turtles have been documented migrating over large distances, greater than 7,000 km to foraging grounds located around the Atlantic (Palka et al. 2017, 2021). Leatherbacks have been spotted off Massachusetts in August, historically with no sightings from October through June (Musick and Limpus 1996). As with other species of sea turtles, with the temperatures of the Gulf of Maine increasing 97 percent faster compared to the rest of the ocean, they may be found more frequently in the area (Griffin et al. 2019).

STSSN data show 35 leatherback sea turtle strandings within the Action Area between January 1, 2013 and September 5, 2023 (STSSN 2023). Nesting has not been reported within the Action Area. The species may be encountered within the Action Area year-round, but are more likely to occur from June through November (**Table 5-2**; DiMatteo et al. 2023a, 2023b). Density surface models indicate highest regional leatherback sea turtle occurrences during September (**Figure 5-8**; DiMatteo et al. 2023a, 2023b). While occurrence within the Gulf of Maine is generally widespread, densities within the Gulf of Maine are much lower than in waters in the vicinity of George’s Bank and coastal shelf waters further south (**Figure 5-8**; DiMatteo et al. 2023a, 2023b). Although leatherbacks are the most abundant sea turtle species in the Action Area **(Table 5-2**), their occurrence is still only in low numbers and seasonal within the Gulf of Maine.



Source: DiMatteo, et al. 2023a, 2023b

Figure 5-8. Leatherback sea turtle maximum mean density during September within the Action Area and surrounding region

5.1.2.4 Loggerhead Sea Turtle–Northwest Atlantic Ocean Distinct Population Segment (Threatened)

The loggerhead sea turtle is a globally distributed species found in temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (NMFS and USFWS 2008). Loggerheads are the most common sea turtle species observed in offshore and nearshore waters along the U.S. East Coast, and virtually all of these individuals belong to the Northwest Atlantic Ocean DPS. Most of the loggerhead sea turtles nesting in the eastern U.S. occur from North Carolina through southwest Florida. Some nesting also occurs in southern Virginia and along the Gulf of Mexico coast westward into Texas (NMFS and USFWS 2008). Foraging loggerhead sea turtles range widely; they have been observed along the entire Atlantic coast of the U.S. as far north as the Gulf of Maine (Shoop and Kenney 1992) and northward into Canadian waters.

Female loggerhead sea turtles in the western north Atlantic nest from late April through early September. Individual females might nest several times within one season and usually nest at intervals of every 2 to 3 years. For their first 7 to 12 years of life, loggerhead sea turtles inhabit pelagic waters near the North Atlantic Gyre and are called pelagic immatures. When loggerhead sea turtles reach 40 to 60 cm straight-line carapace length, they begin recruiting to coastal inshore and nearshore waters of the OCS through the U.S. Atlantic and Gulf of Mexico and are referred to as benthic immatures. Benthic immature loggerheads have been found in waters from Cape Cod, Massachusetts, to southern Texas. Most recent estimates indicate that the benthic immature stage ranges from ages 14 to 32 years; they reach sexual maturity at approximately 20 to 38 years of age. Loggerhead sea turtles are largely present year-round in waters south of North Carolina, but will forage during summer and fall as far north as the Northeastern U.S. and Canada and migrate south as water temperatures drop. Prey species for omnivorous juveniles include crab, mollusks, jellyfish, and vegetation at or near the surface. Coastal subadults and adults feed on benthic invertebrates, including mollusks and decapod crustaceans (TEWG 2009).

The loggerhead sea turtle has a powerful beak and crushing jaws specially adapted to feed on hard-bodied benthic invertebrates, including crustaceans and mollusks. Mollusks and crabs are primary food items for juvenile loggerheads (Burke et al. 1993). Although loggerheads are dietary specialists, the species demonstrates the ability to adjust its diet in response to changes in prey availability in different geographies (Plotkin et al. 1993; Ruckdeschel and Shoop 1988). Loggerheads in Chesapeake Bay, Virginia, primarily targeted horseshoe crabs (*Limulus polyphemus*) in the early to mid-1980s but subsequently shifted their diet to blue crabs in the late 1980s, and then to finfish from discarded fishery bycatch in the mid-1990s (Seney and Musick 2007).

Martin et al. (2012) and Lavender et al. (2014) used behavioral and auditory brainstem response methods to identify the hearing range of loggerhead sea turtles. Both teams identified a generalized hearing range from 100 Hz to 1.1 kHz, with greatest hearing sensitivity between 200 and 400 Hz.

5.1.2.4.1 Current Status

The Northwest Atlantic Ocean DPS of loggerhead sea turtle was listed as federally threatened under the ESA in 2011 (76 *FR* 58868). The regional abundance estimate in the Northwest Atlantic OCS in 2010 was approximately 588,000 adults and juveniles of sufficient size to be identified during aerial surveys (interquartile range of 382,000 to 817,000 [NEFSC and SEFSC 2011]). The three largest nesting subpopulations responsible for most of the production in the western North Atlantic (peninsular Florida, northern U.S., and Quintana Roo, Mexico) have all been declining since at least the late 1990s, thereby indicating a downward trend for this population (TEWG 2009). While some progress has been made since publication of the 2008 Loggerhead Sea Turtle Recovery Plan, the recovery units have not met most of the critical benchmark recovery criteria (NMFS and USFWS 2023).

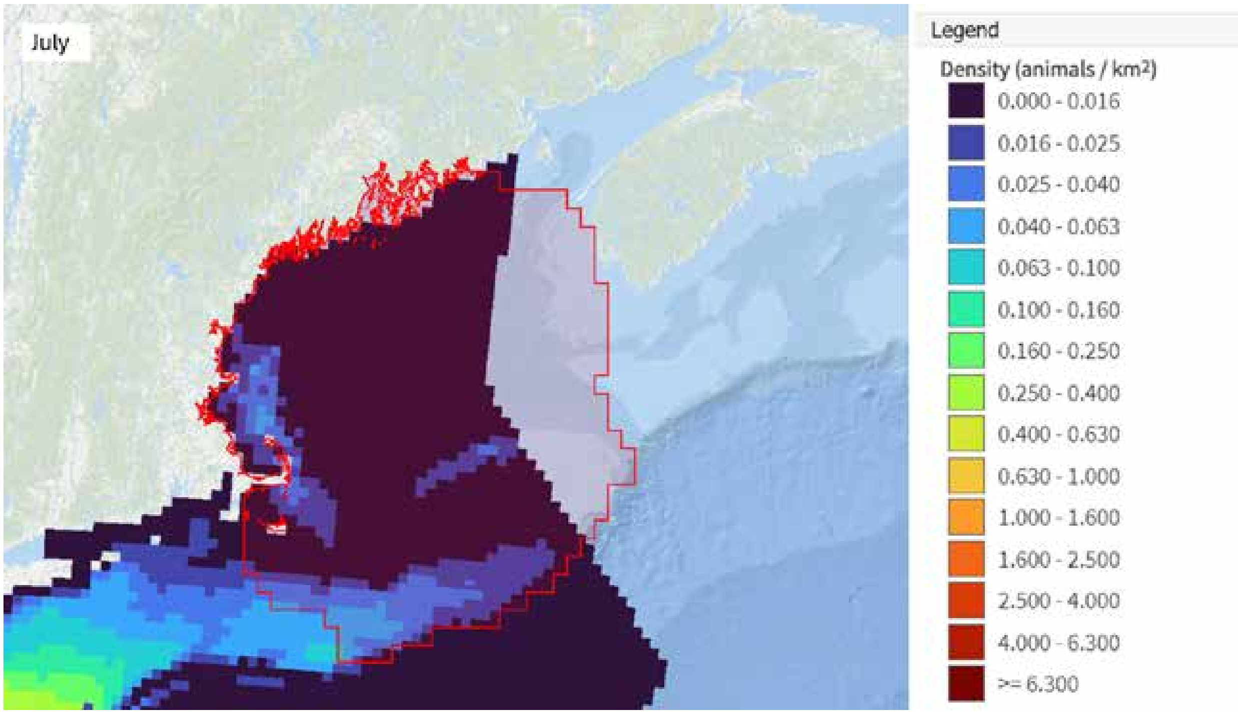
Critical habitat for Northwest Atlantic Ocean DPS of loggerhead sea turtles was designated in 2014 (79 *FR* 39755; 79 *FR* 51264). The four designated critical habitat units are nesting beaches in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi. No designated critical habitat occurs within the Action Area. Factors affecting the conservation and recovery of this species include beach development, related human activities that damage nesting habitat, and light pollution (NMFS and USFWS 2008, 2023). In-water threats include bycatch in commercial fisheries, vessel strikes, anthropogenic noise, marine debris, legal and illegal harvest, oil pollution, and predation by native and exotic species (NMFS and USFWS 2008, 2023).

5.1.2.4.2 Potential Occurrence Within the Action Area

Loggerhead sea turtles inhabit nearshore and offshore habitats, ranging, in the Northwest Atlantic, as far north as Newfoundland (NMFS 2022c). Post-hatchling loggerhead sea turtles have been found to inhabit areas that are characterized by linear accumulations of *Sargassum* spp. near nearshore, localized downwellings (NMFS and USFWS 2008). Winton et al. (2018) reported that loggerheads tagged within the Northwest Atlantic primarily restrict their summertime distribution to OCS waters and occasionally make excursions inshore to bays and estuaries. Core habitat includes sea surface temperatures from 59.0°F to 82.4°F and at depths between 8 and 92 m, and the highest probability of occurrence occurs in regions with sea surface temperatures from 63.9°F to 77.5°F and at depths between 26 and 74 m (Patel et al. 2021).

AMAPPS data from tagged loggerhead sea turtles and visual surveys indicate this species is observed throughout the U.S. Atlantic OCS in summer and fall, with a shift towards the southeastern U.S. in the winter and spring (Palka et al. 2021). Loggerheads are not frequently encountered in the Gulf of Maine, with one study of 70,000 otter trawl hauls over 15 years only finding one loggerhead (Warden 2011).

STSSN data show 7 loggerhead sea turtle strandings within the Action Area between January 1, 2013 and September 5, 2023 (STSSN 2023). Nesting has not been reported within the Action Area. The species may be encountered within the Action Area year-round, but are more likely to occur from June through October (DiMatteo et al., 2023a and 2023b; **Table 5-2**). Density surface models indicate highest regional loggerhead sea turtle occurrences during July (**Figure 5-9**; MGEL, 2023). Based on these data, occurrence within the Gulf of Maine is considered rare and likely limited to the southern and western portions of the Action Area (**Figure 5-9**).



Source: DiMatteo, et al. 2023a, 2023b

Figure 5-9. Loggerhead sea turtle maximum mean density during July within the Action Area and surrounding region

5.1.3 Marine Fish

5.1.3.1 Atlantic Sturgeon–All Distinct Population Segments (Endangered; Threatened)

The Atlantic sturgeon is a large, long-lived, benthic fish found from Canada to Florida in river, estuarine, marine coastal, and OCS habitats. Individuals may be up to 13 ft (4 m) long, can reach up to 600 pounds, and live up to 60 years. Atlantic sturgeon are anadromous, meaning they are born in freshwater, migrate to sea, and then back to freshwater to spawn. Historically, Atlantic sturgeon were present in approximately 38 rivers in the U.S. from St. Croix, ME to the Saint Johns River, FL, of which 35 rivers have been confirmed to have had a historical spawning population (ASSRT 2007). There are 22 rivers along the U.S. East Coast that currently host spawning Atlantic Sturgeon (NMFS 2023h). Spawning in rivers from Delaware to Canada occurs from spring to early summer; some rivers may support a second fall spawning population, though supporting data is limited (NMFS 2023h). Spawning occurs in the late summer and fall in rivers from Georgia to Chesapeake Bay (NMFS 2023h). Females throughout the Atlantic tend to spawn every 2 to 5 years, with egg production between 400,000 to 2 million depending on maturity (NMFS 2023h). In non-spawning years, adults remain in marine waters year-round (Smith and Clugston 1997). Larvae develop into juveniles as they migrate downstream. Juveniles typically remain in their natal river for two to three years before migrating into coastal and ocean waters (NMFS 2023h). Subadults move out to estuarine and coastal waters in the fall; adults inhabit fully marine environments and migrate through deep water when not spawning (ASSRT 2007). They typically occur within the 50-meter depth contour when in the marine environment (NMFS 2023h). While most individuals are most common near their natal river, extensive migrations within the marine environment have been documented for both adults and subadults, with some individuals traveling thousands of kilometers from their natal rivers (Kazyak et al. 2021). Their distribution and abundance vary by season as they are found in shallow coastal waters during the summer months and move to deeper waters in winter and early spring (Dunton et al. 2010). In the pelagic marine environment, Atlantic sturgeon range as far north as eastern Canada and occupy shelf waters up to a depth of 75 m (246 ft).

Adult and subadult Atlantic sturgeon range widely across the Atlantic OCS, feeding primarily on benthic invertebrates and small fish on or near the seafloor. They appear to congregate in areas providing favorable foraging conditions (Stein et al. 2004a, b), exhibit dietary flexibility, and can adapt to changing prey availability (Guilbard et al. 2007; Johnson et al. 1997). During migrations along the eastern seaboard, Atlantic sturgeon are thought to travel north in the spring and south in the fall (Erickson et al. 2011). In a modeled study, Breece et al. (2018) discovered that spring migration takes place in shallower nearshore waters and, conversely, in deeper offshore waters for fall migration. Five genetically distinct DPSs make up the U.S. East Coast population; the Action Area falls within the Gulf of Maine DPS. However, given the species' proclivity to migrate, with extensive movements up and down the U.S. East Coast and into Canadian waters, Atlantic sturgeon encountered within the Action Area more broadly may originate from any of the five DPSs (Kazyak et al. 2021).

Male Atlantic sturgeon generally do not reach maturity until at least 12 years and females as late as 19 years (Dovel and Berggren 1983). Their interannual spawning period can range from 3 to 5 years, and adults inhabit marine waters either all year during non-spawning years or seasonally during spawning years (Bain 1997). Tagging data show that while at sea, adults intermix with populations from other rivers (ASSRT 2007). Despite their ability to range widely along the Atlantic coast, tagging and genetic studies indicate high site fidelity in natal rivers and very low gene flow among populations (Dovel and Berggren 1983; Grunwald et al. 2008; Savoy and Pacileo 2003).

Atlantic sturgeon are opportunistic predators that feed primarily on benthic invertebrates but will adjust their diet to exploit other types of prey resources when available. For example, Johnson et al. (1997) found that polychaetes composed approximately 86 percent of the diet of adult Atlantic sturgeon captured in the NY Bight. Isopods, amphipods, clams, and fish larvae composed the remainder of the diet, with the latter accounting for up to 3.6 percent of diet in some years. In contrast, Guilbard et al. (2007) observed that small fish accounted for up to 38 percent of subadult Atlantic sturgeon diet in the St. Lawrence River estuarine transition zone during summer, but less than 1 percent in fall. The remainder of the species' diet consisted primarily of amphipods, oligochaetes, chironomids, and nematodes, with the relative importance of each varying by season.

There is no available information on the hearing capabilities of Atlantic sturgeon specifically, although the hearing of other species of sturgeon have been studied. Meyer et al. (2010) and Lovell et al. (2005a) studied the auditory system morphology and hearing ability of lake sturgeon (*Acipenser fulvescens*), a closely related species. The *Acipenseridae* (sturgeon family) have a well-developed inner ear that is independent of the swim bladder. The results of these studies indicate a generalized hearing range from 50 to approximately 700 Hz, with greatest sensitivity between 100 and 300 Hz. Popper (2005) summarized studies measuring the physiological responses of the ear of European sturgeon

(*Acipenser sturio*). The results of these studies suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz. While sturgeon do have a swim bladder, it is not involved in hearing (Popper et al. 2014).

5.1.3.1.1 Current Status

All five DPSs of the Atlantic sturgeon are listed under the ESA; the Gulf of Maine DPS is listed as threatened whereas all others (i.e., New York Bight, Chesapeake Bay, Carolinas, and South Atlantic DPSs) are endangered (77 *FR* 5880, 77 *FR* 5914). The 2017 Atlantic sturgeon stock assessment reported that all DPSs remain depleted relative to historic distributions (ASMFC 2017). Though these DPSs represent distinct geographic populations along the U.S. Atlantic Coast, individuals from all DPSs migrate along the coast and are not easily distinguished visually from one another. Therefore, any Atlantic sturgeon encountered in the Action Area is considered endangered for the purpose of this analysis. In 2017, critical habitat was designated for all five DPSs of Atlantic sturgeon (82 *FR* 39160); these critical habitat designations are riverine. Atlantic sturgeon critical habitat is discussed in **Section 4.2.4**.

The species has suffered significant population declines across its range as a result of historical overfishing and degradation of freshwater and estuarine habitats by human development (ASSRT 2007). Bycatch mortality, water quality degradation, and dredging activities remain persistent threats. Some populations are impacted by unique stressors, such as habitat impediments and apparent ship strikes (ASSRT 2007). Historically, the Delaware River is thought to have supported the largest population of Atlantic sturgeon; recent studies estimate the current breeding population size is likely less than 250 adults, representing a greater than 99 percent decline since the late 1800s (USGS 2022). Indices from the New York Bight and Carolina DPSs indicated a greater than 50 percent chance of population increase since 1998, although the index from the Chesapeake Bay DPS only had a 36 percent chance of population increase across the same timeframe (ASMFC 2017). There are no abundance estimates available for the Gulf Maine DPS. Similarly, there are no abundance trends available due to limited available data. Data indicate that there is a 51 percent likelihood that the Gulf of Maine DPS population has increased since 1998, although there is a 74 percent probability that mortality of individuals exceed the mortality threshold (ASMFC 2017).

5.1.3.1.2 Potential Occurrence Within the Action Area

Atlantic sturgeon could be present throughout the Action Area depending on the various life history developmental stages. Similar to the shortnose sturgeon, the Gulf of Maine DPS of Atlantic sturgeon frequent coastal rivers including the Penobscot, Kennebec, Saco, and Merrimack Rivers near the Action Area (Wippelhauser et al. 2017; Fernandes et al. 2010). The Kennebec River system is the only known spawning population within the DPS and sturgeon typically enter the area for spawning in April and May when temperature is on average less than 16.0 degrees C, departing after July, though with some males remaining until October (Wippelhauser et al. 2017). Atlantic sturgeon have similarly been found in the Penobscot River from late May through the end of October, spending the fall and winter in the marine environment or in deeper more saline parts of rivers (Fernandes et al. 2010; Collins and Smith 1997).

Their occurrence within the Action Area is most likely as transients occurring in marine waters in the fall and winter (Fernandes et al. 2010; Collins and Smith 1997). Based on existing information presented previously, Atlantic sturgeon would be more likely to occur near the coast (within the 50-meter depth contour) from fall to early spring rather than farther offshore in the WEA.

5.1.3.2 Atlantic Salmon–Gulf of Maine DPS (Endangered)

The geographic range of the Gulf of Maine DPS includes the Dennys River watershed to the Androscoggin River (74 *FR* 29343). Freshwater habitats in the Gulf of Maine provide spawning habitat and thermal refuge for adults; overwintering and rearing areas for eggs, fry, and parr; and migration corridors for smolts and adults (Bardonnet and Bagliniere 2000). Spawning tends to happen from late October through November, with a preference to lay eggs in gravel areas with sufficient circulation (Fay et al. 2006). Eggs hatch in March or April, and the sac fry emerge from the gravel in mid-May, spending two to three years in the river before migrating to offshore areas (Fay et al. 2006). This migration is strongly affected by oceanic features such as gyres, currents, and water temperature (Meister 1984; Lacroix and Knox 2005; Lacroix et al. 2012). Although individuals utilize the entire water column during their offshore migrations, post-smolts are most commonly detected in the upper 5 m; those that swim in the upper water column have higher survival rates than those that swim deeper (Renkawitz et al. 2012).

Atlantic salmon in the Gulf of Maine are known to migrate long distances in the open ocean to feeding areas in the Davis Strait between Labrador and Greenland, approximately 2,485 mi (4,000 km) from their natal rivers (Danie et al. 1984; Meister 1984). To make these long migrations, salmon smolts require a steady food source, as they are initially energy deficient (Lacroix and Knox 2005; Jonsson and Jonsson 2003). Atlantic salmon consume a variety of food sources, with juveniles eating a variety of invertebrates and plankton, and adults preferring capelin fish when in the open ocean, though they are also opportunistic predators (NMFS 2023i; Dixon et al. 2017). In recent years, notably from estimates from 1968-2008, capelin size has decreased by 33.7 percent, which has likely impacted foraging of the salmon (Renkawitz et al. 2015). Lacroix and Knox (2005) found that post-smolts, the life stage when salmon adapt from fresh to saltwater but are not yet full grown, consumed crustaceans including the amphipod hyperiidae, krill, and larval fish such as sand lances. These prey options extend across the open ocean, with the Gulf of Maine providing more krill than larval fish in their diet (Lacroix and Knox 2005). Approximately 90 percent of Atlantic salmon from the Gulf of Maine return after spending two winters at sea; usually less than 10 percent return after spending one winter at sea and approximately 1 percent of returning salmon are repeat spawners or have spent three winters at sea (Baum 1997).

Atlantic salmon appear not to have sensitive hearing, likely because their swim bladder is not connected to their hearing (Harding et al. 2016; Hawkins and Johnstone 1978). Atlantic salmon may hear at higher frequencies of 400 to 800 Hz, though they may be sensitive to frequencies greater than 100 (Hawkins and Johnstone 1978) or 200 Hz (Harding et al. 2016)

5.1.3.2.1 Current Status

The Gulf of Maine DPS of Atlantic salmon is the only DPS listed under the ESA that may occur within the Action Area. They were originally listed as endangered in December 2000 (65 *FR* 69459), and the listing was updated in June 2009 to expand the range of the Gulf of Maine DPS listed under the ESA (74 *FR* 29343). Though water quality improvements led to an increase in the total population to approximately 5,000 individuals in 1985, due to the continued existence of dams and low survival at sea, the average number of adults that return to Gulf of Maine rivers is currently 1,200 (NMFS 2023i; NMFS and USFWS 2019).

Threats to Atlantic salmon are primarily a result of dams and their effects on migration paths; additional threats include a lack of habitat complexity in certain freshwater areas, poor or insufficient water quantity, disease, and predation (NMFS and USFWS 2019; Fay et al. 2006). The Gulf of Maine DPS is also vulnerable to changing conditions resulting from climate change, particularly at the post-smolt stage. Changes in spring winds have left post-smolts more susceptible to predation in their migration corridors, pushing them closer to inshore waters where they encounter new predators and for a longer amount of time (Friedland et al. 2012).

Critical habitat is designated in the State of Maine for a total of 19,571 km of river, stream, and estuary habitat, as well as 799 sq. km of lake (74 *FR* 29299) (**Section 4.2.3**). However, there is no marine habitat for this species.

5.1.3.2.2 Potential Occurrence Within the Action Area

Atlantic salmon utilize the Gulf of Maine as juveniles to transit hundreds of kilometers to their offshore foraging areas near Greenland before crossing the Gulf of Maine again after two years to return to their natal river for spawning (Danie et al. 1984; Meister 1984; Lacroix et al. 2012). The adults have historically entered rivers from May to Mid-July for spawning, and afterwards return to sea and may return to the river in future years to lay more eggs (Meister 1958; Baum 1997; NMFS 2023i).

After the eggs hatch, the juveniles, referred to as parr, spend two to three years in freshwater (NMFS 2023i), and then emerge from the rivers, utilizing specific migration corridors when transiting to the open sea, with studies showing that they prefer areas with high tidal forces (Kocik et al. 2009). They spend about 3 to10 days traveling down a given river, within a 25-day period for juveniles from all rivers, moving from natal rivers to the Gulf of Maine, although a high mortality rate of 53-64 percent is experienced when entering nearshore waters, potentially due to the transition to saltwater (Kocik et al. 2009). This transition to the marine environment by post-smolts occurs mainly from May through June, though it may extend into July. Individuals then travel eastward across the Gulf of Maine and then northeast along the coast of Nova Scotia, Canada (Meister 1984; Lacroix et al. 2012). Based on this generalized migration pattern, Atlantic salmon are most likely to occur in the marine environment in the Action Area during the summer.

5.1.3.3 Shortnose Sturgeon (Endangered)

The shortnose sturgeon (*Acipenser brevirostrum*) is an anadromous species, spawning and growing in fresh water and foraging in both the estuary of its natal river and shallow marine habitats close to the estuary (Bain 1997; Fernandes et al. 2010). Shortnose sturgeon occur in the Northwest Atlantic Ocean but are typically found in freshwater or estuarine environments. Historically, the species was found in coastal rivers along the entire east coast of North America. Shortnose sturgeon are found in large rivers and estuaries along the North American eastern seaboard from the Indian River in Florida to the Saint John River in New Brunswick, Canada. Generally, spawning occurs far upstream in their natal rivers, with individuals moving downriver to the estuaries to feed, rest, and spend most of their time. They are a primarily benthic species and are rarely known to leave their natal freshwater rivers (Kieffer and Kynard 1993); therefore, their presence in the coastal marine environment is uncommon (Altenritter et al. 2018; Dionne et al. 2013; Wippelhauser et al. 2015). Movement of shortnose sturgeon between rivers is rare, though there have been some reported migrations (Shortnose Sturgeon Status Review Team 2010).

5.1.3.3.1 Current Status

Because of threats such as habitat degradation, water pollution, dredging, water withdrawals, fishery bycatch, and habitat impediments (e.g., dams), shortnose sturgeon were listed as endangered in 1967 (32 *FR* 4001) throughout the entire population range. There are 19 documented populations of shortnose sturgeon ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. Currently, there are significantly more shortnose sturgeon in the northern portion of their overall range.

Developments in genetic research as well as differences in life history support the grouping of shortnose sturgeon into five genetically distinct groups, all of which have unique geographic adaptations (see Grunwald et al. 2008; Grunwald et al. 2002; King et al. 2001; Waldman et al. 2002; Walsh et al. 2001; Wirgin et al. 2009; Wirgin et al. 2002; SSSRT 2010). These groups are: 1) Gulf of Maine; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast. The Gulf of Maine, Delaware/Chesapeake Bay and Southeast groups function as metapopulations. The other two groups (Connecticut/Housatonic and the Hudson River) function as independent populations. The Gulf of Maine metapopulation is the only group of shortnose sturgeon expected to occur within the Action Area.

While there is migration within each metapopulation (i.e., between rivers in the Gulf of Maine and between rivers in the Southeast) and occasional migration between populations (e.g., Connecticut and Hudson), interbreeding between river populations is limited to very few individuals per generation; this results in morphological and genetic variation between most river populations (Walsh et al. 2001; Grunwald et al. 2002; Waldman et al. 2002; Wirgin et al. 2005). Indirect gene flow estimates from mtDNA indicate an effective migration rate of less than two individuals per generation. This means that while individual shortnose sturgeon may move between rivers, very few sturgeon are spawning outside their natal river; it is important to remember that the result of physical movement of individuals is rarely genetic exchange.

5.1.3.3.2 Potential Occurrence within the Action Area

Available data indicate that shortnose sturgeon within the Gulf of Maine metapopulation are present in the Penobscot, Kennebec, Androscoggin, Sheepscot, Saco, St. George, Medomak, Damariscotta, Presumpscot, and Piscataqua Rivers (Zydlewski et al. 2011; Altenritter et al. 2018; GARFO 2023b). Individuals have also been documented in smaller coastal rivers; however, the duration of presence has been limited to hours or days and the smaller coastal rivers are thought to be only used occasionally (Zydlewski et al. 2011; Altenritter et al. 2018; GARFO 2023b).

Since the removal of the Veazie and Great Works Dams (2013 and 2012, respectively), in the Penobscot River, shortnose sturgeon range from Penobscot Bay to the Milford Dam. Shortnose sturgeon now are presumed to have access to their full historical range. Adult and large juvenile sturgeon have been documented using the river. While potential spawning sites have been identified in the Penobscot River, no spawning has been documented. Foraging and overwintering are known to occur in the Penobscot River. Nearly all prespawn females and males detected in the Penobscot River have been documented to return to the Kennebec or Androscoggin Rivers. Robust design analysis with closed periods in the summer and late fall estimated seasonal adult abundance ranging from 636–1,285 individuals (weighted mean), with a low estimate of 602 and a high of 1,306 individuals (Fernandes 2008; Fernandes et al. 2010; Dionne 2010 in Maine DMR 2010).

It is common for sturgeon to migrate from the Penobscot to the Kennebec, though not vice versa; as reproduction has thus far only been observed in the Kennebec River, it has been hypothesized that most sturgeon from these two rivers originate from the Kennebec River (Altenritter et al. 2018; Dionne et al. 2013). Wippelhauser et al. (2015) found that most sturgeon tagged in other rivers and estuaries in Maine migrated to reach the spawning habitat in the Kennebec System, and it was suggested that this system is targeted for spawning and wintering habitat by many shortnose sturgeon in the Gulf of Maine. Sturgeon that migrate were found to grow larger and faster than those solely in the Penobscot River, indicating the productive benefits of migration between the rivers (Altenritter et al. 2018). Migrations have been observed in coastal waters throughout the year, with an average trip of 12 days in the spring, 13.2 days in the fall, and 36.7 days in the summer, with likely movements through the coastal Maine river and bay system (Altenritter et al. 2018; Dionne et al. 2013; Wippelhauser et al. 2015). These patterns indicate that time spent in the marine environment and within the Action Area remains very low. Shortnose sturgeon have also been found entering coastal rivers between the Penobscot and Kennebec, though few east of the Penobscot River (Dionne et al. 2013).

5.2 Critical Habitat Considered for Further Analysis

5.2.1 North Atlantic Right Whale Critical Habitat

In 1994, NMFS designated critical habitat for the Northern right whale population in the North Atlantic Ocean (59 *FR* 28805). This critical habitat designation included portions of Cape Cod Bay, Stellwagen Bank, the Great South Channel, and waters adjacent to the coasts of South Carolina, Georgia, and the east coast of Florida. These areas were determined to provide critical feeding, nursery, and calving habitat for the North Atlantic population of northern right whales.

In 2016, NMFS revised designated critical habitat for the North Atlantic right whale with two new expanded areas. The areas designated as critical habitat contains approximately 29,763 nmi^2 (102,084.2 km^2) of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1) (**Figure 5-10**) and off the Southeast U.S. coast (Unit 2) (**Figure 5-11**). Unit 1 is the only critical habitat that overlaps with the Action Area; only Unit 1 is carried forward in the effects analysis in Section 7.

The physical and biological features (PBFs) essential to the conservation of the North Atlantic right whale, which provide foraging area functions in Unit 1 are a combination of: (1) the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *C. finmarchicus* for North Atlantic right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; (2) low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins; (3) late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and (4) Diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region.

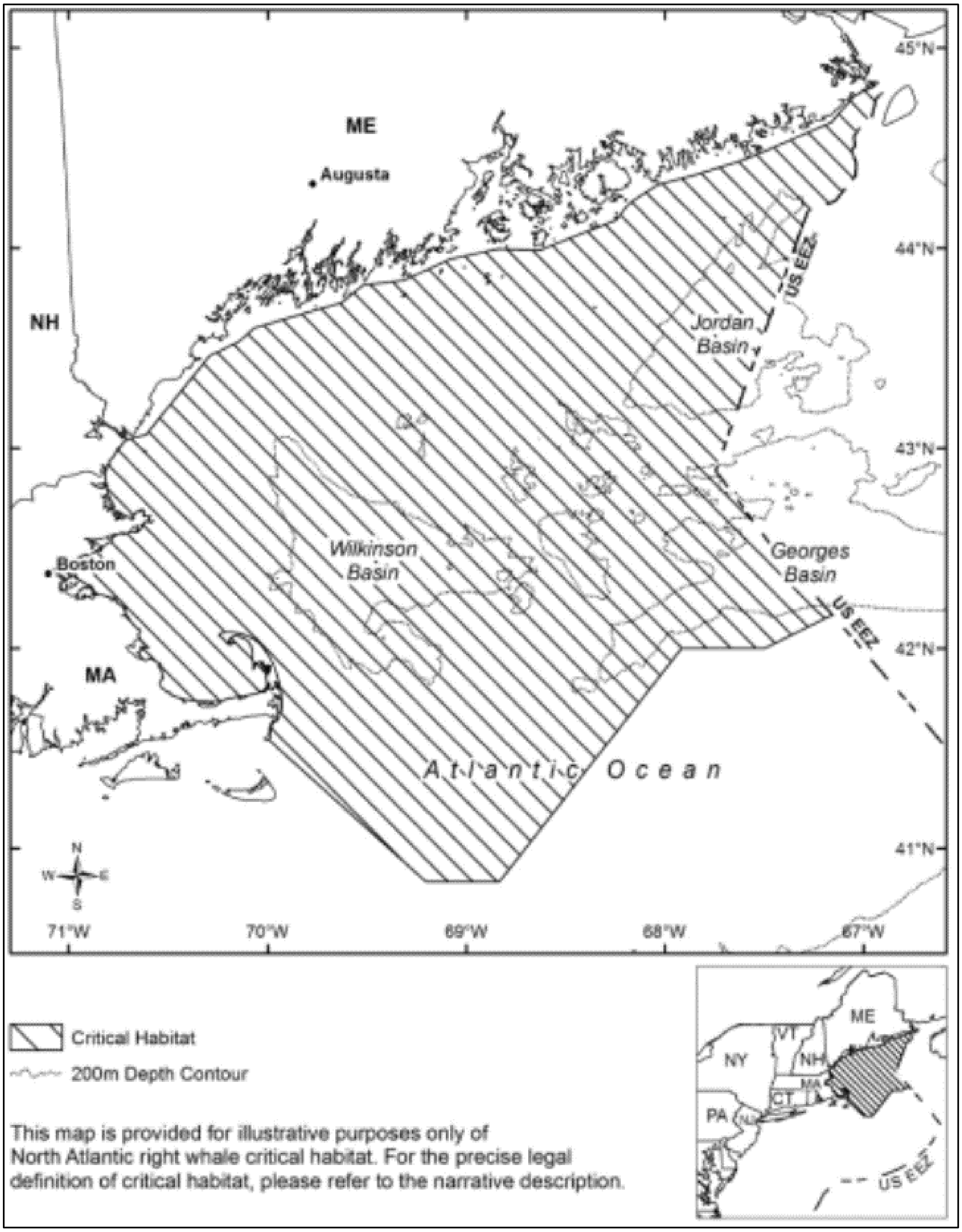


Figure 5-10. Map identifying designated critical habitat in the northeastern foraging area Unit 1 for the North Atlantic right whale

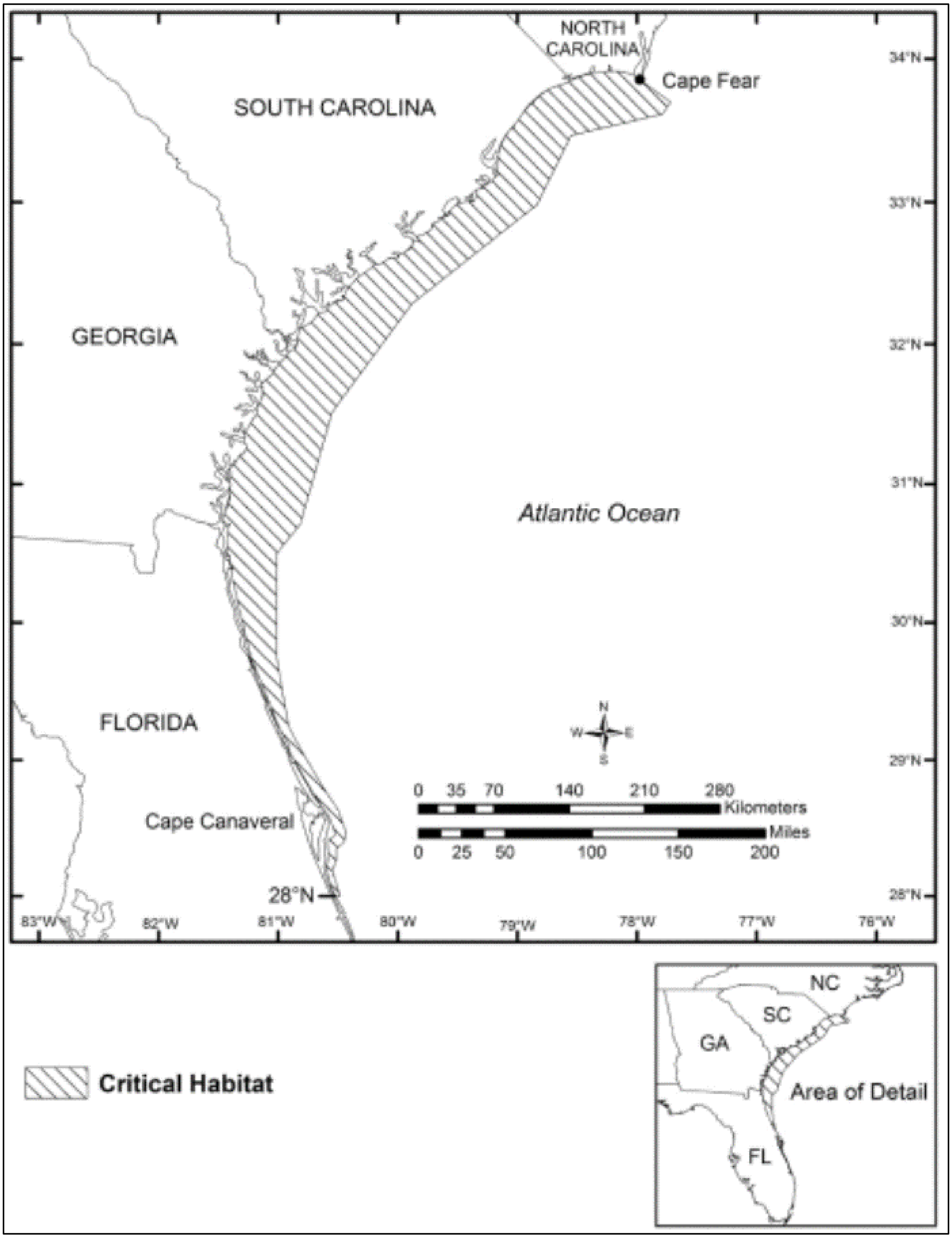


Figure 5-11. Map identifying designated critical habitat in the southeastern calving area Unit 2 for the North Atlantic right whale

5.2.2 Atlantic Sturgeon Critical Habitat–Gulf of Maine DPS

The Gulf of Maine DPS of Atlantic sturgeon was listed as threatened under the ESA in 2012 (77 *FR* 5880; 77 *FR* 5914). The final rule for Atlantic sturgeon critical habitat (all listed DPS) was issued in 2017 (82 *FR* 39160). Included in this rule are 31 units, all rivers, occurring from Maine to Florida. Critical habitat designations for the Atlantic sturgeon Gulf of Maine DPS encompasses five rivers in Maine, New Hampshire, and Massachusetts; Units 1 through 5 occur within the Action Area. No marine habitats were identified as critical habitat because the physical and biological features in these habitats essential for the conservation of Atlantic sturgeon could not be identified.

The critical habitat designation (82 *FR* 39160) for all DPSs is for habitats that support successful Atlantic sturgeon reproduction and recruitment. The physical features essential for Atlantic sturgeon reproduction and recruitment and therefore to the conservation of the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (NMFS 2017) include: (1) hard-bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages; (2) aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development; (3) water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support unimpeded movements of adults to and from spawning sites, seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and staging, resting, or holding of subadults or spawning condition adults; and (4) water quality conditions between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support spawning, annual and interannual adult, subadult, larval, and juvenile survival, and larval, juvenile, and subadult growth, development, and recruitment (e.g., 13° C to 26° C for spawning habitat and no more than 30° C for juvenile rearing habitat, and 6 mg/L or greater dissolved oxygen for juvenile rearing habitat).

Critical habitat designations for the Atlantic sturgeon Gulf of Maine DPS encompasses five rivers in Maine, New Hampshire, and Massachusetts (Units 1 through 5). Within the Action Area there will be some vessel activities which will occur within the port of Portsmouth, New Hampshire which is on the Piscataqua River. This area overlaps with Atlantic sturgeon critical habitat for the Gulf of Maine DPS and will be analyzed further below in Section 7.

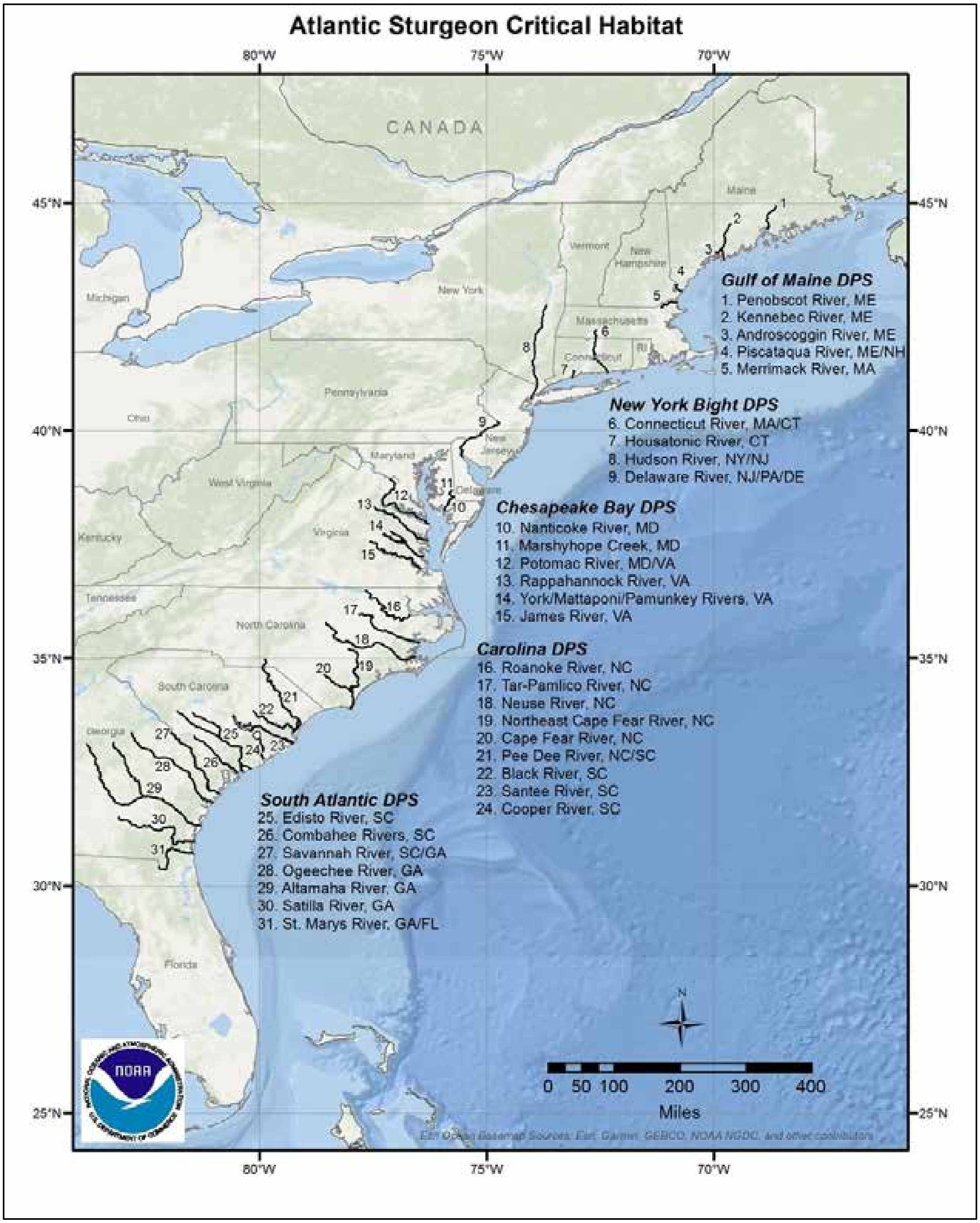


Figure 5-12. Map identifying designated critical habitat for the Atlantic sturgeon

6 Effects of the Action on ESA-listed Species

In this section of the BA, the effects of the Proposed Action on listed species that are likely to be affected are assessed. The quantitative and qualitative analyses in this section are based upon the best available commercial and scientific data on species biology and the effects of the action. Data are limited, so we are often forced to make assumptions to overcome the limits in our knowledge. Sometimes, the best available information may include a range of values for a particular aspect under consideration, or different analytical approaches may be applied to the same data set. In those cases, the uncertainty is resolved in favor of the species. This approach provides the “benefit of the doubt” to threatened and endangered species.

Effects of the Proposed Action are evaluated for the potential to result in harm to listed species. If a project-related activity may affect a listed species, the exposure level and duration of effects are evaluated further for the potential for those effects to harass or injure listed species. The following sections present the potential project-related effects on listed species of marine mammals, sea turtles, and fish from the Proposed Action described in **Section 3.1** with the application monitoring and mitigation measures as described in **Section 3.3** and listed in **Table 6-1**. An overview of these stressors is followed by a detailed analysis of each stressor for each resource is provided in **Sections 6.3** through **6.9.** Effects to critical habitat are discussed in **Section 7**.

“Effects of the action are all consequences to listed species or critical habitat that are caused by the Proposed Action, including the consequences of other activities that are caused by the Proposed Action. A consequence is caused by the Proposed Action if the effect would not occur but for the Proposed Action and the effect is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action” (50 CFR 402.02).

6.1 Determination of Effects

Section 7(a)(2) of the ESA requires federal agencies, in consultation with NMFS, to ensure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat.

“Jeopardize the continued existence of” means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species” (50 CFR §402.02).

“Destruction or adverse modification” means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of an ESA-listed species as a whole (50 CFR §402.02).

Based on an analysis of potential consequences, we provide a determination for each species and designated critical habitat. One of the following three determinations, as defined by the ESA, has been applied for listed species and critical habitat that have potential to be affected by the project: No effect; may affect, not likely to adversely affect; may affect, likely to adversely affect.

The probability of an effect on a species or designated critical habitat is a function of exposure intensity and susceptibility of a species to a stressor’s effects (i.e., probability of response).

No effect–This determination indicates that the Project would have no impacts, positive or negative, on species or designated critical habitat. Generally, this means that the species or critical habitat would not be exposed to the Project and its environmental consequences.

A **may affect, not likely to adversely affect** determination would be given if the project's effects are wholly beneficial, insignificant, or discountable.

Beneficial effects have an immediate positive effect without any adverse effects to the species or habitat.

Insignificant effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. *Insignificant* is the appropriate effect conclusion when plausible effects are going to happen but will not rise to the level of constituting an adverse effect.

Discountable[28] effects are those that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and that would be an adverse effect if it did impact a listed species), but it is extremely unlikely to occur (NMFS and USFWS 1998).

For the purposes of this assessment, BOEM assumes that up to 10 separate lease holders could conduct various aspects of the Proposed Action (site assessment and site characterization surveys) concurrently throughout the WEA. As discussed above in Section 3.1 BOEM is including a condition in the proposed Gulf of Maine WEA leases to require lessee compliance with the PDCs and BMPs **(Appendix B)** of the NMFS June 29, 2021, informal programmatic Endangered Species Act (ESA) consultation and the NMFS June 29, 2021 letter of concurrence (Data Collection and Site Survey Activities Programmatic Informal Consultation). As such, consistent with the conclusions reached in that consultation, BOEM has determined all activities carried out by lessees that are consistent with the scope of activities considered in that consultation are either no effect or not likely to adversely affect any ESA-listed species or critical habitat. BOEM will conduct individual reviews consistent with the steps detailed in the NMFS 2021 informal programmatic consultation in coordination with NMFS to determine consistency with the Gulf of Maine informal consultation.

This BA analyzes the potential effects that may result from site assessment and site characterization activities considered part of the Proposed Action described in **Section 3**. An overview of the stressors considered in this BA are provided in **Table 6-1** and **Table 6-2** summarizes the effects determinations for each species by stressor. Detailed analyses for each stressor provided in **Sections 6.3** through **6.9**.

6.2 Description of Stressors

Stressors that may affect ESA-listed species and critical habitat analyzed in this assessment that were not already discounted in **Sections 4.2** and **4.3** are presented in **Table 6-1**.

[28] When the terms "discountable" or "discountable effects" appear in this document, they refer to potential effects that are found to support a "not likely to adversely affect" conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with the ESA regulatory definition of "effects of the action."

Table 6-1. Stressors that could affect listed species and critical habitat

Stressor[a]	Description	Sources and/or Activities	ESA-Listed Species/Critical Habitat Exposed to the Stressor
Underwater Noise	Refers to noise from various sources and commonly associated with geophysical and geotechnical surveys, and vessel traffic.	Vessels Geophysical and geotechnical surveys	Blue whale Fin whale NARW Sei whale Sperm whale Green sea turtle Kemp's ridley sea turtle Leatherback sea turtle Loggerhead sea turtle Atlantic sturgeon Shortnose sturgeon Atlantic salmon NARW critical habitat
Vessel Strike Risk	Refers to marine vessel traffic, including vessel strikes of marine mammals, sea turtles, and marine fish.	Vessels	Blue whale Fin whale NARW Sei whale Sperm whale Green sea turtle Kemp's ridley sea turtle Leatherback sea turtle Loggerhead sea turtle Atlantic sturgeon Shortnose sturgeon
Habitat Disturbance	Refers to effects from turbidity resulting from benthic disturbances; temporary seafloor disturbances; and the presence of structures.	Placement and removal of buoys Geotechnical surveys, Benthic surveys Vessel anchoring.	Blue whale Fin whale NARW Sei whale Sperm whale Green sea turtle Kemp's ridley sea turtle Loggerhead sea turtle Atlantic sturgeon Shortnose sturgeon Atlantic salmon NARW critical habitat
Entanglement and capture	Activities associated with the potential habitat disturbance, entanglement, or capture as a result of the deployment of up to two met buoys per lease	Buoys	Blue whale Fin whale NARW Sei whale Sperm whale Green sea turtle Kemp's ridley sea turtle Leatherback sea turtle Loggerhead sea turtle Atlantic sturgeon Shortnose sturgeon Atlantic salmon NARW critical habitat

Stressor[a]	Description	Sources and/or Activities	ESA-Listed Species/Critical Habitat Exposed to the Stressor
Air emissions	Refers to the release of gaseous or particulate pollutants into the atmosphere. Can occur on- and offshore.	Internal combustion engines within mobile sources such as vessels, vehicles, or aircraft	Blue whale Fin whale NARW Sei whale Sperm whale Green sea turtle Kemp's ridley sea turtle Leatherback sea turtle Loggerhead sea turtle
Lighting	Refers to the presence of light above the water onshore and offshore as well as underwater	Vessels or met Buoys	Blue whale Fin whale NARW Sei whale Sperm whale Green sea turtle Kemp's ridley sea turtle Leatherback sea turtle Loggerhead sea turtle
Non-Routine Events	Effects associated with non-routine events, such as storms, allisions and collisions, accidental spills, and recovery of lost equipment.	Vessels Equipment loss from surveys	Fin whale NARW Sei whale Sperm whale Green sea turtle Kemp's ridley sea turtle Loggerhead sea turtle Atlantic sturgeon Shortnose sturgeon Atlantic salmon NARW critical habitat

ESA = Endangered Species Act; NARW = North Atlantic right whale
[a] The following stressors have been discounted from the assessment in the BA for the ESA-listed resources analyzed because they are not expected to have any discernable effects on these species: land disturbance, in-air noise.

Table 6-2. Stressors that are not likely to adversely affect ESA-listed species

Stressor		Marine Mammals					Sea Turtles				Marine Fish		
		Blue Whale	**Fin Whale**	**North Atlantic Right Whale**	**Sei Whale**	**Sperm Whale**	**Green Sea Turtle (North Atlantic DPS)**	**Leatherback Sea Turtle**	**Loggerhead Sea Turtle (Northwest Atlantic DPS)**	**Kemp's Ridley Sea Turtle**	**Atlantic Sturgeon**	**Atlantic Salmon**	**Shortnose Sturgeon**
Underwater Noise	Geophysical Reconnaissance Survey Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE
Underwater Noise	Active Acoustic Survey Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE
Underwater Noise	Seafloor Habitat Characterization Survey Equipment Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Underwater Noise	Vessel Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Underwater Noise	Geotechnical Sampling Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Underwater Noise	HRG Survey Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Vessel Strike		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA
Habitat Disturbance	Temporary Seafloor Disturbances	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Habitat Disturbance	Turbidity	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Habitat Disturbance	Behavioral Changes due to the Presence of Structures	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Entanglement and Capture		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Air Emissions		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE
Lighting		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Non-Routine Events	Storms	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Non-Routine Events	Allisions and Collisions	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Non-Routine Events	Spills	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Non-Routine Events	Recovery of Lost Survey Equipment	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Overall Effects Determination		**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**

DPS = distinct population segment; HRG = high-resolution geophysical; NARW = North Atlantic right whale; NE = no effect; LAA; likely to adversely affect; NLAA = not likely to adversely affect

6.3 Underwater Noise

BOEM recognizes that ESA-listed species can be exposed to underwater noise resulting from activities under the Proposed Action including vessel noise, HRG surveys, and geotechnical surveys. While the geophysical reconnaissance surveys will also use geophysical survey equipment, the proposed equipment all have operating frequencies (greater than 180 kHz) above relevant marine mammal, sea turtle, and ESA-listed fish primary hearing sensitivities or produce very narrow beam widths, so they are unlikely to be detectable beyond a few meters from the sources for most species so no notable effects are expected. The extent and severity of auditory and non-auditory effects from the Proposed Action generated underwater noise is dependent on the timing of activities relative to species occurrence, the type of noise impact, and species-specific sensitivity.

Underwater sounds in the marine environment originate from a variety of sources including non-biological sources such as wind and waves, and the movements or vocalizations of marine life (Hildebrand 2009). Human activities can also introduce sound into the marine environment through activities like oil and gas exploration, construction, military sonars, and vessel traffic (Hildebrand 2009). The soundscape, or acoustic habitat, of a given ecosystem comprises all such sounds—biological, non-biological, and anthropogenic (Pijanowski et al. 2011). Soundscapes are highly variable across space, time, and water depth, among other factors, due to the properties of sound transmission and the types of sound sources present in each area. A soundscape is sometimes called the “acoustic habitat,” as it is a vital attribute of a given area where an animal may live (i.e., habitat) (Hatch et al. 2016).

Sounds are created by the vibration of an object within its medium, in this case water. When the object’s vibration is coupled to the medium, that vibration travels as a propagating wave away from the sound source. As this wave moves through the water, the particles undergo tiny back-and-forth movements (i.e., particle motion), when the motion results in more particles in one location, that location has relatively higher pressure. Particles are then accelerated out of the higher pressure region causing particle motion. The particles themselves do not travel with the wave, instead they oscillate in roughly the same location, transferring their energy to surrounding particles. Acoustic pressure is a non-directional (scalar) quantity, whereas particle motion is an inherently directional quantity (a vector). The total energy of the sound wave includes the potential energy associated with the sound pressure as well as the kinetic energy from particle motion.

Propagation of underwater sound can be described through a source-path-receiver model. An underwater acoustic source emits sound energy that radiates outward and travels through the water and the seafloor as mechanical waves. The sound level decreases with increasing distance from the acoustic source as the sound pressure waves spread out under the influence of the surrounding receiving environment. The amount by which the sound levels decrease between a source and a receiver is called transmission loss. The amount of transmission loss that occurs depends on the source-receiver separation, the frequency of the sound, the properties of the water column, and the properties of the seafloor. Underwater sound levels are expressed in decibels (dB), which is a logarithmic ratio relative to a fixed reference pressure of 1 micropascal (μPa) (equal to 10^{-6} pascals [Pa] or 10^{-11} bar).

The efficiency of underwater sound propagation allows marine animals to use underwater sound as a method of communication, navigation, prey detection, and predator avoidance (Richardson et al. 1995; Southall et al. 2007; Dow Piniak et al. 2012; Popper and Hawkins 2018, 2019). Anthropogenic (i.e., human-introduced) noise has gained recognition as a potential stressor for marine life because of their reliance on underwater hearing for maintenance of these critical biological functions (Richardson et al. 1995; Ketten 1998; Dow Piniak et al. 2012; Popper and Hawkins 2018, 2019). Underwater noise generated by human activities can often be detected by marine animals many kilometers from the source. With increasing distance from a noise source, potential acoustic impacts can range from physiological injury to permanent or temporary hearing loss, behavioral changes, and acoustic masking (i.e., communication interference). All the above impacts could induce stress on marine animals in their receiving environment (OSPAR Commission 2009; Erbe 2013).

Anthropogenic noise sources are classified as either impulsive or non-impulsive and continuous or intermittent based on their acoustic characteristics (NMFS 2018, 2023j). Specifically, when it comes to potential damage to marine animal hearing, sounds are classified as either impulsive or non-impulsive, and when considering the potential to affect behavior or acoustic masking, sounds are classified as either continuous or intermittent.

Impulsive noises are characterized as having (Finneran 2016):

- broadband frequency content;
- fast rise-times and rapid decay times;
- short durations (i.e., less than 1 s); and
- high peak sound pressures.

Whereas the characteristics of non-impulsive sound sources are less clear but may be:

- variable in spectral composition, i.e., broadband, narrowband, or tonal;
- longer rise-time/decay times, and total durations compared to an impulsive sound; and
- continuous (e.g., vessel engine radiated noise), or intermittent (e.g., echosounder pulses).

Impulsive sounds are more likely to induce auditory function effects, including temporary threshold shift (TTS) and permanent threshold shift (PTS), than non-impulsive sounds with the same energy. This binary, at-the-source classification of sound types, therefore, provides a conservative framework upon which to predict potential adverse hearing impacts to marine life.

For behavioral effects of anthropogenic sound on marine mammals, NMFS classifies sound sources as either intermittent or continuous (NMFS 2023j). Continuous sounds, such as vessel noise continuously produce noise above ambient sound levels, for a given period of time, during which exposures to the noise may induce a behavioral reaction. An intermittent sound typically consists of pulses of sound on a regular on-off pattern, also called the duty-cycle. Examples of intermittent sounds are those from scientific echosounders, sub-bottom profilers, and geotechnical coring. It is important to recognize that these delineations are not always practical in application, as a continuous yet moving sound source (such as a vessel passing over a fixed receiver) could be considered intermittent from the perspective of the receiver.

Sensitivity to PTS, TTS, and behavioral disturbance will depend upon the frequency of the source and the hearing sensitivity of the receiver to those frequencies. For auditory effects (i.e., PTS, TTS), underwater noise is less likely to affect an animal's hearing if the received noise occurs at frequencies outside an animal's primary hearing sensitivity. The importance of underwater noise for a given animal can be scaled by frequency weighting relative to an animal's sensitivity to those frequencies (Nedwell et al. 2007). Acoustic thresholds used for the purpose of predicting the extent of potential noise impacts on marine mammal, sea turtle, and fish hearing and subsequent management of these impacts account for the duration of exposure, incorporation of more recent hearing and TTS data, and the differences in hearing acuity in various marine species or life stages (Finneran 2016; NMFS 2023j).

Auditory thresholds from underwater noise are expressed using three common metrics: root-mean-square sound pressure level (SPL) and peak sound pressure level (L_{pk}), both measured in dB re 1 μPa, and sound exposure level (SEL), a measure of energy in dB re 1 μPa^2 s. L_{pk} is an instantaneous value, whereas SEL is the total noise energy over a given time period or event. As such, the SEL accumulated over 24 hours, (SEL_{24h}) is appropriate when assessing effects to marine mammals from cumulative exposure to multiple pulses or durations of exposure. SPL is a root mean square average over a period of time and is equal to the SEL divided (linearly) by the time period of exposure. Therefore, if the time period is 1 second, the SEL and the SPL are equal.

The auditory and non-auditory thresholds used in this BA are given below for each species group. The extent and severity of auditory and non-auditory effects from project generated underwater noise is dependent on the timing of activities relative to species occurrence, the type of noise impact, and species-specific sensitivity.

6.3.1 Overview of Underwater Noise and ESA-listed Species

6.3.1.1 Underwater Noise and Marine Mammals

Marine mammals rely heavily on acoustic cues for extracting information from their environment. Sound travels faster and farther in water (~1500 m/s) than it does in air (~350 m/s), making this a reliable mode of information transfer across large distances and in environments where visual cues are limited. Acoustic communication is used in a variety of contexts, such as attracting mates, communicating to young, or conveying other relevant information (Bradbury and Vehrencamp 1998). Marine mammals can also glean information about their environment by listening to acoustic cues, like ambient sounds from a reef, the sound of an approaching storm, or the call from a nearby predator. Finally, toothed whales produce and listen to echolocation clicks to locate food and to navigate (Madsen and Surlykke 2013).

Like terrestrial mammals, the auditory anatomy of marine mammals generally includes the inner, middle, and outer ear (Ketten 1994). Not all marine mammals have an outer ear, but if it is present, it funnels sound into the auditory pathway, capturing the sound. The middle ear acts as a transformer, filtering and amplifying the sound. The inner ear is where auditory reception takes place. The key structure in the inner ear responsible for auditory perception is the cochlea, a spiral-shaped structure containing the basilar membrane, which is lined with auditory hair cells. Specific areas of the basilar membrane vibrate in response to the frequency content of the acoustic stimulus, causing hair cells mapped to specific frequencies to be differentially stimulated and send signals to the brain (Ketten 1994). While the cochlea and basiliar membrane are well conserved structures across all mammalian taxa, there are some key differences in the auditory anatomy of terrestrial versus marine mammals that require explanation. Marine mammals have the unique need to hear in aqueous environments. Amphibious marine mammals (including seals, sea otters, and sea lions) have evolved to hear in both air and under water, and all except phocid pinnipeds have external ear appendages. Cetaceans do not have external ears, do not have air-filled external canals, and the bony portions of the ear are much denser than those of terrestrial mammals (Ketten 1994).

All marine mammals have binaural hearing and can extract directional information from sound. But the pathway that sound takes into the inner ear is not well understood for all cetaceans and may not be the same for all species. For example, in baleen whales (i.e., mysticetes), bone conduction through the lower jaw may play a role in hearing (Cranford and Krysl 2015), while odontocetes have a fat-filled portion of the lower jaw which is thought to funnel sound towards the ear (Mooney et al. 2012). Hearing tests have been conducted on several species of odontocetes, but there has yet to be a hearing test on a baleen whale, so most of our understanding comes from examining the ears from deceased whales (Erbe et al. 2016; Houser et al. 2017).

Many marine mammal species produce sounds through vibrations in their larynx (Frankel 2009). In baleen whales, for example, air in the lungs and laryngeal sac expands and contracts, producing vibrations and sounds within the larynx (Frankel 2009). Baleen whales produce low frequency sounds that can be used to communicate with other animals over great distances (Clark and Gagnon 2002). Differences in sound production among marine mammal species vary, in part, with their use of the marine acoustic environment. Toothed whales hunt for their prey using high-frequency echolocation signals. To produce these signals they have a specialized structure called the "melon" in the top of their head that is used for sound production. When air passes through the phonic lips, a vibration is produced, and the melon helps transmit the vibration from the phonic lips to the environment as a directed beam of sound (Frankel 2009). It is generally believed that if an animal produces and uses a sound at a certain frequency, its hearing sensitivity will at least overlap those particular frequencies. An animal's hearing range is likely much broader than this, as they rely heavily on acoustic information, beyond the signals they produce themselves, to understand their environment.

The sections below provide an overview of the available information on marine mammal hearing, the thresholds applied, information available in the literature regarding source levels for sound sources assessed in this BA, and the impact consequences for each potential underwater noise generating activity for the Proposed Action.

For sound sources or for species where no Project specific modeling was completed, information available in the literature regarding source levels was used to develop the effects analysis.

6.3.1.1.1 Auditory Criteria for Injury and Behavioral Disturbance to Marine Mammals

Assessment of the potential effects of underwater noise on marine mammals requires acoustic thresholds against which received sound levels can be compared. For marine mammals, established acoustic criteria for hearing injury and behavioral disturbance recognized by NMFS have recently been updated in terms of auditory injury thresholds (NMFS 2023j). The revised auditory injury thresholds apply dual criteria based on Lpk and SEL_{24hr} and are based on updated frequency weighting functions for five marine mammal hearing groups described by NMFS (2023j), Southall et al. (2007) and Finneran and Jenkins (2012). However, the species considered in the analysis in this BA only belong to two hearing groups, as summarized in **Table 6-3**.

Table 6-3. Marine mammal hearing groups for Endangered Species Act (ESA)-listed marine mammal species

Hearing Groups	Taxonomic Group	Generalized Hearing Range1
Low-frequency cetaceans (LFC)	Baleen whales (e.g., NARW, fin whale)	7 Hz to 35 kHz
Mid-frequency cetaceans (MFC)	Sperm whale	150 Hz to 160 kHz

Source: Southall et al. (2007) Finneran and Jenkins (2012), and NMFS (2023j).
[1] The generalized hearing range is for all species within a group. Individual hearing may vary. Generalized hearing range based on ~65 dB threshold from normalized composite audiogram, with the exception for lower limits for LFC (Southall et al. 2007).
Hz = hertz; kHz = kilohertz; NARW = North Atlantic right whale.

Behavioral disturbance thresholds for marine mammals are based on SPL of 160 dB re 1 μPa for impulsive or non-impulsive, intermittent sounds and 120 dB re 1 μPa for non-impulsive, continuous sounds for all marine mammal species (NMFS 2023j). Although these behavioral disturbance thresholds remain current (in the sense that they have not been formally superseded by newer directives), they are not frequency weighted to account for different hearing abilities by the five marine mammal hearing groups.

The potential for underwater noise exposures to result in adverse impacts on a marine mammal depends on the received sound level, the frequency content of the sound relative to the hearing ability of the animal, the duration, and the level of natural background noise. Potential effects range from subtle changes in behavior at low received levels to strong disturbance effects or potential injury at high received levels.

Sound reaching the receiver at sufficient loudness and for an ample duration can result in a loss of hearing sensitivity in marine animals termed a noise-induced threshold shift. This may consist of TTS or PTS. TTS is a relatively short-term, reversible loss of hearing following exposure (Southall et al. 2007, 2019), often resulting from cellular fatigue and metabolic changes (Saunders et al. 1985; Yost 2000). While experiencing TTS, the hearing threshold rises, and subsequent sounds must be louder to be detected. Data indicate that TTS onset in marine mammals is more closely correlated with the received SEL_{24h} than with the Lpk and that received sound energy over time, not just the single strongest pulse, should be considered a primary measure of potential impact (Southall et al. 2007; Finnern et al. 2017; NMFS 2018). PTS is an irreversible loss of hearing (permanent damage; not fully recoverable) following exposure that commonly results from inner ear hair cell loss or structural damage to auditory tissues (Saunders et al. 1985; Henderson et al. 2008). PTS has been demonstrated in harbor seals (Reichmuth et al. 2019; Kastak et al. 2008). TTS has been demonstrated in some odontocete and pinniped species in response to exposure to impulsive and non-impulsive noise sources in a laboratory setting (a full review is provided in Southall et al. 2007; Finneran et al. 2017). Prolonged or repeated exposures to sound levels sufficient to induce TTS without recovery time can lead to PTS (Southall et al. 2007).

Table 6-4 outlines the acoustic thresholds for onset of acoustic impacts (PTS and behavioral disturbances) for marine mammals for both impulsive and non-impulsive noise sources. Impulsive noise sources include some HRG equipment. Non-impulsive noise sources include some HRG equipment, vessel activities, and geotechnical surveys.

Table 6-4. Acoustic marine mammal thresholds (temporary threshold shift [TTS] and permanent threshold shift [PTS]) based on National Marine Fisheries Service (NMFS) (2023j) for Endangered Species Act (ESA)-listed cetaceans

Marine Mammal Hearing Group	Effect	Impulsive Source		Non-Impulsive Source
		Unweighted Lpk (dB re 1 µPa)	Weighted SEL24h (dB re 1 µPa² s)	Weighted SEL24h (dB re 1 µPa² s)
LFC	PTS	219	183	199
	TTS	213	168	179
MFC	PTS	230	185	198
	TTS	224	170	178

Source: NMFS 2023j.
dB re 1 µPa = decibels relative to 1 micropascal; dB re 1 $µPa^2s$ = decibels relative to 1 micropascal squared second; LFC = low-frequency cetacean; MFC = mid-frequency cetacean; PTS = permanent threshold shift; TTS = temporary threshold shift.

Marine mammals show varying levels of behavioral disturbance in response to underwater noise sources. Observed behavioral responses include displacement and avoidance, decreases in vocal activity, and habituation. Behavioral responses can consist of disruption in foraging patterns, increases in physiological stress, and reduced breeding opportunities, among other responses. To better understand and categorize the potential effects of behavioral responses, Southall et al. (2007) developed a behavioral response severity scale of low, moderate, or high (Southall et al. 2007; Finneran et al. 2017). This scale was recently updated in Southall et al. (2021). The revised report updated the single severity response criteria defined in Southall et al. (2007) into three parallel severity tracks that score behavioral responses from 0 to 9. The three severity tracks are (1) survival, (2) reproduction, and (3) foraging. This approach is acknowledged as being relevant to vital rates, defining behaviors that may affect individual fitness, which may ultimately affect population parameters.

It was noted that not all the responses within a given category need to be observed but that a score is assigned for a severity category if any of the responses in that category are displayed (Southall et al. 2021). To be conservative, the highest (or most severe) score is to be assigned for instances when several responses are observed from different categories. In addition, the Southall et al. (2021) acknowledge it is no longer appropriate to relate “simple all-or-nothing thresholds” to specific received sound levels and behavioral responses across broad taxonomic groupings and sound types due to the high degree of variability within and between species and noise types. The new scale also moves away from distinguishing noise impacts from impulsive versus non-impulsive sound types into considering the specific sources of noise.

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 communication or 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 understanding the resulting effects. More research is needed to understand the process of masking, the risk of masking by anthropogenic activities such as sonar emissions, 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). For the current assessment, masking was considered possible if the frequency of the sound source overlaps with the hearing range of the marine mammal (**Table 6-3**).

6.3.1.2 Underwater Noise and Sea Turtles

Potential adverse auditory effects to sea turtles from Project-generated underwater noise includes PTS, TTS, and behavioral disruption. The section below provides an overview of the available information on sea turtle hearing, the thresholds applied, and the impact consequences for each potential activity.

6.3.1.2.1 Auditory Criteria for Injury and Disturbance to Sea Turtles

The outermost part of the sea turtle ear, or tympanum, is covered by a thick layer of skin covering a fatty layer that conducts sound in water to the middle and inner ear. This is a distinguishing feature from terrestrial and semi-aquatic turtles. This thick outer layer makes it difficult for turtles to hear well in air, but it facilitates the transfer of sound from the aqueous environment into the ear (Ketten et al. 1999). The middle ear has two components that are encased by bone, the columella and extra columella, which provides the pathway for sound from the tympanum on the surface of the turtle head to the inner ear. The middle ear is also connected to the throat by the Eustachian tube. The inner ear consists of the cochlea and basilar membrane. Because there is air in the middle ear, it is generally believed that sea turtles detect sound pressure rather than particle motion. Sea turtle ears are described as being similar to a reptilian ear, but due to the historically limited data in sea turtles and reptiles, fish hearing has often been used as an analog when considering potential impacts of underwater sound.

Hearing in sea turtles has been measured through electrophysiological and/or behavioral studies both in air and in water on a limited number of life stages for each of the five species. In general, sea turtles hear best in water between 200 to 750 Hz and do not hear well above 1 kHz. It is worth noting that there are species-specific and life-stage specific differences in sea turtle hearing (**Table 6-5**). Sea turtles are also generally less sensitive to sound than marine mammals, with the most sensitive hearing thresholds underwater measured at or above 75 dB re 1 µPa (Papale et al. 2020; Reese et al. 2023). Loggerhead sea turtles have been studied most thoroughly with respect to other species, including post-hatchlings

(Lavender et al. 2012, 2014), juveniles (Bartol et al. 1999; Lavender et al. 2012, 2014), and adults (Martin et al. 2012).

Table 6-5. Hearing capabilities of sea turtles

Species	Life stages tested	Hearing Frequency Range (Hz)	Max sensitivity (Hz)	References
Loggerhead (*Caretta caretta*)	Post-hatchling, juvenile	100–900 (in air)	500–700	Ketten & Bartol 2005
	Post-hatchling, juvenile, adult	50–1,100 (underwater)	100–400	Bartol & Bartol 2011, Lavender et al. 2014, Martin et al. 2012, Lenhardt 2002, Bartol et al. 1999
Green (*Chelonia mydas*)	Juvenile, sub-adult	50–2,000 (in air)	200–700	Ridgway et al. 1969; Ketten & Bartol 2005; Piniak et al. 2016
	Juvenile	50–1,600 (underwater)	200–400	Piniak et al. 2016
Leatherback (*Dermochelys coriacea*)	Hatchling	50–1.600 (in air)	300	Piniak 2012, Piniak et al. 2012
	Hatchling	50–1,200 (underwater)	300	Piniak 2012, Piniak et al. 2012
Kemps ridley (*Lepidochelys kempii*)	Juvenile	100–500 (in air)	100–200	Ketten & Bartol 2005

As with marine mammals, the potential for underwater noise to result in adverse impacts on a sea turtle depends on the received sound level, the frequency content of the sound relative to the hearing ability of the animal. Potential effects range from subtle changes in behavior at low received levels to strong disturbance effects or potential injury and/or mortality at high received levels.

Also known as auditory fatigue, TTS is the milder form of hearing impairment that is non-permanent and reversible, and results from exposure to high intensity sounds for short durations or lower intensity sounds for longer durations. In most cases, it is assumed that TTS would occur before PTS; and ranges to TTS thresholds are expected to be greater than PTS threshold ranges. Both PTS and TTS are species-specific, and lead to an elevation in the hearing threshold, meaning it is more difficult for an animal to hear sounds. TTS can last for minutes, hours, or days; the magnitude of the TTS depends on the level (frequency and intensity), energy distribution, and duration of the noise exposure among other considerations. While there is no direct evidence of PTS occurring in sea turtles, TTS has been demonstrated in other marine species in response to exposure to impulsive and non-impulsive noise sources in laboratory studies (a full review is provided in Southall et al. [2007]). Prolonged or repeated exposure to sound levels sufficient to induce TTS without recovery time can lead to PTS (Southall et al. 2007). TTS is typically applied when assessing regulatory impacts of specific activities (e.g., military operations, explosions). Preliminary analyses from a Woods Hole Oceanographic Institution (WHOI) (2022) freshwater turtle study showed TTS onset occurring lower than the 200 dB re 1 μPa^2 s criteria currently used to predict TTS in sea turtles, which could be a function of species and other conditions. The WHOI (2022) study indicated that TTS up to 40 dB re 1 µPa may be experienced in freshwater turtles; however, hearing returned to initial sensitivities following a recovery period of 20 minutes to several days (WHOI 2022). It is reasonable to assume that the thresholds for TTS onset are lower than those for PTS onset, but higher than behavioral disturbance onset. Until more studies improve the understanding of TTS in sea turtles, ranges to TTS thresholds and TTS exposures should be considered qualitative; and mitigation measures designed to reduce PTS and behavioral exposures should also contribute to reducing the risk of the TTS exposures.

Table 6-6 and **Table 6-7** outline the acoustic thresholds used in the assessment for the onset of PTS, TTS, and behavioral disruptions for sea turtles. Behavioral criteria for both impulsive and non-impulsive sources were developed by the U.S. Navy in consultation with NMFS and was based on exposure to air guns noise presented in McCauley et al. (2000; Finneran et al. 2017). Vessel noise produces non-impulsive, continuous sounds, HRG survey equipment includes both impulsive and non-impulsive, intermittent sources, and geotechnical surveys produce non-impulsive, intermittent sources. In addition, the working group that prepared the ANSI Sound Exposure Guidelines (Popper et al. 2014) provide parametric descriptors of sea turtle behavioral responses to impulsive noise (**Table 6-8**); however, these guidelines were based on pile driving which may not be fully comparable to sources in the proposed activities.

The received sound level at which sea turtles are expected to actively avoid impulsive sounds, an SPL of 175 dB re 1 μPa, is also expected to be the received sound level at which sea turtles would actively avoid exposure to both impulsive and non-impulsive sound sources (Finneran et al. 2017). For sea turtles, no distinction is made in the behavioral threshold between impulsive and non-impulsive sources.

Table 6-6. Acoustic impact thresholds[1] for sea turtles–impulsive sources

PTS		TTS		Behavioral[2]
L_{pk} Unweighted	SEL_{24h} Weighted	L_{pk} Unweighted	SEL_{24h} Weighted	SPL Unweighted
232	204	226	189	175

Sources: Finneran et al. (2017).
[1] Dual metric thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds are recommended for consideration.
[2] The behavioral disturbance threshold is for all sources–currently, there are not enough data to derive separate thresholds for different source types.
L_{pk} = peak sound pressure levels in units of decibels referenced to 1 micropascal; SEL_{24h} = sound exposure level over 24 hours in units of decibels referenced to 1 micropascal squared second; PTS permanent threshold shift; TTS = temporary threshold shift.

Table 6-7. Acoustic impact thresholds[1] for sea turtles–non-impulsive sources

PTS	TTS	Behavioral[2]
SEL_{24h} Weighted	SEL_{24h} Weighted	SPL Unweighted
220	200	175

Source: Finneran et al. (2017).
[1] Dual metric thresholds for impulsive sounds: Use whichever results in the largest isopleth for calculating PTS onset. If a non-impulsive sound has the potential of exceeding the peak sound pressure level thresholds associated with impulsive sounds, these thresholds are recommended for consideration.
[2] Behavioral disturbance threshold applies to all sources–currently, there are not enough data to derive separate thresholds for different source types.
SEL_{24h} = sound exposure level over 24 hours in units of decibels referenced to 1 micropascal squared second; PTS = permanent threshold shift; TTS = temporary threshold shift.

Table 6-8. Qualitative acoustic impact guidelines for sea turtles

Source Type	Recoverable Injury	Impairment TTS	Masking	Behavior
Impulsive Sources	(N) High (I) Low (F) Low	(N) High (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) High (I) Moderate (F) Low
Continuous Sounds	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) High (I) Moderate (F) Low

Source: Popper et al. (2014).
Notes: Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N-tens of meters), intermediate (I - hundreds of meters), and far (F - thousands of meters). Guidelines are not provided for masking for explosive events since the animals are not exposed to more than a one or few explosive events, and masking would not last beyond the period of exposure. For continuous sounds, data is based on fish, knowing they will respond to sounds and their hearing sensitivity; however, there are no data on exposure or received levels that enable guideline numbers to be provided.
Recoverable injury refers to injuries, including hair cell damage, minor internal or external hematoma, etc. None of these injuries are likely to result in mortality.

6.3.1.3 Underwater Noise and Marine Fish

Many fishes produce sounds for basic biological functions like attracting a mate and defending territory. A recent study revealed that sound production in fishes has evolved at least 33 times throughout evolutionary time, and that most ray-finned fishes are likely capable of producing sounds (Rice et al. 2022). Fish may produce sounds through a variety of mechanisms, such as vibrating muscles near the swim bladder, rubbing parts of their skeleton together, or snapping their pectoral fin tendons (Ladich and Bass 2011; Rice et al. 2022).

There are some species that do not appear produce sounds, but still have acute hearing (e.g., goldfish), which has led scientists to surmise that animals glean a great deal of information about their environment through acoustic cues, a process called "auditory scene analysis" (Fay 2009). All the sounds in a given environment, both natural and human-made, compose the "soundscape," or acoustic habitat for that species (Pijanowski et al. 2011). Acoustic habitats naturally vary over space and time, and there is increasing evidence that some fish and invertebrate species can distinguish between soundscapes of different habitats (Kaplan et al. 2015; McWilliam and Hawkins 2013; Radford et al. 2008). In fact, some pelagic larvae may use soundscapes as a cue to orient towards suitable settlement habitat (Lillis et al. 2013, 2015; Montgomery 2006; Radford et al. 2007; Simpson et al. 2005; Vermeij et al. 2010) or to induce molting into their juvenile forms (Stanley et al. 2015).

All fishes are capable of sensing the particle motion component of underwater sound. The inner ear of fishes is similar to that of all vertebrates. Each ear has three otolithic end organs, which contain a sensory epithelium lined with hair cells, as well as a dense structure called an otolith (Popper et al. 2022). Particle motion is the displacement, or back and forth motion, of water molecules and as it moves the body of the fish (which has a density similar to seawater), the denser otoliths lag behind, creating a shearing force on the hair cells which sends a signal to the brain via the auditory nerve (Fay and Popper 2000). Available research shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2022).

In addition to particle motion detection shared across all fishes, some species are also capable of detecting the pressure component of underwater sound (Fay and Popper 2000). Special adaptations of the swim bladder in these species (e.g., anterior projections, additional gas bubbles, or bony parts) bring it in close proximity to the ear, and as the swim bladder expands and contracts, pressure signals are radiated within the body of the fish making their way to the ear in the form of particle motion (Popper et al. 2022). These species can typically detect a broader range of acoustic frequencies (up to 3-4 kHz; Wiernicki et al. 2020) and are therefore considered to be more sensitive to underwater sound than those that can only detect particle motion. Hearing sensitivity in fishes is generally considered to fall along a spectrum: the least-sensitive (sometimes called “hearing generalists”) are those that do not possess a swim bladder and only detect sound through particle motion, limiting their range to sounds below 1 kHz, while the most sensitive (“hearing specialists”) possess specialized structures enabling pressure detection which expands their detection frequency range (Popper et al. 2022). A few species in the herring family can detect ultrasonic (greater than 20 kHz) sounds (Mann et al. 2001), but this is considered very rare among the bony fishes. Another important distinction for species that do possess swim bladders is whether it is open or closed; species with open swim bladders can release pressure through a connection to the gut, while those with closed swim bladders can only release pressure very slowly, making them more prone to injury when experiencing rapid changes in pressure (Popper et al. 2019). It should also be noted that hearing sensitivity can change with age; in some species like black sea bass, the closer proximity between the ear and the swim bladder in smaller fish can mean that younger individuals are more sensitive to sound than older fish (Stanley et al. 2020). In other species, hearing sensitivity seems to improve with age (Kenyon 1996).

Compared to other fauna such as marine mammals, research has only scratched the surface in understanding the importance of sound to fish species, but there is sufficient data thus far to conclude that underwater sound is vitally important to their basic life functions, such as finding a mate, deterring a predator, or defending territory (Popper and Hawkins 2018; 2019). Therefore, these species must be able to detect components of marine soundscapes, and this detectability could be adversely affected by the addition of noise from anthropogenic activity.

As with marine mammals and sea turtles, fishes may experience a range of impacts from underwater sound depending on physical qualities of the sound source and the environment, as well as the physiological characteristics and the behavioral context of the species of interest. It is important to note that unlike marine mammals, whose hair cells do not regenerate, fishes are able to regrow hair cells that die or become damaged (Corwin 1981), making it extremely likely that they could experience PTS. However, fishes do experience TTS, and when very close to impulsive sound sources or explosions they could experience barotrauma, a term that refers to a class of injuries ranging from recoverable bruises to organ damage, which could ultimately lead to death (Popper et al. 2014; Stephenson et al. 2010). When the air-filled swim bladder inside the body of the fish quickly expands and contracts due to a rapid change in pressure, it can cause internal injuries to the nearby tissues (Halvorsen et al. 2011). The greater the difference between the static pressure at the site of the fish and the positive/negative pressures associated with the sound source, the greater the risk of barotrauma. As with marine mammals, continuous, lower-level sources (e.g., vessel noise) are unlikely to result in auditory injury but could induce changes in behavior or acoustic masking.

The three ESA-listed fish species considered in this BA include the Atlantic sturgeon, Atlantic salmon, and shortnose sturgeon, as described in **Section 5.1.3**. All three species have swim bladders so they are able to detect the sound pressure component of noise but it is not directly connected to their hearing like species of carp or herring and would therefore be less sensitive to underwater sound pressure (Popper et al. 2014).

6.3.1.3.1 Auditory Criteria for Injury and Disturbance to Marine Fish

The currently available underwater noise exposure thresholds for fish are based on the sound pressure component. However, as discussed previously, all fishes can detect water-borne particle motion. Anthropogenic sounds that interfere with the ability to detect both sound pressure and particle motion could interfere with an animal's ability to detect acoustic cues in its environment (Hawkins et al. 2021). While these potential effects are acknowledged, exposure thresholds for the particle motion component of sound have yet to be developed for fishes (Hawkins et al. 2021). As such, the potential effects on these species from the particle motion component of cannot be fully assessed at this time.

Acoustic criteria to assess the potential effects to fish were developed by the (FHWG 2008) and are presented in **Table 6-9**. These criteria include thresholds for impulsive sources (e.g., some HRG survey equipment) and non-impulsive sources (e.g., vessel noise, geotechnical sampling, some HRG survey equipment). Impulsive criteria include dual metrics which are used to assess the effects to fish exposed to high levels of accumulated energy (SEL_{24h}) for repeated impulsive sounds and a single strike at high L_{pk}. The criteria include a maximum accumulated SEL_{24h} for lower-level signals and a maximum L_{pk} for a single HRG equipment pulse (FHWG 2008). NMFS has not established a formal threshold for behavioral disturbance; however, the SPL threshold of 150 dB re 1 µPa threshold is typically used and was applied to all noise sources to assess the behavioral response of fish (Andersson et al. 2007; Wysocki et al. 2007; Mueller-Blenkle et al. 2010; Purser and Radford 2011).

The FHWG was formed in 2004 and consists of biologists from NMFS, USFWS, the Federal Highway Administration (FHWA), USACE, and the California, Washington, and Oregon Departments of Transportation (DOTs), supported by national experts on underwater sound producing activities that affect fish and wildlife species of concern. In June 2008, the agencies signed a memorandum of agreement (MOA) documenting criterion for assessing physiological effects of impact pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected and is now applied to multiple source types, not just pile driving. The FHWG outlines thresholds for fish greater and less than 2 g in weight for the onset of physiological effects (Stadler and Woodbury 2009), and not necessarily levels at which fish are mortally damaged. These criteria, provided in **Table 6-9**, were developed to apply to all fish species.

Table 6-9. Thresholds for onset of physiological effects, mortality, and behavioral disturbance for fish from impulsive sources

Marine Fish Type	Physiological Effects[a]		Behavioral Disturbance[b]
	Lpk (dB re 1 µPa) Impulsive	SEL24h (dB re 1 µPa2s) Impulsive	SPL (dB re 1 µPa) Impulsive/Non-Impulsive
Fish (≥2 grams)	206	187	150
Fish (<2 grams)	206	183	150

[a] From the Fisheries Hydroacoustic Working Group (FHWG 2008).
[b] From Andersson et al. (2007); Mueller-Blenke et al. (2010); Purser and Radford (2011); and Wysocki et al. (2007).
> = greater than; < less than; dB re 1 µPa = decibels referenced to 1 micropascal; dB re 1 $µPa^2s$ = decibels referenced to 1 micropascal squared second.

6.3.2 Effects from Exposure to Geophysical Reconnaissance Survey Noise

Geophysical survey equipment for reconnaissance surveys under the Proposed Action have operating frequencies above relevant marine mammal primary hearing sensitivities (i.e., above 180 kHz) or that produce very narrow beamwidths (i.e., highly directional) with low noise levels such that noise from equipment is unlikely to be detectable beyond a few meters from the sources for most marine mammal species. As a result, this limits the area ensonified above acoustic thresholds for ESA-listed marine mammals, sea turtles, and fish.

As discussed in **Section 6.3.1**, the operating frequency of 100 kHz expected for the Innomar Medium USV parametric SBP would only overlap with hearing of marine mammal species, specifically MFC (**Table 6-3**). However, this source has been considered *de minimis* and unlikely to result in adverse effects by Ruppel et al. (2022) and previous MMPA authorization analyses for marine mammals (85 Federal Register [FR] 33730, 87 FR 806, 88 FR 50117, 88 FR 41888, 88 FR 13783, 87 FR 61575). These assessments indicated PTS would not occur in marine mammals due to exposure to these sources, and though there is some potential for behavioral response, the only species considered in this BA that would be able to detect this noise source is sperm whales. Any behavioral responses that do occur for sperm whales would be limited to temporary changes that are not measurable, or so minor that they cannot be meaningfully evaluated and thus **insignificant**. Therefore, effects of exposure to noise during the proposed geophysical reconnaissance surveys **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

Based on the available data, ESA-listed sea turtles and fish are not expected to be able to detect noise at frequencies >4 kHz (Section 6.3.1). Therefore, these species would not be able to detect the noise produced by this equipment and the proposed geophysical reconnaissance surveys would have **no effect** on ESA-listed sea turtles and fish.

6.3.3 Effects from Exposure to HRG Survey Noise

HRG surveys using some types of impulsive and/or non-impulsive, intermittent SBPs (e.g., parametric SBP, sparker systems) may produce noise levels within hearing frequencies and above regulatory hearing thresholds for some marine mammals, sea turtles, and fish. A summary of the equipment proposed for the HRG surveys is provided in **Table 3-3**.

In the 2021 Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic OCS published by BOEM (Baker and Howsen 2021), estimated distances to auditory injury thresholds were less than 15 m for all equipment and species assessed, and the distance to the behavioral thresholds were a maximum of 500 m for marine mammals during use of sparker systems operating at their maximum power settings for all species. Recently, BOEM and USGS characterized underwater sounds produced by HRG sources and their potential to affect marine mammals (Ruppel et al. 2022). Some geophysical sources can be detected by marine mammals, and subsequently by sea turtles and fish; however, Ruppel et al (2022) also found that only a small number of HRG source categories have the potential to produce sound fields that meet or exceed acoustic thresholds.

Additionally, as noted in **Section 3.1.2.2**, some of the HRG survey equipment may be deployed using AUVs. Use of AUVs may be part of the HRG survey activities and specifics of those devices and how they will be used will be survey specific. However, potential effects from HRG equipment deployed using AUVs would be the same as or less than those described for vessel-based HRG surveys discussed in Section 6 which is consistent with the 2021 informal programmatic Biological Assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf (Baker and Howson 2021) that determined geophysical instrumentation deployed from AUVs is unlikely to result in adverse effects on ESA-listed marine species.

6.3.3.1 Marine Mammals

No PTS is expected to occur for any marine mammal species given the small distances to the PTS thresholds and the sound source characteristics of these equipment (Ruppel et al. 2022). Additionally, both the clearance and shutdown ranges would extend out to 500 m for NARW and 100 m for all other ESA-listed marine mammals, which would fully cover the area over which PTS thresholds may be exceeded (**Section 3.3.8**). Therefore, the potential for PTS exposures during HRG surveys is **discountable**. The most likely effects marine mammals may experience due to HRG surveys are behavioral disturbances and these do not rise to the level of harassment under the ESA.

HRG surveys could occur within any of the 15 commercial leases with up to 10 leases conducting survey activities at the same time. These surveys could be concurrent for up to 10 of the leases with surveys lasting for less than a 1-year period (sources operational for up to 270 days per lease) beginning within a year of lease sales (**Section 3.1.2.2**). Although some geophysical sources, including the proposed sparker source (**Table 3-4**), can be detected by marine mammals, given several key physical characteristics of the sound sources, including source level, frequency range, duty cycle, and beamwidth, most HRG sources are unlikely to result in behavioral disturbance of marine mammals, even without mitigation (Ruppel et al. 2022). This finding is supported empirically: Kates Varghese et al. (2020) found no change in three of four beaked whale foraging behavior metrics (i.e., number of foraging clicks, foraging event duration, click rate) during two deep-water mapping surveys using a 12 kHz multibeam echosounder. There was an increase in the number of foraging events during one of the mapping surveys, but this trend continued after the survey ended, suggesting that the change was more likely in response to another factor, such as the prey field of the beaked whales, than to the mapping survey. During both multibeam mapping surveys, foraging continued in the survey area and the animals did not leave the area (Kates Varghese et al. 2020, 2021). Vires (2011) found no change in Blainville's beaked whale click durations before, during, and after a scientific survey with a 38 kilohertz EK-60 echosounder, while Cholewiak et al. (2017) found a decrease in beaked whale echolocation click detections during use of an EK-60 echosounder and Quick et al. (2017) found that short-finned pilot whales did not change foraging behavior but did increase their heading variance during use of an EK-60 echosounder.

The areas where HRG surveys would occur overlap with Unit 1 of the designated critical habitat for foraging NARWs (**Section 5.2.1**). Blue whales are expected to be transient visitors to the WEA in low densities and would not be expected to lose foraging access. There is no designated critical habitat for fin whales, and neither the Southern or Northern Gulf of Maine biologically important foraging areas (NOAA 2023) would overlap with the area in which HRG surveys are likely to occur. Sei whales may be present in the area year-round (**Section 5.1.1.3.2**) and HRG surveys could overlap with foraging animals; however, the HRG source area comprises only a small portion of available habitat so no long-term disruptions to foraging are expected. The area over which HRG surveys would occur would not extend to the outer shelf break where sperm whales are more commonly observed, as evidenced by the low abundance estimates discussed in **Section 5.1.1.4**.

Only a small proportion of HRG sources (e.g., sparkers) have the potential to produce sound levels that exceed behavioral thresholds beyond a few meters from the source (Ruppel et al. 2022). For these sources ESA-listed marine mammals have the potential to be exposed to sound levels that meet or exceed behavioral disturbance thresholds. For the proposed HRG surveys, a 1640-foot (500-meter) clearance and shutdown zone for NARW and a 328-foot (100-meter) shutdown zone for all other marine mammals is included under the Proposed Action (**Section 3.3.8**) which would limit the potential for behavioral effects. Given the small distance to the thresholds (Ruppel et al. 2022) and the mitigation measures included in the Proposed Action, above-threshold noise would not be expected impede the use of critical habitat by NARWs or access to foraging habitat for other ESA-listed marine mammals. There may be some masking effects from the HRG sources; however, most masking would be the result of vessel operations and not HRG equipment.

Given the small distances to the behavioral disturbance thresholds, the limited duration of these surveys, and the mitigation included in the Proposed action, exposures, if they were to occur, would not rise to the level of harassment under the ESA and would be **insignificant**. Therefore, effects of exposures above behavioral thresholds from HRG surveys **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

6.3.3.2 Sea Turtles

No PTS is expected to occur for any sea turtle species given the small distances to the PTS thresholds and the sound source characteristics of these equipment (Ruppel et al. 2022). Therefore, the potential for PTS exposures during HRG surveys is **discountable**. The most likely effects sea turtles may experience due to HRG surveys are behavioral disturbances.

The behavioral disturbance threshold for sea turtles is higher than that for marine mammals since the threshold is higher, meaning the range to the behavioral threshold is smaller. Only a small proportion of HRG sources (e.g., sparkers) have the potential to produce sound levels that exceed behavioral thresholds beyond a few meters from the source (Ruppel et al. 2022). For these sources ESA-listed sea turtles have the potential to be exposed to sound levels that meet or exceed behavioral disturbance thresholds; however, any effects of exposure to noise above thresholds are transient and would dissipate as the vessel moves away from the turtle. Given the low abundance of sea turtles expected in the Gulf of Maine (**Section 5.1.2**), the limited duration of these surveys, and the temporary, transient nature of the HRG surveys (**Section 3.1.2.2**), the potential for behavioral disturbance to ESA-listed turtles is considered unlikely to occur and is **discountable**. Therefore, the effects of noise exposures above behavioral thresholds during HRG surveys **may affect, but is not likely to adversely affect** ESA-listed sea turtles.

6.3.3.3 Marine Fish

Of the sources that may be used during HRG surveys under the Proposed Action, only boomers and sparkers emit sounds at frequencies that are within the hearing range of most fish (Crocker and Fratantonio 2016; Ruppel et al. 2022), neither of which are included as part of the Proposed Action. For the HRG sources that are audible for fishes, it is important to consider other factors such as source level, beamwidth, and duty cycle when assessing the potential risk of adverse effects (Ruppel et al. 2022). Additionally, Atlantic sturgeon and Atlantic salmon are not expected to be in the Action Area in large numbers, and HRG surveys are not expected in spawning rivers. The closest HRG survey location to a spawning river are those that may occur near the mouth of Penobscot Bay, which is adjacent to the spawning habitat in Penobscot River for both species, but would not overlap. Given the small ranges to thresholds, low abundance, and transient nature of the survey, the potential for physiological injury in ESA-listed fish resulting from HRG surveys are **discountable**. The most likely effects marine fish may experience due to HRG surveys are behavioral disturbances.

Behavioral impacts could occur over slightly larger spatial scales given the SPL threshold of 150 dB re 1 µPa recommended for behavioral disturbance in marine fish (FHWG 2008). However, this threshold does not account for the duration of the exposure, and it is worth noting that these numbers are reported in terms of acoustic pressure because there are currently no behavioral disturbance thresholds for particle motion. Additionally, given the limited duration of these surveys and because HRG equipment are considered intermittent sources, where they are typically “on” for short periods with silence in between, the amount of noise emitted from a moving vessel towing an active acoustic source that would reach fish or invertebrates below is limited, behavioral effects would be intermittent and temporary. Should an exposure occur, the potential effects would be brief, and no long-term avoidance of the Action Area or effects on reproduction are expected. Effects of this brief exposure could result temporary disruptions to foraging behavior; however, if exposures were to occur, they would not rise to the level of harassment under the ESA and would be **insignificant**. Therefore, the effects exposure to noise above behavioral thresholds during HRG surveys **may affect, but is not likely to adversely affect** ESA-listed fish.

6.3.4 Effects from Exposure to Geotechnical Survey Noise

Geotechnical surveys that employ coring equipment may produce non-impulsive, intermittent, low frequency noise (less than 3 kHz) with a back-calculated source level, expressed as SPL, estimated to be 187 dB re 1 µPa m (Chorney et al. 2011). Geotechnical survey activities could occur within any of the 15 potential leases over approximately 420 days per lease beginning as early as one year after lease sales are finalized.

6.3.4.1 Marine Mammals

PTS is unlikely to occur for any ESA-listed marine mammals as a result of geotechnical survey noise due to the non-impulsive nature of the sources and relatively low source levels produced (BOEM 2013; McPherson et al. 2016) and is **discountable**. The most likely effects marine mammals may experience due to exposure to geotechnical survey noise are behavioral disturbances.

Noise produced during the proposed geotechnical surveys would be within the hearing range of ESA-listed marine mammals. Though the estimated source levels do exceed the behavioral disturbance threshold of 160 dB re 1 µPa, they would only be exceeded within approximately 65 ft (20 m) of the source using spherical spreading loss equations. Therefore, while geotechnical survey noise may be detectable it is unlikely to result in measurable behavioral effects for any marine mammal species and potential impacts are therefore **discountable**. Therefore, the effects of noise exposure above the behavioral disturbance threshold during the proposed geotechnical surveys **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

6.3.4.2 Sea Turtles

Sea turtles are less sensitive to sound compared to faunal groups like marine mammals and no PTS from geotechnical survey noise is anticipated under the Proposed Action. It is unlikely that received levels of underwater noise from geotechnical survey activities would exceed PTS thresholds for sea turtles, as the PTS threshold for non-impulsive sources is an SEL_{24h} of 200 dB re 1 µPa^2 s (NMFS 2023k) which comparable to the maximum source level estimated for geotechnical coring equipment described previously in this section. This means beyond 3 ft (1 m), the sound level produced by geotechnical survey activities would likely be below the sea turtle PTS threshold and the potential for ESA-listed sea turtles to be exposed to noise above PTS thresholds is considered extremely unlikely to occur and is **discountable**. The most likely effects sea turtles may experience due to exposure to geotechnical survey noise are behavioral disturbances.

Geotechnical surveys using coring equipment would also be detectable by sea turtles, but based on the back-calculated source level, expressed as SPL, of 187 dB re 1 µPa m (Chorney et al. 2011), the behavioral disturbance threshold for sea turtles would only be exceeded within approximately 16 ft (5 m) of the source using spherical spreading loss equations. Therefore, while geotechnical survey noise may be detectable it is unlikely to result in measurable behavioral effects for any sea turtle species and potential impacts are therefore **discountable.** Therefore, the effects of noise exposure above the behavioral disturbance threshold during the proposed geotechnical survey activities **may affect, but is not likely to adversely affect** ESA-listed sea turtles.

6.3.4.3 Marine Fish

Research indicates that the effects of non-impulsive sound sources, like geotechnical surveys, will not cause mortality or injuries in adult fish (Hawkins et al. 2014) given the low source levels and non-impulsive nature of this source. The potential for exposures above physiological injury thresholds to occur is extremely unlikely and are **discountable**. The most likely effects marine fish may experience due to exposure to geotechnical survey noise are behavioral disturbances.

The estimated source level of geotechnical survey equipment is above the behavioral disturbance threshold of 150 dB re 1 µPa for fish recommended by the Fisheries Hydroacoustic Working Group (2008) and NMFS (2023k), so it could lead to behavioral changes, increased stress, or masking. Geotechnical surveys could occur within any of the 15 commercial leases within a year of lease sales commencing with up to 10 leases conducting survey activities at the same time. However, as mentioned above the relatively short duration of these surveys and the fishes avoidance of the noise, would lower the risk of effects on behaviors relevant for foraging or spawning and would not lead to ESA harassment. Overall, due to the transient and localized nature of this source, the likelihood of geotechnical survey noise on ESA-listed is expected to be **insignificant** and would not rise to the level of harassment under the ESA. Therefore, the effects of exposure to noise above physiological injury thresholds as a result of geotechnical survey activity **may affect, but is not likely to adversely affect** ESA-listed fish species.

6.3.5 Effects from Exposure to Vessel Noise

Vessel sound is characterized as low-frequency, typically below 1,000 Hz with peak frequencies between 10 and 50 Hz, non-impulsive, continuous sound, meaning there are no substantial pauses in the sounds that vessels produce. The acoustic signature produced by a vessel varies based on the type of vessel (e.g., tanker, bulk carrier, tug, container ship) and vessel characteristics (e.g., engine specifications, propeller dimensions and number, length, draft, hull shape, gross tonnage, speed). Larger barges and commissioning vessels would produce lower frequency noise with a primary energy near 40 Hz and underwater source levels that can range from 177 to 200 dB re 1 µPa m (McKenna et al. 2012; Erbe et al. 2019). Smaller crew transfer vessels would typically produce higher-frequency noise (1,000 to 5,000 Hz) at source levels between 150 and 180 dB re 1 µPa m (Kipple and Gabriele 2003, 2004). Vessels using DP thrusters for station-keeping are known to generate substantial underwater noise with source levels ranging from 150 to 180 dB re 1 µPa m depending on operations and thruster use (BOEM 2013; McPherson et al. 2016). However, regardless of the propulsion system or type of thruster used, the risk of effects on ESA-listed species would not differ significantly, and the determinations in the following subsections are based on the loudest potential noise levels based on the most common types of vessels expected under the Proposed Action.

Parsons et al. (2021) reviewed literature for the source levels and spectral content of vessels less than 82 ft (25 m) in length, a category often not addressed in vessel noise assessment measurements. Parsons et al. (2021) found reported source levels in these smaller vessels to be highly variable (up to 20 dB difference); however, an increase in speed was consistently shown to increase source levels while vessels at slower speeds were shown to emit low-frequency acoustic energy (less than 100 Hz) that is often not characterized in broadband analyses of small vessel sources. The vessels and estimated number of transits that would be used and occur under the Proposed Action are presented in **Sections 3.1.1.2** and **3.1.2.8** of this BA.

6.3.5.1 Marine Mammals

Due to the non-impulsive nature of the sources and relatively low source levels produced (BOEM 2013; McPherson et al. 2016), PTS is unlikely to occur for any ESA-listed marine mammals as a result of vessel noise and the risk of this effect on marine mammals is **discountable**. The most likely effects marine mammals may experience due to Project-related vessel noise are behavioral disturbances.

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 (e.g., longer dives in beluga whales [Finley et al. 1990]), disruption to resting behavior (harbor seals [Mikkelsen et al. 2019]), increases in swim velocities (belugas [Finley et al. 1990]; humpback whales [Sprogis et al. 2020]; narwhals [*Monodon monoceros*; Williams et al. 2022]), and changes in respiration patterns (longer inter-breath intervals in bottlenose dolphins [Nowacek et al. 2006]; increased breathing synchrony in bottlenose dolphin pods [Hastie et al 2006]; increased respiration rates in humpback whales [Sprogis et al. 2020]). A playback study of humpback whale mother-calf pairs exposed to varying levels of vessel noise revealed that the mother's respiration rates doubled and swim speeds increased by 37 percent in the high noise conditions (low-frequency weighted received SPL at 100 m was 133 dB re 1 µPa) compared to control and low-noise conditions (SPL of 104 dB re 1 µPa and 112 dB re 1µPa respectively [Sprogis et al. 2020]). Changes to foraging behavior, which can have a direct effect on an animal's fitness, have been observed in porpoises (Wisniewska et al. 2018) and killer whales (Holt et al. 2021) in response to vessel noise. Thus far, one study has demonstrated a potential correlation between low-frequency anthropogenic noise and physiological stress in baleen whales. Rolland et al. (2012) showed that fecal cortisol levels in NARWs decreased following the 9/11 terrorist attacks, when vessel activity was significantly reduced. Interestingly, NARWs do not seem to avoid vessel noise nor vessel presence (Nowacek et al. 2004), yet they may incur physiological effects as demonstrated by Rolland et al. (2012). This lack of observable response, despite a physiological response, makes it challenging to assess the biological consequences of exposure. In addition, there is evidence that individuals of the same species may have differing responses if the animal has been previously exposed to the sound versus if it is completely novel interaction (Finley et al. 1990). Reactions may also be correlated with other contextual features, such as the number of vessels present, their proximity, speed, direction or pattern of transit, or vessel type. For a more detailed and comprehensive review of the effects of vessel noise on specific marine mammal groups the reader is referred to Erbe et al. (2019).

Some marine mammals may change their acoustic behaviors in response to vessel noise, either due to a sense of alarm or in an attempt to avoid masking. For example, fin whales (Castellote et al. 2012) and belugas (Lesage et al. 1999) have altered frequency characteristics of their calls in the presence of vessel noise. When vessels are present, bottlenose dolphins have increased the number of whistles (Buckstaff 2006; Guerra et al. 2014), while sperm whales decrease the number of clicks (Azzara et al. 2013), and humpbacks and belugas have been seen to completely stop vocal activity (Tsujii et al. 2018; Finley et al. 1990). Some species may change the duration of vocalizations (fin whales shortened their calls [Castellote et al. 2012]) or increase call amplitude (killer whales [Holt et al. 2009]) to avoid acoustic masking from vessel noise.

Understanding the scope of acoustic masking is difficult to observe directly, but several studies have modeled the potential decrease in "communication space" when vessels are present (Clark et al. 2009, Erbe et al. 2016; Putland et al. 2017). For example, Putland et al. (2017) showed that during the closest point of approach (less than 10 km) of a large commercial vessel, the potential communication space of Bryde's whale (*Balaenoptera edeni*) was reduced by 99 percent compared to ambient conditions.

Although there have been many documented behavioral changes in response to vessel noise (Erbe et al. 2019), it is necessary to consider what the biological consequences of those changes may be. One of the first attempts to understand the energetic cost of a change in vocal behavior found that metabolic rates in bottlenose dolphins increased by 20 to 50 percent in comparison to resting metabolic rates (Holt et al. 2015). Although this study was not tied directly to exposure to vessel noise, it provides insight about the potential energetic cost of this type of behavioral change documented in other works (i.e., increases in vocal effort such as louder, longer, or increased number of calls). In another study, the energetic cost of high-speed escape responses in dolphins was modeled, and the researchers found that the cost per swimming stroke was doubled during such a flight response (Williams et al. 2017). When this sort of behavioral response was also coupled with reduced glide time for beaked whales, the researchers estimated that metabolic rates would increase by 30.5 percent (Williams et al. 2017). Differences in response have been reported both within and among species groups (Finley et al. 1990; Tsujii et al. 2018). Despite demonstrable examples of biological consequences to individuals, there is still a lack of understanding about the strength of the relationship between many of these acute responses and the potential for long-term or population-level effects.

Overall, ESA-listed marine mammals may be exposed to noise above the behavioral thresholds and may experience masking effects depending on the type and speed of the vessel. The likelihood of this may increase given the fact that up to 10 leases may concurrently conduct site characterization surveys and would substantially add to the baseline vessel traffic and therefore vessel noise in the Action Area. However, the likelihood of prolonged exposures that would affect biologically important behaviors such as foraging or reproduction is low with the proposed mitigation and monitoring measures (**Section 3.3**) and the limited number of vessels and transits expected (**Table 3-2** and **Table 3-5**). The contribution of noise from project vessels under the Proposed Action would increase ambient noise conditions, but that increase would be temporary and spread out within the Action Area. The Proposed Action includes mitigation for vessel strike avoidance (**Section 3.3**) such as minimum separation distances, which would reduce the risk of an animal being close enough to receive sound energy above the behavioral threshold, and vessel speed restrictions. This, in turn would help reduce the level of noise exposure from vessels because vessels would remain farther from ESA-listed marine mammals and would slow (thus reducing noise output) in the presence of ESA-listed marine mammals (ZoBell et al. 2021). With mitigation measures, behavioral disturbance would be expected to occur but would not rise to the level of ESA harassment and is **insignificant**. Therefore, vessel noise as a result of the Proposed Action leading to behavioral disturbance **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

6.3.5.2 Sea Turtles

Sea turtles are less sensitive to sound compared to faunal groups like marine mammals and no PTS from vessel noise is anticipated under the Proposed Action. It is unlikely that received levels of underwater noise from vessel activities would exceed PTS thresholds for sea turtles, as the PTS threshold for non-impulsive sources is an SEL_{24h} of 200 dB re 1 μPa^2 s (NMFS 2023j) which is comparable to the maximum source level reported for large shipping vessels described previously in this section. This means beyond 1 m, the sound level produced by the loudest Project vessel would likely be below the sea turtle PTS threshold and the potential for ESA-listed sea turtles to be exposed to Project vessel noise above PTS thresholds is considered extremely unlikely to occur and is **discountable**. The most likely effects of vessel noise on sea turtles would include behavioral disturbances.

There is very little information regarding the behavioral responses of sea turtles to underwater noise. A recent study suggests that sea turtles may exhibit TTS effects even before they show any behavioral response (WHOI 2022). Hazel et al. (2007) demonstrated that sea turtles appear to respond behaviorally to vessels at approximately 33 ft (10 m) or closer. Based on the source levels outlined previously, the behavioral threshold for sea turtles is likely to be exceeded by Project vessels. Behavioral disturbance for sea turtles is likely to be highly contextual and site specific; therefore, generalized effects categories may be more applicable for this group. Popper et al. (2014) suggests that in response to continuous shipping sounds, sea turtles have a high risk for behavioral disturbance in the closer to the source (e.g., tens of meters), moderate risk at hundreds of meters from the source, and low risk at thousands of meters from the source.

Behavioral effects are considered possible but unlikely and any effects would be temporary with effects dissipating once the vessel or individual has left the area. The Proposed Action includes the implementation of minimum vessel separation distance of 164 ft (50 m) for sea turtles which, though geared towards vessel strike avoidance, would help to reduce the level of noise a turtle is exposed to and reducing the likelihood of sea turtles receiving sound energy above the behavioral threshold. The additional BOEM proposed measures to reduce vessel strikes on sea turtles which includes slowing to 4 kn when sea turtle sighted within 328 ft (100 m) of the forward path of the vessel and avoiding transiting through areas of visible jellyfish aggregations or floating sargassum will also reduce the potential for behavioral disturbance effects by reducing the sound level received by sea turtles in the Action Area during vessel activities. Though these mitigation measures will not eliminate the potential for sea turtles to be exposed to above-threshold noise, the potential effects if exposure were to occur would be brief (e.g., a sea turtle may approach the noisy area and divert away from it) it would not rise to the level of ESA harassment and is **insignificant**. Therefore, the effects of noise exposure above the behavioral disturbance threshold during vessel operations under the Proposed Action **may affect, but are not likely to adversely affect** ESA-listed sea turtles.

6.3.5.3 Marine Fish

Research indicates that the effects of vessel noise, including DP vessel noise, will not cause mortality or injuries in adult fish (Hawkins et al. 2014) given the low source levels and non-impulsive nature of this source. The potential for exposures above physiological injury thresholds to occur is extremely unlikely and are **discountable**. The most likely effects marine fish may experience due to Project-related vessel noise are behavioral disturbances.

Several studies have shown an increase in cortisol, a stress hormone, after playbacks of vessel noise (Wysocki et al. 2006; Nichols et al. 2015; Celi et al. 2016), but other work has shown that the stress of being handled during the experiment itself may induce a greater stress response than an acoustic stimulus (Harding et al. 2020; Staaterman et al. 2020). The overlap in the frequency of vessel noise and fish auditory capabilities could lead to masking of important auditory cues, including conspecific communication (Haver et al. 2021; Parsons et al. 2021). Stanley et al. (2017) demonstrated that the communication range of both haddock and cod (species with swim bladders not involved in hearing) would be significantly reduced in the presence of vessel noise, which is frequent in their habitat in Cape Cod Bay. Generally speaking, species that are sensitive to acoustic pressure would experience masking at greater distances than those that are only sensitive to particle motion (See Affected Environment section for an explanation of fish hearing). Rogers et al. (2021) and Stanley et al. (2017) theorize that fish may be able to use the directional nature of particle motion to extract meaning from short range cues (e.g., other fish vocalizations) even in the presence of distant noise from vessels.

Avoidance of vessels and vessel noise has been observed in several pelagic, schooling fishes, including Atlantic herring (Vabo et al. 2002), Atlantic cod (Handegard et al. 2003) and others (reviewed in De Robertis and Handegard [2013]). Fish may dive toward the seafloor, move horizontally out of the vessel’s path, or disperse from their school (De Robertis and Handegard 2013). These types of changes in schooling behavior could render individual fish more vulnerable to predation but these behavioral responses are unlikely to have population-level effects. A more recent body of work has documented other, more subtle behaviors in response to vessel noise, but has focused solely on tropical reef-dwelling fish which are not likely to occur in the Action Area. For example, damselfish antipredator responses (Simpson et al. 2016; Ferrari et al. 2018) and boldness (Holmes et al. 2017) seem to decrease in the presence of vessel noise, while nest-guarding behaviors seem to increase (Nedelec et al. 2017). There is some evidence of habituation, though: Nedelec et al. (2016) found that domino damselfish increased hiding and ventilation rates (i.e., rate of oxygen absorption) after two days of vessel sound playbacks, but responses diminished after one to two weeks, indicating habituation over longer durations.

The planktonic larvae of fishes and invertebrates may experience acoustic masking from continuous sound sources like vessels. Several studies have shown that larvae are sensitive to acoustic cues, and may use sound signals to navigate towards suitable settlement habitat (Simpson et al. 2005; Montgomery 2006), metamorphosize into their juvenile forms (Stanley et al. 2012), or maintain group cohesion during their pelagic journey (Staaterman et al. 2014). However, given the short range of such biologically-relevant signals for particle motion-sensitive animals (Kaplan and Mooney 2016), the spatial scale at which these cues are relevant is rather small. If vessel transit areas overlap with settlement habitat, it is possible that vessel noise could mask some biologically relevant sounds (Holles et al. 2013), but these effects are expected to be short term and would occur over a limited area around the operating vessel.

Overall, evidence suggests fish will return to normal baseline behavior faster following exposure to continuous sources such as vessel noise versus intermittent noise (Neo et al. 2014). Therefore, while vessel noise would be present within the Action Area throughout the life of the Proposed Action, behavioral disturbances would only be expected within a few meters of the vessel and would dissipate once the vessel has moved away. In addition, Atlantic salmon, Atlantic sturgeon, and shortnose sturgeon have swim bladders, which are not involved in hearing (Popper et al. 2014); these species are thought to be more sensitive to particle motion that sound pressure (Popper and Hawkins 2018; Mickle and Higgs 2022). Given the nature of non-impulsive sources such as vessels noise, particle motion levels sufficient to result in behavioral disturbances would not occur more than a few meters from the source, and any effects to this brief exposure would be so small that they could not be measured, detected, or meaningfully evaluated and are, therefore, **insignificant**. Therefore, the effects from exposure to noise levels above behavioral thresholds resulting from vessel operations **may affect, but are not likely to adversely affect** ESA-listed fish.

6.3.6 Effects from Exposure to Aircraft Noise

As described in **Section 3.1.2**, biological surveys may include use of aircrafts to collect visual monitoring data of protected species. Manned aircraft consist of propeller and jet engines, fixed-wing craft, as well as helicopters. Unmanned systems also exist. For jet engine aircraft, the engine is the primary source of sound. For propeller driven aircraft and helicopters, the propellors and rotors also produce noise. Aircraft generally produce low-frequency sound below 500 Hz (Richardson et al. 1995). While aircraft noise can be substantial in air, penetration of aircraft noise into the water is limited because much of the noise is reflected off the water's surface (Richardson et al. 1995). The noise that penetrates into the water column does so via a critical incident angle or cone. With an idealized flat sea surface, the maximum critical incident angle is ~13 degrees (Urick 1983); beyond this, sound is reflected off the surface. When the sea surface is not flat, there may be some additional penetration into the water column in areas outside of this 13 degree cone. Nonetheless, the extent of noise from passing aircraft is more localized in water than it is in air.

Jiménez-Arranz et al. (2020) and Richardson et al. (1995) reviewed sound measurements recorded below passing aircraft of various models. These SPL measurements included 124 dB re 1 µPa (dominant frequencies between 56-80 Hz) from a maritime patrol aircraft at an altitude of 76 m, 109 dB re 1 µPa (dominant frequency content below 22 Hz) from a utility helicopter at an altitude of 152 m, and 107 dB re 1 µPa (tonal, 82 Hz) from a turbo propeller at an altitude of 457 m. Recent published levels associated with unmanned aircraft (Christiansen et al. 2016; Erbe et al. 2017b) indicate source levels are around or below 100 dB re 1 µPa m. Unoccupied aerial vehicles, or drones, have broadband (141-17,783 Hz) SPL ranging from 82.7 to 96.5 dB re 1 µPa measured at a maximum horizontal distance of 7 feet (2 meters) and a maximum vertical distance of 16 feet (5 meters) (Laute et al. 2023).

6.3.6.1 Marine Mammals

In general, marine mammal behavioral responses to aircraft have most commonly been observed at altitudes of less than 496 feet (150 meters) from the aircraft (Patenaude et al. 2002; Smultea et al. 2008). Aircraft operations have resulted in temporary behavioral responses including short surface durations (bowhead and belugas [Patenaude et al. 2002], transient sperm whales [Richter et al. 2006]), abrupt dives (sperm whales [Smultea et al. 2008]), and percussive behaviors (i.e., breaching and tail slapping [Patenaude et al. 2002]). Responses appear to be heavily dependent on the behavioral state of the animal, with the strongest reactions seen in resting individuals (Würsig et al. 1998). As noted above, drones are expected to produce lower sound levels, and would predominantly affect species in-air vs. noise penetrating the sea surface and propagating through the water. Additionally, studies suggest that flying drones, specifically larger drones, at least 393 feet (120 meters) above where the animals are located would avoid consequential behavioral effects (Duporge et al. 2021).

BOEM requires all aircraft operations to comply with current approach regulations for NARWs or unidentified large whales (50 CFR 222.32). These include the prohibition of aircraft from approaching within 1,500 ft (457 m), which would minimize the potential responses of marine mammals to aircraft noise. As discussed above, most observations of behavioral disturbances in marine mammals have occurred when the aircraft was flown at altitudes <496 feet (150 meters). In addition, based on the physics of sound propagation across different media (e.g., air and water), only a small portion of the acoustic energy from aircraft operations couples into the water. Therefore, while aircraft noise may be detectable it is unlikely to result in measurable behavioral effects for any marine mammal species and potential impacts are therefore **discountable**. Therefore, the effects of noise exposure above the behavioral disturbance threshold during use of aircrafts **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

6.3.6.2 Sea Turtles

Noises generated by project-related survey aircraft that are directly relevant to sea turtles include both airborne sounds for individual turtles nesting or on the sea surface, and underwater sounds from air-to-water transmission from passing aircraft. The dominant tones for both types of aircraft are generally below 500 Hz (Richardson et al. 1995) and are within the auditory range of all sea turtles. Given the frequency range and sound levels produced, when aircraft travel at relatively low altitude, aircraft noise has the potential to elicit stress or behavioral responses in turtles (e.g., diving or swimming away or altered dive patterns) (BOEM 2017; National Science Foundation and U.S. Geological Survey 2011; Samuel et al. 2005). Sea turtle sensitivity to airborne noise is not well understood, and existing studies have yielded mixed results. For example, Balazs and Ross (1974) exposed postnatal green sea turtles in a transplanted nest to short duration high intensity noise from aircraft engine testing. On numerous occasions, a sudden burst of activity was noted within the nest at the onset of engine noise and continued until the noise subsided (Balazs and Ross 1974). On the other hand, Bevan et al. (2018) observed no evidence of behavioral responses from three species of sea turtles (green, flatback, and hawksbill turtles) exposed to drones flown directly overhead at altitudes ranging from 50 to 102 feet (18 to 31 meters). As noted for marine mammals, aircraft would operate throughout the Action Area at altitudes of 1,500 ft (457 m) or more to avoid large whales, except when landing or departing from service vessels which would similarly reduce the risk of effects on sea turtles. Therefore, while aircraft noise may be detectable it is unlikely to result in measurable behavioral effects for any sea turtle species and potential impacts are therefore **discountable**. Therefore, the effects of noise exposure above the behavioral disturbance threshold during use of aircrafts **may affect, but is not likely to adversely affect** ESA-listed sea turtles.

6.3.6.3 Marine Fish

The penetration of noise from aircraft into the water is limited because much of the noise is reflected off of the water’s surface as discussed above; due to the air-water interface, an animal needs to be close to the sea surface a to be affected. Given that most fish do not spend significant time near the sea surface, impacts on marine from aircraft use would be **discountable**. Therefore, the effects of noise exposure above the behavioral disturbance threshold during use of aircrafts **may affect, but is not likely to adversely affect** ESA-listed fish.

6.3.7 Effects from Exposure to Seafloor Habitat Characterization Survey Equipment Noise

During the proposed seafloor habitat characterization surveys, noise will be produced by the survey vessels and the MBES proposed for these surveys. Potential effects from exposure to vessel noise associated with all vessels included under the Proposed Action is discussed in **Section 6.3.5**, and only potential effects from exposure to the MBES will be discussed in this section.

The specifics of the proposed MBES equipment are summarized **Table 3-3**. All MBES equipment proposed for these surveys operate >180 kHz. This frequency is above the hearing range for all ESA-listed species considered in this BA (**Section 6.3.1**) so these species would not be able to detect the noise produced by this equipment and the proposed MBES equipment operations would have **no effect** on ESA-listed marine mammals, sea turtles, and fish.

6.3.8 Effects to Prey from Underwater Noise

Prey species important to ESA-listed marine mammals, sea turtles, and fish include plankton, squid, small schooling fish, bottom-dwelling fish such as sand lance, crustaceans, and sea grasses. Further details of the primary prey for each species considered in this BA are provided in **Section 5.1**.

Reduction of prey availability could affect marine animals if rising sound levels alter prey abundance, behavior, distribution, or both (McCauley et al. 2000a, 2000b; 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 loss of availability to marine mammals. These species have been increasingly researched as concern has grown related to noise effects on the food web. Invertebrates appear to be able to detect sounds and particle motion (André et al. 2016; Budelmann 1992; 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, 2005b; Mooney et al. 2010).

Squid and other cephalopods are an extremely important food chain component for many higher order marine predators, including fin and sperm whales. 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. (2005a) found a similar sensitivity for common 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. (2000a) reported that caged squid exposed to seismic airguns showed behavioral responses such as inking. Wilson et al. (2007) exposed two groups of longfin inshore 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 auditory debilitation. However, both the McCauley et al. (2000a) 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, 2005b, 2006) reported potential auditory-evoked responses from prawns 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.

Solé et al. (2021) showed that seagrasses may be sensitive to anthropogenic noise. In their study, they exposed Neptune grass (*Posidoniaceae oceanica)* to noise sweeping through 50 to 400 Hz frequencies at received SPL of 157 dB re 1 µPa within a few meters (16 ft [less than 5 m]) from the source to the grasses. Neptune grass is a slow-growing seagrass, endemic to the Mediterranean Sea; though is not the same species as the common eelgrass (*Zostera marina*) which is typically found in the Northeastern U.S. Atlantic, they both come from same order (Alismatales) and have similar physiological traits (Biodiversity of the Central Coast 2022). Results show deformed structure of starch grains in the plants studies after 48 hours of noise exposure, and damage to starch grains present after 96 to 120 hours of exposures (Solé et al. 2021). Damage to the starch grains in seagrasses could affect successful growth, and though the sound source used in the study is not the same as many of the noise-producing activities included under the Proposed Action, this shows seagrasses may be affected by low-frequency noise.

Fish are typically sensitive to the 100 to 500 Hz range, which is below most HRG survey sources, but does overlap with many of the Project activities described previously. 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 fin and sperm whales. McCauley et al. (2000a) 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 effects on potential prey items (fishes, cephalopods, crustaceans) are expected from the proposed survey activities.

Minimal data are available for zooplankton (the primary prey for NARW) responses to anthropogenic sound. 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 131 ft [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 and temporary nature of the movement would not cause significant loss in the availability of the species to marine mammals.

Based on the data provided above, the reduction in prey resources for ESA-listed species from underwater noise as a result of the Proposed Action would be expected to be so low as to be undetectable and **insignificant**. Therefore, the effects of underwater noise on prey **may affect, but is not likely to adversely affect** ESA-listed marine mammals, sea turtles, and fish.

6.4 Vessel Strike Risk

Vessel strikes are a known source of injury and mortality for marine mammals, sea turtles, and Atlantic and shortnose sturgeon. Increased vessel activity in the Action Area associated with the survey activities of the Proposed Action would pose a theoretical risk of increased collision-related injury and mortality for ESA-listed species. In general, large vessels traveling at high speeds pose the greatest risk of mortality to ESA-listed marine mammals, whereas sea turtles and sturgeon are vulnerable to a range of vessel types and speeds depending on the environment.

Vessel strike is relatively common with cetaceans (Kraus et al. 2005) and one of the primary causes of anthropogenic mortality in large whale species (Hayes et al. 2020; Hill et al. 2017; Waring et al. 2012, 2015). NARWs are particularly vulnerable to vessel strikes based on the distribution of preferred coastal region habitats and their feeding, diving, and socializing behaviors (Baumgartner et al. 2017). Risk of collision injury is commensurate with vessel speed; the probability of a vessel strike increases significantly as speeds increase above 10 kn (Conn and Silber 2013; Kite-Powell et al. 2007; Laist et al. 2001; Vanderlaan and Taggart 2007). Vessels operating at speeds exceeding 10 kn under poor visibility conditions have been associated with the highest risk for vessel strikes of NARWs (Vanderlaan and Taggart 2007), though collisions at lower speeds are still capable of causing serious injury, even when smaller vessels (less than 20 m length) are involved (Kelley et al. 2020).

Vessel strikes are also implicated in sea turtle mortality, with collision risk similarly commensurate with vessel speed although at much lower speeds (Hazel et al. 2007; Shimada et al. 2017). Hazel et al. (2007) found that green sea turtles were unlikely to actively avoid vessels traveling faster than 2.1 kn (4 km/hour), indicating that 10-knot speed restrictions may not be protective for this and potentially other sea turtle species.

Atlantic and shortnose sturgeon are vulnerable to vessel collisions within restricted riverine habitats resulting in potential mortality (Balazik et al. 2012), though risk in open ocean environments is speculative at best for Atlantic sturgeon and not expected for shortnose sturgeon. Vessel strike is not a documented risk for Atlantic salmon (NMFS 2023i); therefore, vessel strike risk under the Proposed Action is expected to have **no effect** on Atlantic salmon.

6.4.1 Site Assessment and Site Characterization Vessel Traffic

Vessel traffic anticipated as a result of the Proposed Action would add to the existing vessel traffic in the area (**Section 3.2.1.7**). BOEM estimates a total of 4,800 vessel round trips[29] to and from lease areas – 1,440 vessel trips associated with PAM/met buoy (**Table 3-3**) and 3,360 round trips associated with site characterization activities (**Table 3-5**) will be conducted under the Proposed Action. Of these, 3,200 vessel roundtrips would be needed to conduct routine activities during Phase 1, and 1,600 vessel roundtrips would be needed to conduct routine activities during Phase 2 (see **Section 3.1** for a description of the phased leasing approach and assumptions). Survey and sampling activities during each phase is estimated to last a minimum of 53 months with approximately 6 months of overlap[30]. Trip estimates incorporate travel in the lease area and over export cable routes leading to onshore connections for fish surveys and benthic and geotechnical sampling. Vessel movement during survey activity would potentially be slower and require more maneuvering.

If vessel survey activities are evenly distributed during a 53-month period during Phase 1, the approximately 3,200 vessel roundtrips are estimated to be 724 vessel roundtrips per year resulting from the Proposed Action. This represents a 0.59 percent increase of the average annual vessel tracks counted in the Action Area from 2019 to 2022 and a 36 percent increase of the average annual vessel tracks counted in the WEA (**Table 3-6**) during the same time period.

Similar calculations for Phase 2 using 362 vessel roundtrips per year result in a 0.29 percent increase of the average annual vessel tracks counted in the Action Area from 2019 to 2022 and an 18 percent increase of the average annual vessel tracks counted in the WEA (**Table 3-6**) during the same time period. During the approximate half year of overlap (April through August 2029), a total of 453 estimated roundtrips for buoy placement and maintenance and survey and sampling would result in a 0.75 percent increase and 45 percent increase in the Action Area and the WEA, respectively.

Proposed Action vessels would range in size from approximately 37 ft (11 m) to 262 ft (80 m) and include 12- and 24-hour survey vessels, research vessels, commercial fishing vessels, and crew boats. The vessels that would be used under the Proposed Action are presented in **Sections 3.1.1.2** and **3.1.2.1.8** of this BA. Some survey vessels would remain in the WEA or along potential cable routes for days or weeks at a time, potentially making infrequent trips to port for bunkering and provisioning as needed. Other vessels would conduct daily transits, departing and returning to port each day. All vessels are expected to travel at speeds slow speeds (i.e., 4 to 7 knots) during surveys, though transits may exceed 10 knots. Vessels could use the following general port locations: Searsport, ME; Portland, ME; Portsmouth, NH; Boston, MA; Salem, MA; and New Bedford, MA. No vessel transits from ports outside of this region are considered under the Proposed Action. Further, no upriver vessel transits are planned under the Proposed Action.All SAPs and subsequent surveys would be required to follow the Avoidance and Minimization Measures provided in **Section 3.3.4** and are effective mitigation measures for the activities considered in this BA.

6.4.1.1 Marine Mammals

Vessels operating under the Proposed Action pose a potential collision risk to marine mammals. Vessel strikes are a well-documented threat to large whales worldwide and are a measurable source of mortality and injury for many marine mammal species (Laist et al. 2001; Vanderlaan and Taggart 2007; Martin

[29] Some vessel trips last more than one day (e.g., two days for a round trip or a 24-hour vessel spends 30 days on a single trip), so for consistency in estimating vessel impacts (e.g., from traffic, emissions, and collision risk), the total number of days of vessel activity is used for analyses.
[30] Survey and sampling activities for each phase are anticipated to take slightly less time than the full 5 years. To be conservative, vessel trip calculations were estimated over a period of 53 months instead of 60 months.

et al. 2016; Hayes et al. 2022), indicating the importance of protective measures to minimize risks to vulnerable species. Vessel strikes are of particular concern for mysticetes due to their size, relatively slow maneuverability, proportion of time spent at the surface between dives, lack of clear and consistent avoidance behavior, and their relatively low detectability by vessels without focused observation efforts and (Garrison et al. 2022; Gende et al. 2011; Rockwood et al 2017; Martin et al 2016). Vessel strikes are a known or suspected contributor to three active unusual mortality events in the Atlantic Ocean for cetaceans (humpback whale, minke whale, and NARW) (NMFS 2023k).

If a vessel strike were to occur, the impact on marine mammals could range from minor injury to mortality of an individual, depending on the species and severity of the strike. Injuries are typically the result of one of two mechanisms: either blunt force trauma from impact with the vessel or lacerations from contact with the propellers (Wiley et al. 2016). Depending on the severity of the strike and the injuries inflicted, the animal may or may not recover (Wiley et al. 2016). The size of the vessel and animal, speed of the vessel, and the orientation of the marine mammal with respect to vessel trajectory all affect the severity of the injury (Vanderlaan and Taggart 2007; Martin et al. 2016).

The ability for vessel operators to detect a marine mammal within the path of the moving vessel can reduce vessel strike risk and is dependent on a variety of factors, including atmospheric/visibility conditions, observer training and experience, and vessel size and speed. Vessel speed is inversely correlated with detection rates, such that slower transit speeds, especially those below 9.7 kn (5.0 m/s), generally lead to a higher in-time detection rates for most vessel sizes provided adequate (3,281 ft [greater than 1,000 m]) reliable detection ranges (Baille and Zitterbart 2022).

Almost all sizes and classes of vessels have been involved in collisions with marine mammals around the world, including large container ships, ferries, cruise ships, military vessels, recreational vessels, commercial fishing boats, whale-watch vessels, research vessels and even jet skis (Dolman et al. 2006; Winkler et al. 2020).

Primary factors that affect the probability of a marine mammal-vessel strike include:

- Density, distribution, species, age, size, speed, health, and behavior of animal(s) (Vanderlaan and Taggart 2007; Martin et al. 2016);
- Number, speed, and size of vessel(s) (Vanderlaan and Taggart 2007; Martin et al. 2016);
- Vessel path (Vanderlaan and Taggart 2007; Martin et al. 2016);
- Operator’s ability to detect and avoid collisions (Martin et al. 2016; Williams et al. 2016); and
- Animal’s ability to detect an approaching vessel and propensity to avoid collisions (Gende et al. 2019; McKenna et al. 2015; Nowacek et al. 2004).

An individual whale’s ability to detect and actively avoid a vessel collision is poorly understood. Aversion to an approaching vessel is likely dependent on the age and behavioral state of the animal and will differ among species (Gende et al. 2019; McKenna et al. 2015; Nowacek et al. 2004). Auditory recognition of a vessel by a marine mammal such that timely avoidance is triggered is likely highly variable and highly contextual. The following factors can impair the ability of a marine mammal to detect and locate the sound of an approaching vessel:

- Attenuation of low frequency vessel sound near the surface (i.e., Lloyd mirror effect);
- Decreased propeller sound at the bow as a vessel’s length increases (i.e., spreading loss);
- Impedance of forward-projecting propeller sound due to hull shape and relative placement of keel (above-keel propeller location resulting in acoustic shadowing); and

Ambient (background) sound interfering with the sound of an approaching vessel (i.e., acoustic masking).

Vessel speed and size are two of the most important factors for determining the probability and severity of vessel strikes. The size and bulk of large vessels inhibits the ability for crew to detect and react to marine mammals along the vessel's transit route. In 93 percent of marine mammal collisions with large vessels reported in Laist et al. (2001), whales were either not seen beforehand, or were seen too late to be avoided. Laist et al. (2001) reported that the most lethal or severe injuries are caused by ships 262 ft (80 m) or longer traveling at speeds greater than 13 kn (6.7 m/s). An analysis conducted by Conn and Silber (2013) built upon collision data collected by Vanderlaan and Taggart (2007) and Pace and Silber (2005) and included new observations of serious injury to marine mammals as a result of vessel strikes at lower speeds (e.g., 2 and 5.5 kn [1.0 and 2.8 m/s]). The relationship between lethality and strike speed was still evident; the probability of a vessel strike increases significantly as speeds increase above 10 kn (Conn and Silber 2013; Kite-Powell et al. 2007; Laist et al. 2001; Vanderlaan and Taggart 2007). Smaller vessels have also been involved in marine mammal collisions. Minke, humpback, and fin whales have been killed or fatally wounded by whale-watching vessels around the world (Jensen and Silber 2004). Strikes have occurred when whale watching boats were actively watching whales as well as when they were transiting through an area, with the majority of reported incidences occurring during active whale watching activities (Laist et al. 2001; Jensen and Silber 2004).

In general, ESA-listed marine mammal densities within the Action Area range from relatively low to seasonally high. Annual blue whale densities are extremely low (0.00001/km) and this species is not a common visitors to the Action Area. Fin whale densities are the greatest whereas NARW and sei whale densities are comparatively lower; sperm whale densities are the lowest. Fin whales are common and widespread throughout the Gulf of Maine, with highest abundances during summer and fall (MGEL 2022). NARWs are also common in the Gulf of Maine; visual and acoustic surveys area indicate that NARWs may be present year-round in the Gulf of Maine, though the highest abundances occur from mid-fall through early summer (Hayes et al. 2023; MGEL 2022; Davis et al. 2017). Sei whales typically express irregular movement patterns that appear to be associated with oceanic fronts, sea surface temperatures, and specific bathymetric features (Olsen et al., 2009; Hayes et al., 2022); the species is considered regular in the Gulf of Maine, with higher, though variable, densities from spring through fall (MGEL, 2022). Sperm whales are primarily found in deeper offshore waters near the continental shelf edge beyond Georges Bank and in proximity to the prominent bathymetric features such as the Northeast Channel (Hayes et al. 2020); the species is considered uncommon within the Gulf of Maine, with seasonal occurrences during the summer to early fall months (MGEL 2022).

A range of mitigation and monitoring measures to minimize the potential for vessel collisions and impacts to marine mammals are included under the Proposed Action (**Section 3.3**). Specific to mitigation for vessel strike, **Section 3.3.4** describes all conditions under the Proposed Action for protected species detection and vessel strike avoidance conditions. Specifically, the following measures serve to reduce the likelihood of a vessel strike occurring when effectively implemented:

Project-specific training to all vessel crew members, Visual Observers, and Trained Lookouts on the identification of sea turtles and marine mammals, vessel strike avoidance and reporting protocols, and the associated regulations for avoiding vessel collisions with protected species.

Alternative monitoring technology (e.g., night vision, thermal cameras, etc.) must be available on all survey vessels to maintain a vigilant watch at night and in any other low visibility conditions.

Vessels of all sizes must operate at 10 knots or less between October 1 and May 30 and while operating port to port and operating in the lease area, or in the transit area to and from ports in Maine, New Hampshire, and Massachusetts.

Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (11.5 mph) or less while operating in any SMA or DMA or visually detected Slow Zones. Additionally, any proposed revisions to the NARW speed rule will be followed upon Rule adoption.

Regardless of vessel size, the vessel captain and crew must maintain a vigilant watch for all protected species and slow down, stop their vessel, or alter course, as appropriate, to avoid striking any listed species.

Minimum separation distances and strike avoidance protocols are established in **Section 3.3.4**, and includes a 1,640 ft (500 m) separation from all ESA-listed whales or large unidentified whales.

While the baseline encounter rate for vessels and animals to be within a strike risk with one another is already low, several additional factors are expected to further reduce the probability of a Proposed Action-related vessel strike. The communication and reporting procedures outlined in **Section 3.3.6** are designed to increase awareness of the presence of marine mammals, and NARWs in particular. All Proposed Action-related vessels operating in the Action Area are required to post trained and dedicated lookouts onboard that will utilize the best available tools and/or technology to continuously monitor the vessel strike zone anytime a vessel is underway. Although the Proposed Action will result in a temporary increase in the number of vessels operating in the Action Area, data sharing amongst all vessels will be beneficial to each trained lookout. When combined with the effective implementation of vessel strike avoidance mitigation measures, encounters that have a high risk of resulting in collision or injury would be minimized by reducing both the encounter potential (e.g., separation distances, seasonal restrictions, avoidance of aggregations) and severity potential (e.g., speed reduction, vessel positioning parallel to animals). Slower operational speeds of less than or equal to 10 kn would allow whales to avoid vessels, vessels to avoid whales, or both to take evasive actions. Additionally, slower vessel speeds are generally correlated with a reduction in injury extent and reduced instances of mortality when compared to faster vessel speeds (Vanderlaan and Taggart 2007). All vessels, including those traveling faster than 10 kn when permitted to do so, are required to maintain minimum separation distances of 1,640 ft (500 m) from all observed ESA-listed whales. While this measure cannot entirely eliminate an undetected marine mammal from entering this zone, a reduction in strike/injury risk ultimately relies on the ability for a responsive action to be taken if there is an encounter with a marine mammal. The deployment of trained lookouts on all vessels along with operable and effective monitoring equipment, including equipment specialized for low-light conditions (i.e., thermal imaging, night vision devices) in order to effectively monitor at night, will serve to minimize the collision and injury risk of any encounters that may occur.

Seasonally high densities of some ESA-listed whales, specifically fin whales and NARWs, are possible within the Action Area (**Section 5.1.1**). Based on the assumption that up to 10 leases may concurrently conduct site assessment and site characterization activities, the contribution of the number of vessel trips under the Proposed Action compared to current baseline levels in the Action Area would be a substantial increase. However, the mitigation measures outlined above and in **Section 3.3.4** are expected to minimize potential interactions with ESA-listed species during vessel movements when properly and fully implemented. As a result, the risk of interactions between marine mammals and Proposed Action-related vessel traffic during site assessment and site characterization activities would be greatly reduced based on the effective implementation of mitigation measures.

The risk of vessel strike cannot be fully eliminated due to the unpredictable nature of animal-vessel interactions, even with dedicated observers. However, vessel strike risk, and importantly, injury resulting from vessel strikes, can be significantly reduced to a negligible level by strict adherence to the guidelines and proposed mitigation measures outlined in the vessel strike avoidance measures in **Section 3.3.4**. Therefore, vessel strike risk is low, but not eliminated, when monitoring and mitigation activities are effectively implemented, as outlined; and trained, dedicated lookouts are used on all vessels. With full implementation of mitigation measures discussed in **Section 3.3** and due to their rare occurrence within the Action Area, the potential for injury-causing vessel strikes to blue whales is not expected and **discountable.** For all other ESA-listed marine mammals the risk of vessel strike is considered **insignificant** with full implementation of mitigation measures. Therefore, the effects of vessel traffic under the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

6.4.1.2 Sea Turtles

Vessels working under the Proposed Action pose a potential collision risk to sea turtles. Vessel-animal collisions are a measurable and increasing source of mortality and injury for sea turtles; the percentage of stranded loggerhead sea turtles with injuries that were apparently caused by vessel strikes increased from approximately 10 percent in the 1980s to over 20 percent in 2004, although some stranded turtles may have been struck post-mortem (NMFS and USFWS 2008). Sea turtles are expected to be most vulnerable to vessel strikes in coastal foraging areas and may not be able to avoid collisions when vessel speeds exceed 2 kn (1 m/s) (Hazel et al. 2007). The recovery plan for loggerhead sea turtles (NMFS and USFWS 2008) notes that, from 1997 to 2005, 14.9 percent of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having some type of propeller or collision injuries, although it is not known what proportion of these injuries occurred before or after the turtle died. Regardless, increased vessel traffic associated with the Proposed Action may increase the potential for impacts from vessel strikes.

Vessels traveling at higher speeds pose a higher risk to sea turtles. Relative to marine mammals, as discussed in **Section 6.4.1.1**, sea turtles require more stringent speed reductions before lethal injury probabilities are reduced. To reduce the risk of lethal injury to loggerhead sea turtles from vessel strikes by 50 percent, Sapp (2010) found that small vessels (10 to 30 ft [3 to 6 m] in length) had to slow down to 7.5 kn (3.9 m/s); the probability of lethal injury decreased by 60 percent for vessels idling at 4 kn (2.1 m/s). Foley et al. (2008) further indicated that vessel speed greater than 4 kn (2.1 m/s) may cause serious injury or mortality to sea turtles. The most informative study of the relationship between ship speed and collision risk was conducted on green sea turtles (Hazel et al. 2007). Green sea turtles often failed to flee approaching vessels. Hazel et al. (2007) concluded that green sea turtles rarely fled when encountering fast vessels (greater than 10 kn [5 m/s]), infrequently fled when encountering vessels at moderate speeds of around 6 kn (3.1 m/s), and frequently fled when encountering vessels at slow speeds of approximately 2 kn (1 m/s). Based on the observed responses of green sea turtles to approaching boats, Hazel et al. (2007) further concluded that sea turtles rely primarily on vision rather than hearing to avoid vessels; although both may play a role in eliciting responses, sea turtles may habituate to vessel sound and be more likely to respond to the sight of a vessel rather than the sound of a vessel. The potential for collisions between vessels and sea turtles, thus, increases at night and during inclement weather. Based on these findings, vessel speed restrictions may be inconsequential to reducing strike risk at anything but the slowest speeds (less than 2 kn [1 m/s]) due to the relatively low rate of flee responses of sea turtles.

There are limited measures that have been proven to be effective at reducing collisions between sea turtles and vessels (Schoeman et al. 2020). The relatively small size of turtles and the significant time spent below the surface makes their observation by vessel operators extremely difficult, therefore reducing the effectiveness of trained observers to mitigate vessel strike risk on sea turtles. Nevertheless, the use of trained lookouts would serve to reduce potential collisions. In addition to the observer requirements discussed in **Section 6.4.1.1** for marine mammals, strike avoidance measures that are specifically geared towards sea turtles (**Section 3.3.4**) include:

Vessels must slow down to 4 knots if a sea turtle is sighted within 328 ft (100 m) of the operating vessel’s forward path.

> Between June 1 and November 30, all vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats). In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.
>
> All vessel crew members must be briefed on the identification of sea turtles and on regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all Project vessels for identification of sea turtles.

Although vessel strike risk to sea turtles is expected to be reduced with the application of monitoring and mitigation measures, some unavoidable effects on sea turtles may occur, primarily due to the difficulty in detecting sea turtles. Though vessel speed restrictions are designed primarily to reduce impact to marine mammals, they would also reduce potential impacts to sea turtles. However, sea turtle collisions may still occur at slow speeds, and individuals would still be vulnerable when vessels travel over 2 kn (1 m/s). Additionally, effective detection of sea turtles in low visibility conditions (nighttime, fog, inclement weather) is likely low, even with the application of alternative monitoring technologies, thereby increasing the vulnerability of sea turtles to vessel strike risk during these periods, even with all other mitigative measures implemented.

The increase in vessel traffic associated with the Proposed Action would increase the relative risk of vessel strike for sea turtles, particularly during nighttime and periods of reduced visibility. Based on the assumption that up to 10 leases may concurrently conduct site assessment and site characterization activities, the contribution of the number of vessel trips under the Proposed Action compared to current baseline levels in the Action Area would be a substantial increase. However, given the large size of the WEA, relatively low concentrations of vessel traffic expected within any specific lease under the Proposed Action (described in **Section 6.4.1**), and the low sea turtle densities in the Action Area (**Section 5.1.2**), there is a low likelihood of interaction between ESA-listed sea turtles and vessel traffic associated with the Proposed Action. Therefore, strike risk, though not fully eliminated, is not expected to exceed negligible levels. The seasonal patterns of sea turtles in the region will result in a reduction in risk during periods of time when individuals are less likely to be present, such as during winter months. Mitigation measures (e.g., minimum vessel separation distances, vessel speed restrictions) would reduce the overall encounter potential. The deployment of trained observers on all vessels along with operable and effective monitoring equipment, including the alternative monitoring gear such as night vision, thermal cameras, etc., would additionally contribute to minimizing the collision risk with sea turtles. As a result, the probability of a vessel strike between Proposed Action-related vessels and sea turtles would be **insignificant**. Therefore, the effects of vessel traffic under the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed sea turtles.

6.4.1.3 Marine Fish

Propeller-driven vessels and barges can pose a risk to fishes that swim near the water surface and are a potential source of mortality for Atlantic sturgeon due to direct collisions with the vessel’s hull or propeller (Brown and Murphy 2010). The majority of vessel-related Atlantic and shortnose sturgeon mortality is likely caused by large transoceanic vessels in river channels (Brown and Murphy 2010; Balazik et al. 2012). Large vessels have been implicated because of their deep draft (up to 40 to 45 ft) relative to smaller vessels (15 ft), which increases the probability of vessel collision with demersal fishes like Atlantic sturgeon, even in deep water (Brown and Murphy 2010). Although smaller vessels and those with relatively shallow drafts provide more clearance with the river bottom, they can operate at a higher speed, which is expected to limit a sturgeons’ ability to avoid being struck. However, as discussed previously, no upriver transits are considered under the Proposed Action[31], so vessel traffic will be limited to coastal waters and deeper waters offshore near the WEA.

There are limited measures that would be effective at reducing collisions between ESA-listed fish and vessels; while the use of trained lookouts and other monitoring and mitigation measures such as vessel speed restrictions would reduce potential collisions to some extent, these measures ultimately provide limited effectiveness at reducing vessel strike risk to ESA-listed fish.

Vessel strikes of Atlantic sturgeon are most likely to occur in areas where Atlantic sturgeon populations overlap with abundant boat traffic such as large ports or areas with relatively narrow waterways (ASSRT 2007). Telemetry studies on adults and juvenile in the Delaware Estuary indicate that sturgeon utilize the shipping channel for upriver and downriver movements (Brundage and O'Herron 2009, Simpson and Fox 2007). A recent study indicated that the loss of only a few adult female Atlantic sturgeon from the Delaware River riverine population because of vessel strikes would hinder recovery of that riverine population (Brown and Murphy 2010). However, the only riverine port considered in this Proposed Action is Portsmouth, New Hampshire, located on the Piscataqua River, 4.0 nautical miles (7.4 km) from the mouth of the river. Documented mortality attributed to vessel strikes adjacent to other riverine ports (e.g., Philadelphia/Delaware River port complex or Richmond port on the James River) are located much further up the estuary than the Portsmouth port. Additionally, these ports are in areas where the estuary narrows significantly, limiting habitat outside the shipping channel for sturgeon to inhabit (Brown and Murphy 2010). Brown and Murphy (2010) found that a "majority of vessel strikes appeared to result from interactions with large vessels, such as tankers, with a lower percentage likely resulting from interactions with small recreational or commercial fishing vessels [equipped with outboard or inboard/outboard (stern drive) engines]" likely due to larger vessels drafting closer to the bottom of the channel. Though there is some possibility that Project vessels may encounter sturgeon within the Action Area, the likelihood of an interaction is considered very small, and the majority of survey vessels would fall into the smaller, shallow draft vessels transiting at low speeds (see vessel category characteristics in Barkaszi et al. 2021)-less likely to interact with sturgeon.

Studies of adult vessel strike mortality in the Delaware River documented a majority of carcasses and strikes occurring in the spring, coinciding with the period of likely spawning (Fox et al. 2020). Neither sturgeon species spawns[32] in the Piscataqua River and confirmed species presence and use of the river remains data limited[33], but use of the lower river for foraging or migration is a possibility(Altenritter et al. 2017, ASSRT, 2007, Wippelhauser et al., 2017). Additionally, the Atlantic Sturgeon Status Review Team

[31] The Atlantic sturgeon critical habitat would be located in the Gulf of Maine DPS, Unit 4 Piscataqua River. The port of Portsmouth, New Hampshire is located on the Piscataqua River, 4.0 nautical miles (7.4 km) from the mouth of the river. Therefore, vessels that utilize Portsmouth will transit up to 4.0 nautical miles (7.4 km) through Atlantic sturgeon critical habitat; no vessel transits further upriver from the port are considered under the Proposed Action. OCS EIS/EA BOEM 2024-045.
[32] In NMFS' Greater Atlantic Region, shortnose sturgeon are known to spawn in the Kennebec, Androscoggin, Merrimack, Connecticut, Hudson, and Delaware Rivers. Shortnose sturgeon are also known to occur in the Penobscot and Potomac Rivers; although it is unclear if spawning is currently occurring in those systems. Tagging and telemetry studies indicate that shortnose sturgeon are present in the Penobscot, Kennebec, Androscoggin, Sheepscot, and Saco Rivers (ASSRT, 2007).
[33] As noted in NMFS's November 15, 2013 letter, included in the Final Feasibility Report and Final Environmental Assessment (FR/EA) for the Portsmouth Harbor and Piscataqua River Navigation Improvement Project, File Code: Sec. 7 ACOE; Technical Assistance for Portsmouth Harbor and Piscataqua River Navigation Project Improvement, New Hampshire and Maine (2013).
https://www.nae.usace.army.mil/Portals/74/docs/Topics/Portsmouth/Portsmoth_Harbor-Final_Feasibility_Report_EA_FONSI_NIS.pdf

(2007) confirms that few sturgeon have been caught in the Piscataqua, despite surveys for both species sporadically since the 1980s. Between 2010 and 2016, three Atlantic sturgeon were detected in the Piscataqua River using passive acoustic array (M. Kieffer, USGS, pers. comm , referenced in GARFO-2021-03216[34]). DiJohnson (2019) found little evidence that Atlantic sturgeon altered their behavior in response to vessel traffic in the Delaware River, perhaps attributable to the high levels of ambient noise due to dense vessel traffic in the area. Furthermore, vessel strikes were not identified as a primary threat in the listing determination (77 FR 5880) or the most recent 5-year review (NMFS 2022) to the Gulf of Maine DPS of Atlantic sturgeon because the risk appears to be less than that of the New York Bight and Chesapeake Bay DPSs based on the limited number of known vessel struck carcasses in Gulf of Maine rivers and given differences in vessel presence in the DPS's natal river.

Atlantic sturgeon spend most of their time below the water's surface, making their observation by vessel operators extremely difficult and therefore reducing the effectiveness of trained observers to mitigate vessel strike risk. The potential occurrence of Atlantic sturgeon near ports described in **Sections 3.1.1.2** and **3.1.2.8** and shallow navigation channels are expected to be the areas of highest risk for vessel interaction with this benthic-dwelling species. However, their limited presence at the water's surface and the dispersed nature of vessel traffic and individual sturgeon reduces the potential for co-occurrence of individual sturgeon with vessels under the Proposed Action. Additionally, vessel transits within riverine habitat are not considered under the Proposed Action, further reducing the co-occurrence of Proposed Action-related vessels with Atlantic sturgeon. Based on the best available information on vessel strike risk, BOEM finds that vessel strikes as a result of the Proposed Action with Atlantic sturgeon are extremely unlikely to occur.

Reports of shortnose sturgeon vessel strikes in the Gulf of Maine are limited. Only one carcass has been reported from the lower Kennebec River in 2008 with evidence of lacerations to the head presumed to be the result of a propeller strike (Shortnose Sturgeon Status Review Team 2010). Vessels under the Proposed Action are expected to use ports in Portland and Boothbay, Maine which could occur offshore or within the bays at the mouth of the Sheepscot River, Medomak River, Damariscotta River, Androscoggin River, and Presumpscot River, and within Penobscot Bay which are adjacent to the critical habitat rivers. However, none of the proposed survey vessel traffic will transit upriver where shortnose sturgeon are most likely to occur, and vessel traffic associated with surveys of the wet storage area in Penobscot Bay would be expected to remain in the Bay and would not travel up the Penobscot River. Shortnose sturgeon would therefore only encounter Proposed Action related vessel traffic during their migrations in coastal marine waters, which are not documented to be a common occurrence, during the fall, spring, and summer (Altenritter et al. 2018; Dionne et al. 2013; Wippelhauser et al. 2015). Based on the best available information on vessel strike risk, BOEM finds that vessel strikes as a result of the Proposed Action with shortnose sturgeon are extremely unlikely to occur.

The increase in vessel traffic associated with site assessment and site characterization activities under the Proposed Action is likely to increase the relative risk of vessel strike for Atlantic sturgeon offshore. Increases in vessel traffic into ports and nearshore waters could pose an increased risk to Atlantic and shortnose sturgeon. Based on the assumption that up to 10 leases may concurrently conduct site assessment and site characterization activities, the contribution of the number of vessel trips under the Proposed Action compared to current baseline levels in the Action Area would be a substantial increase. However, given their limited presence at the water's surface and the dispersed occurrence throughout the Action Area, the large size of the WEA, and the relatively low concentrations of vessel traffic expected

[34] Referenced in the Biological Opinion for Issuance of a new license at Shawmut (FERC #2322) Hydro Project (GARFO-2021-03216) https://doi.org/10.25923/0cee-za20

within any specific lease under the Proposed Action (described in **Section 6.4.1**), the rate of co-occurrence with Proposed Action-related vessel traffic is expected to be very low for Atlantic sturgeon and shortnose sturgeon. As such, the likelihood of vessel strikes occurring is assumed to be extremely unlikely to occur and would be **discountable**. Therefore, the effects of vessel traffic under the Proposed Action **may affect, but is not likely to adversely affect** Atlantic sturgeon and shortnose sturgeon.

As indicated previously, vessel strike is not a documented risk for Atlantic salmon (NMFS 2023i); therefore, vessel strike risk under the Proposed Action is expected to have **no effect** on Atlantic salmon.

6.5 Habitat Disturbance

6.5.1 Temporary Seafloor Disturbances

Temporary disturbances of the seafloor during the proposed site assessment and site characterization activities would result from the placement and removal of the met buoys, geotechnical surveys, benthic surveys, and vessel anchoring. The total estimated area of temporary seafloor disturbance resulting from the Proposed Action during these survey activities is provided in **Table 6-10**.

Table 6-10. Estimated temporary seafloor disturbance resulting from the site assessment and site characterization activities for the Proposed Action

Activity	Disturbance Area
Met and PAM Buoy[35]	32 ft^2 (3 m^2) per buoy
Geotechnical Surveys[36]	Up to hundreds of ft^2 (several m^2) per sample
Benthic Surveys	Up to hundreds of ft^2 (several m^2) per grab
Vessel anchoring	Up to hundreds of ft^2 (several m^2) per anchor

Source: Draft EA Section 2.2, BOEM 2023a.

Met and PAM Buoy positions, as well as WTG and cable corridor benthic sampling stations, will be selected using the geophysical data collected during the initial assessment as a preclearance to avoid sensitive habitats as much as practically possible. Adverse effects related to seafloor disturbance would be direct but minimal since the seafloor area impacted is very small and localized (in comparison to the 2.0 million acre [8,093.7 square kilometers] area of the WEA). The impact related to anchor installation and presence during the 5-year operation of the met buoy systems would be temporary and the seafloor impacted could potentially return to pre-existing conditions without mitigation once the met buoy and anchoring system is removed (Dernie et al. 2003). While the biological sampling will result in some benthic disturbance and direct mortality of soft bottom assemblages, the dispersed geographical nature of this activity over the WEA and the connected cable corridors will have a limited if not unmeasurable direct, short term adverse effect on the benthic resources.

[35] This BA assumes a maximum of two met buoys per lease would be installed; thus, with an assumed 15 leases within the WEA, a total of 30 met buoys are considered (see **Section 3.1.1.1**). This BA assumes that a maximum of four PAM buoys per lease, for a total of 60 PAM buoys within the WEA (see **Section 3.1.1.2**). There would also be one benthic sample at each potential met buoy and PAM buoy location (total n=9.
[36] Geotechnical sampling (**Section 3.1.2.3**) of the WEA would require one sample at every potential wind turbine location and one sample per kilometer of offshore export cable corridor (for a maximum total of 3,645 geotechnical samples at the WTG and substation locations and 6,149 along the cable routes for all 15 leases). Geotechnical and benthic sampling of the WEA would require three geotechnical and three benthic samples at every potential wind turbine location, representing the likely scenario of three anchor legs each with one line, which would only occur in the portion of the WEA where structural placement of floating turbine anchors is allowed. Geotechnical and benthic sampling of the WEA would also require one sample per kilometer of offshore export cable corridor.

Restoration of marine soft-sediment habitats occurs through a range of physical (e.g., currents, wave action) and biological (e.g., bioturbation, tube building) processes (Dernie et al. 2003). In areas of seafloor disturbance, benthic habitat recovery and mobile and sessile benthic infaunal and epifaunal species abundances may take 1 to 3 years to recover to preimpact levels, based on the results of a number of studies on benthic recovery (e.g., AKRF et al. 2012; Carey et al. 2020; Germano et al. 1994; Guarinello and Carey 2022; Hirsch et al. 1978; Kenny and Rees 1994; Department for Business, Enterprise and Regulatory Reform 2008; Collie et al. 2000; Gerdes et al. 2008). Based on a review of impacts of sand mining in the U.S. Atlantic and Gulf of Mexico, softbottom communities within the cable corridors would recover within 3 months to 2.5 years (Brooks et al. 2006; Kraus and Carter 2018; Normandeau Associates 2014). However, it is important to note that the actual mechanisms of recovery are highly complex and site-specific; recovery to baseline conditions may take much longer in some areas and for some benthic species. Generally, soft-bottom habitats are more rapidly restored following a disturbance compared to complex or hard-bottom habitats (Collie et al. 2000).

Benthic habitat recolonization rates depend on the benthic communities in the area surrounding the affected region. The Action Area comprises both rocky sediment with sand and gravel deposits with muddy sediment deposits over large areas (**Section 3.2.1.2**). Areas of coarser sediment are often more dynamic in nature and therefore quicker to recover following a disturbance than more stable environments such as those with fine-grained sediment or rocky reefs (Dernie et al. 2003). Species inhabiting these dynamic habitats are adapted to deal with physical disturbances, for example, frequent sedimentation associated with strong bottom currents and ground swell. As such, these communities are expected to recolonize more quickly after a disturbance than communities not well-adapted to frequent disturbance (e.g., cobble and boulder habitats). Mobile species may be indirectly affected by the temporary reduction of benthic forage species; however, given the prevalence of similar habitat in the area, this is likely to have a nominal effect.

6.5.1.1 Marine Mammals

Given the range of benthic habitat present in the Action Area (**Section 3.2.1.2**), some displacement of benthic prey resources for marine mammals may occur, but this is expected to be temporary. Seafloor disturbances for the Proposed Action could be on the order of tens of thousands of square feet (thousands of square meters) assuming several hundred geotechnical samples and benthic grabs are required and each result in a disturbance of hundreds of square feet (several square meters) for each lease (**Table 6-10**).

The only forage fish species for marine mammals that are expected to be impacted by the physical disturbance of sediment would be benthic fish species like the sand lance. The only ESA-listed marine mammal species that is expected to feed on benthic prey species are fin whales, which may feed on sand lance in the Action Area (**Section 5.1.1.1**). There are two biologically important foraging areas identified for fin whales within the Gulf of Maine: the Southern Gulf of Maine BIA, where fin whales forage year round; and the Northern Gulf of Maine BIA, where fin whales forage between June and October (LaBrecque et al. 2015). Benthic surveys may overlap with these Gulf of Maine BIA; however, only a minimal amount of seafloor disturbances are expected (**Table 6-10**) relative to the total areal extent of both BIAs. Additionally, there is no evidence to suggest that fin whales occurring within this region feed exclusively on sand lance; the species is expected to utilize other pelagic prey resources within the Action Area, which would therefore minimize potential impact as a result of potential seafloor disturbances.

Given the limited overlap with important benthic feeding habitats for ESA-listed marine mammals, and the temporary, localized nature of the disturbance, effects from seafloor disturbance would be so small that they could not be meaningfully measured, detected, or evaluated and are **insignificant**. Therefore, effects of seafloor disturbance from the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

6.5.1.2 Sea Turtles

The site assessment and characterization surveys of the Proposed Action would result in temporary disturbances of the seafloor within the Action Area as provided in **Table 6-10**. After the survey activities are completed, the areas of temporary disturbance should return to the baseline state.

Seafloor disturbances could directly impact benthic species such as mollusks and crabs, which are prey for some sea turtle species (**Section 5.1.2**). Green, Kemp’s ridley, and loggerhead sea turtles all may feed on benthic organisms, though some degree of behavioral plasticity is evident for all species. Once mature, green sea turtles leave pelagic habitats and enter benthic foraging grounds, primarily feeding on seagrasses and algae (Bjorndal 1997), although they will occasionally feed on sponges and invertebrates (NMFS 2023f). Kemp’s ridley sea turtles are generalist feeders that prey on a variety of species, including crustaceans, mollusks, fish, jellyfish, and tunicates, and forage on aquatic vegetation (Byles 1988; Carr and Caldwell 1956; Schmid 1998). Although loggerheads are dietary specialists, the species demonstrates the ability to adjust its diet in response to changes in prey availability in different geographies (Plotkin et al. 1993; Ruckdeschel and Shoop 1988); juvenile loggerhead sea turtles are likely better adept at responding to changing environmental conditions than adults (Cardona et al. 2017). Leatherback sea turtles (**Section 5.1.2.3**) are dietary specialists, feeding almost exclusively on pelagic jellyfish, salps, and siphonophores, rather than prey species affected by benthic habitat alteration.

Benthic habitat disturbances are anticipated to be temporary and localized (**Table 6-10**) and unlikely to affect the availability of prey resources for these species. Although the Proposed Action would temporarily impact benthic prey resources, those effects would be temporary and limited to a very small percentage of the Action Area. Given that the Action Area is naturally dynamic and exposed to anthropogenic disturbance (**Section 3.2.1**), the individuals that do occur in this region are expected to be able to adjust their foraging behavior based on prey availability. Green and Kemp’s ridley sea turtles are omnivorous species with flexible diets, and loggerhead sea turtles readily target new prey species to adapt to changing conditions. Additionally, as discussed in **Section 5.1.2**, green, Kemp’s ridley, and loggerhead sea turtle occurrence within the Gulf of Maine is very low, indicating the region is not currently a critical foraging habitat for large numbers of individuals.

Given the limited amount of foraging habitat exposed to seafloor disturbances, the temporary and localized nature of these effects, and the ability of these species to adjust their diet in response to resource availability, the resulting effects of temporary seafloor disturbance on these species would be **insignificant** and **may affect, but is not likely to adversely affect** ESA-listed sea turtles.

6.5.1.3 Marine Fish

The site assessment and site characterization activities of the Proposed Action would result in temporary disturbances of the seafloor within the Action Area as provided in **Table 6-10**. After the survey activities are completed, the areas of temporary disturbance should return to the baseline state. Although the Proposed Action would kill or displace preferential prey organisms (invertebrates, such as crustaceans, worms, and mollusks, and bottom-dwelling fish, such as sand lance) within the survey footprint, these effects would be temporary in duration and limited to a very small area of available foraging habitat in the Action Area.

Atlantic sturgeon are known to eat a variety of benthic organisms and are believed to be opportunistic feeders with stomach contents ranging from mollusks, worms, amphipods, isopods, shrimp, and small benthic fish (e.g., sand lance; Smith 1985; Johnson et al. 1997; Dadswell 2006; Novak et al. 2017). Generally, the disturbance of benthic habitat would be short term and localized (**Table 6-10**), with an abundance of similar foraging habitat and prey available in adjacent areas for Atlantic sturgeon. As discussed in **Section 5.1.3.1.2**, Atlantic sturgeon in the Gulf of Maine would primarily inhabit coastal waters and spawning rivers, so there would be minimal overlap with foraging sturgeon and the proposed benthic and geotechnical surveys[37]. Given their generalist feeding behaviors and the limited total area of potential habitat disturbance, Atlantic sturgeon are unlikely to be affected by the effects of short-term, localized, seabed disturbance. Atlantic salmon prey vary based on their age; adults prefer capelin, which is a pelagic species, while juveniles forage on insects, invertebrates, and plankton (NMFS 2023i). As discussed in **Section 5.1.3.2.2**, juveniles spend two or three years in freshwater before migrating across the Gulf of Maine to their offshore foraging areas near Greenland. Therefore, Atlantic salmon occurring in the benthic and geotechnical sampling areas would be minimal and a low number of them would likely be foraging on benthic prey species. As discussed in **Section 5.1.3.3**, shortnose sturgeon are a primarily benthic species, but they most commonly occur in their natal freshwater rivers and would only be present in nearshore marine waters during their migrations between rivers in the fall, spring and summer Altenritter et al. 2018; Dionne et al. 2013; Wippelhauser et al. 2015), limiting their expected overlap with the benthic and geotechnical sampling areas.

Given the limited extent of effects and the likelihood of rapid recovery to baseline benthic community conditions, the effects of seafloor disturbance from the Proposed Action are likely to be **insignificant** and therefore **may affect, but is not likely to adversely affect** ESA-listed fish.

6.5.2 Turbidity

The site assessment and site characterization surveys of the Proposed Action are likely to result in elevated levels of turbidity in the immediate proximity of seafloor-disturbing activities like placement and removal of the met and PAM buoys, geotechnical surveys, benthic surveys, and vessel anchoring. There would be temporary increases in sediment suspension and deposition during activities that entail the disturbance of the seafloor. Elevated turbidity levels could be on the order of tens of thousands of square feet (thousands of square meters) assuming several hundred geotechnical samples and benthic grabs are required and each results in a disturbances are of hundreds of square feet (several square meters) per lease area (**Table** 6-10). However, only a few benthic grabs and geotechnical coring samples would be expected per day during sampling surveys and only two met buoys per lease (up to 30 total) would be placed and removed. Vessel anchoring is likely to be minimal per day throughout the duration of the Proposed Action. Given the nature of these activities, the increases in turbidity are not likely to persist beyond a few hours, so cumulative increases in turbidity from day to day would not occur, and the increased total suspended solids (TSS) for each day of sampling would likely be experienced by marine life as discrete and temporary events.

6.5.2.1 Marine Mammals

The NMFS Atlantic Region has developed a policy statement on turbidity and TSS effects on ESA-listed species for the purpose of Section 7 consultation (Johnson 2018). The agency concluded that elevated TSS could result in effects on listed whale species under specific circumstances (e.g., high TSS levels over long periods during dredging operations), but insufficient information is available to make ESA effect determinations. In general, marine mammals are not subject to effects mechanisms that injure fish (e.g., gill clogging, smothering of eggs and larvae), so injury-level effects are unlikely. Behavioral effects, including avoidance or changes in behavior, increased stress, and temporary loss of foraging opportunity,

[37] No geotechnical or bottom disturbing activities will take place during the spawning/rearing season within freshwater reaches of rivers where Atlantic or shortnose sturgeon spawning occurs. Any survey plan that includes geotechnical or other benthic sampling activities in freshwater reaches (salinity 0 to 0.5 parts per thousand) of such rivers will identify a time of year restriction that will avoid such activities during the time of year when Atlantic sturgeon spawning and rearing of early life stages occurs in that river. All vessels in coastal waters will operate in a manner to minimize propeller wash and seafloor disturbance and transiting vessels should follow deep-water routes (e.g., marked channels), as practicable, to reduce disturbance to sturgeon habitat.

could occur but only at excessive TSS levels (Johnson 2018). Todd et al. (2015) postulated that dredging and related turbidity effects could affect the prey base for marine mammals, but the significance of those effects would be highly dependent on site-specific factors. Small-scale changes from one-time, localized activities are not likely to have significant effects.

Data are not available regarding whales' avoidance of localized turbidity plumes; however, Todd et al. (2015) suggest that since marine mammals often live in turbid waters, significant effects from turbidity are not likely. If elevated turbidity caused any behavioral responses such as avoiding the turbidity zone or changes in foraging behavior, such behaviors would be temporary, and any negative effects would likewise be short term and temporary. Cronin et al. (2017) suggest that NARWs may use vision to find copepod aggregations, particularly if they locate prey concentrations by looking upwards. However, Fasick et al. (2017) indicate that NARWs must rely on other sensory systems (e.g., vibrissae on the snout) to detect dense patches of prey in very dim light (at depths greater than 525 ft [160 m] or at night). These studies indicate that whales, including NARWs, are likely able to forage in low-visibility conditions and, thus, could continue to feed in areas of elevated turbidity. If turbidity from the proposed activities caused foraging whales to leave the area, there would be an energetic cost of swimming out of the turbid area. However, increases in turbidity from the Proposed Action would be temporary, localized events, and whales could resume foraging behavior once they were outside of the turbidity zone or once the suspended sediment settled out of the water column.

Elevated TSS concentrations are expected to be limited in magnitude, short term in duration, and likely within the range of natural variability. This limited temporal effect over a relatively small area are not expected to interfere with ESA-listed species foraging success. Therefore, effects from increased turbidity are expected to be localized, temporary, non-measurable and **insignificant**. Increased turbidity associated with the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

6.5.2.2 Sea Turtles

NMFS has concluded that although scientific studies and literature are lacking, the effects of elevated TSS on ESA-listed sea turtles are likely to be similar to the expected effects on marine mammals (Johnson 2018). Physical or lethal effects in increased turbidity during the proposed surveys are unlikely because sea turtles are air-breathing and, therefore, do not share the physiological sensitivities of susceptible organisms like fish and invertebrates. Additionally, only short-term, localized increases in turbidity around the survey activities would be expected to settle quickly due to the nature of these activities.

Elevated TSS may cause individuals to alter normal movements and behaviors (e.g., moving away from an affected area). They may also experience behavioral stressors, like reduced ability to forage and avoid predators; however, turtles are migratory species that forage over wide areas and would likely be able to avoid short-term TSS impacts that are limited in severity and extent without consequence. As a result, these behavioral changes are expected to be limited in extent, short term in duration, and likely too small to be detected (NOAA 2021). Moreover, many sea turtle species routinely forage in nearshore and estuarine environments with periodically high natural turbidity levels. Therefore, short term exposure to elevated suspended sediment levels is unlikely to measurably inhibit foraging (Michel et al. 2013). However, elevated levels of turbidity may negatively affect sea turtle prey items, including benthic mollusks, crustaceans, sponges, and sea pens by clogging respiratory apparatuses. The more mobile prey items like crabs may also be negatively affected by turbidity by clogging their gills but likely to a lesser extent due to their ability to leave the turbid area (BOEM 2021). Only short term, limited impacts to fish and invertebrates are expected from suspended sediments; therefore, secondary effects on sea turtle prey availability are not expected. Any effects from increased turbidity levels from the proposed survey activities on turtles, their habitat, or their prey would be isolated and temporary and are so small that they could not be measured and are, therefore, **insignificant**. Increased turbidity associated with the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed sea turtles.

6.5.2.3 Marine Fish

Studies of the effects of turbid water on fish suggest that concentrations of suspended solids can reach thousands of milligrams per liter before an acute reaction is expected (Wilber and Clarke 2001). Johnson (2018) recommends that sturgeon should not be exposed to TSS levels of 1,000 milligrams per liter above ambient levels for longer than 14 days at a time to avoid behavioral and physiological effects. Tolerance of juvenile Atlantic sturgeon to suspended sediments has been evaluated in a laboratory setting and exposed individuals to TSS concentrations of 100, 250, and 500 milligrams per liter for a 3-day period (Wilkens et al. 2015). Of the fish exposed, 96 percent survived the test, and the authors suggested that the absence of any significant effects on survival or swimming performance indicates that the impacts of sediment plumes in natural settings are minimal where fish can move or escape. Directed studies of sturgeon TSS tolerance are currently lacking, but sturgeons, as a whole, are adapted to living in naturally turbid environments like large rivers and estuaries (Johnson 2018). Given this, adult and subadult sturgeon expected to occur in the Action Area are likely tolerant of elevated suspended sediment levels.

Increases in TSS can influence the behavior of Atlantic salmon. Robertson et al. (2007) observed avoidance responses in all individuals studied in response to an increase in suspended sediment concentration from 20 to 180 mg/L, and also observed increased foraging behaviors on the sediment floating in the water column as the sediment concentration increased. Studies have also noted that increased turbidity levels can also provide a level of protection from predation for migration salmon (Gregory and Levings 1998; Aldvén et al. 2015). However, the nominal increases in turbidity expected from the Proposed Action would provide minimal protection from predators, and would also result in minimal, if any, changes in behavior. While in the marine environment, the majority of individuals would occur and forage within the pelagic environment, with limited association with the seafloor. Therefore, there would be minimal overlap between the increases in turbidity from the Proposed Action and foraging Atlantic salmon.

Atlantic sturgeon are opportunistic benthivores that feed primarily on mollusks, polychaete worms, amphipods, isopods, shrimps and small bottom-dwelling fishes; therefore, suspended sediment and turbidity could result in some temporary avoidance of turbid areas or feeding challenges. Any effects from elevated level of turbidity from the Proposed Action on Atlantic sturgeon or their prey are considered so small that they could not be measured. Fish would likely depart or avoid unfavorable water quality conditions they may encounter.

As discussed in **Section 5.1.3.3**, shortnose sturgeon are a primarily benthic species, but they most commonly occur in their natal freshwater rivers and would only be present in nearshore marine waters during their migrations between rivers in the fall, spring and summer Altenritter et al. 2018; Dionne et al. 2013; Wippelhauser et al. 2015), limiting their expected overlap with the areas where localized increases in turbidity from the Proposed Action would occur.

Suspended sediment and turbidity could result in some temporary avoidance of turbid areas, but the short-term increases in turbidity are expected to result in minor, non-measurable effects. In addition, suspended sediment concentrations during the proposed survey activities would likely be within the range of natural variability for this location. The effects of elevated turbidity on Atlantic sturgeon, Atlantic salmon, and shortnose sturgeon would be so small that they could not be measured and, therefore, **insignificant**. Increased turbidity associated with the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed fish.

6.5.3 Presence of Structures

Under the Proposed Action, two met buoys and 4 PAM buoys could be deployed for each lease area (15 leases = 30 met buoys and 60 PAM buoys) in a maximum of 620 ft (189 m) water depth. The met and PAM buoys will be moored with a single gravity-based anchor covering a total area of 32 ft^2 (3 m^2). The buoys will be connected to the anchor using chain or synthetic rope kept taut such that it would extend vertically up from the anchor and would not have any loops or slack.

6.5.3.1 Behavioral Changes due to the Presence of Structures

Up to 30 met buoys (2 buoys per lease area [15]) and 60 PAM buoys (4 buoys per lease area [15]) could be deployed within the entire WEA. Each buoy would present a vertical structure that constitutes an obstacle in the water column that could alter the normal behavior of marine species in the Action Area during the approximate 5-year deployment period.

However, two met buoys and four PAM buoys per lease area are unlikely to alter the foraging, migrating, or mating behavior of any ESA-listed marine mammal, sea turtle, or fish species given its minimal footprint of each buoy within the Action Area. Therefore, the potential for effects is **discountable**. Behavioral changes due to the presence of structures under the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed marine mammals, sea turtles, and fish.

6.6 Entanglement and Capture

Entanglement and capture is a risk for all ESA-listed marine mammals, sea turtles, and fish. A number of mechanisms are in effect that may increase or alter exposure to entanglement risk, potentially leading to injury or death. The mechanisms largely associated with entanglement risk include the presence of vertical lines, particularly those that extend through the whole water column; and slack lines with low tension between the anchor and the equipment/gear. Survey activities that incorporate these mechanisms would pose an entanglement risk to ESA-listed marine mammals, sea turtles, and fish, but these activities are not included in the Proposed Action (Section 3.1). This risk can be minimized by reducing the amount of vertical line extending through the water column; increasing the tension of the lines between the anchor and equipment/gear; and implementing the mitigation measures described in **Section 3.3**.

For all Gulf of Maine commercial leases, BOEM will require adherence to the programmatic informal consultation PDCs/BMPs[38] **(Appendix B)** and will continue to require all lessees to follow these requirements.

6.6.1 Entanglement and Capture from Deployment of Met and PAM Buoys during Site Characterization Surveys

The mooring components associated with the met buoys (**Section 3.1.1.1**) and PAM buoys (**Section 3.1.1.2**) are expected to be under buoyant tension and are not expected to pose an entanglement risk to ESA-listed species.

[38] In 2021, BOEM completed a biological assessment for Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf, which established programmatic project design criteria (PDCs) and best management practices (BMPs) for data collection and site survey activities developed through consultation with the National Marine Fisheries Service (NMFS). PDC 6 covers "Minimize Risk During Buoy Deployment, Operations, and Retrieval".

BOEM continues to work with lessees and requires the use of the best available mooring systems, using the shortest practicable line lengths, anchors, chain, cable, or coated rope systems, to prevent or reduce to discountable levels any potential entanglement of marine mammals and sea turtles. BOEM reviews each buoy design to ensure that reasonable low risk mooring designs are used. For all Gulf of Maine commercial leases, BOEM will require adherence to the programmatic informal consultation PDCs/BMPs **(Appendix B)** and will continue to require all lessees to follow these requirements (excerpt from PDC 6 "Minimize Risk During Buoy Deployment, Operations, and Retrieval":

1. Ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device.

2. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables, or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species.

Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose.Given the minimal use of vertical lines and the buoyant tension that the floated receivers will be under, minimal entanglement risk is associated with met buoys. As such, entanglement and capture of any ESA-listed species as a result of the Proposed Action is considered **insignificant**. Therefore, the risk of entanglement in vertical lines from met and PAM buoy deployment under the Proposed Action **may affect, but is not likely to adversely** ESA-listed species.

6.7 Air Emissions

It is expected that the vessels, aircrafts, and equipment used during the site assessment and site characterization surveys would generate emissions that could affect air quality within the marine component of the Action Area. Most emissions would likely result from the Proposed Action-related vessel and aircraft activities in the Action Area. While the potential for ongoing vessels, aircraft, and equipment could be increased based on concurrent survey activities, and thus increases in air emissions, this increase in air emissions would be occurring over a large area of the WEA and dissipated by the prevalent winds.

At this time, there is no information on the effects of air quality on ESA-listed marine mammal and sea turtle species that may occur in the marine component of the Action Area. Marine mammal and sea turtle exposures to air pollutant emissions during the proposed surveys are anticipated to be temporary and short term in duration. Given the fact that vessel exhausts and aircrafts used during the digital aerial surveys are located high above the water surface, and most survey activity will occur in the open ocean where exhaust will be readily dispersed by winds, the likelihood of individual animals being repeatedly exposed to high concentrations of airborne pollutants from vessels is extremely low, and changes in concentration at the water surface level are expected to be so small that they cannot be meaningfully measured.

On this basis, it is reasonable to conclude that any effects to ESA-listed marine mammals and sea turtles from these emissions will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are **insignificant.** Air emissions resulting from the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed marine mammals and sea turtles. Atlantic sturgeon, Atlantic salmon, and shortnose sturgeon would not be exposed to airborne emissions, therefore this stressor would have **no effect** on ESA-listed fish.

6.8 Lighting

The Proposed Action would introduce mobile and stationary artificial light sources to the Action Area that would persist from dusk to dawn. Vessels would have deck and safety lighting, producing artificial light throughout the duration of the Proposed Action. The met buoy may also have lighting on the top-side structure, though this would likely only affect a limited area around the buoy.

Artificial light has been shown to alter the invertebrate epifauna and fish community composition and abundance in proximity to human-made structures (Davies et al. 2015; McConnell et al. 2010; Nightingale et al. 2006). Artificial lighting may disrupt the diel migration (vertical distribution) of some prey species, including zooplankton, which may secondarily influence marine mammal distribution patterns (Orr et al. 2013). Observations at offshore oil rigs showed dolphin species foraging near the surface and staying for longer periods of time around platforms that were lit (Cremer et al. 2009). Artificial light in coastal environments is an established stressor for juvenile sea turtles, which use light to aid in navigation and dispersal and can become disoriented when exposed to artificial lighting sources, but the significance of artificial light in offshore environments is less clear (Gless et al. 2008). Finfish impacts due to artificial light are highly species dependent and can either cause attraction or avoidance (Orr et al. 2013).

Collectively, these findings suggest the potential for effects on ESA-listed marine mammal, sea turtle, and fish species as a result of artificial lighting. Overall, these effects would be localized and limited to the area exposed to operational lights from the vessels and met buoy. Orr et al. (2013) indicate that lights on offshore structures flash intermittently for navigation or safety purposes and do not present a continuous light source. Limpus (2006) suggested that intermittent flashing lights with a very short “on” pulse and long “off” interval are non-disruptive to marine turtle behavior, irrespective of the color. Similarly, navigation and anchor lights on top of vessel masts are unlikely to adversely affect sea turtles (Limpus 2006). Atlantic sturgeon, Atlantic salmon, and shortnose sturgeon are demersal species and are unlikely to encounter the minimal lighting generated by the Proposed Action.

Orr et al. (2013) summarized available research on potential operational lighting effects from offshore structures and concluded that the operational lighting effects on marine mammal, marine turtle, and fish distribution, behavior, and habitat use were unknown but likely negligible when recommended design and operating practices are implemented. Specifically, using low intensity shielded directional lighting on structures, activating work lights only when needed, and using red navigation lights with low strobe frequency would reduce the amount of detectable light reaching the water surface to negligible levels.

Based on the available information, effects of lighting of vessels and the met buoy on ESA-listed marine mammals, sea turtles, and fish leading to changes in behavior and alterations in prey distribution would be too small to be meaningfully measured or detected and, therefore, **insignificant**. Given the small scale of effects, the effects of lighting associated with the Proposed Action **may affect, but is not likely to adversely affect** ESA-listed marine mammals, sea turtles, and fish.

6.9 Non-Routine Events

In this section, BOEM considers the “low probability events" that were identified by BOEM in Section 2.2.2 of the Draft EA. These events, while not part of the Proposed Action, include storms, allisions and collisions, spills, and recovery of lost survey equipment, and are briefly assessed below.

6.9.1 Storms

Severe weather events have the potential to cause structural damage and injury to personnel. Major storms, winter nor'easters, and hurricanes pass through the area regularly, resulting in elevated water levels (storm surge) and high waves and winds. Storm surge and wave heights from passing storms are worse in shallow water and along the coast but can pose hazards in offshore areas. The Atlantic Ocean hurricane season extends from June 1 to November 30, with a peak in September; hurricanes would be most likely to occur in the Action Area during this time. Storms could contribute to an increased likelihood of allisions and collisions that could result in a spill. However, the storm would cause the spill and its effects to dissipate faster, vessel traffic is likely to be significantly reduced in the event of an impending storm, and surveys related to the Proposed Action would be postponed until after the storm has passed. Although storms have the potential to affect the met buoy, the structures are designed to withstand storm conditions. Though unlikely, structural failure of a met buoy could result in a temporary hazard to navigation.

Storms in the Action Area resulting in potential structural failures of the met buoy would not be expected to affect ESA-listed marine mammals, sea turtles, or fish, and therefore **no effect** is expected for any species.

6.9.2 Allisions and Collisions

An allision occurs when a moving object (i.e., a vessel) strikes a stationary object (e.g., met buoy); a collision occurs when two moving objects strike each other. The presence of the met buoy in the Commercial Lease Area may pose a risk to vessel navigation. An allision between a vessel and the met buoy could result in the damage or loss of the buoy and/or the vessel, as well as loss of life and spillage of petroleum product. Vessels conducting site assessment and site characterization activities could collide with other vessels, resulting in damages, petroleum product spills, or capsizing. Collisions between vessels and allisions between vessels and the met buoy are considered unlikely because vessel traffic is subject to USCG Navigation Rules and Regulations and controlled by multiple routing measures, such as safety fairways, traffic separation schemes, and anchorages for vessels transiting into and out of the ports of Maine and the other New England states. Risk of allisions with met buoys would be further reduced by USCG-required marking and lighting.

BOEM anticipates that aerial surveys would not be conducted during periods of storm activity because the reduced visibility conditions would not meet visibility requirements for conducting the surveys; flying at low elevations would pose a safety risk during storms and times of low visibility.

Allisions and collisions of vessels and aircrafts under the Proposed Action with the met buoy are not likely to affect ESA-listed marine mammals, sea turtles, or fish, and therefore **no effect** is expected for any species.

6.9.3 Spills

A spill of petroleum product could occur as a result of hull damage from allisions with a met buoy, collisions between vessels, accidents during the maintenance or transfer of offshore equipment and/or crew, or natural events (i.e., strong waves or storms). From 2011 to 2021, the average spill size for vessels other than tank ships and tank barges was 95 gallons (360 liters) (USCG, 2022); should a spill from a vessel associated with the Proposed Action occur, BOEM anticipates that the volume would be similar.

Diesel fuel is lighter than water and may float on the water's surface or be dispersed into the water column by waves. Diesel would be expected to dissipate very rapidly, evaporate, and biodegrade within a few days (MMS, 2007). The National Oceanic and Atmospheric Administration's (NOAA's) Automated Data Inquiry for Oil Spills (an oil weathering model) was used to predict dissipation of a maximum spill of 2,500 barrels (105,000 gallons or 397,468 liters), a spill far greater than what is assumed as a non-routine event during the Proposed Action. Results of the modeling analysis showed that dissipation of spilled diesel fuel is rapid. The amount of time it took to reach diesel fuel concentrations of less than 0.05 percent varied between 0.5 and 2.5 days, depending on ambient wind (Tetra Tech Inc., 2015), suggesting that 95 gallons (360 liters) would reach similar concentrations much faster and limit the environmental impact of such a spill.

Vessels are expected to comply with USCG requirements relating to prevention and control of oil spills. Solar panels would be the primary source of power for equipment on the met buoy, with backup energy supplied by methanol fuel cells in the hull, which would minimize the volume of oil and fuel that could be released in the event of a spill. BOEM expects that each of the vessels involved with site assessment and site characterization activities would minimize the potential for a release of oils and/or chemicals in accordance with 33 Code of Federal Regulations (CFR) Part 151, 33 CFR Part 154, and 33 CFR Part 155, which contain guidelines for implementation and enforcement of vessel response plans, facility response plans, and shipboard oil pollution emergency plans. In addition, vessels to be utilized for the site assessment and characterization activities are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and EPA National Pollutant Discharge Elimination System Vessel General Permit standards, both of which aim to prevent the release of contaminated water discharges. Based on the size of the spill, it would be expected to dissipate very rapidly and would then evaporate and biodegrade within a day or two (at most), limiting the potential impacts to a localized area for a short duration.

Even with the increase in the number of met buoys (2 buoys per lease – up to 15 leases) the chance of simultaneous spills occurring is unlikely. Additionally, buoys would be widely dispersed and subsequent spills – if occurring simultaneously would be dispersed by the wind and waves and not be highly concentrated in any location for an extended period of time.

Marine mammals are susceptible to the effects of contaminants from pollution and spills, which can lead to issues in reproduction and survivorship, and other health concerns (e.g., Pierce et al., 2008; Jepson et al., 2016; Hall et al., 2018; Murphy et al., 2018). All vessels would be expected to comply with USCG requirements relating to prevention and control of oil and fuel spills. Any spills associated with the Proposed Action would be an isolated event with rapid dissipation; impacts on marine mammals would be unlikely to occur and therefore **discountable**. Effects of spills under the Proposed Action therefore **may affect, but is not likely to adversely affect** ESA-listed marine mammals.

Similar to marine mammals, sea turtles are also susceptible to the effects of contaminants from pollution and spills, which can lead to issues in reproduction and survivorship, and other health concerns (e.g., Pierce et al., 2008; Jepson et al., 2016; Hall et al., 2018; Murphy et al., 2018). All vessels would be expected to comply with USCG requirements relating to prevention and control of oil and fuel spills. Any spills associated with the Proposed Action would be an isolated event with rapid dissipation; impacts on sea turtles would be unlikely to occur and therefore **discountable**. Effects of spills under the Proposed Action therefore **may affect, but is not likely to adversely affect** ESA-listed sea turtles.

Exposure to aquatic contaminants or inhalation of fumes from oil spills can result in mortality or sublethal effects on the affected ESA-listed fish, including adrenal effects, hematological effects, liver effects, lung disease, poor body condition, skin lesions, and several other health affects attributed to oil exposure (Mohr et al. 2008; Sullivan et al. 2019; Takeshita et al. 2017). All vessels would be expected to comply with USCG requirements relating to prevention and control of oil and fuel spills. Any spills associated with the Proposed Action would be an isolated event with rapid dissipation; impacts on Atlantic sturgeon, Atlantic salmon, or shortnose sturgeon would be unlikely to occur and therefore **discountable**. Effects of spills under the Proposed Action therefore **may affect, but is not likely to adversely affect** ESA-listed fish.

6.9.4 Recovery of Lost Survey Equipment

Equipment used during site assessment and site characterization activities could be accidentally lost during survey operations. Additionally, it is possible (though unlikely) that the met buoy could disconnect from its anchor. In the event of lost equipment, recovery operations may be undertaken to retrieve the equipment. Recovery operations may be performed in a variety of ways depending on the equipment lost. A commonly used method for retrieval of lost equipment that is on the seafloor is through dragging grapnel lines (e.g., hooks, trawls). A single vessel deploys a grapnel line to the seafloor and drags it along the bottom until it catches the lost equipment, which is then brought to the surface for recovery. This process can result in significant bottom disturbances, as it requires dragging the grapnel line along the bottom until it hooks the lost equipment, which may require multiple passes in a given area. In addition to dragging a grapnel line along the bottom, after the line catches the lost equipment, it will drag all the components along the seafloor until recovery.

Marine debris, such as lost survey equipment, that cannot be retrieved because it is either small or buoyant enough to be carried away by currents or is completely or partially embedded in the seafloor (for example, a broken vibracore rod) could create a potential hazard for bottom-tending fishing gear or cause additional bottom disturbance. A broken vibracore rod that cannot be retrieved may need to be cut and capped 1 to 2 m below the seafloor. For marine debris unable to be recovered within 48 hours, BOEM will work with the operator to develop a recovery plan developed through BOEM’s programmatic ESA consultation with NMFS for data collection activities (BOEM 2023b). Selection of a mitigation strategy would depend on the nature of the lost equipment, and further consultation may be necessary.

Other impacts associated with recovery of marine debris such as lost survey equipment may include vessel traffic, noise and lighting, air emissions, and routine vessel discharges from a single vessel.

The recovery of lost equipment could affect marine mammals and sea turtles through additional vessel traffic and noise and the potential impact from entanglement stemming from the dragging of grapnel lines. Traffic and noise associated with non-routine activities likely would be from a single vessel and therefore **discountable**. The extent of impacts from the grapnel lines would be dependent upon the type of lost equipment, which would dictate the number of attempts made at recovery. Regardless, the potential for marine mammals or sea turtles to interact with the grapnel line and to become entangled is extremely unlikely given the low probability of a marine mammal or sea turtle encountering the line within the Action Area; therefore, impacts are expected to be **discountable**. Effects of recovery of lost survey equipment under the Proposed Action therefore **may affect, but is not likely to adversely affect** ESA-listed marine mammals and sea turtles.

The extent of impacts on ESA-listed fish would depend on the type of lost equipment and if it can be recovered. The larger the equipment lost, or the more costly it would be to replace, would dictate the number of attempts made at recovery, affecting the size of the resultant impact area and time spent searching. When equipment is not able to be retrieved, bottom disturbance may occur if the equipment interacts with the seafloor and is moved by bottom currents. However, the entanglement risk in grapnel lines is likely so low that it is non-measurable for Atlantic sturgeon, Atlantic salmon, and shortnose sturgeon. Similarly, any benthic disturbance would likely be extremely minimal and have very little, if any, effect on ESA-listed fish. The impacts resulting from the recovery of lost equipment are unlikely to occur for Atlantic salmon and would be **discountable**; impacts would not be expected to be meaningfully measured, detected, or evaluated for Atlantic sturgeon or shortnose sturgeon and would be **insignificant**. Effects of recovery of lost survey equipment under the Proposed Action therefore **may affect, but is not likely to adversely affec**t ESA-listed fish.

7 Effects of the Action on the Critical Habitat

In this section, BOEM considers the possible effect from the Proposed Action on the critical habitats found in the Action Area. The critical habitats associated with the following species will be considered for further analysis: North Atlantic right whale, and Atlantic sturgeon–Gulf of Maine DPS. Detailed information about each critical habitat can be found in **Section 5.2**. **Table 7-1** shows the stressors that may affect critical habitats for ESA-listed species considered in this BA.

Table 7-1. Stressors that are not likely to adversely affect designated critical habitat

Stressor		NARW Unit 1	Atlantic Sturgeon Gulf of Maine DPS Unit 4
Underwater Noise	Geophysical Reconnaissance Survey Noise	NLAA	NE
	Active Acoustic Survey Noise	NLAA	NE
	Seafloor Habitat Characterization Survey Equipment Noise	NLAA	NE
	Vessel Noise	NLAA	NE
	Geotechnical Sampling Noise	NLAA	NE
	HRG Survey Noise	NLAA	NE
Vessel strike		NE	NE
Habitat Disturbance	Temporary Seafloor Disturbances	NE	NE
	Turbidity	NLAA	NLAA
	Behavioral Changes due to the Presence of Structures	NE	NE
Entanglement and Capture		NE	NE
Air Emissions		NE	NE
Lighting		NE	NE
Non-Routine Events	Storms	NE	NE
	Allisions and Collisions	NE	NE
	Spills	NLAA	NLAA
	Recovery of Lost Survey Equipment	NE	NE
Overall Effects Determination		**NLAA**	**NLAA**

DPS = distinct population segment; HRG = high-resolution geophysical; NARW = North Atlantic right whale; LAA = likely to adversely affect; NE = no effect; NLAA = not likely to adversely affect.

7.1 North Atlantic Right Whale Critical Habitat

Given the overlap between NARW critical habitat for the Gulf of Maine foraging habitat Unit 1 (**Section 5.2.1**) and the Action Area, all Project-related vessels and survey activities would operate entirely within designated NARW critical habitat. As mentioned above in Section 5.2.1 the PBFs essential to the conservation of the NARW all address the factors associated with NARW prey concentrations and availability. Activities from the Proposed Action that would have **no effect** on the PBFs include vessel strike, temporary seafloor disturbance, behavioral change due to structures, entanglement and capture, air emissions, lighting, storms, allisions and collisions, and recovery of lost survey equipment (**Table 7-1**).

Increases in underwater noise as a result of the vessel traffic, vessel noise, and associated survey activities (HRG, G & G surveys, benthic sampling) are not expected to result in any long-term impacts to prey availability for NARW (see also **Section 6.3.8**). Impacts of anthropogenic sounds on invertebrates are limited and species-specific, yielding inconsistent findings thus far (Aguilar de Soto 2016, Vereide and Kühn 2023). Copepod specific studies have shown feeding behavior and early life history stages unaffected by vessel noise (Aspirault et al. 2023). A 2022 study (Guihen et al. 2022) found avoidance behavior in an Antarctic krill species to the presence of an autonomous glider carrying a single beam echosounder, however, these disturbances had small ranges (approximately 131 ft [40 m]). Fields et al. (2019) found that airgun arrays, used in seismic surveys, had a limited effects on mortality or escape response of *Calanus spp.* – only at close (10m) distances, with no effect at larger distances.

As discussed above, the number of proposed Project-related vessels and associated survey noise would add to the existing high levels of commercial and recreational vessel traffic in the region (see vessel numbers in **Section 6.4.1**). This is based on the assumption that up to 10 leases may concurrently conduct site assessment and site characterization surveys (although as previously stated, concurrent activities in all lease areas is impractical given the availability of vessels and project demand). However, vessel transits and survey activities within Unit 1 as a result of the Proposed Action would not affect or modify the biological or physical oceanographic conditions associated with foraging area functions (i.e., the distribution and aggregations of *C. finmarchicus*). Therefore, given the extent of the effects described and the relatively short duration of the proposed Project vessel activities, any disturbances resulting from Project activities on the essential features and foraging resources within Unit 1 of the NARW critical habitat would be so low as to be undetected and **insignificant**. Therefore, the effects vessel transits and survey noise from the Proposed Action on NARW critical habitat **may affect,** but are **not likely to adversely affect** NARW critical habitat.

Other stressors that may have temporary impacts to NARW PBFs include turbidity associated with benthic sampling and the possibility of spills as a non-routine event. Turbidity could occur due to benthic disturbance from the Proposed Action as discussed in **Section 6.5.2** and would be the result of benthic cores and/or placement of met buoy moorings. NARWs feed almost exclusively on copepods (**Section 5.1.1.2**). Copepods exhibit diel vertical migration; that is, they migrate downward out of the euphotic zone at dawn, presumably to avoid being eaten by visual predators, and they migrate upward into surface waters at dusk to graze on phytoplankton at night (Baumgartner and Fratantoni 2008; Baumgartner et al. 2011). Baugmartner et al. (2011) conclude that there is considerable variability in this behavior and that it may be related to stratification and presence of phytoplankton prey with some copepods in the Gulf of Maine remaining at the surface and some remaining at depth. Because copepods even at depth are not in contact with the substrate, no burial or loss of copepods is anticipated during any project activity. No scientific literature could be identified that evaluated the effects on marine copepods resulting from exposure to TSS. Based on what is known about effects of TSS on other aquatic life, it is possible that high concentrations of TSS could negatively affect copepods. However, given that 1) the expected TSS levels are below those that are expected to result in effects on even the most sensitive species evaluated; 2) the sediment plume would be transient and temporary; and 3) elevated TSS plumes would occupy only a miniscule portion of the Action Area at any given time. As such, the PBFs associated with feeding – that is, any effects on copepod availability, distribution, or abundance on foraging whales would be so small that they could not be meaningfully evaluated, measured, or detected and **insignificant**. Therefore, increased turbidity associated with the Proposed Action **may affect, but is not likely to adversely affect** NARW critical habitat.

The potential for spills is discussed in **Section 6.9.3** resulting from unexpected collisions with met buoys and/or the highly unlikely event of vessel collisions. While the impact of any fuel/oil spill would be unfortunate, the small spatial scale of a spill, limited amounts of the spill, the highly dynamic nature of the marine oceanography, and the implementation of mitigation measures, such that any effects from spills on copepod availability, distribution, or abundance on foraging whales would be so small that they could not be meaningfully evaluated, measured, or detected and **insignificant** from the Proposed Action **may affect, but is not likely to adversely affect** NARW critical habitat.

7.2 Atlantic Sturgeon Critical Habitat – Gulf of Maine DPS

Given the overlap between Atlantic sturgeon critical habitat for the Gulf of Maine DPS (**Section 5.2.2**) and the Action Area, there may be an unknown number of Project-related vessel transits within the Atlantic sturgeon critical habitat (Gulf of Maine DPS, Unit 4 Piscataqua River). The port of Portsmouth, NH is located on the Piscataqua River, 4.0 nautical miles (7.4 km) from the mouth of the river. Therefore, vessels that utilize Portsmouth, NH will transit up to 4.0 nautical miles (7.4 km) through Atlantic sturgeon critical habitat; no vessels transits further upriver from the port are considered under the Proposed Action.

As discussed in **Section 5.2.2**, the PBFs essential to the conservation of the Atlantic sturgeon are related to the physical features essential for reproduction of the species. BOEM determined that none of the actions under consideration would have any noticeable effect to PBFs 1 through 3[39]. Project vessels (whether transiting or surveying) do not have the potential to effect salinity. Project vessels will not interact with or impact the river bottom in any way and therefore, there would be no impact to hard bottom habitat. Vessels are expected to maintain a minimum of 4-feet clearance with the river bottom (see PDC 2) and, therefore, effects to the soft substrate are extremely unlikely. Project vessels will have no effect on water depth or water flow and will not be physical barriers to passage for any life stage of Atlantic sturgeon that may occur in this portion of the Action Area. The PDCs **(Appendix B)** also require operation of vessels in a way that ensures that vessel activities do not result in disturbance of bottom habitat[40].

[39] The essential features identified in the final rule are: (1) Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages; (2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development; (3) Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (i) Unimpeded movement of adults to and from spawning sites; (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and, (iii) Staging, resting, or holding of subadults or spawning condition adults. Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.

[40] All vessels in coastal waters will operate in a manner to minimize propeller wash and seafloor disturbance and transiting vessels should follow deep-water routes (e.g., marked channels), as practicable, to reduce disturbance to sturgeon habitat (PDC 1).

Only PBF number 4 may be affected by the Proposed Action – "water quality conditions between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support spawning, annual and interannual adult, subadult, larval, and juvenile survival, and larval, juvenile, and subadult growth, development, and recruitment (e.g., 13° C to 26° C for spawning habitat and no more than 30° C for juvenile rearing habitat, and 6 mg/L or greater dissolved oxygen for juvenile rearing habitat)". Vessel traffic would not serve as a barrier to passage of Atlantic sturgeon, have any effect on water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment.

The potential effects from vessel use within the critical habitat would be increased turbidity or spills from the Proposed Action that could occur at the port of Portsmouth, NH. As discussed in the Gulf of Maine EA (Section 3.2.3, Water Quality), releases could expose coastal and offshore waters to contaminants in the event of a spill or release during routine vessel use[41], collisions and allisions. The risk of any type of accidental release would be increased primarily during survey operations. Estuarine ports often have highly turbid water (e.g., silts and muds), which may be compounded by sediment disturbance in port due to vessel movement, but studies[42] have shown that the Great Bay Estuary and the mouth of the Piscataqua River already experience an increase in nutrient loading[43] , widespread chemical presence in estuarine sediments,increasing trends for total suspended solids (Trowbridge 2006). Total suspended solids are most likely to affect sturgeon if a plume causes a barrier to normal behaviors or if a thick sediment layer settles on the bottom affecting their prey.

Likewise, activities associated with vessel traffic, like dredging for navigation safety, can impact river systems (e.g., channel maintenance affecting sedimentation, water quality changes). The U.S. Army Corps of Engineers completed maintenance dredging in the Portsmouth Harbor and portions of the Piscataqua River in early 2024, with no additional dredging projects scheduled for the Piscataqua through at least 2028[44]. The lower reaches of the Piscataqua River are likely unsuitable spawning and rearing habitat due to relatively high salinities and unsuitable as overwintering habitat due to high velocity currents, although they could serve as migratory habitat or foraging habitat for either sturgeon species if suitable forage was present[45]. The potential for spills resulting from the highly unlikely event of vessel

[41] Vessels to be utilized for the site characterization activities are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and USEPA NPDES Vessel General Permit standards, both of which aim to prevent the release of ballast waters contaminated with an invasive species. Implementation of these waste management and mitigation measures, as well as marine debris awareness training, would reduce the likelihood of an accidental release.
[42] See also "State of our Estuaries" (2023) by the Piscataqua Region Estuaries Partnership at https://www.stateofourestuaries.org/wp-content/uploads/2023/05/SOOE-2023-Digital.pdf
[43] Of the 7 major wastewater treatment facilities (WWTF) within the Great Bay Estuary, the Portsmouth WWTF had the greatest loading of TDN, NH4 + -N, DON and DOC, however, the plant is near the mouth of the Piscataqua River and therefore only a portion of the nutrients are transported into the upper portions of the Great Bay Estuary. Most of the nutrients discharged by Portsmouth are most likely transported to Portsmouth Harbor and even the Atlantic Ocean. Bolster, Carl H.; Jones, Stephen H.; and Bromley, Jonathan M., "Evaluation of Effects of Wastewater Treatment Discharge on Estuarine Water Quality" (2003). PREP Reports & Publications. 304.
[44] Five-year dredging schedule published at https://ndc.ops.usace.army.mil/dis/reports . Maintenance dredging is required approximately every 6-10 years in this area to remove shoals that hinder navigation for deep-draft vessels.
[45] As noted in NMFS's November 15, 2013 letter, included in the Final Feasibility Report and Final Environmental Assessment (FR/EA) for the Portsmouth Harbor and Piscataqua River Navigation Improvement Project, File Code: Sec. 7 ACOE; Technical Assistance for Portsmouth Harbor and Piscataqua River Navigation Project Improvement, New Hampshire and Maine (2013).
https://www.nae.usace.army.mil/Portals/74/docs/Topics/Portsmouth/Portsmoth_Harbor-

collisions is discussed in **Section 6.9.3**Given the short duration of any vessel transits within the critical habitat and the dynamic nature (tidal flow and water movement) of the riverine habitat, any potential effects would be isolated, temporary, small-scale, would not affect salinity, water depth, temperature, or dissolved oxygen and are thus discountable. The limited number of project vessels (generally smaller in size than the deep-draft vessels currently utilizing Portsmouth Harbor) that may utilize the Portsmouth Harbor are extremely unlikely to alter the maintenance dredging schedule already in effect. . The increase in vessel traffic is expected to be a direct, but very short term if not unmeasurable adverse effect and not expected to cause a synergistic or cumulative impact on critical habitat.

Therefore, effects of increased turbidity or spills from the Proposed Action **may affect, but is not likely to adversely affect** any PBFs (i.e., PBF 4) associated with Atlantic sturgeon critical habitat – Gulf of Maine DPS. All other activities from the Proposed Action, including underwater noise, vessel strike, temporary seafloor disturbance, behavioral change due to structures, entanglement and capture, air emissions, lighting, storms, allisions and collisions, and recovery of lost survey equipment (**Table 7-1**), would have **no effect** on the PBFs associated with Atlantic sturgeon critical habitat – Gulf of Maine DPS.

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8 Summary of Effects Determinations and Conclusion

Table 8-1 summarizes the effects determinations for ESA-listed marine mammals, sea turtles, and fish species, and **Table 8-2** summarizes the effects determinations for critical habitat considered in this BA. The following two effects determinations were made:

1. A **may affect, not likely to adversely affect** determination was made when the Project stressors were determined to be **insignificant** or **discountable**.
    a. **Insignificant:** Effects relate to the size or severity of the effect and include effects that are undetectable, not measurable, or so minor they cannot be meaningfully evaluated. Insignificant is the appropriate effects conclusion when plausible effects are going to happen but will not rise to the level of constituting an adverse effect.

    b. **Discountable:** Effects that are extremely unlikely to occur. For an effect to be discountable, there must be a plausible adverse effect (i.e., a credible effect that could result from the action and would be an adverse effect if it affected an ESA-listed species), but it is extremely unlikely to occur (NMFS and USFWS 1998).[46]
2. A **may affect, likely to adversely affect** determination was also made when a project stressor could not be fully mitigated and was expected to result in an adverse effect on an ESA-listed species that could result in an ESA-level take.

[46] When the terms "discountable" or "discountable effects" appear in this document, they refer to potential effects that are found to support a "not likely to adversely affect" conclusion because they are extremely unlikely to occur. The use of these terms should not be interpreted as having any meaning inconsistent with the ESA regulatory definition of "effects of the action."

Table 8-1. Effects determinations by stressor and species for effects from the Proposed Action

Stressor		Marine Mammals					Sea Turtles				Marine Fish		
		Blue Whale	**Fin Whale**	**North Atlantic Right Whale**	**Sei Whale**	**Sperm Whale**	**Green Sea Turtle (North Atlantic DPS)**	**Leatherback Sea Turtle**	**Loggerhead Sea Turtle (Northwest Atlantic DPS)**	**Kemp's Ridley Sea Turtle**	**Atlantic Sturgeon**	**Atlantic Salmon**	**Shortnose Sturgeon**
Underwater Noise	Geophysical Reconnaissance Survey Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE
Underwater Noise	Active Acoustic Survey Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE	NE	NE	NE	NE
Underwater Noise	Seafloor Habitat Characterization Survey Equipment Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Underwater Noise	Vessel Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Underwater Noise	Geotechnical Sampling Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Underwater Noise	HRG Survey Noise	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Vessel Strike		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NLAA
Habitat Disturbance	Temporary Seafloor Disturbances	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Habitat Disturbance	Turbidity	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Habitat Disturbance	Behavioral Changes due to the Presence of Structures	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Entanglement and Capture		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE
Air Emissions		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NE	NE	NE
Lighting		NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Non-Routine Events	Storms	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Non-Routine Events	Allisions and Collisions	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
Non-Routine Events	Spills	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Non-Routine Events	Recovery of Lost Survey Equipment	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA	NLAA
Overall Effects Determination		**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**	**NLAA**

DPS = distinct population segment; HRG = high-resolution geophysical; NARW = North Atlantic right whale; NE = no effect; NLAA = not likely to adversely affect

Table 8-2. Effects determinations by stressor and critical habitat for effects from the Proposed Action

Stressor		NARW Unit 1	Atlantic Sturgeon Gulf of Maine DPS
Underwater Noise	Geophysical Reconnaissance Survey Noise	NLAA	NE
	Active Acoustic Survey Noise	NLAA	NE
	Seafloor Habitat Characterization Survey Equipment Noise	NLAA	NE
	Vessel Noise	NLAA	NE
	Geotechnical Sampling Noise	NLAA	NE
	HRG Survey Noise	NLAA	NE
Vessel strike		NE	NE
Habitat Disturbance	Temporary Seafloor Disturbances	NE	NE
	Turbidity	NLAA	NLAA
	Behavioral Changes due to the Presence of Structures	NE	NE
Entanglement and Capture		NE	NE
Air Emissions		NE	NE
Lighting		NE	NE
Non-Routine Events	Storms	NE	NE
	Allisions and Collisions	NE	NE
	Spills	NLAA	NLAA
	Recovery of Lost Survey Equipment	NE	NE
Overall Effects Determination		**NLAA**	**NLAA**

HRG = high-resolution geophysical; NARW = North Atlantic right whale; LAA = likely to adversely affect;
NE = no effect; NLAA = not likely to adversely affect.

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Appendix A Standard Field Codes and Units

Beaufort Scale

Beaufort	Description of Sea State
0	Windless: Glassy sea surface, 0 knot winds, 0-meter swell
1	Calm, light air: Ripples, no white caps, 1-3 knot winds, 0.1-meter swells
2	Light breeze: Short, small wavelets that don't break, 4-6 knot winds, 0.2-0.3-meter swells
3	Gentle breeze: Large wavelets that begin to break, 7-10 knot winds, 0.6-1-meter swells
4	Moderate breeze: Small waves with frequent white caps, 11-16 knot winds, 1-1.5-meter swells
5	Fresh breeze: Long, moderate waves with many white caps, 17-21 knot winds, 2-2.5-meter swells
6	Strong breeze: Large waves with extensive foaming and some spray, 22-27 knot winds, 3-4-meter swells
7	Near gale: Sea heaps up, waves breaking, streaks forming, 28-33 knot winds, 4-4.5-meter swells
8	Gale: Moderately high waves of great length, well-marked streaks, 34-40 knot winds, 5.5-7.5-meter swells
9	Severe gale: High waves, dense streaking, spray may affect visibility, 41-47 knot winds, 7-10-meter swells
10	Storm: Very high waves with long over-hanging crests, sea becoming white with streaks, 48-55 knot winds, 9-12.5-meter swells
11	Violent storm: Exceptionally high waves, sea completely covered with foam, 56-63 knot winds, 11.5-12.5-meter swells
12	Hurricane: Air filled with foam and spray, sea completely white, no visibility, 63+ knot winds, 16+ meter swells

Units

Date	YYYY-MM-DD
Durations (e.g., start and end times) (Coordinated Universal Time, UTC)	YY-MM-DDT HH:MM
Wind Speed	Knots (kt)
Distance, height, and depth	Meters (m) or kilometers (km)
Position in Latitude and longitude	Decimal degrees (North American Datum of 1983 (NAD83); e.g., dd.ddddd, dd.ddddd
Bearing or direction of travel	Ship heading + clock face to animal

Cloud Cover Code	Percent (%) of sky covered with clouds:
1	<10%
2	10–50%
3	50–90%
4	>90%

Monitoring Equipment

Code	Equipment	Code	Equipment
HB	Hand-held Binoculars	IG	Infrared Goggles
BE	Big Eyes	CR	Crew Reported (any method)
NE	Naked Eye	PT	Passive Acoustic Towed Array
IC	Infrared Camera	PA	Passive Acoustic Moored/Stationary

Distance Finding

Code	Distance Finding Method
EST	Eye estimation
RET	Reticle
LAS	Laser range-finder
RFS	Range-finding stick or calipers

Species Identification

Species Group	Code	ITIS	WoRMS APHIA	Common name	Scientific name
Marine Mammals	ASDO	552460	137108	Atlantic spotted dolphin	*Stenella frontalis*
	WSDO	180443	137100	Atlantic white-sided dolphin	*Lagenorhynchus acutus*
	BLBW	180517	137122	Blainville's beaked whale	*Mesoplodon densirostris*
	BLWH	180528	137090	Blue whale	*Balaenoptera musculus*
	BODO	180426	137111	Bottlenose dolphin	*Tursiops truncatus*
	BRWH	180525	242603	Bryde's whale	*Balaenoptera edeni*
	GOBW	180498	137127	Cuvier's beaked whale	*Ziphius cavirostris*
	DSWH	180492	159025	Dwarf sperm whale	*Kogia sima*
	FKWH	180463	137104	False killer whale	*Pseudorca crassidens*
	FIWH	180527	137091	Fin whale	*Balaenoptera physalus*
	BEBW	180509	137123	Gervais' beaked whale	*Mesoplodon europaeus*
	HAPO	180473	137117	Harbor Porpoise	*Phocoena phocoena*
	HUWH	180530	137092	Humpback whale	*Megaptera novaeangliae*
	KIWH	180469	137102	Killer whale	*Orcinus orca*
	MANA	180684	159504	Manatee	*Trichechus manatus*
	MHWH	180459	137103	Melon-headed whale	*Peponocephala electra*
	MIWH	180524	137087	Minke whale	*Balaenoptera acutorostrata*
	RIWH	180537	159023	North Atlantic right whale	*Eubalaena glacialis*
	NBWH	180504	343899	Northern bottlenose whale	*Hyperoodon ampullatus*
	SPDO	180430	137105	Pantropical spotted dolphin	*Stenella attenuata*
	SFPW	552461	137097	Pilot whale (shortfinned)	*Globicephala macrorhynchus*

Species Group	Code	ITIS	WoRMS APHIA	Common name	Scientific name
Marine Mammals (cont'd)	LFPW	180466	137096	Pilot whale (longfinned)	*Globicephala melas*
	PYKW	180461	137095	Pygmy killer whale	*Feresa attenuata*
	PSWH	180491	137113	Pygmy sperm whale	*Kogia breviceps*
	GRAM	180457	137098	Risso's dolphin	*Grampus griseus*
	RTDO	180417	137110	Rough-toothed dolphin	*Steno bredanensis*
	SEWH	180526	137088	Sei whale	*Balaenoptera borealis*
	SADO	180438	137094	Short-beaked common dolphin	*Delphinus delphis*
	SOBW	180515	137121	Sowerby's beaked whale	*Mesoplodon bidens*
	SPWH	180488	137119	Sperm whale	*Physeter macrocephalus*
	STDO	180434	137107	Striped dolphin	*Stenella coeruleoalba*
	TRBW	180508	137126	True's beaked whale	*Mesoplodon mirus*
	WBDO	180442	137101	White-beaked dolphin	*Lagenorhynchus albirostris*
Seals	GRSE	180653	137080	Gray seal	Halichoerus grypus
	HASE	180649	137084	Harbor seal	Phoca vitulina
	HGSE	622022	159019	Harp seal	Pagophilus groenlandicus
	HOSE	180657	137078	Hooded seal	Cystophora cristata
Sea Turtles	LHST	173833	137206	Loggerhead sea turtle	*Caretta caretta*
	LBST	173836	137207	Leatherback sea turtle	*Dermochelys coriacea*
	KRST	551770	137208	Kemp's ridley sea turtle	*Lepidochelys kempii*
	HBST	173843	137209	Hawksbill sea turtle	*Eretmochelys imbricata*
	GRST	173830	137205	Green sea turtle	*Chelonia mydas*
Fish	MARA	—	1026118	Giant manta ray	*Mobula birostris*
	STUR	—	—	Atlantic sturgeon	*Acipenser oxyrinchus oxyrinchus*
Unidentified Species	UNID	—	—	Unidentified animal	—
	UNBA	180403	2688	Unidentified baleen whale	—
	UNBW	180493	136986	Unidentified beaked whale	—
	UNTU	173828	136999	Unidentified turtle	—
	UNLW	180403	2688	Unidentified large whale	—
	UNTW	180404	148723	Unidentified odontocete	—
	UNSE	—	—	Unidentified seal	—
	KOGI	180490	159024	Unidentified Kogia spp.	—
	PIWH	180464	137017	Unidentified pilot whale	—

Behavioral/State

Code	Behavior/state	Code	Behavior/state
14	acrobatic	78	milling
25	blowing	22	motionless at surface
12	bow riding	11	porpoising
13	breaching	90	SAG
05	injured (e.g., visible wound)	21	spy hopping
00	dead	19	surfacing
03	dead in fishing gear	17	swimming at surface (non-travel)
23	diving (mammal)	18	swimming below surface
69	diving (turtle)	20	tail slapping (lobtailing)
07	diving fluke up	16	travel (slow <1 kt)
92	entangled in lines, ropes, gear	07	travel (moderate 1–10 kt)
54	feeding	06	fast travel >10 kt
22	logging	94	undetermined

Appendix B. Project Design Criteria (PDC) and Best Management Practices (BMPs) for Threatened and Endangered Species for Site Characterization and Site Assessment Activities to Support Offshore Wind Projects

Any survey plan must meet the following minimum requirements specified below, except when complying with these requirements would put the safety of the vessel or crew at risk.

PDC 1: Avoid Live Bottom Features

BMPs:

1. All vessel anchoring and any seafloor-sampling activities (i.e., drilling or boring for geotechnical surveys) are restricted from seafloor areas with consolidated seabed features[47]. All vessel anchoring and seafloor sampling must also occur at least 150 m from any known locations of threatened or endangered coral species. All sensitive live bottom habitats (eelgrass, cold-water corals, etc.) should be avoided as practicable. All vessels in coastal waters will operate in a manner to minimize propeller wash and seafloor disturbance and transiting vessels should follow deep-water routes (e.g., marked channels), as practicable, to reduce disturbance to sturgeon and sawfish habitat.

PDC 2: Avoid Activities that Could Affect Early Life Stages of Atlantic Sturgeon

BMP:

1. No geotechnical or bottom disturbing activities will take place during the spawning/rearing season within freshwater reaches of rivers where Atlantic or shortnose sturgeon spawning occurs. Any survey plan that includes geotechnical or other benthic sampling activities in freshwater reaches (salinity 0-0.5 ppt) of such rivers will identify a time of year restriction that will avoid such activities during the time of year when Atlantic sturgeon spawning and rearing of early life stages occurs in that river.

PDC 3: Marine Trash and Debris Awareness and Prevention

"Marine trash and debris" is defined as any object or fragment of wood, metal, glass, rubber, plastic, cloth, paper or any other solid, man-made item or material that is lost or discarded in the marine environment by the Lessee or an authorized representative of the Lessee (collectively, the "Lessee") while conducting activities on the OCS in connection with a lease, grant, or approval issued by the Department of the Interior (DOI). To understand the type and amount of marine debris generated, and to minimize the risk of entanglement in and/or ingestion of marine debris by protected species, lessees must implement the following BMPs.

BMPs:

1. Training: All vessel operators, employees, and contractors performing OCS survey activities on behalf of the Lessee (collectively, "Lessee Representatives") must complete marine trash and

[47] Consolidated seabed features for this measure are pavement, scarp walls, and deep/cold-water coral reefs and shallow/mesophotic reefs as defined in the CMECS Geologic Substrate Classifications.

debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris. The training videos, slides, and related material may be downloaded directly from the website. Lessee Representatives engaged in OCS survey activities must continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that they, as well as their respective employees, contractors, and subcontractors, are in fact trained. The training process must include the following elements: a. Viewing of either a video or slide show by the personnel specified above; b. An explanation from management personnel that emphasizes their commitment to the requirements; c. Attendance measures (initial and annual); and d. Recordkeeping and availability of records for inspection by DOI. By January 31 of each year, the Lessee must submit to DOI an annual report signed by the Lessee that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. You must send the reports via email to renewable_reporting@boem.gov and to TIMSWeb and email to protectedspecies@bsee.gov.

2. Marking: Materials, equipment, tools, containers, and other items used in OCS activities which are of such shape or configuration that they are likely to snag or damage fishing devices, and could be lost or discarded overboard, must be clearly marked with the vessel or facility identification and properly secured to prevent loss overboard. All markings must clearly identify the owner and must be durable enough to resist the effects of the environmental conditions to which they may be exposed.

3. Recovery: Lessees must recover marine trash and debris that is lost or discarded in the marine environment while performing OCS activities when such incident is likely to: (a) cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components, with particular attention to those that could result in the entanglement of or ingestion by marine protected species; or (b) significantly interfere with OCS uses (e.g., are likely to snag or damage fishing equipment, or present a hazard to navigation). Lessees must notify DOI when recovery activities are (i) not possible because conditions are unsafe; or (ii) not practicable because the marine trash and debris released is not likely to result in any of the conditions listed in (a) or (b) above. The lessee must recover the marine trash and debris lost or discarded if DOI does not agree with the reasons provided by the Lessee to be relieved from the obligation to recover the marine trash and debris. If the marine trash and debris is located within the boundaries of a potential archaeological resource/avoidance area, or a sensitive ecological/benthic resource area, the Lessee must contact DOI for approval prior to conducting any recovery efforts.

Recovery of the marine trash and debris should be completed immediately, but no later than 30 days from the date in which the incident occurred. If the Lessee is not able to recover the marine trash or debris within 48 hours (See BMP 4. Reporting), the Lessee must submit a recovery plan to DOI explaining the recovery activities to recover the marine trash or debris (“Recovery Plan”). The Recovery Plan must be submitted no later than 10 calendar days from the date in which the incident occurred. Unless otherwise objected by DOI within 48 hours of the filing of the Recovery Plan, the Lessee can proceed with the activities described in the Recovery Plan. The Lessee must request and obtain approval of a time extension if recovery activities cannot be completed within 30 days from the date in which the incident occurred. The Lessee must enact steps to prevent similar incidents and must submit a description of these actions to BOEM and BSEE within 30 days from the date in which the incident occurred.

4. Reporting: The Lessee must report all marine trash and debris lost or discarded to DOI (using the email address listed on DOI's most recent incident reporting guidance). This report applies to all marine trash and debris lost or discarded, and must be made monthly, no later than the fifth day of the following month. The report must include the following:

    a. Project identification and contact information for the lessee, operator, and/or contractor;

    b. The date and time of the incident;

    c. The lease number, OCS area and block, and coordinates of the object's location (latitude and longitude in decimal degrees);

    d. A detailed description of the dropped object to include dimensions (approximate length, width, height, and weight) and composition (e.g., plastic, aluminum, steel, wood, paper, hazardous substances, or defined pollutants);

    e. Pictures, data imagery, data streams, and/or a schematic/illustration of the object, if available;

    f. Indication of whether the lost or discarded item could be a magnetic anomaly of greater than 50 nanoTesla (nT), a seafloor target of greater than 0.5 meters (m), or a sub-bottom anomaly of greater than 0.5m when operating a magnetometer or gradiometer, side scan sonar, or sub-bottom profile in accordance with DOI's applicable guidance;

    g. An explanation of how the object was lost; and .

    h. A description of immediate recovery efforts and results, including photos.

In addition to the foregoing, the Lessee must submit a report within 48 hours of the incident ("48-hour Report") if the marine trash or debris could (a) cause undue harm or damage to natural resources, including their physical, atmospheric, and biological components, with particular attention to those that could result in the ingestion by or entanglement of marine protected species; or (b) significantly interfere with OCS uses (e.g., are likely to snag or damage fishing equipment, or present a hazard to navigation). The information in the 48-hour Report would be the same as that listed above, but just for the incident that triggered the 48- hour Report. The Lessee must report to DOI if the object is recovered and, as applicable, any substantial variation in the activities described in the Recovery Plan that were required during the recovery efforts. Information on unrecovered marine trash and debris must be included and addressed in the description of the site clearance activities provided in the decommissioning application required under 30 CFR § 585.906. The Lessee is not required to submit a report for those months in which no marine trash and debris was lost or discarded.PDC 4: Minimize Interactions with Listed Species during Geophysical Survey Operations.

To avoid injury of ESA-listed species and minimize any potential disturbance, the following measures will be implemented for all vessels operating impulsive survey equipment that emits sound at frequency ranges <180 kHz (within the functional hearing range of marine mammals)[48]. The Clearance Zone is defined as the area around the sound source that needs to be visually cleared of listed species for 30 minutes before the sound source is turned on. The Clearance Zone is equivalent to a minimum visibility zone for survey operations to begin (See **BMP 6**). The Shutdown Zone is defined as the area around the sound source that must be monitored for possible shutdown upon detection of protected species within or

[48] Note that this requirement does not apply to Parametric Subbottom Profilers, Ultra Short Baseline, echosounders or side scan sonar; the acoustic characteristics (frequency, narrow beam width, rapid attenuation) are such that no effects to listed species are anticipated. Limited BMPs apply to CHIRP sub-bottom profilers as indicated in text.

entering that zone. For both the Clearance and Shutdown Zones, these are minimum visibility distances and for situational awareness PSOs should observe beyond this area when possible. Surveys utilizing CHIRP sub-bottom profilers must comply with BMPs 1, 3, 4, 11, and 12.

BMPs:

1. For situational awareness a Clearance Zone extending at least (500 m in all directions) must be established around all vessels operating sources <180 kHz.
    a. The Clearance Zone must be monitored by approved third-party PSOs at all times and any observed listed species must be recorded (see reporting requirements below).
    b. For monitoring around the autonomous surface vessel (ASV) where remote PSO monitoring must occur from the mother vessel, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. PSOs must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft. In addition, night-vision goggles with thermal clip-ons and a handheld spotlight must be provided and used such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.
2. To minimize exposure to noise that could be disturbing, Shutdown Zone(s) (500 m for North Atlantic right whales and 100 m for other ESA-listed whales visible at the surface) must be established around the sources operating at <180 kHz being towed from the vessel.
    a. The Shutdown Zone(s) must be monitored by third-party PSOs at all times when noise-producing equipment (<180 kHz) is being operated and all observed listed species must be recorded (see reporting requirements below).
    b. If an ESA-listed species is detected within or entering the respective Shutdown Zone, any noise-producing equipment operating below 180 kHz must be shut off until the minimum separation distance from the source is re-established (500 m for North Atlantic right whales and 100 m for other ESA-listed species, including other ESA-listed marine mammals) and the measures in (5) are carried out.
        i. A PSO must notify the survey crew that a shutdown of all active boomer, sparker, and bubble gun acoustic sources below 180 kHz is immediately required. The vessel operator and crew must comply immediately with any call for a shutdown by the PSO. Any disagreement or discussion must occur only after shutdown.
    c. If the Shutdown Zone(s) cannot be adequately monitored for ESA-listed species presence (i.e., a PSO determines conditions, including at night or other low-visibility conditions, are such that listed species cannot be reliably sighted within the Shutdown Zone(s), no equipment operating at <180 kHz can be deployed until such time that the Shutdown Zone(s) can be reliably monitored.
3. Before any noise-producing survey equipment (operating at <180 kHz) is deployed, the Clearance Zone (500 m for all listed species) must be monitored for 30 minutes of pre-clearance observation.

a. If any ESA-listed species is observed within the Clearance Zone during the 30-minute pre-clearance period, the 30-minute clock must be paused. If the PSO confirms the animal has exited the zone and headed away from the survey vessel, the 30-minute clock that was paused may resume. The pre-clearance clock will reset to 30 minutes if the animal dives or visual contact is otherwise lost.

4. When technically feasible, a “ramp up” of the electromechanical survey equipment must occur at the start or re-start of geophysical survey activities. A ramp up must begin with the power of the smallest acoustic equipment for the geophysical survey at its lowest power output. When technically feasible the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.

5. Following a shutdown for any reason, ramp up of the equipment may begin immediately only if: (a) the shutdown is less than 30 minutes, (b) visual monitoring of the Shutdown Zone(s) continued throughout the shutdown, (c) the animal(s) causing the shutdown was visually followed and confirmed by PSOs to be outside of the Shutdown Zone(s) (500 m for North Atlantic right whales and 100 m for other ESA listed species, including other ESA-listed marine mammals) and heading away from the vessel, and (d) the Shutdown Zone(s) remains clear of all listed species. If all (a, b, c, and d) the conditions are not met, the Clearance Zone (500 m for all listed species) must be monitored for 30 minutes of pre-clearance observation before noise-producing equipment can be turned back on.

6. In order for geophysical surveys to be conducted at night or during low-visibility conditions, PSOs must be able to effectively monitor the Clearance and Shutdown Zone(s). No may occur if the Clearance and Shutdown Zone(s) cannot be reliably monitored for the presence of ESA-listed species to ensure avoidance of injury to those species.

    a. An Alternative Monitoring Plan (AMP) must be submitted to BOEM (or the federal agency authorizing, funding, or permitting the survey) detailing the monitoring methodology that will be used during nighttime and low-visibility conditions and an explanation of how it will be effective at ensuring that the Shutdown Zone(s) can be maintained during nighttime and low-visibility survey operations. The plan must be submitted 60 days before survey operations are set to begin.

    b. The plan must include technologies that have the technical feasibility to detect all ESA-listed whales out to 500 m and sea turtles to 100 m.

    c. PSOs should be trained and experienced with the proposed alternative monitoring technology.

    d. The AMP must describe how calibration will be performed, for example, by including observations of known objects at set distances and under various lighting conditions. This calibration should be performed during mobilization and periodically throughout the survey operation.

    e. PSOs shall make nighttime observations from a platform with no visual barriers, due to the potential for the reflectivity from bridge windows or other structures to interfere with the use of the night vision optics.

7. To minimize risk to North Atlantic right whales, no surveys may occur in Cape Cod Bay from January 1 - May 15 of any year (in an area beginning at 42°04′56.5″ N-070°12′00.0″ W; thence north to 42°12′00.0″ N-070°12′00.0″ W; thence due west to charted mean high water line; thence along charted mean high water within Cape Cod Bay back to beginning point).

8. Sound sources used within the North Atlantic right whale Critical Habitat Southeastern U.S. Calving Area (i.e., Unit 2) during the calving and nursing season (December-March) shall operate at frequencies <7 kHz and >35 kHz (functional hearing range of right whales) at night or low visibility conditions.
9. At times when multiple survey vessels are operating within a lease area, adjacent lease areas, or exploratory cable routes, a minimum separation distance (to be determined on a survey specific basis, dependent on equipment being used) must be maintained between survey vessels to ensure that sound sources do not overlap.
10. To minimize disturbance to the Northwest Atlantic Ocean DPS of loggerhead sea turtles, a voluntary pause in sparker operation should be implemented for all vessels operating in nearshore critical habitat for loggerhead sea turtles. These conditions apply to critical habitat boundaries for nearshore reproductive habitats LOGG N-3 through LOGG N-16 (79 FR 39855) from April 1 to September 30. Following pre-clearance procedures, if any loggerhead or other unidentified sea turtles is observed within a 100 m Clearance Zone during a survey, sparker operation should be paused by turning off the sparker until the sea turtle is beyond 100 m of the survey vessel. If the animal dives or visual contact is otherwise lost, sparker operation may resume after a minimum 2-minute pause following the last sighting of the animal.
11. Any visual observations of listed species by crew or project personnel must be communicated to PSOs on-duty.
12. During good conditions (e.g., daylight hours; Beaufort scale 3 or less) when survey equipment is not operating, to the maximum extent practicable, PSOs must conduct observations for protected species for comparison of sighting rates and behavior with and without use of active geophysical survey equipment. Any observed listed species must be recorded regardless of any mitigation actions required.

PDC 5: Minimize Vessel Interactions with Listed Species

All vessels associated with survey activities (transiting [i.e., travelling between a port and the survey site] or actively surveying) must comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. If any such incidents occur, they must be reported as outlined below under Reporting Requirements (**PDC 8**). The Vessel Strike Avoidance Zone is defined as 500 m or greater from any sighted ESA-listed species or other unidentified large marine mammal.

BMPs:

1. Vessel captain and crew must maintain a vigilant watch for all protected species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any listed species. The presence of a single individual at the surface may indicate the presence of submerged animals in the vicinity; therefore, precautionary measures should always be exercised. If pinnipeds or small delphinids of the following genera: Delphinus, Lagenorhynchus, Stenella, and Tursiops are visually detected approaching the vessel (i.e., to bow ride) or towed equipment, vessel strike avoidance and shutdown is not required.

2. Anytime a survey vessel is underway (transiting or surveying), the vessel must maintain a 500 m minimum separation distance and a PSO must monitor a Vessel Strike Avoidance Zone (500 m or greater from any sighted ESA-listed species or other unidentified large marine mammal visible at the surface) to ensure detection of that animal in time to take necessary measures to avoid striking the animal. If the survey vessel does not require a PSO for the type of survey equipment used, a

trained crew lookout may be used (see **#3**). For monitoring around the autonomous surface vessels, regardless of the equipment it may be operating, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. A dedicated operator must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft.

a. Survey plans must include identification of vessel strike avoidance measures, including procedures for equipment shut down and retrieval, communication between PSOs/crew lookouts, equipment operators, and the captain, and other measures necessary to avoid vessel strike while maintaining vessel and crew safety. If any circumstances are anticipated that may preclude the implementation of this PDC, they must be clearly identified in the survey plan and alternative procedures outlined in the plan to ensure minimum distances are maintained and vessel strikes can be avoided.

b. All vessel crew members must be briefed in the identification of protected species that may occur in the survey area and in regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all project vessels for identification of listed species. The expectation and process for reporting of protected species sighted during surveys must be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so.

c. The Vessel Strike Avoidance Zone(s) are a minimum and must be maintained around all surface vessels at all times.

d. If a large whale is identified within 500 m of the forward path of any vessel, the vessel operator must steer a course away from the whale at 10 knots (18.5 km/hr) or less until the 500 m minimum separation distance has been established. Vessels may also shift to idle if feasible.

e. If a large whale is sighted within 200 m of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel’s path and beyond 500 m. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 m.

f. If a sea turtle or manta ray is sighted within 100 m of the operating vessel’s forward path, the vessel operator must slow down to 4 knots (unless unsafe to do so) and steer away as possible. The vessel may resume normal operations once the vessel has passed the individual.

g. During times of year when sea turtles are known to occur in the survey area, vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats). In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.

h. Vessels operating in water depths with less than 4 ft. clearance between the vessel and the bottom should maintain speeds no greater than 4 knots to minimize vessel strike risk to sturgeon and sawfish.

3. To monitor the Vessel Strike Avoidance Zone, a PSO (or crew lookout if PSOs are not required) must be posted during all times a vessel is underway (transiting or surveying) to monitor for listed species in all directions.

    a. Visual observers monitoring the vessel strike avoidance zone can be either PSOs or crew members (if PSOs are not required). If the trained lookout is a vessel crew member, this must be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. All observations must be recorded per reporting requirements.

    b. Regardless of monitoring duties, all crew members responsible for navigation duties must receive site-specific training on ESA-listed species sighting/reporting and vessel strike avoidance measures.

4. Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (18.5 mph) or less while operating in any Seasonal Management Area (SMA), Dynamic Management Area (DMA)/Slow Zones triggered by visual detection of North Atlantic right whales. The only exception to this requirement is for vessels operating in areas within a DMA/visually triggered Slow Zone where it is not reasonable to expect the presence of North Atlantic right whales (e.g. Long Island Sound, shallow harbors). Reducing vessel speed to 10 knots or less while operating in Slow Zones triggered by acoustic detections of North Atlantic right whales is encouraged.

5. Vessels underway must not divert their course to approach any listed species.

6. All vessel operators must check for information regarding mandatory or voluntary ship strike avoidance (SMAs, DMAs, Slow Zones) and daily information regarding North Atlantic right whale sighting locations. These media may include, but are not limited to: NOAA weather radio, U.S. Coast Guard NAVTEX and channel 16 broadcasts, Notices to Mariners, the Whale Alert app[49], or WhaleMap[50] website.

    a. North Atlantic right whale Sighting Advisory System info can be accessed at: https://apps-nefsc.fisheries.noaa.gov/psb/surveys/MapperiframeWithText.html

    b. Information about active SMAs, DMAs, and Slow Zones can be accessed at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-vessel-strikes-north-atlantic-right-whales

PDC 6: Minimize Risk During Buoy Deployment, Operations, and Retrieval

Any mooring systems used during survey activities prevent any potential entanglement or entrainment of listed species, and in the unlikely event that entanglement does occur, ensure proper reporting of entanglement events according to the measures specified below.

BMPs:

[49] https://www.fisheries.noaa.gov/resource/tool-app/whale-alert
[50] https://whalemap.org/

1. Ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device.

2. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species.

3. Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose.

4. During all buoy deployment and retrieval operations, buoys should be lowered and raised slowly to minimize risk to listed species and benthic habitat. Additionally, PSOs or trained project personnel (if PSOs are not required) should monitor for listed species in the area prior to and during deployment and retrieval and work should be stopped if listed species are observed within 500 m of the vessel to minimize entanglement risk.

5. If a live or dead marine protected species becomes entangled, you must immediately contact the applicable NMFS stranding coordinator using the reporting contact details (see **Reporting Requirements section**) and provide any on-water assistance requested.

6. All buoys must be properly labeled with owner and contact information.

PDC 7: Protected Species Observers

Qualified third-party PSOs to observe Clearance and Shutdown Zones must be used as outlined in the conditions above.

1. **BMPs:** All PSOs must have completed an approved PSO training program and must receive NMFS approval to act as a PSO for geophysical surveys. Documentation of NMFS approval for geophysical survey activities in the Atlantic and copies of the most recent training certificates of individual PSOs' successful completion of a commercial PSO training course with an overall examination score of 80% or greater must be provided upon request. Instructions and application requirements to become a NMFS-approved PSO can be found at: http://www.fisheries.noaa.gov/national/endangered-species-conservation/protected-species-observers

2. In situations where third-party party PSOs are not required, crew members serving as lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.

3. PSOs deployed for geophysical survey activities must be employed by a third-party observer provider. While the vessel is underway, they must have no other tasks than to conduct observational effort, record data, and communicate with and instruct relevant vessel crew to the presence of listed species and associated mitigation requirements. PSOs on duty must be clearly listed on daily data logs for each shift.

    a. Non-third-party observers may be approved by NMFS on a case-by-case basis for limited, specific duties in support of approved, third-party PSOs.

4. A minimum of one PSO (assuming condition 5 is met) must be on duty observing for listed species at all times that noise-producing equipment <180 kHz is operating, or the survey vessel is actively transiting during daylight hours (i.e. from 30 minutes prior to sunrise and through 30 minutes following sunset). Two PSOs must be on duty during nighttime operations. A PSO schedule showing that the number of PSOs used is sufficient to effectively monitor the affected area for the project (e.g., surveys) and record the required data must be included. PSOs must not be on watch for more than 4 consecutive hours, with at least a 2-hour break after a 4-hour watch. PSOs must not be on active duty observing for more than 12 hours in any 24-hour period.

5. Visual monitoring must occur from the most appropriate vantage point on the associated operational platform that allows for 360-degree visual coverage around the vessel. If 360-degree visual coverage is not possible from a single vantage point, multiple PSOs must be on watch to ensure such coverage.

6. Suitable equipment must be available to each PSO to adequately observe the full extent of the Clearance and Shutdown Zones during all vessel operations and meet all reporting requirements.

    a. Visual observations must be conducted using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.

    b. Rangefinders (at least one per PSO, plus backups) or reticle binoculars (e.g., 7 x 50) of appropriate quality (at least one per PSO, plus backups) to estimate distances to listed species located in proximity to the vessel and Clearance and Shutdown Zone(s).

    c. Digital full frame cameras with a telephoto lens that is at least 300 mm or equivalent. The camera or lens should also have an image stabilization system. Used to record sightings and verify species identification whenever possible.

    d. A laptop or tablet to collect and record data electronically.

    e. Global Positioning Units (GPS) if data collection/reporting software does not have built-in positioning functionality.

    f. PSO data must be collected in accordance with standard data reporting, software tools, and electronic data submission standards approved by BOEM and NMFS for the particular activity.

    g. Any other tools deemed necessary to adequately perform PSO tasks.

PDCs 8: Reporting Requirements

To ensure compliance and evaluate effectiveness of mitigation measures, regular reporting of survey activities and information on listed species will be required as follows.

BMPs:

1. Data from all PSO observations must be recorded based on standard PSO collection and reporting requirements. PSOs must use standardized electronic data forms to record data. The following information must be reported electronically in a format approved by BOEM and NMFS:

    Visual Effort:

a. Vessel name

b. Dates of departures and returns to port with port name;

c. Lease number;

d. PSO names and affiliations;

e. PSO ID (if applicable);

f. PSO location on vessel;

g. Height of observation deck above water surface (in meters);

h. Visual monitoring equipment used;

i. Dates and times (Greenwich Mean Time) of survey on/off effort and times corresponding with PSO on/off effort;

j. Vessel location (latitude/longitude, decimal degrees) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts; recorded at 30 second intervals if obtainable from data collection software, otherwise at practical regular interval;

k. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any change;

l. Water depth (if obtainable from data collection software) (in meters);

m. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort scale, Beaufort wind force, swell height (in meters), swell angle, precipitation, cloud cover, sun glare, and overall visibility;

n. Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (e.g., vessel traffic, equipment malfunctions);

o. Survey activity information, such as type of survey equipment in operation, acoustic source power output while in operation, and any other notes of significance (i.e., pre-clearance survey, ramp-up, shutdown, end of operations, etc.);

Visual Sighting (all Visual Effort fields plus):

a. Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);

b. Vessel/survey activity at time of sighting;

c. PSO/PSO ID who sighted the animal;

d. Time of sighting;

e. Initial detection method;

f. Sightings cue;

g. Vessel location at time of sighting (decimal degrees);

h. Direction of vessel's travel (compass direction);

i. Direction of animal's travel relative to the vessel;

j. Identification of the animal (e.g., genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;

k. Species reliability;

l. Distance and direction to animal at initial and final detection, and closest point of approach of animal to vessel;

m. Distance method;

n. Group size; Estimated number of animals (high/low/best);

o. Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);

p. Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);

q. Detailed behavior observations (e.g., number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);

r. Mitigation Action; Description of any actions implemented in response to the sighting (e.g., delays, shutdown, ramp-up, speed or course alteration, etc.) and time and location of the action.

s. Behavioral observation to mitigation;

t. Equipment operating during sighting;

u. Source depth (in meters);

v. Source frequency;

w. Animal's closest point of approach and/or closest distance from the center point of the acoustic source;

x. Time entered shutdown zone;

y. Time exited shutdown zone;

z. Time in shutdown zone;

2. Photos/VideoThe project proponent must submit a final monitoring report to BOEM, BSEE and NMFS (to renewable_reporting@boem.gov, TIMSWeb and email to protectedspecies@bsee.gov, and nmfs.gar.incidental-take@noaa.gov) within 90 days after completion of survey activities. The

report must fully document the methods and monitoring protocols, summarizes the survey activities and the data recorded during monitoring, estimates of the number of listed species that may have been taken during survey activities, describes, assesses and compares the effectiveness of monitoring and mitigation measures. PSO sightings and effort data and trackline data in Excel spreadsheet format must also be provided with the final monitoring report.

3. Reporting sightings of North Atlantic right whales:

    a. If a North Atlantic right whale is observed at any time by a PSO or project personnel during surveys or vessel transit, sightings must be reported within two hours of occurrence when practicable and no later than 24 hours after occurrence. In the event of a sighting of a right whale that is dead, injured, or entangled, efforts must be made to make such reports as quickly as possible to the appropriate regional NOAA stranding hotline (from Maine-Virginia report sightings to 866-755-6622, and from North Carolina-Florida to 877-942-5343). Right whale sightings in any location may also be reported to the U.S. Coast Guard via channel 16 and through the WhaleAlert App (http://www.whalealert.org/).

    b. Further information on reporting a right whale sighting can be found at: https://appsnefsc.fisheries.noaa.gov/psb/surveys/documents/20120919_Report_a_Right_Whal e.pdf

4. In the event of a vessel strike of a protected species by any survey vessel, the project proponent must immediately report the incident to BOEM (renewable_reporting@boem.gov), BSEE TIMSWeb and email to protectedspecies@bsee.gov, and NMFS (nmfs.gar.incidental-take@noaa.gov) and for marine mammals to the NOAA stranding hotline: from Maine-Virginia, report to 866- 755-6622, and from North Carolina-Florida to 877-942-5343 and for sea turtles from Maine-Virginia, report to 866-755-6622, and from North Caroline-Florida to 844-732-8785. The report must include the following information:

    a. Name, telephone, and email or the person providing the report;

    b. The vessel name;

    c. The Lease Number;

    d. Time, date, and location (latitude/longitude) of the incident;

    e. Species identification (if known) or description of the animal(s) involved;

    f. Vessel’s speed during and leading up to the incident;

    g. Vessel’s course/heading and what operations were being conducted (if applicable);

    h. Status of all sound sources in use;

    i. Description of avoidance measures/requirements that were in place at the time of the strike and what measures were taken, if any, to avoid strike;

    j. Environmental conditions (wave height, wind speed, light, cloud cover, weather, water depth);

    k. Estimated size and length of animal that was struck;

l. Description of the behavior of the species immediately preceding and following the strike;

m. If available, description of the presence and behavior of any other protected species immediately preceding the strike;

n. Disposition of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, last sighted direction of travel, status unknown, disappeared); and

o. To the extent practicable, photographs or video footage of the animal(s).

5. Sightings of any injured or dead listed species must be immediately reported, regardless of whether the injury or death is related to survey operations, to BOEM (renewable_reporting@boem.gov), BSEE TIMSWeb and email to protectedspecies@bsee.gov, NMFS (nmfs.gar.incidental-take@noaa.gov), and the appropriate regional NOAA stranding hotline (from Maine-Virginia report sightings to 866-755-6622, and from North Carolina-Florida to 877-942-5343 for marine mammals and 844-732-8785 for sea turtles). If the project proponent's activity is responsible for the injury or death, they must ensure that the vessel assist in any salvage effort as requested by NMFS. When reporting sightings of injured or dead listed species, the following information must be included:

   a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);

   b. Species identification (if known) or description of the animal(s) involved;

   c. Condition of the animal(s) (including carcass condition if the animal is dead);

   d. Observed behaviors of the animal(s), if alive;

   e. If available, photographs or video footage of the animal(s); and

   f. General circumstances under which the animal was discovered.

6. Reporting and Contact Information:

   a. Dead and/or Injured Protected Species:

      i. NMFS Greater Atlantic Region's Stranding Hotline: 866-755-6622 \

      ii. NMFS Southeast Region's Stranding Hotline: 877-942-5343 (marine mammals), 844-732-8785 (sea turtles)

   b. Injurious Takes of Endangered and Threatened Species:

      i. NMFS Greater Atlantic Regional Office, Protected Resources Division (nmfs.gar.incidental-take@noaa.gov)

      ii. BOEM Environment Branch for Renewable Energy, Phone: 703- 787-1340, Email: renewable_reporting@boem.gov

      iii. BSEE through TIMSWeb and email to protectedspecies@bsee.gov