Draft Environmental Assessment for IODP³/NSF Expedition 501, Northwest Atlantic Ocean, May–August 2025

Prepared for

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ABSTRACT

Researchers from the Colorado School of Mines (Mines) and University of Massachusetts (UMass), with funding from the United States (U.S.) National Science Foundation (NSF), propose to conduct the International Ocean Drilling Programme (IODP[3])/NSF Expedition 501 *New England Shelf Hydrogeology*, from the liftboat (L/B) *Robert*, in the northwestern Atlantic Ocean (Proposed Action). Research activities during Expedition 501 would include drilling, coring, and logging operations in water depths ranging from ~40 m to 55 m. The Expedition would occur within the Exclusive Economic Zone (EEZ) of the U.S.

NSF has a mission to "promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense…". The proposed Expedition would collect data in support of a collaborative research proposal that was reviewed under the NSF/IODP merit review process and identified as an NSF program priority. Expedition 501 would examine the offshore freshened groundwater system in the continental shelf south of Nantucket, Massachusetts (MA).

This Environmental Assessment (EA) addresses NSF's requirements under the National Environmental Policy Act (NEPA) for the proposed NSF federal action. The analysis in this document provides information on various marine species, such as marine mammals, sea turtles, seabirds, marine fish, and marine invertebrates that could occur near the proposed research activities. As analysis on endangered and threatened species under the U.S. Endangered Species Act (ESA) was included, this document will also be used to support ESA Section 7 consultation with NMFS (National Marine Fisheries Service). Alternatives addressed in this EA consist of the Proposed Action and the No Action alternative, with no Expedition.

Numerous species of marine mammals inhabit the Expedition area in the Northwest Atlantic Ocean. Under the U.S. ESA, several of these species are listed as ***endangered***, including the North Atlantic right, sei, fin, blue, and sperm whales, which are managed by NMFS. ESA-listed sea turtle species that could occur in the area include the ***endangered*** leatherback and Kemp's ridley sea turtles, and the ***threatened*** Northwest Atlantic distinct population segment (DPS) of loggerhead sea turtle and North Atlantic DPS of green sea turtle. ESA-listed fish species that could occur in the proposed Expedition area include the ***endangered*** shortnose sturgeon and Gulf of Maine DPS of Atlantic salmon, various DPSs of Atlantic sturgeon, and the ***threatened*** giant manta ray and oceanic whitetip shark. The ***endangered*** roseate tern, Bermuda petrel, and black-capped petrel, as well as the ***threatened*** piping plover could also occur in the Expedition area.

Potential impacts of the proposed Expedition on the environment would be primarily a result of the drilling operations and use of the liftboat. Potential impacts could include vessel collisions with marine mammals and disturbance to various marine biota. However, it is anticipated that most impacts from the Proposed Action would result in minor and temporary changes in behavior by marine mammals, sea turtles, seabirds, fish, and marine invertebrates. An integral part of the planned activities are the best management practices (BMPs), mitigating measures and monitoring which are designed to protect the marine life and environment, dispose of waste materials in a manner consistent with applicable standards, and store and transport samples in such a way as to prevent contamination of the environment. The measures would minimize any potential impacts of the proposed activities on marine animals present during Expedition 501, as much as possible. Injurious impacts to marine mammals, sea turtles, and seabirds have not been proven to occur near drilling or liftboat operations. However, a precautionary approach would be taken, and the planned monitoring and mitigation measures, along with best management practices, would reduce the possibility of any effects.

The proposed monitoring and mitigation measures are designed to mitigate the potential environmental impacts to marine mammals, sea turtles, and ESA-listed seabirds, with a focus on the endangered North Atlantic right whale. The measures include lookouts during daytime hours to avoid potential vessel collisions and vessel speed restrictions with respect to North Atlantic right whales. The IODP^3 and its contractors are committed to applying these measures in order to minimize effects on marine mammals and sea turtles, and other potential environmental impacts. Ultimately, the research activities would be conducted in accordance with all applicable U.S. state and federal regulations. With the planned BMP, monitoring, and mitigation measures, unavoidable impacts to marine mammals, sea turtles, seabirds, fish, and marine invertebrates that could be encountered would be expected to be limited to short-term, localized changes in behavior and distribution near the Expedition. No long-term or significant effects would be expected on individual marine mammals, sea turtles, seabirds, fish, the populations to which they belong, or their habitats.

List of Acronyms

~	approximately
2-D	two-dimensional
ADCP	Acoustic Doppler Current Profiler
AEP	Auditory Evoked Potential
AFTT	Atlantic Fleet Testing and Training
AMVER	Automated Mutual-Assistance Vessel Rescue
ASMFC	Atlantic States Marine Fisheries Commission
BGS	British Geological Survey
BIA	Biologically Important Area
BMP	best management practices
CBD	Convention on Biological Diversity
CITES	Convention on International Trade in Endangered Species
CT	Connecticut
D	depth
DAA	Detailed Analysis Area
dB	decibel
DFO	Canadian Department of Fisheries and Oceans
DoN	Department of the Navy
DPP	Draft Proposed Program
DPS	Distinct Population Segment
DSPS	Deep Sea Drilling Project
EA	Environmental Assessment
EBSA	Ecologically or Biologically Significant Marine Areas
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	(U.S.) Endangered Species Act
EZ	Exclusion Zone
EEZ	Exclusive Economic Zone
FAO	Food Agricultural Organization
FM	Frequency Modulated
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
Ft	feet
G&G	geological and geophysical
GEO	Directorate for Geosciences
GIS	Geographic Information System
h	hour
HAPC	Habitat Area of Particular Concern
hp	horsepower
HRG	high-resolution geophysical
Hz	Hertz
IMO	International Maritime Organization
in	inch
IODP	International Ocean Discovery Program (former U.S. program, ended 2024)
$IODP^3$	International Ocean Drilling Program (international program, started 2025)

ITS	Incidental Take Statement
IUCN	International Union for the Conservation of Nature
IWC	International Whaling Commission
kHz	kilohertz
km	kilometer
kt	knot
L	length
L/B	liftboat
LFA	Low-frequency Active (sonar)
LME	Large Marine Ecosystem
m	meter
MA	Massachusetts
MAB	Mid-Atlantic Bight
MAFMC	Mid-Atlantic Fishery Management Council
MassDMF	Massachusetts Department of Marine Fisheries
MBES	Multibeam Echosounder
Mbsf	metres below sea floor
MCAS	Marine Corps Air Station
MCB	Marine Corps Base
MCS	Multi-Channel Seismic
MFA	Mid-frequency Active (sonar)
min	minute
Mines	Colorado School of Mines
MMC	Marine Mammal Commission
MMPA	(U.S.) Marine Mammal Protection Act
MOTT	Massachusetts Office of Travel and Tourism
mt	metric tons
ms	millisecond
MTD	mass transport deposits
M/V	motor vessel
n.d.	No Date
NAMMCO	North Atlantic Marine Mammal Commission
NCDEQ	North Carolina Environmental Quality
NCWD	North Carolina Wreck Diving
NEPA	National Environmental Policy Act
NEFSC	Northeast Fisheries Science Center
NEFMC	New England Fishery Management Council
NMFS	(U.S.) National Marine Fisheries Service
Nmi	nautical mile
NMR	nuclear magnetic resonance
NOAA	National Oceanic and Atmospheric Administration
NRC	(U.S.) National Research Council
NSF	National Science Foundation
OCS	Outer Continental Shelf
ODP	Ocean Drilling Program
OEIS	Overseas Environmental Impact Statement
OFG	Offshore freshened groundwater

p or pk	peak
PEIS	Programmatic Environmental Impact Statement
PI	Principal Investigator
PTS	Permanent Threshold Shift
PSO	Protected Species Observer
PVC	polyvinyl chloride
RI	Rhode Island
rms	root-mean-square
ROD	Record of Decision
R/V	research vessel
RWSAS	Right Whale Sighting Advisory System
s	second
SAFMC	South Atlantic Fishery Management Council
SBES	Split Beam Echosounder
SBP	Sub-bottom Profiler
SCIMPI	simple cabled instrument for measuring parameters in-situ
SEA	Supplemental Environment Assessment
SEL	Sound Exposure Level (a measure of acoustic energy)
SL	Source Level
SMA	Seasonal Management Area
SODV	scientific ocean drilling vessel
SOSUS	(U.S. Navy) Sound Surveillance System
SPL	Sound Pressure Level
SPUE	Sighting per unit effort
SWFSC	Southwest Fisheries Science Center
SWOT	The State of the World's Sea Turtles
t	tonnes
TSS	Traffic Separation Scheme
TTS	Temporary Threshold Shift
U.K.	United Kingdom
UMass	University of Massachusetts
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
U.S.	United States of America
USCG	United States Coast Guard
USGS	United States Geological Survey
USFWS	United States Fish and Wildlife Service
USIO	United States Implemented Organization
UT	University of Texas at Austin
μPa	microPascal
v	volts
vs.	versus
W	Wit
WCMC	World Conservation Monitoring Centre
yBP	Years Before Present

I PURPOSE AND NEED

Researchers from the Colorado School of Mines (Mines) and University of Massachusetts (UMass), with funding from the United States (U.S.) National Science Foundation (NSF), propose to conduct the International Ocean Drilling Programme (IODP[3])/NSF Expedition 501 *New England Shelf Hydrogeology* from the liftboat (L/B) *Robert*, in the northwestern Atlantic Ocean (Proposed Action). As a science operator of IODP[3], the British Geological Survey (BGS) would provide operations and science management for the Proposed Action, which would include coordinating participating institutes, overseeing commercial service contracts, and managing field activities. Research activities during Expedition 501 would include drilling, coring, and logging operations in water depths ranging from ~40 m to 55 m. The Expedition would occur within the Exclusive Economic Zone (EEZ) of the U.S., south of Nantucket, Massachusetts (MA).

This Draft Environmental Assessment (EA) was prepared pursuant to the National Environmental Policy Act (NEPA). The Draft EA tiers to the Programmatic Environmental Impact Statement, Integrated Ocean Drilling Program-U.S. Implementing Organization (IODP-USIO), referred to herein as the IODP-USIO PEIS (NSF 2008); IODP PEIS bridging document (NSF 2019); and the Final Programmatic Environmental Impact Statement (PEIS)/Overseas Environmental Impact Statement (OEIS) for Marine Seismic Research funded by the National Science Foundation or Conducted by the U.S. Geological Survey (NSF and USGS 2011), referred to herein as the NSF PEIS.

The purpose of this Draft EA is to provide the information needed to assess the potential environmental impacts associated with the Proposed Action, including drilling, coring, and the use of a liftboat during the proposed Expedition. The Draft EA provides details of the Proposed Action at the site-specific level and addresses potential impacts of the proposed research activities on marine mammals, sea turtles, seabirds, fish, and marine invertebrates. The Draft EA will also be used in support of other regulatory processes, including a Section 7 consultation under the Endangered Species Act (ESA) with the National Marine Fisheries Service (NMFS).

1.1 Mission of NSF

The NSF was established by Congress with the National Science Foundation Act of 1950 (Public Law 810507, as amended) and is the only federal agency dedicated to the support of fundamental research and education in all scientific and engineering disciplines. Further details on the mission of NSF are described in the IODP-USIO PEIS (e.g., see §5.2), the IODP PEIS bridging document, and also § 1.2 of the NSF PEIS, which are incorporated herein by reference.

1.2 Purpose of and Need for the Proposed Action

As noted in § 1.3 of the NSF PEIS, NSF has a continuing need to fund research that enables scientists to collect data essential to understanding the complex Earth processes beneath the ocean floor. The purpose of the proposed Expedition 501 would be to examine the continental shelf freshwater off New England to better understand the onshore-offshore hydrologic system dynamics. The Expedition would collect data from drilling, coring, and logging in support of a research proposal that was reviewed through the NSF/IODP merit review process and identified as an NSF program priority to meet the agency's critical need to foster an understanding of Earth processes. Geoscience exploration through ocean drilling has been an ongoing effort by NSF with international partners since the early 1970s.

1.3 Background of NSF-funded Marine Research

The background of NSF-funded ocean drilling research is described in the IODP-USIO PEIS, the bridging document, and § 1.5 of the NSF PEIS. The proposed action relates to the long history of NSF interest and support of ocean drilling, including through the International Ocean Discovery Program (IODP) and the program's predecessors: IODP-USIO, Ocean Drilling Program (ODP), and Deep Sea Drilling Project (DSDP). These documents have also described the mitigation of hazards due to environmental factors and managing the potential safety and pollution risks (e.g., avoiding submarine hazards or the environmental dangers that result from drilling into gas zones or other potential pollution sources).

The IODP-USIO PEIS, the bridging document, and the NSF PEIS address basic environmental concerns for NSF-funded ocean drilling research, including in the Divisions of Ocean Sciences and Earth Sciences within the Directorate for Geosciences (GEO). GEO is one of the primary research arms within NSF that provides funding for ocean drilling research. GEO supports research in the atmospheric, Earth, and ocean sciences and is the principal source of federal funding for university-based fundamental research in the geosciences. GEO addresses the nation's need to know more about how our planet is structured, how it works as a system, and through its research support, improves our ability to understand, predict, and respond to environmental events and changes. GEO-supported research also advances our ability to locate new resources and understand and predict natural phenomena of economic and human significance, such as earthquakes and tsunamis.

1.4 Regulatory Setting

The regulatory setting of this Draft EA is described in § 2.7 of the IODP-USIO PEIS and § 1.8 of the NSF PEIS, including the

- *National Environmental Protection Act* (NEPA) of 1969 (42 United States Code [USC] §4321 *et seq.*);
- *Marine Mammal Protection Act* (MMPA) of 1972 (16 USC 1631 *et seq.*);
- *Endangered Species Act* (ESA) of 1973 (16 USC ch. 35 §1531 *et seq.*);
- *National Historic Preservation Act* (NHPA) (Public Law 89-665; 54 USC 300101 *et seq.*);
- *Coastal Zone Management Act* (CZMA) of 1972 (16 USC §§1451 *et seq.*); and
- *Magnuson-Stevens Fishery Conservation and Management Act* – Essential Fish Habitat (EFH) (Public Law 94-265; 16 USC ch. 38 §1801 *et seq.*).

In this Draft EA, two alternatives are evaluated: (1) Proposed Action: conducting the proposed research, including drilling, coring, and liftboat operations, and (2) No Action alternative. One additional alternative was considered but was eliminated from further analysis. A summary of the Proposed Action, the alternative, and alternative eliminated from further analysis is provided at the end of this section.

2.1 Proposed Action

The Proposed Action, including project objectives and context, activities, and monitoring/mitigation measures for the research activities, are described in the following subsections.

2.1.1 Project Objectives and Context

Principal Investigators (PIs) Drs. B. Dugan (Mines) and K. Johannesson (UMass) are proposing to conduct geological research using L/B *Robert* south of Nantucket, MA, in the northwest Atlantic Ocean (Fig. 1). Specifically, the PIs plan to conduct a shallow drilling program to assess the Pleistocene hydrogeology, geomicrobiology, nutrient fluxes, and freshwater resources of the New England continental shelf (Dugan et al. 2025). The primary goal of the Expedition would be to investigate the hydrodynamics and origins of the offshore freshened groundwater (OFG) system in the continental shelf south of Nantucket, MA. The program is designed to determine whether meteoric recharge and local flow cells or subglacial recharge and proglacial lakes are responsible for fresh water. This project would characterize the spatial extent of the OFG, emplacement mechanisms, porewater geochemistry, microbe diversity and activity, and anomalous pressure distribution. To achieve the project goals, the researchers propose to conduct drilling, coring, and downhole logging, including nuclear magnetic resonance (NMR), from L/B *Robert*, to examine the onshore-offshore hydrologic system along the U.S. Atlantic continental shelf extending south from Nantucket, MA.

The OFG system off the northeast coast of the U.S. is one of the best understood freshwater shelf systems in the world with studies documenting vast quantities of freshened water going back to the 1970s. It has been estimated that the quantity of OFG sequestered between New Jersey and Maine may be sufficient to meet the needs of large population centers (e.g., New York City) for years. Despite this, little is known about the origin, emplacement, or replenishment mechanisms of this freshened water. For example, it is unclear whether the groundwater offshore New England is replenished via the modern, active hydrologic cycle through permeable basement rocks outcrops on the mainland or decoupled from the active cycle and is a non-renewable reserve. This Expedition would improve understanding of the OFG extent and emplacement mechanisms. The proposed project would provide new insights into OFG as a potential freshwater resource. The main objectives are to:

1. establish distribution of freshwater, fluid pressure, and temperature;
2. determine ground water age;
3. establish emplacement mechanism(s);
4. determine origin of fluid pressures;
5. establish concentrations of methane and nutrients and their controls;
6. characterize rates of decomposition of organic matter, redox processes, and microbial communities involved;
7. establish long-term methane and nutrient fluxes; and
8. determine whether ice sheet meltwaters had any influence on methane production.

2.1.2 Proposed Activities

2.1.2.1 Location of the Survey Activities

The proposed research activities would occur at up to four proposed drill sites between 40°N–41°N and 70°W–71°W (Fig. 1). The exact locations of the proposed drill sites are shown in Table 1. There would be three primary drill sites (MV-08A, MV-03C, MV-04C) and one alternate drill site (MV-10A). The alternate drill site would only be drilled if necessary. All research activities would occur in water depths ranging from ~40 to 55 m deep within the U.S. EEZ.

2.1.2.2 Description of Activities

The procedures to be used for Expedition 501 would be similar to those used during previous IODP expeditions, except the drilling would occur from a smaller vessel, L/B *Robert*, instead of the riserless scientific ocean drilling vessel (SODV) *JOIDES Resolution*. All drilling would occur in water less than 100 m deep. In addition to drilling and coring operations, a suite of downhole logging tools would be available for Expedition 501, including spectral and total gamma ray, sonic (P-wave velocity), formation conductivity and magnetic susceptibility, hydrogeological measurements, caliper, flow meter, and NMR. Supplies and personnel transfers would occur with supply vessels and helicopters.

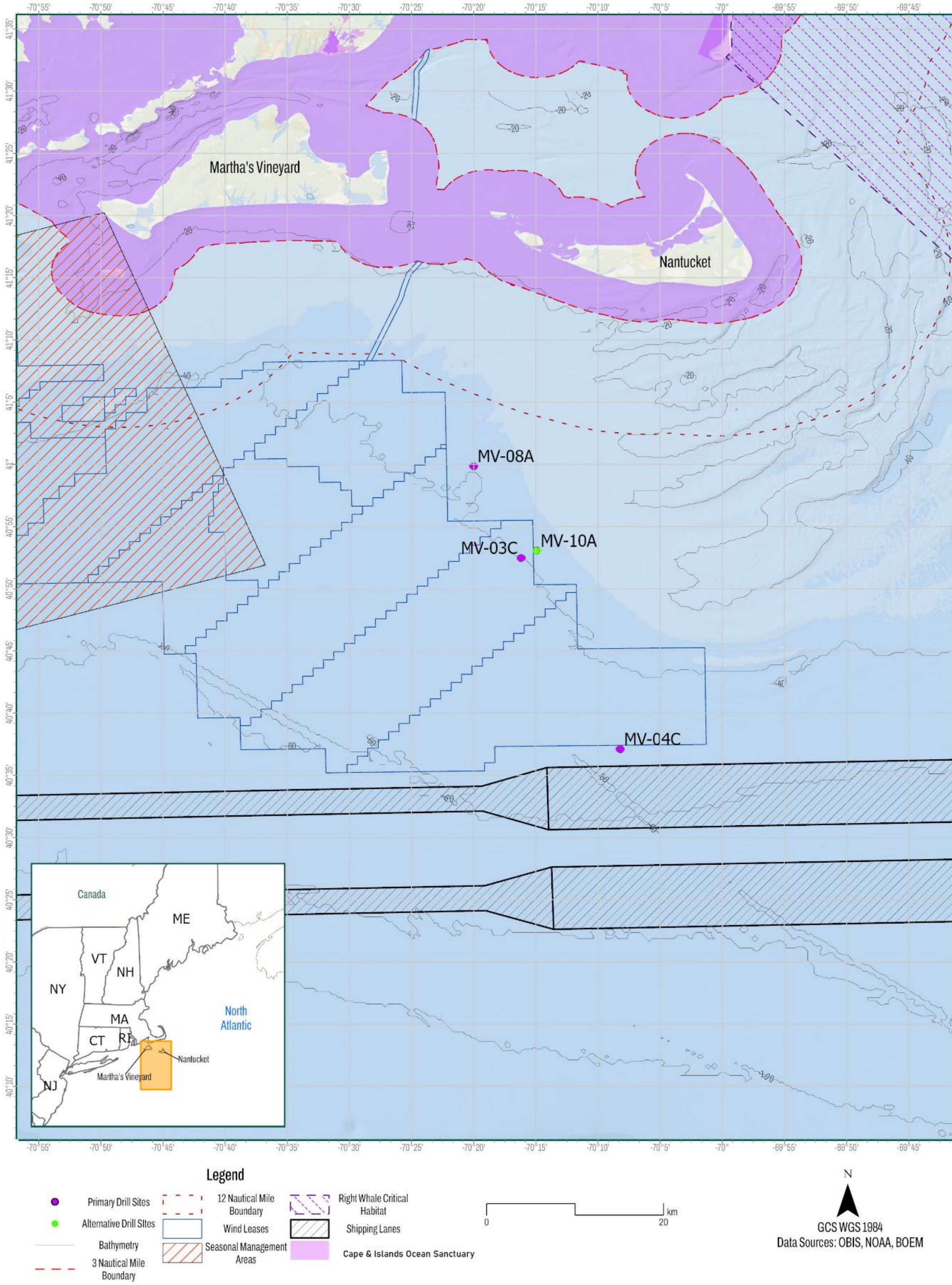

FIGURE 1. Location of the proposed Expedition 501 drill sites south of Nantucket, MA, marine protected areas, North Atlantic right whale critical habitat and seasonal management areas, shipping lanes, and wind energy leases.

TABLE 1. Description of drill site locations.

Site	Coordinates		Water Depth (m)	Penetration Depth (m)	Description
	Latitude (°N)	Longitude (°W)			
Primary					
MV-08A	40.9976	70.3334	41	550	MV-8A would characterize the freshwater endmember
MV-03C	40.8746	70.2697	42	550	MV-3C would characterize the freshwater-to-seawater transition zone of the transect
MV-04C	40.6185	70.137	52	550	MV-4C would likely characterize the seawater endmember
Alternate					
MV-10A	40.8843	70.2489	40	550	MV-10A would be implemented if MV-3C is abandoned

All planned activities would be conducted by IODP^3 and its subcontractors (SEACOR Marine, Miller's Launch, Inc., Matrix Offshore Services, and European Petrophysics Consortium at University of Montpellier, France), with on-board assistance by the scientists who have proposed the studies. SEACOR Marine is responsible for liftboat, drilling, and coring operations, and the European Petrophysics Consortium with the University of Montpellier is responsible for logging activities. The vessel would be self-contained, and the crew would live aboard the vessel.

2.1.2.3 Schedule

Expedition 501 would take place during summer 2025 (May–August) for a period of ~100 days, including ~96 days of drilling/coring/logging and ~4 days of transit. L/B *Robert* would likely leave out of and return to the port of Bridgeport, CT (240 km west of the Expedition sites). IODP^3 strives to schedule its operations in the most efficient manner possible, including availability of scientists. Because of the nature of the NSF/IODP merit review process and the long timeline associated with the ESA Section 7 consultation, not all research project or vessel logistics are identified at the time the consultation documents are submitted to federal regulators; typically, however, these types of details, such as port arrival/departure locations, are not a substantive component of the consultations.

2.1.2.4 Vessel Specifications

The self-propelled and self-elevating L/B *Robert* would be used to carry out the Expedition (Appendix A, Fig. A-1). It is a U.S. flagged vessel, built in 2011, and owned and operated by SEACOR Marine. It has a gross tonnage (GRT) of 3,915 t, accommodation for 148 berths, and a maximum speed of 6 knots (11 km/h). A liftboat is a seaworthy platform with legs that are used to support the vessel when on site. The vessel legs can be lowered to the seafloor to anchor the boat, and the platform can then be lifted out of the water. The vessel is secured to the seabed with three legs, equipped with flat pads at the ends, that are lowered under power to the seafloor and then settle onto the seabed soft sediments. This form of anchoring can take just a few minutes depending on conditions and water depth. A typical liftboat can elevate at 4 to 6 feet (1.2–1.8 m) per minute and lower the legs at 14 to 18 feet (4.3–5.5 m) per minute (Offshore Fleet n.d.). L/B *Robert* does not require heave motion compensators. The vessel platform can be lifted out of the water to a desired working height, which elevates the generators out of the water. The platform has a length of 185 ft (56.3 m), beam of 135 ft (41.4.m), and a draft of 15 ft (4.6 m). The leg pad dimensions are a length of 45 ft (13.7 m), width of 30 ft (9.1 m), and a depth of 6 ft (1.8 m).

L/B *Robert* would transit under its own power to/from port and between the proposed sites. The vessel would position itself into place using dynamic positioning, then lower the legs for anchoring.

Generators (2 Caterpillar 3516C 2,350 kW@690v) onboard power the machinery. L/B *Robert* is equipped with a helipad capable of supporting aircraft as large as a Sikorsky S-92 (i.e., a twin-engine aircraft with seating for 19 passengers). In the event L/B *Robert* were unable to support the proposed action, a similar vessel with similar capabilities would be used instead; any impacts would be anticipated to be the same as for L/B *Robert*.

2.1.2.5 Supply Vessel and Supporting Aircraft

In addition to L/B *Robert*, a supply vessel and/or helicopter (e.g., 8-seater Leonardo AW 169) would be used over the course of the Expedition to bring supplies to the vessel and for personnel transfers. Personnel transfers and/or delivery of provisions would take place every 10 days via helicopter resulting in ~11 to 12 trips. Helicopter trips would originate from Providence, RI. It is anticipated that there would be up to two deliveries of supplies and/or provisions by supply boat during the course of the Expedition.

The supply boat would be the motor vessel (M/V) *Rana Miller* which is 150 ft (46 m) long, with a beam of 36 ft (11 m), and a draft of 5 ft (1.5 m) when light or 10 ft (3.05 m) when loaded (Appendix A, Fig. A-2). It is a U.S. flagged vessel built in 1997, owned by Miller's Tug & Barge, Inc., and operated by Miller's Launch/Miller's Tug & Barge, Inc. It has a weight of 90 long tons, and uses 2 Cummins KTA-38-9850HP generator. It has accommodation for 18 berths, a cruising speed of 10 knots (~18 km/h), and a maximum speed of 12 knots (~22 km/h). Vessel trips would originate from New Bedford, MA (~100 km northwest of the Expedition sites). In the event M/V *Rana Miller* were unable to support the proposed action, a similar vessel with similar capabilities would be used instead; any impacts would be anticipated to be the same as for M/V *Rana Miller*.

2.1.2.6 Drill Rig

A land-based mining rig, Boart Longyear LF160 Drill Rig (Appendix A, Fig. A-3), would be temporarily installed on L/B *Robert*. This mobile drilling rig is designed for shallow hole drilling and is equipped with a FREEDOM series loader. The combined rig and loader offer hands-free rod handling with all operations (e.g., rod aligning or cycling, connecting the hoist plugs) happening from the control panel. All drilling operations during Expedition 501 would be conducted by Matrix Offshore Services. The project's mobile mining-style rig is up to 10.6 m high and is at least an order of magnitude smaller compared to derrick-based drill rigs. The LF160 features a low noise engine and pumps, both of which are located far from drilling area and within an acoustic enclosure. The drill rig has an A-weighted sound power level of 112 dB and an A-weighted sound pressure level (SPL) of 89 dB.

2.1.2.7 Drilling Operations

The proposed drilling strategy is to start at the shallowest site MV-08A and then move to sites MV-03C (or -10A) and MV-4C; however, some deviation in order may be determined necessary. Two boreholes would be drilled at each site, the first primarily for coring and logging, and the other to perform pumping tests. If conditions in the first borehole are favorable, an attempt to extract fresh water may be considered. The maximum drilled depth would be 550 m below seafloor (mbsf); however, penetration depth would be determined by drilling constraints, time, and porewater chemistry data. All boreholes would be drilled with a drill bit that has a maximum diameter of 14 cm (5.5 inches). A 6-5/8" buttress casing that would extend through the water column and into the uppermost portion of the borehole would allow for recirculation of the drilling fluids. The casing would be washed from the top-hole section into the seabed to create a "riser" with a natural seal allowing the system to recirculate all drill fluids. Seawater would be used for drilling which would be mixed with the water-based drilling fluid Pure-Bore®. This is a biodegradable, non-toxic additive for drilling fluids composed of mainly water, naturally occurring bentonite clay, and starch.

As much drill fluid (i.e., drill mud) as possible would be recycled by circulating it via a riser back to the liftboat. Indefinite mud recycling is not feasible for this project, and 3.8–5.7 m^3 of mud per week is anticipated to be released into the environment during drilling. Approximately 43 m^3 of drill cuttings or solids cut from the borehole (6.8 m^3 at each of the 3 cored boreholes; 7.6 m^3 at each of the 3 non-cored boreholes) are estimated to be released. The solids, comprising the sand-, silt- and mud-(stone) from the sub-seabed, would be discharged from the liftboat, leaving the solids on the seafloor in the vicinity of the borehole. Fine-grained solids and fluid mud mixture would be dispersed by local currents. When drilling has concluded, the casing would be removed from the top-hole section. Uncased sections of the boreholes are expected to naturally collapse. Natural collapse is the preferred abandonment method for all boreholes. A wide range of inner barrels would be available to handle the varied lithology or rock characteristics that may be encountered.

2.1.2.8 Corers

The wireline coring would be done using QD Tech 450 series tools. Two push-style samplers would be used to collect soft sediments — the 450 Hydraulic Piston Core and the 450 Extended Nose Punch Core. The piston corer would be used until quality or penetration rate drops in which case the punch corer would be used to reach the full depth. If seabed formations become harder or if the limitations of the other tools are reached, the 450 "Alien" IFlush-Extended Lithified/Rock Corer would be used. This Inner Tube Assembly places a full-face drill bit within the main outer bit. The coring tools have a nominal diameter of ~7.6 cm (3.0 inches) and polycarbonate plastic liners. Each core run would be 3 m in length if the formation conditions allow. Cores would be recovered to the deck and undergo initial labelling and sampling; cores would not be split at sea.

2.1.2.9 Logging

As soon as coring operations have completed, logging operations would commence. For Expedition 501, the downhole logging programme is coordinated by the European Petrophysics Consortium with logging services provided by the University of Montpellier. The tool suite available for the Expedition includes spectral and total gamma ray, sonic (P-wave velocity), formation conductivity and magnetic susceptibility, hydrogeological measurements (borehole fluid temperature and conductivity), caliper, flow meter, and NMR. Tool suite use is dependent on borehole conditions and stability, and logging would be prioritized based on borehole conditions. The suite of tools available would have the ability to collect multiple measurements in a single tool string run. It would be a lightweight assembly likely between 4.0 and 5.2 cm in diameter and not exceeding 5 m in length.

To characterize the porosity and permeability of formations, the novel technique of NMR logging through polyvinyl chloride (PVC) casing may be employed. NMR is a well logging method that determines a lithology's porosity by estimating the amount of water trapped in the formation. This is done by applying a magnetic field that disturbs the hydrogen nuclei in the water molecules, and measuring the electromagnetic signal created by the hydrogen atoms. The NMR tool does not contain any radioactive sources. Use of this tool is dependent on the Expedition's operations.

2.1.2.9 Borehole Observatory

Long-term seafloor borehole observatories may be installed in a maximum of two sites. If implemented, a simple cabled instrument for measuring parameters in-situ (SCIMPI) would be installed before abandoning the borehole. The tool is installed into the borehole covering the length of the borehole and is deployed through the drill string or hollow drill pipe. A command module would extend a couple of meters out of the borehole and would rest on the seafloor adjacent to the borehole; it would not float in the water column. The command module would be connected to the sensors in the borehole with cable that is rubber coated to prevent it from looping or tangling. These observatories would measure pressure, temperature, and resistivity at pre-defined subsurface depths. The observatories would remain in place for multiple years with periodic recovery of data and replacement of the command module. The installation of these long-term observatories would be determined based on operational time and pump test success.

2.1.3 Best Management Practices, Mitigation Measures, and Monitoring

Best management practices (BMPs), mitigating measures and monitoring are an integral part of the proposed Expedition. The BMPs and measures are designed to protect the marine life and environment, dispose of waste materials in a manner consistent with applicable standards, and store and transport samples in such a way as to prevent contamination of the environment (NSF 2019). The BMPs pertain to the L/B *Robert*; drilling and coring activities; scientific research-related activities; air emissions; discharges; solid and hazardous waste, and prevention of accidental releases. These general BMPs are described in detail in the IODP-USIO PEIS and bridging document and are not repeated here.

Site-specific mitigation measures are also described in the IODP-USIO PEIS and bridging document, and are further described below for the proposed Expedition. They occur in two phases: pre-cruise planning and operations. Mitigation of potential impacts from the proposed activities begins during the planning phase. Planning efforts include a review of the proposed Expedition's activities to ensure that science-related objectives can be achieved while minimizing or eliminating adverse environmental impacts. The review intends to identify safe drilling locations, environmentally safe drilling methods, site-specific sensitive environments, or special conditions warranting site-specific mitigating measures to minimize potential impacts to these resources. The following sections describe the efforts during both stages for the proposed Expedition.

2.1.3.1 Planning Phase

The review process and Expedition planning include the following:

- Identify the biological resources at proposed drill sites, including pertinent information such as presence of sensitive species, threatened or endangered species habitats, known breeding/feeding grounds or migration routes, or seasonal distribution patterns.
- Identify known (mapped) or suspected cultural resources at proposed drill sites, including availability of alternate drill sites.
- During pre-cruise planning efforts, avoid planning expedition activities at drill sites such as the following:
    - o Steep slopes that may impose significant risks to drilling and coring equipment;
    - o Areas where biologically sensitive species may be present;
    - o Areas characterized as critical marine mammal habitats, breeding or feeding grounds, native hunting areas, or migration pathways;
    - o Regions warranting special mitigating measures to protect marine mammals from acoustic outputs, such as areas characterized by the presence of rare or sensitive species (e.g., North Atlantic right whale), or specific regions where certain species are suspected to concentrate, such as submarine canyons on continental slopes believed to be preferred by beaked whales;
    - o Areas containing significant cultural resources;
    - o Sites within the International Maritime Organization (IMO) Traffic Separation Schemes or Precautionary Areas.

- Minimize seafloor terrain alteration by selecting the optimum number of boreholes to be drilled and site conditions needed to meet specific scientific objectives.
- Based on site characterization data or to address observed site conditions, modify proposed activities as needed or develop site-specific mitigating measures to:
  - o Reduce intensity or duration of discharges from drilling and coring operations to reduce or avoid adverse impacts to known biological resources such as sensitive benthic communities;
  - o Reduce intensity of acoustic outputs, change timing of an expedition, or select alternate sites to reduce or avoid impacts to marine mammals in critical habitats, breeding or feeding grounds, native hunting areas, or migration pathways;
  - o Relocate drilling activities to preapproved alternate drill sites to avoid adverse impacts to densely populated benthic communities or marine mammal habitats or populations.
- Incorporate modified activities and customized mitigating measures into the Operating Plan and Scientific Prospectus for each expedition.
- Perform supplemental environmental reviews (Environmental Evaluations) to evaluate site-specific risk and incorporate additional mitigating measures to reduce risks or avoid adverse impacts if any of the following conditions are anticipated at proposed drill sites:
  - o Densely populated benthic communities;
  - o Sensitive benthic communities or ecosystems;
  - o Endangered or threatened species;
  - o Marine organisms potentially sensitive to acoustic sources; and/or
  - o Fisheries or aquaculture resources.

The Environmental Evaluations are formally approved by NSF prior to starting operations in areas where the condition(s) listed may exist. For the proposed Expedition, an Environmental Evaluation/ Environmental Assessment were required due to the aforementioned conditions, and because of the replacement of the SODV *JOIDES Resolution* with the L/B *Robert*.

The PIs, along with IODP^3 and NSF, considered potential times to carry out the proposed Expedition; key factors taken into consideration included environmental conditions (i.e., the seasonal presence of marine mammals, sea turtles, and seabirds), weather conditions, equipment, and optimal timing for other proposed IODP^3 studies. Most species of marine mammals are expected to occur in the proposed Expedition area throughout the year (DoN 2005), although the occurrence of baleen whales, other than right whales, peaks in the waters south of Nantucket and Martha's Vineyard during spring/summer (Stone et al. 2017). In contrast, the occurrence of North Atlantic right whales typically peaks off Nantucket and Martha's Vineyard during winter/spring (Leiter et al. 2017; Stone et al. 2017; O'Brien et al. 2022), and this area is thought to be an important feeding habitat at that time of the year (Leiter et al. 2017; Stone et al. 2017). However, the Expedition would avoid all active feeding grounds, including the important feeding grounds of the Great South Channel, Massachusetts Bay, Cape Cod Bay, and Jeffreys Ledge, as it would occur during late spring and summer. In addition, the Expedition would not take place near calving areas which are located to the south. Hurricane season typically occurs during June–November. Late spring/summer was determined to be the most practical timing for the proposed Expedition based on the occurrence of marine mammals, weather conditions, other operational requirements, and availability of researchers.

2.1.3.2 Operational Phase

The mitigating measures and monitoring designed to protect marine life and environment, as outlined in the IODP-USIO PEIS and bridging document, and additional measures that would be adopted during the proposed operational phase of the Expedition include:

- **Drilling and Coring Operations**
  - o Minimize deposition of used material or debris on the seafloor.
  - o If a primary drill site is unsuitable, an alternate location must be used to achieve research objectives.
  - o If sensitive benthic communities or cultural resources are anticipated at a drill site, inspect or survey the seafloor prior to drilling to identify conditions that may require modifying drilling operations or developing additional mitigating measures to reduce risks or avoid adverse impacts.
- **Research-Related Activities**
  - o There would be limited use of the dynamic positioning system to position the platform (L/B *Robert*) at each borehole, as the Expedition would use a fixed platform during drilling operations.
  - o In active fishery areas, use trawl-resistant devices for borehole completion structures (e.g., re-entry cones, CORKs) placed on the seafloor.
- **Accidental Events**
  - o Develop site-specific procedures and contingencies to avoid geological hazards and prevent or minimize environmental releases and incorporate these procedures into the operating plan and *Scientific Prospectus* for each expedition. Examples of possible recommendations include (1) selecting alternate drill sites; (2) performing a specific drilling sequence; (3) limiting drilling depths; and (4) performing additional monitoring to address site-specific conditions.
  - o Continuously monitor petroleum volatile hydrocarbon content in recovered cores to detect potential penetration of an oil or gas accumulation and to distinguish potentially hazardous accumulations of hydrocarbons from the background of the normal increase in hydrocarbon content with depth.
  - o If geochemical data indicate that a formation with elevated hydrocarbon content may be penetrated while drilling, cease drilling operations and plug the borehole with heavy mud.
- **Vessel Strike Avoidance**
  - o Crew would perform lookouts for marine mammals (specifically North Atlantic right whales) during vessel transits for vessel strike avoidance.
  - o All project vessels would observe the NMFS North Atlantic Right Whale Vessel Speed Rule and limit speeds to 10 knots (the maximum speed of L/B *Robert* is 6 knots).
  - o Vessels would operate at “Idle/No Wake” speeds (a) while in any project construction areas, (b) while in water depths where the draft of the vessel provides less than four feet of clearance from the bottom, or (c) in all depths after a protected species has been observed in and has recently departed the area.
  - o When a protected species is sighted, vessels will attempt to maintain a distance of 150 feet or greater between the animal and the vessel.
  - o When dolphins are bow- or wake-riding, maintain course and speed as long as it is safe to do so.
  - o If a whale is sighted in the vessel’s path or within 300 feet from the vessel, reduce speed and shift the engine to neutral.
  - o If a whale is sighted farther than 300 feet from the vessel, maintain a distance of 300 feet or greater between the whale and the vessel and reduce speed to 10 knots or less.

2.2 Alternative 1: No Action Alternative

An alternative to conducting the Proposed Action is the "No Action" alternative, i.e., do not conduct the research operations (Table 2). Under the "No Action" alternative, NSF would not support IODP[3] to conduct the proposed research. Although the No-Action Alternative is not considered a reasonable alternative because it does not meet the purpose and need for the Proposed Action, it is included and carried forward for analysis in § 4.3. Table 2 provides a summary of the Proposed Action and the alternative.

TABLE 2. Summary of Proposed Action, Alternative Considered, and Alternatives Eliminated.

Proposed Action	Description
Proposed Action: Conduct marine research in the Northwest Atlantic	Under this action, research activities are proposed to study Earth processes and would involve drilling and liftboat operations. Active drilling would be expected to take ~96 days and transit would require ~4 days, for a total of 100 days. The affected environment, environmental consequences, and reasonably foreseeable impacts of the proposed activities are described in § III and IV. The general BMPs and site-specific mitigation measures and monitoring (as detailed in the IODP-USIO PEIS and bridging document) would apply, along with any additional requirements identified by regulating agencies in the U.S. All necessary permits and authorizations would be requested from regulatory bodies.
Alternatives	Description
Alternative 1: No Action	Under this Alternative, no proposed activities would be conducted, and data would not be collected. While this alternative would avoid any impacts to marine resources, it would not meet the purpose and need for the Proposed Action. Geological data of scientific value that would provide new insights to offshore freshwater resources would not be collected, and the collection of new data, interpretation of these data, and introduction of new results into the greater scientific community and applicability of these data to other similar settings would not be achieved. No permits and authorizations would be needed from regulatory bodies, as the Proposed Action would not be conducted.
Alternatives Eliminated from Further Analysis	Description/Analysis
Alternative E1: Alternative Location	An alternative location would not meet the purpose and need for the Proposed Action. The continental shelf that extends south from MA exhibits seismic anomalies that have been interpreted as offshore freshwater resources. Thus, there are no other locations outside of this region where this study could be conducted.

2.3 Alternatives Considered but Eliminated from Further Analysis

2.3.1 Alternative E1: Alternative Location

An alternative location is not considered a reasonable alternative because it does not meet the purpose and need for the Proposed Action. The continental shelf extending south from MA has experienced numerous glaciations and sea-level fluctuations which have been suggested as driving mechanisms for freshwater emplacement. The Proposed Action builds on seismic data that were collected in 2009 and the experience from IODP Expedition 313. The proposed sites also build on information gathered from boreholes previously drilled at Martha's Vineyard (ENW-05) and Nantucket (6001), previous Atlantic Margin Coring and IODP analyses, and geophysical observations. The proposed drill sites were selected to target resistive anomalies interpreted to reflect freshened groundwater (see Gustafson et al. 2019). In addition, proposing alternative locations would result in a significant delay of planned studies for 2025 and beyond, depending on the timing of the decision. Thus, there are no other locations outside of this region that would meet the purpose of the Expedition.

III AFFECTED ENVIRONMENT

In this Draft EA, the description of the affected environment focuses only on those resources potentially subject to impacts. Accordingly, the discussion of the affected environment (and associated analyses) focuses mainly on those related to marine biological resources, as the proposed short-term marine activity has the potential to impact those resources within the project area. These resources, along with fisheries, cultural resources, and biologically sensitive areas are identified in § III, and the potential impacts to these resources are discussed in § IV. Potential direct impacts on marine water quality, sea bottom and sediment quality, and catastrophic events are described in the IODP-USIO PEIS and are not discussed further here. Additionally, an initial review and analysis of the proposed Project activity determined that the following resource areas did not require further analysis in this EA:

- *Air Quality*—Project vessel emissions would result from the proposed activity; however, these short-term emissions would not result in any exceedance of Federal Clean Air standards. Emissions would be expected to have a negligible impact on the air quality within the proposed Expedition area.
- *Land Use*—All activities are proposed to occur in the marine environment. Thus, no changes to current land uses or activities in the proposed Expedition area would result from the Project.
- *Safety and Hazardous Materials and Management*—No hazardous materials would be generated or used during the proposed activities. All Project-related wastes would be disposed of in accordance with international, U.S. state, and federal requirements.
- *Geological Resources (Topography, Geology and Soil)*—The proposed Project would result in minor, temporary disturbances to seafloor sediments from liftboat operations. The proposed activities would not significantly impact geologic resources.
- *Water Resources*—No discharges to the marine environment that would adversely affect marine water quality are expected in the Project area. Therefore, there would be no impacts to water resources resulting from the proposed Expedition.
- *Terrestrial Biological Resources*—All proposed Project activities would occur in the marine environment and would not impact terrestrial biological resources;
- *Visual Resources*—No visual resources would be expected to be negatively impacted as the proposed activities would be short-term (~100 days) and the vessel would be located at least 32 km from the coast during drilling operations.
- *Socioeconomics*—Implementation of the proposed project would not affect, beneficially or adversely, socioeconomic resources, or the protection of children. No changes in the population or additional need for housing or schools would occur. Activities from the project would have no effects on solid structures. Although numerous shipwrecks occur near the Expedition area, shipwrecks would be avoided; thus, no significant impacts on shipwrecks would be expected. Although there are a number of shore-accessible SCUBA dive sites off MA (see Section 3.9), most of the dive sites south of Cape Cod are located in Nantucket Sound or Vineyard Sound. The closest known dive site to the drill sites (MV-08A) is located ~42 km to the northwest, south of Martha's Vineyard. Other anthropogenic activities in the area would include fishing, other vessel traffic, and whale watching. Given the relatively short and temporary duration of the Expedition, it would be unlikely that the whale watching industry

would be affected by the Proposed Action. For this reason, this issue is only considered in the context of reasonably foreseeable effects (See 4.1.6.6). Fishing and potential impacts to fishing are described in further detail in Sections 3.7 and 4.1.2, respectively. No other socioeconomic impacts would be anticipated as a result of the proposed activities.

3.1 Physical Environment and Oceanography

As a result of processes such as glaciation, volcanism, erosion, and sea level rise, the bathymetry off the U.S. east coast varies considerably from the Gulf of Maine to Cape Hatteras, NC. The continental shelf extends over much of the Gulf of Maine and northeastern U.S. waters, continues south as the Mid-Atlantic Bight (MAB), and tapers very narrowly off Cape Hatteras. From Florida to Cape Cod, the continental shelf has a very gradual slope with a relatively uniform seafloor and is relatively shallow. Northeast of Cape Cod and into the Gulf of Maine, the continental shelf is marked with considerable seafloor relief attributable to glaciation. Georges Bank to the east of New England forms a massive shoal and is flanked to the west and northeast by two channels—the Northeast and Great South Channels. Shallow waters, strong currents, and tidal forces contribute to year-round well-mixed and productive waters over Georges Bank (Bumpus 1976 *in* DoN 2005). The continental shelf break, where it transitions into slope waters, features an abrupt change to a steep gradient. Several canyons and seamounts characterize the slope and offshore waters of the Northwest Atlantic Ocean, and both types of oceanographic features tend to contain higher biological productivity than surrounding slope and deep waters. Currents on and around Georges Bank move clockwise and generally southwesterly as part of the coastal current system from the North Atlantic; productive frontal boundaries often form on the edges of the bank or near the slope (DoN 2005). The Gulf of Maine and Bay of Fundy exhibit extreme semidiurnal tidal changes; tidal currents rotate clockwise in the Gulf of Maine with well-mixed, cold waters, promoting a region of high productivity.

Three water masses determine the physical environment off the U.S. east coast: coastal or shelf waters, slope waters, and the Gulf Stream (summarized in DoN 2005). Coastal waters from the North Atlantic, mostly originating in the Labrador Sea, move southwesterly over the continental shelf until reaching Cape Hatteras, where they are entrained between slope waters and the Gulf Stream (DoN 2005). The continental slope waters of the western North Atlantic are marked by mixing of colder shelf waters and the warm Gulf Stream; continental slope waters are strongly influenced by wind, tides, and variability in the Gulf Stream. The Gulf Stream is a strong ocean current that brings warm water from the Gulf of Mexico into the cooler North Atlantic Ocean. It flows through the Straits of Florida and then parallel to the continental margin, becoming stronger as it moves northward. It has a mean speed of 1 m/s; its surface speed is higher in summer than in winter. It turns seaward near Cape Hatteras and moves northeast into the open ocean. Slope waters in the mid-Atlantic are a mixture of water from the shelf and the Gulf Stream. North of Cape Hatteras, an elongated cyclonic gyre of slope water that forms because of the southwest flow of coastal water and the northward flowing Gulf Stream, is present most of the year and shifts seasonally relative to the position of the north edge of the Gulf Stream. South of Nantucket and Martha's Vineyard, surface currents flow in a westerly direction (DoN 2005). The Gulf Stream works as an oceanographic barrier separating the warm tropical waters found to the south, and the southeast U.S. shelf is protected from subarctic influences because the Gulf Stream convergences with the coast near Cape Hatteras (Aquarone 2009).

The shelf waters from Cape Hatteras to southern Cape Cod are part of the MAB. The shelf is dominated by a sandy to muddy-sandy bottom (Steimle and Zetlin 2000; USGS 2000 *in* DoN 2005). Sea surface temperatures vary seasonally, sometimes with more than a 20ºC temperature flux throughout the year along the coast (summarized in DoN 2005). The water column of the shelf becomes stratified in the spring as the water warms and is fully stratified throughout the summer, i.e., warmer, fresher water accumulates at the surface and denser, colder, more saline waters occur near the seafloor (DoN 2005). However, nearshore salinities are usually lower than salinities farther offshore because of terrestrial freshwater inputs. The stratification breaks down in fall because of mixing by wind and surface cooling (Castelao et al. 2008). Summer upwelling occurs, where nutrient-rich cold water is brought closer to the surface and stimulates primary production (DoN 2005). Phytoplankton abundance in shelf waters also varies seasonally: low light levels and strong mixing in winter limit primary productivity, but the mixed layer becomes shallower and light levels increase to promote phytoplankton blooms from early until late spring, when stratification of the water column limits nutrients in the sun-rich top layers. Copepods dominate the zooplankton community of New England shelf waters, and abundances are highest on the outer shelf in spring and on the inner shelf during the summer (Wiebe et al. 2002). The Northeast U.S. Continental Shelf Large Marine Ecosystem (LME) which is a Class I highly productive ecosystem, with a primary productivity of >300 $gCm^{-2}yr^{-1}$ (Aquarone and Adams 2009). This LME includes four regions: Gulf of Maine, Georges Bank, Southern New England, and MAB.

3.2 Protected Areas

3.2.1 Marine Sanctuaries and Restricted Areas

Several marine sanctuaries have been established off New England, primarily with the intention of preserving cetacean habitat (Hoyt 2005). There are five ocean sanctuaries in MA: Cape Cod, Cape Cod Bay, Cape and Islands, North Shore, and South Essex (Commonwealth of Massachusetts 2025). Only one of these – Cape and Islands Ocean Sanctuary – occurs near the Expedition area (Fig. 1). These sanctuaries include most of the marine waters of MA, except Mount Hope Bay (Commonwealth of Massachusetts 2025). The sanctuaries extend out to three miles offshore or the limit of state waters (Commonwealth of Massachusetts 2025). These sanctuaries were established in the 1970s and are managed by MA Office of Coastal Zone Management (Commonwealth of Massachusetts 2025).

Prohibited activities in the sanctuaries include drilling or removal of gases or oils, commercial advertising, and incineration of refuses on, or in, vessels; activities prohibited with exceptions include dumping or discharge of waste, drilling or removal of minerals, construction or operation of offshore or floating electric generating stations; and the building or laying of structures on the seabed or subsoil (Commonwealth of Massachusetts 2025). The Cape & Islands Ocean Sanctuary includes nearshore waters of southern Cape Cod, Martha's Vineyard, and Nantucket; it is the closest sanctuary to the proposed Expedition sites, located ~26 km north of MV-08A (Fig. 1). The Stellwagen Bank National Marine Sanctuary is located in the Gulf of Maine, far north of the proposed drill sites. The entirety of the Gulf of Maine and the Great South Channel are designated as North Atlantic right whale critical habitat, which is described further in section 3.2.2, below. However, the proposed drill sites are not located within any marine protected areas, marine sanctuaries, or critical habitat. In addition to the marine sanctuaries in state waters, there is a National Monument on the seaward edge of Georges Bank southeast of Nantucket. The Northeast Canyons and Seamounts Marine National Monument encompasses 4,913 square miles of biodiverse canyons and seamounts protecting fragile deep-sea corals, endangered whales, sea turtles, and other marine life (NOAA Fisheries 2025a). It is located ~150 km southeast of the proposed drill sites and is not discussed further.

There are several areas off MA that are closed to commercial fishing on a seasonal basis to reduce the risk of entanglement or incidental mortality to marine mammals (NOAA Fisheries 2022; Appendix B). To protect large whales like North Atlantic right, humpback, and fin whales, NMFS has implemented seasonal restricted areas that prohibit trap/pot fishing that uses persistent (traditional) buoy lines in the Great South Channel Area from April through June, and from February through April in the Massachusetts Restricted Area (Massachusetts Bay, Cape Cod Bay, and from Cape Cod to Nantucket) and the South Islands Restricted Area (south of Martha's Vineyard and east including Nantucket) (NMFS 1999, 2008, 2021).

3.2.2 Critical Habitat, Seasonal Management Areas, and Dynamically Managed Areas

Currently, there are no critical habitats, seasonal management areas (SMAs), or dynamically managed areas (DMA) located at the Expedition site. Along the U.S. East Coast, there is critical habitat for North Atlantic right whale and loggerhead sea turtle, as well as several fish species; critical habitat has also been proposed (in 2023) for the green sea turtle. The North Atlantic right whale critical habitat is located at least 60 km northeast of the Expedition sites, and the closest SMA is located ~27 km west of Expedition site MV-08A (Fig. 1). The right whale critical habitat and SMAs are described in further detail below. Critical habitat (designated or proposed) for sea turtles is located more than 300 km south of the proposed drill sites and is not described in further detail. Critical habitat for the Gulf of Maine DPS of Atlantic salmon includes perennial river, stream, estuary, and lake habitat along the Gulf of Maine and is not described further in this section. Critical habitat in rivers and creeks has also been designated for various DPSs of the Atlantic sturgeon (NOAA Fisheries 2025b). It is described further in Section 3.6.1.

Critical habitat for North Atlantic right whales was first designated in 1994 (NMFS 1994). In 2016, the critical habitat designation was revised to include areas that support the species' recovery (NMFS 2016a). NMFS designated 102,084 km^2 of combined and expanded critical habitat for North Atlantic right whales in the Gulf of Maine and Georges Bank region (Unit 1) and off the Southeast U.S. coast (Unit 2) (NMFS 2016a) Unit 1 is the Northeastern U.S. Foraging Area; it is located at least 60 km from the proposed drill sites (Fig. 1). The boundaries for Unit 1 extend south from the U.S./Canada border along the coast to Cape Cod, MA and out to the EEZ and George's Bank (NOAA Fisheries 2025a). This area has been identified as an important foraging area due to the physical and biological features present. The oceanographic conditions and structures present in the Gulf of Maine and Georges Bank region, including prevailing currents and circulation patterns, oceanic fronts, and temperature regimes support dense aggregations of the copepods *Calanus finmarchicus*, which is an important food source for right whales (50 CFR § 226.203). Unit 2 off the southeastern U.S. is recognized as critical for calving right whales; mother-calf pairs are consistently observed there, particularly during January and February (NMFS 2016a). Unit 2 is not located near the Expedition area and is not discussed further.

Impacts with vessels are a concern for North Atlantic right whale conservation, and detection is key. To reduce collisions, reporting systems have been put in place within the right whale's U.S. range, including monitoring equipment that provide sightings in near real-time (NOAA Fisheries 2025c). In an effort to reduce ship collisions with North Atlantic right whales, the Right Whale Sighting Advisory System (RWSAS) was designed to alert ship traffic to the presence of right whales by mapping their locations (e.g., WhaleMap) using sighting information from numerous sources (e.g., aerial surveys, fishing vessels, general public). The RWSAS WhaleMap area includes the Expedition area and supply vessel routes.

In 1999, a Mandatory Ship Reporting System was implemented by the U.S. Coast Guard (USCG 1999, 2001). This reporting system requires specified vessels (larger than 300 GRT) to report their location while in the right whale critical habitat (Ward-Geiger et al. 2005). Mandatory ship reporting takes place from 15 November to 15 April in the southeastern U.S., in coastal waters within ~46 km of shore along a 167-km stretch of coast in Florida and Georgia. In the northeastern U.S., the reporting system is year-round and the geographical boundaries include the waters of Cape Cod Bay, Massachusetts Bay, and the Great South Channel. The Expedition area is not within the boundaries of the year-round mandatory reporting area.

In November 2006, NOAA established recommended shipping routes in key right whale aggregation areas at the entrances to three ports in Georgia and Florida from November through April, and in Cape Cod Bay from January to May (NOAA 2006). In July 2007, the Boston Traffic Separation Scheme (TSS) was realigned by a 12º shift in the northern leg, and the two traffic lanes were narrowed by 0.8 km each in an effort to reduce ship strike risk to right whales.

On 9 December 2008, NMFS established regulations to implement a uniform mandatory vessel speed restriction of 18.5 km/h (10 kt) or less for all vessels ~20 m (65 ft) or longer in specific locations known as SMAs along the U.S. East Coast during times when whales are likely present (NOAA 2008; NOAA Fisheries 2025c). The speed restrictions extend out to ~37 km around the major ports along the mid-Atlantic corridor. The restriction applies seasonally from the 15 November–15 April in the southeast calving grounds, 1 January–15 May in Cape Cod Bay, 1 March–30 April off Race Point at the northern end of Cape Cod, 1 April–31 July in the Great South Channel, and 1 November–30 April in the Block Island Sound SMA and near entrances to several ports along the mid-Atlantic corridor. The closest SMA to the proposed Expedition area, the Block Island Sound SMA, is located at least ~27 km west of the drill sites.

NOAA may also establish temporary DMAs in direct response to actual whale sightings (NOAA 2008), or Right Whale Slow Zones, which would be established in response to acoustic detections (NOAA Fisheries 2021a). Mariners are encouraged to avoid these areas or reduce speeds to 18.5 km/h (10 kt) or less while transiting through these areas. The size of a DMA or Slow Zone would be determined by the number of whales sighted. A DMA is established if 3 or more right whales are visually detected within a discrete area while a Slow Zone is established by both visual and acoustic detections (NOAA Fisheries 2025d). Once an area has been designated, the rule stays in effect for 15 days and may be extended for a further 15 days if whales remain in the area (NOAA 2008; NOAA Fisheries 2025d). For example, Woods Hole Oceanographic Institute operates a buoy off Martha's Vineyard that is used to acoustically detect right whales. On 29 January 2025, the buoy detected right whales southwest of Nantucket; NOAA then implemented a Slow Zone for 15 days (NOAA Fisheries 2025e). NOAA encourages all mariners/boaters to pre-emptively check the following NOAA resources for the latest sighting information and active right whale safety zones: SMAs and DMAs, RWSAS, Whale Alert, Right Whale Slow Zones (NOAA Fisheries 2025d). L/B *Robert* maximum cruising speed is 6 kt (11 km/h).

Spatial and temporal closures and gear modification requirements are also implemented for other species. To reduce fishery impacts on harbor porpoises, additional time and area closures in the Gulf of Maine may include fall, winter, and spring along the mid-coastal area, spring in Massachusetts Bay and southern Cape Cod, winter and spring in offshore areas, and February around Cashes Ledge (NOAA Fisheries 2015). The Expedition would occur in the Southern New England Management Area which requires gear modifications (e.g., pingers) from 1 December–31 May (NOAA Fisheries 2015).

Commercial ships (greater than 300 gross tons) must report to shore-based stations when entering designated right whale critical habitat areas to receive information on reducing right whale collision, precautionary measures the ship can employ to avoid a striking a whale, and recent sighting locations (NOAA Fisheries 2025d). A voluntary seasonal "Area To Be Avoided" for commercial ships is in effect from April 1 to July 31 each year. Recommended routes in key right whale habitats have also been established for four locations in Massachusetts, Georgia, and Florida (NOAA Fisheries 2025c).

3.3 Marine Mammals

Thirty cetacean species (6 mysticetes and 24 odontocetes) could occur near the proposed drill sites (Table 3). Six of the 30 species are listed under the U.S. Endangered Species Act (ESA) as ***endangered***: the North Atlantic right, humpback, blue, fin, sei, and sperm whales. General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of cetaceans are given in § 3.6.1 and § 3.7.1 of the NSF PEIS. The general distributions of mysticetes, odontocetes, and pinnipeds in this region of the Northwest Atlantic Ocean are discussed in the Northwestern Atlantic Detailed Analysis Area (DAA) in § 3.6.2.1, § 3.7.2.1, and § 3.8.2.1, of the NSF PEIS, respectively. The rest of this section focuses on species distribution in and near the proposed Expedition area in shelf waters south of Nantucket.

3.3.1 Mysticetes

3.3.1.1 North Atlantic Right Whale (*Eubalaena glacialis*)

The North Atlantic right whale occurs primarily in the continental shelf waters of the eastern U.S. and Canada, from Florida to Nova Scotia (Winn et al. 1986; Jefferson et al. 2015; Hayes et al. 2024). Although historically North Atlantic right whales showed a reliable seasonal north-south migration between northern spring/summer feeding areas and southern winter calving areas (Gaskin 1982), their predictable migration has changed, likely due to warming in the Gulf of Maine and resultant changes in North Atlantic right whale prey, the copepod *Calanus* (O'Brien et al. 2022). Prior to 2010, there were five well-known habitat areas in the Northwest Atlantic used annually by right whales: winter calving grounds in coastal waters of the southeastern U.S. (Florida/Georgia); late winter/spring feeding grounds and nursery grounds in Massachusetts Bay and Cape Cod Bay); spring feeding grounds in the Great South Channel (east of Cape Cod); summer/fall feeding and nursery grounds in the Bay of Fundy; and summer/fall feeding grounds on the Nova Scotian Shelf, Browns and Baccaro Banks, Roseway Basin, and areas to the east (Winn et al. 1986; O'Brien et al. 2022).

During fall, right whales are also often found at Jeffreys Ledge off New Hampshire and in the central Gulf of Maine (Weinrich et al. 2000; O'Brien et al. 2022). Morano et al. (2012) and Mussoline et al. (2012) indicated that right whales are present in the southern Gulf of Maine year-round. Although the previous feeding areas are still in use by right whales, new feeding areas have also emerged since 2010, likely due to a shift in prey distribution, and include the Gulf of St. Lawrence in Canada and the southern New England shelf (see O'Brien et al. 2022).

Biologically Important Areas (BIAs) for North Atlantic right whales were identified off the U.S. East Coast in 2015, including: (1) a migratory corridor BIA along the U.S. East Coast (including the Expedition area) for right whales migrating south to calving grounds in November and December and north to the feeding areas in March and April; (2) three feeding BIAs off New England, including (a) June and July, October to December on Jeffreys Ledge; (b) February to April on Cape Cod Bay and Massachusetts Bay; and (c) April to June in the Great South Channel and on the northern edge of Georges Bank; (3) a mating BIA in the central Gulf of Maine from November to January; and (4) a calving BIA in the southeast Atlantic from mid-November to late April (LaBrecque et al. 2015).

TABLE 3. The habitat, occurrence, population sizes, and conservation status of marine mammals that could occur in or near the proposed Expedition area south of Nantucket, MA, in the Northwest Atlantic Ocean.

Species	Habitat[1]	Occurrence in Expedition Area[2]	Abundance for U.S. East Coast[3]	US ESA[4]	IUCN[5]	CITES[6]
Mysticetes						
North Atlantic right whale	Coastal and shelf	Uncommon	372	E	CR	I
Fin whale	Coastal, pelagic	Common	6,802	E	VU	I
Blue whale	Pelagic	Rare	402[7]	E	EN	I
Sei whale	Pelagic	Uncommon	6,292[8]	E	EN	I
Minke whale	Coastal waters	Common	21,968[9]	NL	LC	I
Humpback whale *West Indies DPS*	Mainly nearshore and banks	Common	1,396[10] 11,570[11]	NL	LC	I
Odontocetes						
Sperm whale	Usually pelagic and deep seas	Uncommon	5,895[12]	E	VU	I
Pygmy sperm whale	Deeper waters off the shelf	Rare	9,474[13]	NL	LC	II
Dwarf sperm whale	Deeper waters off the shelf	Rare	9,474[13]	NL	LC	II
Cuvier's beaked whale	Pelagic	Rare	4,260	NL	LC	II
Northern bottlenose whale	Pelagic	Rare	27,464[15]	NL	NT	I
Gervais' beaked whale	Pelagic	Rare	8,595	NL	LC	II
Blainville's beaked whale	Pelagic	Rare	2,936	NL	LC	II
Sowerby's beaked whale	Pelagic	Rare	492	NL	LC	II
True's beaked whale	Pelagic	Rare	4,480	NL	LC	II
Bottlenose dolphin	Coastal, shelf, pelagic	Common	64,587[14]	NL	LC	II
Atlantic white-sided dolphin	Shelf and slope	Common	93,233	NL	LC	II
Pantropical spotted dolphin	Mainly pelagic	Rare	2,757	NL	LC	II
Atlantic spotted dolphin	Shelf, pelagic	Rare	31,506	NL	LC	II
Spinner dolphin	Mainly pelagic	Rare	3,181	NL	LC	II
Striped dolphin	Slope, pelagic	Rare	48,274	NL	LC	II
Risso's dolphin	Slope, pelagic	Uncommon	44,067	NL	LC	II
Common dolphin	Shelf, pelagic	Common	93,100	NL	LC	II
White-beaked dolphin	Shelf	Uncommon	536,016	NL	LC	II
Killer whale	Widely distributed	Uncommon	29,000[15]	NL	DD	II
False killer whale	Pelagic	Rare	1,298	NL	NT	II
Pygmy killer whale	Mostly pelagic	Rare	unknown	NL	LC	II
Short-finned pilot whale	Shelf, slope, pelagic	Uncommon	18,726	NL	LC	II
Long-finned pilot whale	Shelf, slope, pelagic	Uncommon	39,215	NL	LC	II
Harbor porpoise	Mostly coastal, shelf	Common	85,765	NL	LC	II
Pinnipeds						
Harbor seal	Coastal	Common	61,336	NL	LC	N.A.
Gray seal	Coastal	Common	27,911	NL	LC	N.A.
Harp seal	Coastal	Rare	7,600,000	NL	LC	N.A.
Hooded seal	Coastal	Rare	593,500[16]	NL	VU	N.A.

N.A. Not available/not applicable.

1 Typical habitat where species occurs.

2 Occurrence in area at the time of the Expedition; based on professional opinion and available data including sightings and densities.

[3] Abundance for the U.S. Atlantic or Western North Atlantic from U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessment (Hayes et al. 2024) unless otherwise indicated.
[4] U.S. Endangered Species Act: E = endangered, NL = not listed.
[5] International Union for the Conservation of Nature (IUCN) Red List of Threatened Species version 2024-2: CR = critically endangered; VU = vulnerable; NT = near threatened; LC = least concern; DD = data deficient.
[6] Convention on International Trade in Endangered Species of Wild Fauna and Flora: Appendix I = Threatened with extinction; Appendix II = not necessarily now threatened with extinction but may become so unless trade is closely controlled.
[7] Minimum population size for Western North Atlantic.
[8] Nova Scotia.
[9] Canadian East Coast.
[10] Gulf of Maine.
[11] Entire North Atlantic (Stevick et al. 2003).
[12] North Atlantic.
[13] *Kogia* spp.
[14] Offshore stock.
[15] Estimate for North Atlantic (NAMMCO 2025).
[16] Total population size (Hammill and Stenson 2006).

The majority of the right whale population is unaccounted for on the southeastern U.S. winter calving ground, and not all reproductively-active females return to the area each year (Kraus et al. 1986; Winn et al. 1986; Kenney et al. 2001). Other wintering areas have been suggested, based on sparse data or historical whaling logbooks, including the Gulf of St. Lawrence, Newfoundland and Labrador, coastal waters of the northeastern U.S., Bermuda, and Mexico (Payne and McVay 1971; Aguilar 1986; Mead 1986; Lien et al. 1989; Knowlton et al. 1992; Cole et al. 2009; Patrician et al. 2009). Surveys off North Carolina during the winter of 2001 and 2002 reported eight calves, suggesting that there could be a calving area as far north as Cape Fear (Hayes et al. 2024). North Atlantic right whales are also known to occur in southern New England shelf waters during the winter (e.g., Leiter et al. 2017; Stone et al. 2017; O'Brien et al. 2022).

Right whales are generally not gregarious, usually occurring singly or in small, transitory groups although in prime feeding habitats, aggregations of up to 150 can be seen (Reeves et al. 2002). Right whale courtship groups consist of 2 to 14 whales and are known as "surface active groups" (Kraus and Hatch 2001; Leiter et al. 2017); these groups have been observed year-round in all high-use habitats (DoN 2005). Right whales forage at a range of depths, with surface feeding (skim-feeding) predominating in late winter and spring, deeper dives into the water column occurring in summer and fall, and sporadic feeding activity observed near the seafloor (Gavrilchuck et al. 2020). Feeding dives are characterized by rapid descent to depths of 80–175 m for 5–14 min and then rapid ascent back to the surface (Goodyear 1993; Baumgartner and Mate 2003). Mother/calf pairs have shorter dives and longer surface intervals than single whales, suggesting that they could be more at risk of ship collisions (Baumgartner and Mate 2003).

Right whales must locate and exploit very dense patches of prey (zooplankton) in order to feed efficiently (Fortune et al. 2013). Temporal and spatial formations of zooplankton concentrations have been correlated with shifts in the distribution of right whales on feeding grounds (Meyer-Gutbrod et al. 2023). Shifts in copepod abundance are thought to significantly impact the North Atlantic right whale population, as calving rates have been linked to the abundance of prey; the calving rate remained stable when the abundance of the copepod *Calanus* was high, but it fell when the abundance of *Calanus* declined in the late 1990s and 2010s (Greene et al. 2003; Meyer-Gutbrod et al. 2015; Gavrilchuk et al. 2021).

Knowlton et al. (2002) provided an extensive and detailed analysis of survey data, satellite tag data, whale strandings, and opportunistic sightings along State waters of the mid-Atlantic, from the border of Georgia/South Carolina to south of New England, spanning the period from 1974 to 2002. The majority of sightings (94%) during migration were within 56 km of shore, and more than half (64%) were within 18.5 km of shore. Water depth preference was for shallow waters; 80% of all sightings were in depths

<27 m, and 93% were in depths <45 m (Knowlton et al. 2002). Most sightings farther than 56 km from shore occurred at the northern end of the corridor, off New York and south of New England.

Hayes et al. (2024) show many sightings on the shelf of the U.S. East Coast between 2018 and 2023, including near the proposed drill sites. DoN (2005) reported sightings of right whales off New England, including the Expedition area, throughout the year. Southern New England has shown a marked increase in year-round presence and residency of right whales post 2010 (e.g., Davis et al. 2017; Leister et al. 2017; Stone et al. 2017), with nearly a quarter of the population utilizing those waters from December to May (Quintana-Rizzo et al. 2021). O'Brien et al. (2022) also documented an increase in right whale abundance in this region when comparing survey data from 2017–2019 with those from 2013–2015, as well as year-round occurrence in the area since 2017. The area south of Nantucket and Martha's Vineyard has been identified as a novel U.S. foraging area in southern New England (Leiter et al. 2017; Stone et al. 2017).

During surveys south of Nantucket and Martha's Vineyard from 2011 and 2015, the greatest number of sightings were reported during the months of February and March, including near the proposed drill sites (Kraus et al. 2016; Leiter et al. 2017; Stone et al. 2017). During those surveys, annual sightings per unit effort near the proposed drill sites ranged from zero to 50–105 right whales per 1000 km, with the area around drill site MV-03C identified as a "hot spot" during March–May (Leiter et al. 2017). No right whales were sighted during summer or fall during those surveys. In the OBIS database, there are 242 sightings since 1970 for the proposed Expedition area south of Nantucket and Martha's Vineyard, including 18 sightings during May–August (OBIS 2025). On WhaleMap, there are over 7,000 definite sighting records and over 2,500 definite acoustic detection records of North Atlantic right whales off MA between 2010 and 2025; most sightings were made between November and April (Johnson et al. 2021). Near the proposed drill sites, there were over 1,800 sightings and 1,100 acoustic detections (Johnson et al. 2021).

Acoustic detections have been made year-round from Cape Hatteras to MA, including New England (e.g., Whitt et al. 2013; Salisbury et al. 2016; Estabrook et al. 2022; Kowarski et al. 2022; Murray et al. 2022; PACM 2025). Detections off MA, including the Expedition area, peak in winter and spring, with an increase in detections beginning in December and ending in April, although detections are made throughout the year (Davis et al. 2017, 2020, 2023; Leiter et al. 2017; Palka et al. 2021; PACM 2025). Acoustic recorders located in and near the Expedition area during 2021–2022 detected right whales throughout the year, with the highest right whale presence from October to April (Davis et al. 2023). Based on sightings and acoustic data, North Atlantic right whales could occur near the proposed drill sites at the time of the Expedition, in particular during May, but they are less likely to occur there from June–August.

3.3.1.2 Humpback Whale (*Megaptera novaeangliae*)

The humpback whale is found throughout all oceans of the world (Clapham 2018). Based on genetic data, there could be three subspecies occurring in the North Pacific, North Atlantic, and Southern Hemisphere (Jackson et al. 2014). It is highly migratory, undertaking one of the world's longest mammalian migrations by traveling between mid- to high-latitude waters where it feeds during spring to fall and low-latitude wintering grounds over shallow banks, where it mates and calves (Winn and Reichley 1985; Bettridge et al. 2015). Although considered to be mainly a coastal species, humpback whales often traverse deep pelagic areas while migrating (Calambokidis et al. 2001; Garrigue et al. 2002, 2015; Zerbini et al. 2011).

In the western North Atlantic, the humpback whale occurs from Greenland to Venezuela (Würsig et al. 2000). Based on modeling for the western North Atlantic, higher densities of humpbacks are expected to occur north of 35°N during the summer; very low densities are expected south of 35°N (Mannocci et al. 2017; Palka et al. 2021; Roberts et al. 2023). For most North Atlantic humpbacks, the summer feeding grounds range from the northeast coast of the U.S. to the Barents Sea (Katona and Beard 1990; Smith et al. 1999). In the winter, the majority of humpback whales migrate to wintering areas in the West Indies (Smith et al. 1999); this is known as the West Indies Distinct Population Segment (DPS) (Bettridge et al. 2015). Some individuals from the North Atlantic migrate to Cape Verde to breed (e.g., Wenzel et al. 2009); however, a small proportion of the Atlantic humpback whale population remains in high latitudes in the eastern North Atlantic during winter (e.g., Christensen et al. 1992). Feeding areas have no DPS status (Bettridge et al. 2015; NMFS 2016b).

In the Northwest Atlantic, a Gulf of Maine stock of humpback whale is recognized off the northeastern U.S. coast as a distinct feeding stock (Palsbøll et al. 2001; Vigness-Raposa et al. 2010; Hayes et al. 2020). Whales from this stock feed during spring, summer, and fall in areas ranging from Cape Cod to Newfoundland. Greatest concentrations of humpback whales in spring occur in the western and southern edges of the Gulf of Maine. During the summer and fall, their greatest concentrations are found throughout the Gulf of Maine and east of Cape Cod (Clapham et al. 1993; DoN 2005; Hayes et al. 2020; Roberts et al. 2023). From December to March, there are few occurrences of humpback whales over the continental shelf of the Gulf of Maine, Cape Cod, and Massachusetts Bay (Clapham et al. 1993; DoN 2005; Roberts et al. 2023). Low numbers of humpbacks are thought to remain during the winter over the continental shelf from the Gulf of Maine to Georges Bank (DoN 2005; Roberts et al. 2023).

A humpback whale feeding BIA was been identified off New England from March through December, including the Gulf of Maine, Stellwagen Bank, and the Great South Channel (LaBrecque et al. 2015). The highest numbers of humpback whales off New England waters occurs from mid-April to mid-November, where they can be found near Stellwagen Bank, Jeffreys Ledge, the Great South Channel, the edges and shoals of Georges Bank, and Cashes Ledge (DoN 2005; Hayes et al. 2020), as well as within the Expedition area south of Nantucket and Martha's Vineyard (Roberts et al. 2023). Numerous sightings have been made during summer surveys in the Expedition area south of Nantucket and Martha's Vineyard (Hayes et al. 2020). DoN (2005) also reported sightings of humpbacks off New England throughout the year, with peak occurrence during spring and summer. During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, 82 sightings were made, with the highest sighting rates during summer, followed by spring (Kraus et al. 2016; Stone et al. 2017). Humpback whales have also been detected acoustically off New England, including in the Expedition area south of Nantucket and Martha's Vineyard, throughout the year (Davis et al. 2020; PACM 2025); the greatest number of detections days were reported from winter through summer (Davis et al. 2020). In the OBIS database, there are 210 sightings since 1970 for the proposed Expedition area south of Nantucket and Martha's Vineyard, including 104 sightings during May–August (OBIS 2025). Humpback whales could occur near the proposed drill sites.

3.3.1.3 Common Minke Whale (*Balaenoptera acutorostrata scammoni*)

The minke whale has a cosmopolitan distribution that spans from tropical to polar regions in both hemispheres (Jefferson et al. 2015). In the Northern Hemisphere, the minke whale is usually seen in coastal areas, but can also be seen in pelagic waters during its northward migration in spring/summer and southward migration in autumn (Stewart and Leatherwood 1985). There are four recognized minke whale populations in the North Atlantic largely based on feeding grounds: Canadian east coast, west Greenland, central North Atlantic, and northeast Atlantic (Donovan 1991). Although some minke whale populations have been well studied on summer feeding grounds, information on wintering areas and migration routes is lacking (Risch et al. 2014).

Based on habitat modeling for the western North Atlantic, higher densities are expected to occur north of 35°N from April through October, with lower densities south of 35°N (Mannocci et al. 2017; Palka et al. 2021; Roberts et al. 2023). Minke whales are common off the northeastern U.S. coast over continental shelf waters from spring to fall (CETAP 1982; DoN 2005; Hayes et al. 2024). Seasonal movements in the Northwest Atlantic are apparent, with animals moving south and into offshore waters from late fall through early spring (DoN 2005; Roberts et al. 2023; Hayes et al. 2024). Risch et al. (2013) deployed acoustic detectors in the Stellwagen Bank National Marine Sanctuary to detect minke whale occurrence. They found that minke whales migrate north of 30°N from March to April and migrate south from mid-October to early November. Detections generally increased over the month of August and peaked in September and October, with no detections during January or February, and only a few detections from March to June. During spring migration, animals migrate along the continental shelf, whereas they migrate farther offshore during fall. In the southeastern U.S., minke whales are commonly detected during winter (Risch et al. 2013; Kiehbadroudinezhad et al. 2021). The lack of acoustic detections in the southeastern U.S. during summer indicates either absence of minke whales at that time of year or a change in vocal behavior at different times of the year (Risch et al. 2013). Detections were made in Canadian waters during the summer, suggesting most minke whales likely occur there during the summer (Risch et al. 2013).

Two minke whale feeding BIAs have been identified off New England from March through November – the larger of the two areas is located just east of the Expedition area and extends from the northwestern Gulf of Maine southward, including the Great South channel and Georges Bank; the smaller area is in the central Gulf of Maine (LaBrecque et al. 2015). Off New England, minke whales are most abundant during spring and summer, including in the Expedition area south of Nantucket and Martha's Vineyard (DoN 2005). Hayes et al. (2024) also reported sightings in the Expedition area during summer. During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, at least 83 sightings were reported from spring through fall, with the highest sighting rates during spring, followed by summer (Kraus et al. 2016; Stone et al. 2017). In the OBIS database, there are 142 sightings since 1970 for the proposed Expedition area south of Nantucket and Martha's Vineyard, including 68 during May–August (OBIS 2025). Minke whales could occur near the proposed drill sites.

3.3.1.4 Sei Whale (*Balaenoptera borealis*)

The sei whale occurs in all ocean basins (Horwood 2018) but appears to prefer mid-latitude temperate waters (Jefferson et al. 2015). It undertakes seasonal migrations to feed in subpolar latitudes during summer and returns to lower latitudes during winter to calve (Horwood 2018). On summer feeding grounds, sei whales associate with oceanic frontal systems (Horwood 1987). Habitat suitability models indicate that sei whale distribution is related to cool water with high chlorophyll levels (Palka et al. 2017; Chavez-Rosales et al. 2019). A feeding BIA has been identified off New England from March through November, and extends from the northern Gulf of Maine southward into the Great South Channel and to the 2000-m isobath; it is located east of the Expedition area (LaBrecque et al. 2015).

The sei whale is pelagic and generally not found in coastal waters (Harwood and Wilson 2001). It occurs in deeper waters characteristic of the continental shelf edge region (Hain et al. 1985) and in other regions of steep bathymetric relief such as seamounts and canyons (Kenney and Winn 1987; Gregr and Trites 2001). Sei whales migrate from temperate zones occupied in winter to higher latitudes in the summer, where most feeding takes place (Gambell 1985). A small number of individuals have been sighted in the eastern North Atlantic between October and December, indicating that some animals may remain at higher latitudes during winter (Evans 1992). Sei whales have been seen from South Carolina south into the Gulf of Mexico and the Caribbean during winter (Rice 1998); however, the location of sei whale wintering grounds in the North Atlantic is unknown (Víkingsson et al. 2010). Based on modeling for the western

North Atlantic, during summer, higher densities are expected to occur north of 35°N, and very low densities are expected south of 35°N (Mannocci et al. 2017; Palka et al. 2021; Roberts et al. 2023).

Three stocks are currently recognized in the North Atlantic: the Nova Scotia, Iceland-Denmark Strait, and Eastern North Atlantic stocks; a third stock off Labrador was proposed by Donovan (1991), but was never designated (Huijser et al. 2018). Although Huijser et al. (2018) did not find a high degree of genetic divergence between the current North Atlantic stocks, they noted that multiple stocks could occur. The Nova Scotia stock has a distribution that includes continental shelf waters from the northeastern U.S. to areas south of Newfoundland (Waring et al. 1999). The southern portion of the Nova Scotia stock's range includes the Gulf of Maine and Georges Bank during spring and summer (Waring et al. 1999).

Mitchell and Chapman (1977) suggested that this stock moves from spring feeding grounds on or near Georges Bank to the Scotian Shelf in June and July, eastward to Newfoundland and the Grand Banks in late summer, back to the Scotian Shelf in fall, and offshore and south in winter. DoN (2005) reported the highest number of sightings off New England during spring, with sightings on the shelf as well as along the shelf edge around Georges Bank; four sightings were reported in the Expedition area south of Nantucket and Martha's Vineyard, with additional sightings along the shelf break. During summer, most sei whale sightings occur on feeding grounds off Nova Scotia and the Grand Banks, but sightings were still reported on the shelf off New England and along the shelf edge of Georges Bank (DoN 2005). Sei whales have been detected acoustically from southern New England to the Scotian Shelf throughout the year, but primarily during spring and summer, including within the Expedition area south of Nantucket and Martha's Vineyard (Davis et al. 2020; Palka et al. 2021; PACM 2025). During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, 12 sightings were made during spring and 13 during the summer, with the highest sighting rates during summer (Kraus et al. 2016; Stone et al. 2017). In the OBIS database, there are 99 sightings since 1970 for the proposed Expedition area south of Nantucket and Martha's Vineyard, including 49 during May–August (OBIS 2025). Sei whales could be encountered near the drill sites.

3.3.1.5 Fin Whale (*Balaenoptera physalus*)

The fin whale is widely distributed in all the world's oceans (Gambell 1985), although it is most abundant in temperate and cold waters (Aguilar and García-Vernet 2018). Nonetheless, its overall range and distribution are not well known (Jefferson et al. 2015). Fin whales most commonly occur offshore but can also be found in coastal areas (Jefferson et al. 2015). Most populations migrate seasonally between temperate waters where mating and calving occur in winter, and polar waters where feeding occurs in summer (Aguilar and García-Vernet 2018). Some animals may remain at high latitudes in winter or low latitudes in summer (Edwards et al. 2015). The northern and southern fin whale populations likely do not interact owing to their alternate seasonal migration; the resulting genetic isolation has led to the recognition of two subspecies, *B. physalus quoyi* and *B. p. physalus* in the Southern and Northern hemispheres, respectively (Aguilar and García-Vernet 2018). The fin whale is known to use the shelf edge as a migration route (Evans 1987). Sergeant (1977) suggested that fin whales tend to follow steep slope contours, either because they detect them readily, or because the contours are areas of high biological productivity. However, fin whale movements have been reported to be complex (Jefferson et al. 2015).

In the North Atlantic, fin whales are found in summer from Baffin Bay, Spitsbergen, and the Barents Sea, south to North Carolina and the coast of Portugal (Rice 1998). In winter, they have been sighted from Newfoundland to the Gulf of Mexico and the Caribbean, and from the Faroes and Norway south to the Canary Islands (Rice 1998). Based on geographic differences in fin whale calls, Delarue et al. (2014) suggested that there are four distinct stocks in the Northwest Atlantic, including a central North Atlantic stock that extends south along the Mid-Atlantic Ridge. The four feeding stocks in the Northwest Atlantic currently recognized by the North Atlantic Marine Mammal Commission (NAMMCO 2025) are located off West Iceland (in the Central Atlantic), Eastern Greenland, Western Greenland, and Eastern Canada; there are an additional three stocks in the eastern Atlantic.

In the western North Atlantic, higher densities are typically found north of 35°N especially during spring and summer, with lower densities south of 35°N (Edwards et al. 2015; Mannocci et al. 2017; Roberts et al. 2023). Fin whales occur off the U.S. East Coast year-round, but generally north of Cape Hatteras (Davis et al. 2020; Hayes et al. 2024). During winter, fin whales are sighted more frequently on the shelf than any other large whale (DoN 2005). Based on acoustic detections using the U.S. Navy's Sound Surveillance System (SOSUS), fin whales are believed to move south during the fall and north during the spring (Clark 1995). However, not all individuals are likely to follow an annual migration (Hayes et al. 2024). During summer, most fin whale sightings are north of 40ºN, with concentrations in the Gulf of Maine, Great South Channel, and Georges Basin, and smaller numbers on the shelf south of there (DoN 2005; Hayes et al. 2024). During fall, almost all fin whales move out of U.S. waters to feeding grounds in the Bay of Fundy and on the Scotian Shelf or remain at Stellwagen Bank and Murray Basin (DoN 2005) or begin a southward migration (Clark 1995). Three feeding BIAs has been identified off New England: (1) June to October in the northern Gulf of Maine; (2) year-round in the southern Gulf of Maine (east of the Expedition area); and (3) March to October east of Montauk Point (west of the Expedition area) (LaBrecque et al. 2015).

Fin whales occur year-round in New England continental shelf waters (DoN 2005). They are most frequently sighted off New England during spring and summer seasons, including in the Expedition area south of Nantucket and Martha's Vineyard (DoN 2005; Hayes et al. 2024). During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, 86 sightings were made throughout the year, with the highest sighting rates during summer, followed by spring (Kraus et al. 2016; Stone et al. 2017). Fin whales have also been detected acoustically off New England during all seasons, including the Expedition area, with the highest number of detection days from August through April (Davis et al. 2020; Palka et al. 2021; PACM 2025). In the OBIS database, there are 138 sightings since 1970 for the proposed Expedition area south of Nantucket and Martha's Vineyard, including 87 during May–August (OBIS 2025). Fin whales could be encountered at the proposed drill sites.

3.3.1.6 Blue Whale (*Balaenoptera musculus*)

The blue whale has a cosmopolitan distribution and tends to be pelagic, only coming nearshore to feed and possibly to breed (Jefferson et al. 2015). The distribution of the species, at least during times of the year when feeding is a major activity, occurs in areas that provide large seasonal concentrations of euphausiids (Yochem and Leatherwood 1985). Blue whales are most often found in cool, productive waters where upwelling occurs (Reilly and Thayer 1990). Lesage et al. (2017a) identified seamounts and other deep ocean areas as potentially important habitat to blue whales.

Blue whales are seasonal migrants between high latitudes in summer, where they feed, and low latitudes in winter, where they mate and give birth (Lockyer and Brown 1981). Their summer range in the North Atlantic extends from Davis Strait, Denmark Strait, and the waters north of Svalbard and the Barents Sea, south to the Gulf of St. Lawrence and the Bay of Biscay (Rice 1998). Although the winter range is mostly unknown, Lesage et al. (2017a) identified the MAB, located off the southeastern U.S. as wintering habitat, and possibly a breeding or calving area. The acoustic detections during the SOSUS program tracked blue whales throughout most of the North Atlantic, including deep waters east of the U.S. Atlantic EEZ and subtropical waters north of the West Indies (Clark 1995).

In the western North Atlantic, higher densities are typically found north of 40°N especially during summer, with lower densities south of 40°N (DoN 2005; Roberts et al. 2023). Wenzel et al. (1988) suggested that it is unlikely that blue whales occur regularly in the shelf waters off the U.S. East Coast. Modeled densities in shelf waters of the proposed Expedition area south of Nantucket and Martha's Vinyard are predicted to be very low (Roberts et al. 2023). Nonetheless, several sightings have been reported during summer surveys along the southern and eastern edges of Georges Bank (Hayes et al. 2020), and there are additional records for New England for spring, summer, and fall. Blue whales have also been detected acoustically at recorders on New England's continental shelf, including the Expedition area south of Nantucket and Martha's Vineyard, as well as at Georges Bank from fall through spring, with the highest detection rates during fall and winter (Davis et al. 2020; Palka et al. 2021; PACM 2025). In the OBIS database, there are no records of blue whales for the proposed Expedition area south of Nantucket and Martha's Vineyard, but there are about 50 records for the surrounding waters of MA (OBIS 2025).

3.3.2 Odontocetes

3.3.2.1 Sperm Whale (*Physeter macrocephalus*)

The sperm whale is widely distributed, occurring from the edge of the polar pack ice to the Equator in both hemispheres, with the sexes occupying different distributions (Whitehead 2018). In general, it is distributed over large temperate and tropical areas that have high secondary productivity and steep underwater topography, such as volcanic islands (Jaquet and Whitehead 1996). Its distribution and relative abundance can vary in response to prey availability, most notably squid (Jaquet and Gendron 2002). Females generally inhabit waters >1000 m deep at latitudes <40º where sea surface temperatures are <15ºC; adult males move to higher latitudes as they grow older and larger in size, returning to warm-water breeding grounds (Whitehead 2018).

In the Northwest Atlantic, the shelf edge, oceanic waters, seamounts, and canyon shelf edges are predicted habitats of sperm whales (Waring et al. 2001). Off the U.S. East Coast, they are also known to concentrate in regions with well-developed temperature gradients, such as along the edges of the Gulf Stream and warm core rings, which may aggregate their primary prey, squid (Jaquet 1996). Based on modeling, sperm whales are expected to occur throughout the deeper offshore waters of the western North Atlantic (Mannocci et al. 2017; Palka et al. 2021; Roberts et al. 2023).

Sperm whales appear to have a well-defined seasonal cycle in the Northwest Atlantic (CETAP 1982; Stanistreet et al. 2018). In winter, most historical records are in waters east and northeast of Cape Hatteras, with few animals north of 40ºN; in spring, they shift the center of their distribution northward to areas east of Delaware and Virginia, but they are widespread throughout the central area of the MAB and southern tip of Georges Bank (DoN 2005; Hayes et al. 2024). During summer, they expand their spring distribution to include areas east and north of Georges Bank, the Northeast Channel, and the continental shelf south of New England (Hayes et al. 2024). By fall, sperm whales are most common south of New England on the continental shelf but also along the shelf edge in the MAB (DoN 2005; Hayes et al. 2024).

Numerous sightings have been made off New England during summer surveys, including several sightings on the MA shelf near the proposed drill sites (Hayes et al. 2024). Sperm whale sightings near the proposed drill sites have also been reported during all other season (DoN 2005; Cohen et al. 2022). Acoustic detections have been made off the U.S. East Coast, including off New England and at Nantucket Canyon, during all seasons (Cohen et al. 2022; Kowarski et al. 2022; PACM 2025). Stanistreet et al. (2018) also noted seasonal patterns in sperm whale clicks in the North Atlantic, with a winter peak off North Carolina and an increase in detections north of there during spring. Westell et al. (2024) detected sperm whales year-round at passive acoustic recorders deployed at shallow (<60 m) sites south of Nantucket and Martha's Vineyard, with 78% of detections occurring between May and August; sightings were also made near proposed drill site MV-04C. In the OBIS database, there are 20 records of sperm whales since 1970 for the proposed Expedition area south of Nantucket and Martha's Vineyard, including seven during May–August (OBIS 2025). Sperm whales could occur on the continental shelf near the proposed drill sites during the Expedition.

3.3.2.2 Pygmy and Dwarf Sperm Whales (*Kogia breviceps and K. sima*)

Pygmy and dwarf sperm whales are distributed widely throughout tropical and temperate seas, but their precise distributions are unknown because much of what we know of the species comes from strandings (McAlpine 2018). It has been suggested that the pygmy sperm whale is more temperate and the dwarf sperm whale more tropical, based at least partially on live sightings at sea from a large database from the eastern tropical Pacific (Wade and Gerrodette 1993). *Kogia* spp. are difficult to sight at sea, because of their dive behavior and perhaps because of their avoidance reactions to ships and behavior changes in relation to survey aircraft (Würsig et al. 1998). When they are observed, both *Kogia* species are found primarily along the continental shelf edge and slope and over deeper waters off the shelf (Hansen et al. 1994; Davis et al. 1998; Jefferson et al. 2015). However, McAlpine (2018) noted that dwarf sperm whales may be more pelagic than pygmy sperm whales. Although there are few useful estimates of abundance for pygmy or dwarf sperm whales anywhere in their range, they are thought to be fairly common in some areas.

In the western North Atlantic, pygmy sperm whales are known to occur from Nova Scotia to Cuba, and dwarf sperm whales are distributed from Virginia to the Caribbean (Würsig et al. 2000; Würsig 2017). Hodge et al. (2018) suggested that *Kogia* spp. are common on the shelf break and in slope waters between Virginia and Florida. Based on modeling for the western North Atlantic, higher densities of *Kogia* spp. are expected to occur south of 40°N compared to northern regions (Mannocci et al. 2017; Palka et al. 2021; Roberts et al. 2023).

Hayes et al. (2024) reported numerous sightings of pygmy and dwarf sperm whales off the U.S. East Coast, along the shelf break and in slope waters, including sightings of dwarf sperm whales in slope waters south of Nantucket. Sightings off the U.S. East Coast have been made during all seasons, but most sightings off New England, including south of Nantucket, have been made during summer (DoN 2005; Cohen et al. 2022). Palka et al. (2021) also reported numerous visual and acoustic detections of *Kogia* spp. along the shelf break and in slope waters off New England, including south of Nantucket (Palka et al. 2021). Acoustic detections have been made off the U.S. East Coast, including off New England, during all seasons (Cohen et al. 2022; Kowarski et al. 2022; PACM 2025). Acoustic detections at Nantucket Canyon, south of Nantucket, were most frequent during spring and summer (Cohen et al. 2022). Between 2017 and 2021, there were 37 dwarf sperm whale strandings along the U.S. East Coast and 72 strandings of pygmy sperm whales, including two in MA (Hayes et al. 2024). DoN (2005) reported additional stranding records for the northeastern U.S., including several pygmy sperm whales along the coast of MA. There are no OBIS records for the waters of the proposed Expedition area south of Nantucket and Martha's Vineyard (OBIS 2025). Pygmy and dwarf sperm whales are unlikely to occur in the shallow waters of the proposed drill sites.

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

Cuvier's beaked whale is probably the most widespread and common of the beaked whales, although it is not found in high-latitude polar waters (Heyning 1989; Baird 2018a). Cuvier's beaked whale is found in deep water in the open ocean and over and near the continental slope (Gannier and Epinat 2008; Baird 2018a). It is rarely found close to mainland shores, except in submarine canyons or in areas where the continental shelf is narrow and coastal waters are deep (Carwardine 1995). Its inconspicuous blows, deep-diving behavior, short surfacing intervals, and tendency to avoid vessels all help to explain the infrequent sightings (Barlow and Gisiner 2006; Shearer et al. 2019).

In the western North Atlantic, these whales typically occur from MA to Florida, the West Indies, and the Gulf of Mexico (Würsig et al. 2000), although sightings have also been made to the north in Canadian waters (Hayes et al. 2024). Most sightings in the Northwest Atlantic occur in late spring or summer, particularly along the continental shelf edge in the mid-Atlantic region (CETAP 1982; Waring et al. 2001), with lower densities south of Virginia, based on modeling (Palka et al. 2021). However, sightings off New England have been reported throughout the year, with most sightings during summer (DoN 2005). Sightings south of Nantucket, near Nantucket Canyon, have only been reported during summer (DoN 2005; Cohen et al. 2022; Hayes et al. 2024). Cuvier's beaked whales have also been detected acoustically off the U.S. East Coast throughout the year, mainly along the shelf break and deep offshore waters (Stanistreet et al. 2017; Palka et al. 2021; Cohen et al. 2022; Kowarski et al. 2022; PACM 2025). Hayes et al. (2024) reported four strandings along the U.S. East Coast from 2017 to 2021. There are no OBIS records for the waters of the proposed Expedition area south of Nantucket and Martha's Vineyard (OBIS 2025). Sightings of Cuvier's beaked whales near the proposed drill sites are not expected.

3.3.2.4 Northern Bottlenose Whale (*Hyperoodon ampullatus*)

The northern bottlenose whale is found only in the North Atlantic, from the subarctic to ~30°N (Jefferson et al. 2015). Northern bottlenose whales are most common in deep waters beyond the continental shelf or over submarine canyons, usually near or beyond the 1000-m isobath (Jefferson et al. 2015). Northern bottlenose whales are deep divers, and animals tagged off Nova Scotia dove every ~80 min to over 800 m, with a maximum dive depth of 1453 m (Hooker and Baird 1999). They forage primarily on large-bodied squid (MacLeod et al. 2003).

Northern bottlenose whales are considered uncommon off the U.S. East Coast, but two primary areas of known concentration are located in Canadian waters: "The Gully" just north of Sable Island, Nova Scotia, and Davis Strait off northern Labrador (Waring et al. 2007). In the Northwest Atlantic, they range from New England to subarctic waters, but only a few sightings have been reported there (DoN 2005; Waring et al. 2015). Acoustic detections have been made off eastern Georges Bank (PACM 2025). Strandings have also been reported for the U.S. East Coast, including along the coast of MA (DoN 2005; MacLeod and D'Amico 2006). In the OBIS database, there is one record for May–August for the proposed Expedition area south of Nantucket and Martha's Vineyard (OBIS 2025). However, sightings of northern bottlenose whales in the shallow waters near the proposed drill sites are not expected.

3.3.2.5 Sowerby's Beaked Whale *(Mesoploden bidens)*

Sowerby's beaked whale occurs in cold temperate waters of the Atlantic from the Labrador Sea to the Norwegian Sea, and south to New England, the Azores, and Madeira (Mead 1989). Sowerby's beaked whale is known primarily from strandings, which are more common in the eastern than the western North Atlantic (MacLeod et al. 2006). It is mainly a pelagic species and is found in deeper waters of the shelf edge and slope (Mead 1989). Although there are few records of Sowerby's beaked whales off the U.S. East Coast, Cohen et al. (2022) reported sightings along the U.S. East Coast shelf break during summer from Virginia northwards (Cohen et al. 2022). Acoustic detections have also been made from North Carolina to Georges Bank throughout the year (e.g., Stanistreet et al. 2017; Engelhaupt et al. 2019, 2020 *in* Palka et al. 2021; Palka et al. 2021; Rafter et al. 2021; Cohen et al. 2022; PACM 2025), including at Nantucket Canyon (Cohen et al. 2022). Hayes et al. (2024) reported one stranding along the U.S. East Coast from 2017 to 2021 in Maine. DoN (2005) reported additional strandings of Sowerby's beaked whale for the northeastern coast of the U.S, including MA. Sightings of Sowerby's beaked whales near the proposed drill sites are not expected.

3.3.2.6 Gervais' Beaked Whale (*Mesoplodon europaeus*)

Although Gervais' beaked whale is generally considered to be a North Atlantic species, it likely occurs in deep waters of the temperate and tropical Atlantic Ocean in both the northern and southern hemispheres (Jefferson et al. 2015). Its distribution is primarily known from stranding records. Strandings may be associated with calving, which takes place in shallow water (Würsig et al. 2000). Gervais' beaked whale usually inhabits deep waters (Davis et al. 1998). It is more frequent in the western than the eastern Atlantic (Mead 1989).

Off the U.S. East Coast, it occurs from Cape Cod Bay (Moore et al. 2004) to Florida, with a few records in the Gulf of Mexico (Mead 1989). Sightings have been reported along the shelf break and on the slope off the U.S. East Coast, with the majority of sightings during summer (DoN 2005; Cohen et al. 2022; Hayes et al. 2024), including near Nantucket Canyon. Gervais' beaked whales have also been detected acoustically along the continental slope of the U.S. East Coast throughout the year, but from Georges Bank southward (Stanistreet et al. 2017; Palka et al. 2021; Cohen et al. 2022; Kowarski et al. 2022; PACM 2025). Hayes et al. (2024) reported a total of 18 strandings of Gervais' beaked whales along the U.S. East Coast from 2017 to 2021, and DoN (2005) reported additional strandings for the northeastern coast of the U.S. There are no OBIS records for the waters of the proposed Expedition area south of Nantucket and Martha's Vineyard (OBIS 2025). Sightings of Gervais' beaked whales near the proposed drill sites are not expected.

3.3.2.7 Blainville's Beaked Whale (*Mesoplodon densirostris*)

Blainville's beaked whale is found in tropical and warm temperate waters of all oceans; it has the widest distribution throughout the world of any *Mesoplodon* species (Pitman 2018). Occasional occurrences in cooler, higher-latitude waters are presumably related to warm-water incursions (Reeves et al. 2002). It is rarely sighted, and most of the knowledge on the distribution of this species is derived from stranding data. There is no evidence that Blainville's beaked whales undergo seasonal migrations, although movements into higher latitudes are likely related to warm currents, such as the Gulf Stream in the North Atlantic. Like other beaked whales, Blainville's beaked whale is generally found in waters 200–1400 m deep (Gannier 2000; Jefferson et al. 2015). However, it may also occur in coastal areas, particularly where deep-water gullies come close to shore.

In the western North Atlantic, Blainville's beaked whale is found from Nova Scotia to Florida, the Bahamas, and the Gulf of Mexico (Würsig et al. 2000). There are several sighting records along the shelf break and slope waters of the U.S. East Coast, in particular during summer (DoN 2005; Cohen et al. 2022; Hayes et al. 2024), as well as stranding records (DoN 2005; Macleod et al. 2006; Hayes et al. 2024). Blainville's beaked whales have been detected acoustically off the U.S. East Coast throughout the year, ranging from North Carolina southward (Stanistreet et al. 2017; Palka et al. 2021; Cohen et al. 2022; Kowarski et al. 2022; PACM 2025). Hayes et al. (2024) reported four Blainville's beaked whale strandings along the U.S. East Coast from 2017 to 2021, and DoN (2005) reported additional strandings for the northeastern coast of the U.S. There are no OBIS records for the waters of the proposed Expedition area south of Nantucket and Martha's Vineyard (OBIS 2025). Sightings of Blainville's beaked whales near the proposed drill sites are not expected.

3.3.2.8 True's Beaked Whale (*Mesoplodon mirus*)

True's beaked whale is mainly oceanic and occurs in warm temperate waters of the North Atlantic and southern Indian oceans (Pitman 2018). In the western North Atlantic, strandings have been recorded from Nova Scotia (~46°N) to Florida (~27°N; MacLeod et al. 2006). Hayes et al. (2024) reported one stranding along the U.S. East Coast from 2017 to 2021 along the Virginia coast. Sightings have been made in deep offshore waters off New England during summer (Cohen et al. 2022; Hayes et al. 2024), including one sighting in July 2016 and one sighting in September 2017 off southern Georges Bank (DeAngelis et al. 2018). Sightings have also been made off North Carolina (Cohen et al. 2022). Acoustic detections have been reported along the shelf break off the U.S. East Coast during summer from MA and Georges Bank to Delaware (Palka et al. 2021; PACM 2025). True's beaked whales have been detected acoustically from North Carolina to Georges Bank (Palka et al. 2021; Cohen et al. 2022; Kowarski et al. 2022); detections at Nantucket Canyon were highest from winter through summer. DoN (2005) reported one stranding on the coast of Maine, and Macleod et al. (2006) reported numerous other stranding records for the U.S. East Coast. Sightings of True's beaked whales near the proposed drill sites are not expected.

3.3.2.9 Atlantic white-sided dolphin (*Lagenorhynchus acutus*)

The Atlantic white-sided dolphin occurs in cold temperate and subpolar waters in the North Atlantic; in the western Atlantic, its range is from ~38°N to southern Greenland (Jefferson et al. 2015). It appears to prefer deep waters of the outer shelf and slope, but can also occur in shallow and pelagic waters (Jefferson et al. 2015). Based on density modeling for the western North Atlantic, densities are highest north of 40°N and gradually decrease to the south (Mannocci et al. 2017; Roberts et al. 2023). Along the U.S. East Coast, the Atlantic white-sided dolphin ranges south to ~37ºN (CETAP 1982). There are seasonal shifts in its distribution off the northeastern U.S. coast, with low numbers in winter from Georges Basin to Jeffreys Ledge and high numbers in spring in the Gulf of Maine (CETAP 1982; DoN 2005). In summer, Atlantic white-sided dolphins are mainly distributed northward of Cape Cod (DoN 2005), but sightings south of ~40ºN are infrequent during all seasons (CETAP 1982; DoN 2005). Sightings in the Expedition area are expected to peak during spring (DoN 2005; Roberts et al. 2023). There are several sightings during spring and summer off New England, including near the proposed drill sites (DoN 2005; Hayes et al. 2024). During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, eight sightings were made from spring through fall (Kraus et al. 2016; Stone et al. 2017). In the OBIS database, there are 64 sightings in the Expedition area, south of Nantucket and Martha's Vineyard, including near the proposed drill sites; 38 records were reported during May–August (OBIS 2025). Hayes et al. (2024) reported 142 strandings of Atlantic white-sided dolphins in New England during 2017–2021. This species is likely to be common in the proposed Expedition area.

3.3.2.10 Common Bottlenose Dolphin (*Tursiops truncatus*)

The bottlenose dolphin occurs in tropical, subtropical, and temperate waters throughout the world (Wells and Scott 2018). Although it is more commonly found in coastal and shelf waters, it can also occur in deep offshore waters (Jefferson et al. 2015). In the Northwest Atlantic, these dolphins occur from Nova Scotia to Florida, the Gulf of Mexico, and the Caribbean and southward to Brazil (Würsig et al. 2000). There are two distinct bottlenose dolphin types: a shallow water type mainly found in coastal waters and a deepwater type mainly found in oceanic waters (Duffield et al. 1983; Walker et al. 1999). The nearshore dolphins usually inhabit shallow waters along the continental shelf and upper slope, at depths <200 m (Davis et al. 1998, 2002). Klatsky (2004) noted that offshore dolphins show a preference for water <2186 m deep. As well as inhabiting different areas, these ecotypes differ in their diving abilities (Klatsky 2004) and prey types (Mead and Potter 1995). Coastal common bottlenose dolphins exhibit a range of movement patterns including seasonal migration, year-round residency, and a combination of long range movements and repeated local residency (Wells and Scott 2018).

There are regional and seasonal differences in the distribution of the offshore and coastal forms of bottlenose dolphins off the U.S. East Coast. Evidence of year-round or seasonal residents and migratory groups exists for the coastal form of bottlenose dolphins, with the northern migratory coastal stock occurring north of Cape Hatteras to New Jersey, but only during summer and in waters <25 m deep (Hayes et al. 2024). The Western North Atlantic offshore form occurs from Georges Bank to Florida in water >25 m deep (Garrison et al. 2003). South of Cape Hatteras, the offshore form appears to be most abundant along the shelf break and is differentiated from the coastal form by occurring in waters >34 m deep and >34 km from shore (Torres et al. 2003). Several resident bottlenose dolphin BIAs have been identified along the U.S. East Coast from North Carolina to Florida (LaBrecque et al. 2015).

Bottlenose dolphin records in the Northwest Atlantic suggest that they can occur there year-round from the continental shelf to deeper waters over the abyssal plain, from the Scotian Shelf to Florida (DoN 2005; Hayes et al. 2024). Modeling indicates that densities are high along the coast south of New England, with lower densities to the north and in deep offshore waters of the western North Atlantic (Mannocci et al. 2017; Palka et al. 2021; Roberts et al. 2023). Nonetheless, numerous sightings have been made off New England, including near the proposed drill sites during summer (DoN 2005; Hayes et al. 2024). Four sightings totaling 32 bottlenose dolphins were made in the proposed Expedition area south of Nantucket during a seismic survey in August 2009 (Holst and Robertson 2009). During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, at least 33 sightings were reported, with the highest sighting rates during summer, followed by fall (Kraus et al. 2016; Stone et al. 2017). In the OBIS database, there are 45 sightings of bottlenose dolphins in the Expedition area, south of Nantucket and Martha's Vineyard, including near the proposed drill sites; 29 records were reported during May–August (OBIS 2025). This species is likely to be common in the proposed Expedition area.

3.3.2.11 Pantropical Spotted Dolphin (*Stenella attenuata*)

The pantropical spotted dolphin is distributed worldwide in tropical and some subtropical waters, between ~40°N and 40°S (Jefferson et al. 2015). It is one of the most abundant cetaceans and is found in coastal, shelf, slope, and deep waters (Perrin 2018a). In the Northwest Atlantic, it occurs from New England (Hayes et al. 2024) south to the Equator (Würsig et al. 2000). Off the U.S. East Coast, sightings north of Cape Hatteras have been made along the continental slope whereas south of Cape Hatteras, sightings occur in deep offshore waters (Hayes et al. 2024). Modeling shows that sighting rates and densities are expected to be very low in the shelf waters of New England (DoN 2005; Roberts et al. 2023), and no sightings have been reported there (DoN 2005; Hayes et al. 2024; OBIS 2025). However, sightings have been reported along southern Georges Bank (DoN 2005; Hayes et al. 2024). Hayes et al. (2024) also reported three strandings in Florida during 2017–2021. Pantropical spotted dolphins are not expected to occur near the proposed drill sites.

3.3.2.12 Atlantic Spotted Dolphin (*Stenella frontalis*)

The Atlantic spotted dolphin is one of the most abundant cetaceans and is distributed worldwide in tropical and some subtropical waters, between ~40°N and 40°S (Jefferson et al. 2015). In the North Atlantic, it occurs from Brazil to New England and to the coast of Africa (Jefferson et al. 2015). There are two forms of Atlantic spotted dolphin—a large, heavily spotted coastal form that is usually found in shelf waters, and a smaller and less-spotted offshore form that occurs in pelagic offshore waters and around oceanic islands (Jefferson et al. 2015). In the western Atlantic, the distribution extends from southern New

England, south to the Gulf of Mexico, and the Caribbean to Venezuela (Leatherwood et al. 1976; Perrin et al. 1994a; Rice 1998). During summer, Atlantic spotted dolphins are sighted in shelf waters south of Chesapeake Bay and near the continental shelf edge, on the slope, and offshore north of there (Hayes et al. 2024). During fall, very few Atlantic spotted dolphins occur north of New Jersey (DoN 2005). Based on modeling, Atlantic spotted dolphins occur at low densities on the shelf off New England (DoN 2005; Mannocci et al. 2017; Roberts et al. 2023). Sightings off New England have been made in deep offshore waters during summer, but there are no sighting records in the shallow waters near the proposed drill sites (DoN 2005; Hayes et al. 2024; OBIS 2025). Hayes et al. (2024) reported 21 strandings for the U.S. East Coast during 2017–2021. Atlantic spotted dolphins are not expected to occur near the proposed drill sites.

3.3.2.13 Spinner Dolphin (*Stenella longirostris*)

The spinner dolphin is pantropical in distribution, including oceanic tropical and sub-tropical waters between 40ºN and 40ºS (Jefferson et al. 2015). It is generally considered a pelagic species (Perrin 2018b) but can also be found in coastal waters and around oceanic islands (Rice 1998). The distribution of spinner dolphins in the Atlantic is poorly known, but in the western North Atlantic, it is thought to occur in deep water along most of the U.S. coast, southward to the Caribbean, Gulf of Mexico, and Venezuela (Würsig et al. 2000). Based on habitat modeling, higher densities are expected to occur north of Cape Hatteras, with lower densities offshore the southeastern U.S. (Roberts et al. 2023). Hayes et al. (2024) reported sightings off Virginia and North Carolina, in offshore waters >2000 m (Hayes et al. 2024). DoN (2005) reported records in offshore waters of the U.S. East coast as far north as 40ºN during summer. Hayes et al. (2024) reported one stranding in Florida during 2017–2021. Spinner dolphins are not expected to occur near the proposed drill sites.

3.3.2.14 Striped Dolphin (*Stenella coeruleoalba*)

The striped dolphin has a cosmopolitan distribution in tropical to warm temperate waters from ~50°N to 40°S (Perrin et al. 1994b; Jefferson et al. 2015). It is typically found in waters outside the continental shelf and is often associated with convergence zones and areas of upwelling; however, it has also been observed approaching shore where there is deep water close to the coast (Jefferson et al. 2015). In the Northwest Atlantic, the striped dolphin occurs from Nova Scotia to the Gulf of Mexico and south to Brazil (Würsig et al. 2000). Based on habitat modeling for the western North Atlantic, higher densities are expected in offshore waters north of ~35°N, with the lowest densities south of ~32°N and on the shelf (Mannocci et al. 2017; Roberts et al. 2023). Similarly, DoN (2005) showed the highest sighting rates along the continental shelf edge north of 35°N during summer.

Off the northeastern U.S., striped dolphin sightings have been reported along the shelf edge and over the continental slope from Cape Hatteras to the southern edge of Georges Bank (DoN 2005; Hayes et al. 2024). In all seasons, striped dolphin sightings mainly occur in water >2000 m deep and have been associated with the north edge of the Gulf Stream and warm core rings (Hayes et al. 2024). DoN (2005) reported sightings near Nantucket Canyon and along the southern edge of Georges Bank during all season but fall and stranding records for Cape Cod, Martha's Vineyard, and Nantucket. Hayes et al. (2024) reported one stranding in Florda during 2017–2021. There are no sighting records for the waters of the Expedition area (DoN 2005; Hayes et al. 2024; OBIS 2025). Striped dolphins are unlikely to occur near the proposed drill sites.

3.3.2.15 Risso's Dolphin (*Grampus griseus*)

Risso's dolphin is distributed worldwide in mid-temperate and tropical oceans (Kruse et al. 1999). although it shows a preference for mid-temperate waters of the shelf and slope between 30° and 45°

(Jefferson et al. 2014; Hartman 2018). In the western Atlantic, this species is distributed from Newfoundland to Brazil (Kruse et al. 1999). Based on density modeling for the western North Atlantic, higher densities are expected to occur north of 35°N (Mannocci et al. 2017; Roberts et al. 2023). Risso's dolphin occurs along the edge of the U.S. East Coast shelf year-round (Payne et al. 1984; DoN 2005; Jefferson et al. 2014; Hayes et al. 2024). Off the northeast coast, Risso's dolphins are distributed along the shelf edge from Cape Hatteras to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne et al. 1984), but they range to the MAB and into oceanic waters during winter (Payne et al. 1984).

Sightings have been made off New England, including south of Nantucket, mainly during spring and summer (DoN 2005; Jefferson et al. 2014; Cohen et al. 2022; Hayes et al. 2024). During aerial surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, at least two sightings were reported during spring (Kraus et al. 2016; Stone et al. 2017). Acoustic detections have also been made at recorders deployed off the U.S. East Coast, with the highest detection rates off the northeastern coast; near Nantucket Canyon, acoustic detections occurred throughout the year, with a peak during spring and summer (Cohen et al. 2022). In the OBIS database, there are three sightings in the Expedition area, south of Nantucket and Martha's Vineyard, including two records during May–August (OBIS 2025). Strandings have also been reported for MA (DoN 2005; Hayes et al. 2024). Thus, Risso's dolphins could occur near the proposed drill sites.

3.3.2.16 Common Dolphin (*Delphinus delphis delphis*)

The common dolphin is distributed in tropical to cool temperate waters of the Atlantic and the Pacific oceans from 60ºN to ~50ºS (Jefferson et al. 2015). Based on Perrin (2018c), here we assume that there are currently three recognized subspecies of common dolphin, including *D. delphis delphis* (the short-beaked form), *D. d. bairdii* (the long-beaked form, formerly known as *D. capensis*), and *D. d. tropicalis* (Indian Ocean subspecies). The common dolphin is common in coastal waters 200–300 m deep (Evans 1994), but it can also occur thousands of kilometers offshore; the pelagic range in the North Atlantic extends south to ~35ºN (Jefferson et al. 2015). It appears to have a preference for areas with upwelling and steep sea-floor relief (Doksæter et al. 2008; Jefferson et al. 2009, 2015). Off the U.S. East Coast, the common dolphin occurs from Cape Hatteras to Georges Bank during mid-January–May, moves onto Georges Bank and the Scotian Shelf during mid-summer and fall, and has been observed in large aggregations on Georges Bank in fall (CETAP 1982; Selzer and Payne 1988; Payne et al. 1984; Hayes et al. 2022). Based on density modeling for the western North Atlantic, higher densities occur in offshore areas north of ~35°N; very low densities are expected south of 35°N and in shelf waters (Mannocci et al. 2017; Roberts et al. 2023).

Sightings off New England have been made in continental shelf and slope waters year around, including south of Nantucket (DoN 2005; Hayes et al. 2024). Nine groups of ~568 common dolphins were seen in the proposed Expedition area south of Nantucket during a seismic survey in August 2009 (Holst and Robertson 2009). During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, at least 84 sightings were made, with the highest sighting rates during summer, followed fall (Kraus et al. 2016; Stone et al. 2017). In the OBIS database, there are 478 sightings in the Expedition area, south of Nantucket and Martha's Vineyard, including near the proposed drill sites; 88 records were reported during May–August (OBIS 2025). Hayes et al. (2024) reported over 200 strandings in MA during 2017–2021. Thus, common dolphins are likely to occur near the proposed drill sites.

3.3.2.17 White-beaked dolphin (*Lagenorhynchus albirostris*)

The white-beaked dolphin is widely distributed in cold temperature and subarctic North Atlantic waters, often occurring to the edge of the arctic pack ice (Jefferson et al. 2015). It occurs off the east coast of North America, from Labrador to MA (Rice 1998), with many sighting records off Newfoundland during summer (Hayes et al. 2021). White-beaked dolphins are found widely over the continental shelf, especially along the shelf edge (Carwardine 1995). Off the northeastern U.S. coast, white-beaked dolphins primarily occur in the western Gulf of Maine and around Cape Cod, including in coastal waters (CETAP 1982). Based on habitat modeling, white-beaked dolphin density is low in the Expedition area south of Nantucket, with higher densities to the east (such as Georges Bank) and to the north (Roberts et al. 2023). During spring and summer, white-beaked dolphins occur primarily over the continental shelf north of Cape Cod; during summer, sightings have also been reported on Georges Bank and in the Expedition area, south of Nantucket (DoN 2005). The highest sighting rates in the U.S. are expected to occur along the shelf break north of Georges Bank during winter (DoN 2005). In the OBIS database, there are two records of white-beaked dolphins just to the east of Nantucket Island during the month of May (OBIS 2025). Hayes et al. (2024) reported four strandings for MA in 2014; DoN (2005) also reported strandings on Cape Cod. White-beaked dolphins could occur near the proposed drill sites.

3.3.2.18 Killer Whale (*Orcinus orca*)

The killer whale is cosmopolitan and globally fairly abundant; it has been observed in all oceans of the world (Ford 2018). It is very common in temperate waters and also frequents tropical waters, at least seasonally (Heyning and Dahlheim 1988). Killer whales tend to be more common in nearshore areas and at higher latitudes (Jefferson et al. 2015). The greatest abundance is thought to occur within 800 km of major continents (Mitchell 1975). In the Northwest Atlantic, killer whales occur from the polar pack ice to Florida and the Gulf of Mexico (Würsig et al. 2000). Based on historical sightings and whaling records, killer whales apparently were most often found along the shelf break and offshore in the Northwest Atlantic (Katona et al. 1988).

Killer whales are considered uncommon or rare in waters of the U.S. Atlantic EEZ (Katona et al. 1988). Based on habitat modeling, densities of killer whales are expected to be higher in offshore water north of Cape Hatteras; densities off the shelf to the south are lower (Roberts et al. 2023). There have been few sightings off the U.S. East Coast; most sightings have been reported in nearshore and shelf waters of New England, north of Cape Cod, during summer (DoN 2005). Sightings have also been made near the shelf break south of Nantucket during every season, and strandings in MA have been reported for winter and summer (DoN 2005). There are no records for the Expedition area south of Nantucket and Martha's Vineyard in the OBIS database (OBIS 2025). Pilot/killer whale whistles have been detected throughout the year at acoustic recorders deployed off the U.S. East Coast from Virgina to Florida (Kowarski et al. 2022). Killer whales could be encountered near the proposed drill sites.

3.3.2.19 False Killer Whale (*Pseudorca crassidens*)

The false killer whale is found worldwide in tropical and temperate waters, generally between 50ºN and 50ºS (Odell and McClune 1999). It is widely distributed, but rare to uncommon throughout its range (Baird 2018b). It generally inhabits deep, offshore waters, but sometimes is found over the continental shelf and occasionally moves into very shallow water (Jefferson et al. 2015; Baird 2018b). It is gregarious and forms strong social bonds, as is evident from its propensity to strand en masse (Baird 2018b).

In the Northwest Atlantic, the false killer whale is generally thought to occur from Maryland to the Gulf of Mexico and the Caribbean (Würsig et al. 2000). Based on habitat modeling, densities of false killer whales are expected to be higher in offshore water north of Cape Hatteras; densities off the shelf break to the south and on the shelf are lower (Roberts et al. 2023). Few false killer whales have been sighted off the U.S. East Coast, all in water more than 200 m deep (Hayes et al. 2024). Sightings and strandings have been reported in New England during summer and winter (DoN 2005). A few sightings have been made south and east of Georges Bank off the continental shelf during summer (DoN 2005; Hayes et al. 2024). However, there are no sighting records for the Expedition area south of Nantucket and Martha's Vineyard (DoN 2005; Hayes et al. 2024; OBIS 2025). Sightings of false killer whales are not expected to occur near the proposed drill sites.

3.3.2.20 Pygmy Killer Whale (*Feresa attenuata)*

The pygmy killer whale has a worldwide distribution in tropical waters (Baird 2018c). It is found in nearshore areas where the water is deep and in offshore waters (Jefferson et al. 2015). It is known to inhabit the warm waters of the Indian, Pacific, and Atlantic oceans (Jefferson et al. 2015). In the Northwest Atlantic, it occurs from Georges Bank (Hayes et al. 2024) southward to the West Indies and the Gulf of Mexico (Würsig et al. 2000). There is no abundance estimate for the pygmy killer whale off the U.S. East Coast because it is rarely sighted during surveys (Hayes et al. 2024).

Based on habitat modeling, densities of false killer whales are expected to be higher in offshore water north of Cape Hatteras; densities off the shelf break to the south and on the shelf are lower (Roberts et al. 2023). Very few pygmy killer whales have been sighted off the U.S. East Coast; sightings have occurred in water deeper than 1000 m east of Georges Bank and off the southeastern U.S. (Hayes et al. 2024). Strandings have primarily been reported for South Carolina and Georgia, with two from North Carolina and one from MA (Hayes et al. 2024). However, there are no sighting records in the Expedition area south of Nantucket and Martha's Vineyard (DoN 2005; Hayes et al. 2024; OBIS 2025). Sightings of pygmy killer whales are not expected to occur near the proposed drill sites.

3.3.2.21 Short-finned Pilot Whale (*Globicephala macrorhynchus*) and Long-finned Pilot Whale (*G. melas*)

In the western North Atlantic, pilot whales are distributed from Iceland and Greenland to northern South America, including the Caribbean Sea and Gulf of Mexico (Jefferson et al. 2015; Würsig et al. 2000). There are two species of pilot whale, both of which could occur in the Expedition area; long-finned pilot whales would be more likely to be encountered. The long-finned pilot whale (*G. melas*) is distributed antitropically, whereas the short-finned pilot whale (*G. macrorhynchus*) is found in tropical, subtropical, and warm temperate waters (Olson 2018). The ranges of the two species overlap along the mid-Atlantic shelf break of the northeastern U.S. between Delaware and southern Georges Bank, with long-finned pilot whales mainly occurring to the north (Rone and Pace 2012). In the Northwest Atlantic, pilot whales often occupy areas of high relief or submerged banks and are associated with the Gulf Stream edge or thermal fronts along the continental shelf edge (Waring et al. 1992). Pilot whales are generally nomadic and often occur on the shelf break, over the slope, and in areas with prominent topographic features (Olson 2018), but they are also known to occur on the shelf (e.g., DoN 2005; Hayes et al. 2024).

Based on habitat density modeling, densities off the U.S. East Coast are highest along the shelf break north of Cape Hatteras; densities are lower to the south and on the shelf including the Expedition area (Mannocci et al. 2017; Roberts et al. 2023). Long-finned pilot whales occur off New England and on and around Georges Bank throughout the year, with higher sighting rates during spring and summer (DoN 2005). Long-finned pilot whales have been seen on the shelf south of Nantucket during spring and summer (DoN 2005; Hayes et al. 2024) and along the shelf break south of Nantucket throughout the year (DoN 2005). Two stranded juvenile long-finned pilot whales released off Long Island in October 1999 traveled through the Expedition area south of Nantucket (Nawojchik et al. 2003). Pilot/killer whale whistles have been detected throughout the year at acoustic recorders deployed off the U.S. East Coast from Virgina to Florida (Kowarski et al. 2022). During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, at least 14 sightings of pilot whales were made (Kraus et al. 2016; Stone et al.

2017). Hayes et al. (2024) reported three strandings of short-finned pilot whales in MA during 2019, and long-finned pilot whale strandings have been reported for MA throughout the year (DoN 2005). There are no records of pilot whales in the Expedition area south of Nantucket and Martha's Vineyard in the OBIS database (OBIS 2025). Short- or long-finned pilot whales could be encountered at the proposed drill sites.

3.3.2.22 Harbor porpoise (*Phocoena phocoena*)

The harbor porpoise inhabits cool temperate to subarctic waters of the Northern Hemisphere (Jefferson et al. 2015). Most animals are found over the continental shelf, but some are also encountered over deep water (Westgate et al. 1998). There are likely four populations in the western North Atlantic: Gulf of Maine/Bay of Fundy, Gulf of St. Lawrence, Newfoundland, and Greenland (Gaskin 1984, 1992). Individuals found off the U.S. East Coast likely would be almost exclusively from the Gulf of Maine/Bay of Fundy stock. A small and resident BIA was identified in the Gulf of Main for July to September (LaBrecque et al. 2015).

In the northwestern Atlantic, harbor porpoises concentrate in the northern Gulf of Maine and southern Bay of Fundy during July–September, with lower densities elsewhere (Mannocci et al. 2017; Roberts et al. 2023; Hayes et al. 2024). During October–December and April–June, harbor porpoises mainly occur from New Jersey to Maine, although there are lower densities at the northern and southern extremes (DoN 2005; Hayes et al. 2024). During January–March, harbor porpoises concentrate farther south, from New Jersey to North Carolina, with lower densities occurring from New York to New Brunswick (DoN 2005; Hayes et al. 2024).

Sightings off New England have been made throughout the year, including in the Expedition area south of Nantucket and Martha's Vineyard (DoN 2005; Hayes et al. 2024). During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, at least 45 sightings were made, with the highest sighting rates during fall followed by winter (Kraus et al. 2016; Stone et al. 2017). Acoustic detections have also been made off New England, including the proposed Expedition area, throughout the year (PACM 2025). Hayes et al. (2024) reported 305 strandings for the U.S. East Coast during 2017–2021, including 137 for MA. In the OBIS database, there are 238 sightings since 1970 for the proposed Expedition area south of Nantucket and Martha's Vineyard, including 80 during May–August (OBIS 2025). Harbor porpoise could occur near the proposed drill sites.

3.3.3 Pinnipeds

3.3.3.1 Harbor Seal (*Phoca vitulina concolor*)

Harbor seals are among the most widespread of pinnipeds, but they are primarily restricted to coastal regions (Jefferson et al. 2015). In the northwest Atlantic Ocean, harbor seals are distributed from the eastern Canadian Arctic to southern New England and New York (Jefferson et al. 2015). Harbor seals occur in coastal waters and are rarely seen more than 20 km from shore; they often use bays, estuaries, and inlets, and sometimes follow anadromous prey upstream in coastal rivers (Baird 2001). Most harbor seals haul out on land daily, although they can spend several days at sea feeding (Jefferson et al. 2015). In New England, they typically haul out on rocky outcroppings and intertidal ledges (Schneider and Payne 1983; Payne and Selzer 1989). At sea, harbor seals usually occur alone, but groups can occur when prey is abundant (Jefferson et al. 2015).

Harbor seals typically occur year-round in the Gulf of Maine but occur seasonally from New England to Virginia (DoN 2005; Hayes et al. 2022). From late September through late May, they occur predominantly south of Maine, with 75% of counted seals in New England waters hauling out on Cape Cod and Nantucket Island (Schneider and Payne 1983; Payne and Selzer 1989). In summer, almost all harbor seals are found north of ~43º, in coastal waters of central and northern Maine and the Bay of Fundy (DoN 2005; Hayes et al. 2022); however, observations have been documented as far south as Delaware in the summer (Hayes et al. 2022). Harbor seal haul-outs occur throughout MA, including Nantucket and on islets south of Martha's Vineyard (DoN 2005). During aerial surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, Kraus et al. (2016) reported sightings of harbor seals. In the OBIS database, there are five records of harbor seals for the waters south of Martha's Vineyard and Nantucket, including just north of MV-08A, just southeast of MV-10A, and to the west of MV-04C; one record was for May–August (OBIS 2025). Between 2015 and 2019, there were 490 harbor seal stranding mortalities in MA (Hayes et al. 2022); strandings in MA are reported throughout the year (DoN 2005). Harbor seals could be encountered near the proposed drill sites.

3.3.3.2 Gray seal (*Halichoerus grypus*)

The gray seal is found in cold temperate to sub-arctic waters of the North Atlantic (Jefferson et al. 2015). There are three major populations—eastern Canada, northwestern Europe, and the Baltic Sea (Jefferson et al. 2015). The western North Atlantic stock, considered the same population as the eastern Canadian population, ranges from New Jersey to Labrador (Lesage and Hammill 2001; Hayes et al. 2024). The gray seal is primarily a coastal species, and foraging appears to be restricted to continental shelf regions (Lesage and Hammill 2001). Foraging gray seals tagged on Sable Island, Nova Scotia, nearly always remained within the 100-m isobath and mostly over offshore banks (Austin et al. 2006). There are two main breeding sites in the northwest Atlantic Ocean where gray seals aggregate from December to February: Sable Island and in the southern Gulf of St. Lawrence. Gray seals disperse widely after breeding but return for a spring molt (Lesage and Hammill 2001).

After harbor seals, gray seals are the most commonly sighted seal in the northeastern U.S. (Hayes et al. 2022); strandings have occurred as far south as North Carolina (DoN 2005). Small numbers of gray seals were observed pupping on several isolated islands along the Maine coast and in Nantucket Sound in the mid-1980s (Katona et al. 1993). A year-round breeding population of ~400 animals on outer Cape Cod and Muskeget Island was documented in the late 1990s (Barlas 1999 *in* DoN 2005). Aerial surveys for pupping sites in the area are routinely conducted (Wood et al. 2022). Muskeget Island in Nantucket Sound has been an active pupping site for gray seals since 1988 (Wood et al. 2022) and is the largest pupping colony in the U.S. (den Heyer et al. 2020). The pupping colony on Nomans Land Island south of Martha's Vineyard has been active since 2011 (Wood et al. 2022).

Gray seals are present in the waters off New England year-round (DoN 2005). Gray seals aggregate in coastal areas for breeding (December to February) and during the spring molt (May to June); for the rest of the year (March to April and July to November) they are typically widely dispersed offshore (Lesage and Hammill 2001; Rough 1995 *in* DoN 2005). Tracking data of young-of-the-year gray seals found that from January to June, the areas south and east of Cape Cod (including the Expedition area) were in high use, but from July to December, seals spent more time in Canadian waters (Murray et al. 2021). During aerial surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, Kraus et al. (2016) reported sightings of gray seals. Fishery observer bycatch data documented gray seals in the Expedition area mostly between January and June and less frequently between October and December (Murray et al. 2021). Strandings have been reported in MA throughout the year (DoN 2005). Between 2017 and 2021, there were 1,019 stranding mortalities in MA (Hayes et al. 2024). Gray seals could be encountered near the proposed drill sites.

3.3.3.3 Harp seal (*Pagophilus groenlandicus*)

The harp seal has a widespread distribution in the Arctic and in cold waters of the North Atlantic (Jefferson et al. 2015). It is the most abundant seal in the North Atlantic, with most seals aggregating off the east coast of Newfoundland and Labrador to pup and breed; the remainder congregates in the Gulf of St. Lawrence (Lavigne and Kovacs 1988). Jefferson et al. (2015) indicate that vagrant harp seals occur as far south as New York. DoN (2005) reported strandings from Maine to Delaware in particular during the winter and spring, but with some strandings also in summer.

Sightings of harp seals off the U.S. East Coast, from Maine to New Jersey, are rare but have been increasing, particularly from January to May (Harris et al. 2002; Harris and Gupta 2006; Hayes et al. 2022). DoN (2005) noted that harp seals may occasionally occur along the U.S. East Coast from fall through spring. However, sightings in New England are more likely to occur in the winter months (BOEM 2024). An observation of a harp seal in MA was documented as recently as January 2025 (Dwyer 2025). One harp seal was taken as bycatch in a bottom trawl in Massachusetts Bay in March 2019 (Hayes et al. 2022). In the OBIS database, there are 18 records of harp seals for the waters south of Martha's Vineyard and Nantucket, including just southeast of MV-04C; two records were for May–August (OBIS 2025). Harp seal stranding mortalities reported between 2015 and 2019 totaled 176 in Massachusetts (Hayes et al. 2022). Harp seals could be encountered near the proposed drill sites.

3.3.3.4 Hooded seal (*Cystophora cristata*)

The hooded seal inhabits the Arctic and high latitudes of the North Atlantic, with four primary pupping areas—Gulf of St. Lawrence, northeast of Newfoundland, Davis Strait, and Greenland (Jefferson et al. 2015). Pupping and breeding occurs on pack ice in March (Hayes et al. 2019). Hooded seals appear to prefer deeper water and occur farther offshore than harp seals (Lavigne and Kovacs 1988). Although they tend to occur at high latitudes of the North Atlantic, hooded seals are highly migratory and known to wander widely, with animals hauled out on the U.S. East Coast from New England to Florida and Puerto Rico (Jefferson et al. 2015; Hayes et al. 2019).

Hooded seals typically occur in New England between January and May, and they can also occur off the southeastern U.S. during summer or fall (McAlpine et al. 1999; Harris et al. 2002; DoN 2005; Hayes et al. 2019). Between 2012 and 2016, a total of three hooded seals were found stranded in MA (Hayes et al. 2019). Hooded seals are typically observed in Nantucket Sound in winter and spring (TON 2025). In the OBIS database, there are records of hooded seals in Long Island Sound, near New London, CT, and along the coast of Rhode Island, but none near the proposed drill sites south of Nantucket (OBIS 2025). Hooded seals are unlikely to be encountered near the proposed drill sites.

3.4 Sea Turtles

Five species of sea turtles including the leatherback, loggerhead, green, Kemp's ridley, and hawksbill turtles are known to occur off the U.S. East Coast. Loggerhead, green, Kemp's ridley, and leatherback turtles are commonly found along the U.S. East Coast while hawksbill turtles are considered rare and possibly extralimital to this region (Lazell 1980; Eckert 1995). A sixth species, olive ridley turtle, has been reported around the southern tip of Florida (DoN 2008a,b), but would be unlikely to occur near the proposed drill sites. Thus, hawksbill and olive ridley turtles are not discussed further. Under the ESA, the leatherback and Kemp's ridley sea turtles are listed as ***endangered***; the Northwest Atlantic DPS of loggerhead turtle and the North Atlantic DPS of the green sea turtle are listed as ***threatened*** (Table 4).

TABLE 4. The habitat, occurrence, and conservation status of sea turtles that are known to occur off the U.S. East Coast.

Species	Habitat	Occurrence in Expedition Area[1]	US ESA[2]	IUCN[3]	CITES[4]
Leatherback sea turtle	Beaches (nesting females); oceanic (juveniles and foraging adults)	Uncommon	E	EN[5]	I
Loggerhead sea turtle *Northwest Atlantic DPS*	Beaches (nesting females); coastal/oceanic (juveniles); coastal (foraging adults); oceanic (migration)	Uncommon	T	LC[6]	I
Green sea turtle *North Atlantic DPS*	Beaches (nesting females); oceanic (juveniles and migrating adults); coastal (foraging adults)	Rare	T	EN	I
Kemp's ridley sea turtle	Coastal/oceanic (juveniles and immatures foraging and migrating)	Rare	E	CR	I

[1] Occurrence in area at the time of the expedition; based on professional opinion and available data.
[2] U.S. Endangered Species Act: E = Endangered, T = Threatened.
[3] International Union for the Conservation of Nature (IUCN) Red List of Threatened Species, version 2024-2: CR = critically endangered, EN = endangered, VU = vulnerable, LC = least concern.
[4] Convention on International Trade in Endangered Species: Appendix I, species that are the most endangered and are considered threatened with extinction.
[5] Globally, the leatherback turtle is listed as vulnerable, but the Northwest Atlantic population is considered endangered.
[6] Globally, the loggerhead turtle is listed as Vulnerable, but the Northwest Atlantic subpopulation is considered Least Concern.

The U.S. is a signatory of the InterAmerican Convention (IAC) for the Protection and Conservation of Sea Turtles. The IAC complies with CITES and prohibits the deliberate take or harvesting of sea turtles or their eggs (IAC 2015). Leatherback, loggerhead, green, and Kemp's ridley sea turtles nest in the Wider Caribbean Region (Piniak and Eckert 2011; Eckert and Eckert 2019), but all species have also been reported to nest along the U.S. East C, although in smaller numbers (Seaturtle.org 2025). General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of sea turtles are given in § 3.4.1 of the NSF PEIS. The general distribution of sea turtles in the Northwest Atlantic is discussed in § 3.4.2.1 of the NSF PEIS. The rest of this section focuses on their distribution near the proposed drill sites.

3.4.1 Leatherback Sea Turtle (*Dermochelys coriacea*)

The leatherback is the most widely distributed sea turtle, occurring from 71°N to 47°S (Eckert et al. 2012). In the western Atlantic Ocean, leatherbacks are known to range from Greenland to Argentina. During the non-breeding season, the leatherback turtle undertakes long-distance migrations between its tropical and subtropical nesting grounds, located between 38°N and 34°S, and high-latitude foraging grounds in continental shelf and pelagic waters (Eckert et al. 2012). The number of nesting females in the Northwest Atlantic is 20,659 (NMFS and USFWS 2020a). Although important nesting areas occur only as far north as Florida (NMFS and USFWS 2020a), nesting has also been confirmed for North Carolina, and a crawl was reported as far north as Maryland (Rabon et al. 2023).

Leatherbacks are known to traverse entire ocean basins (Valverde and Holzwart 2017) and have the longest migrations (up to 5000 km) of any reptile. Juveniles are oceanic and likely spend their early years in tropical waters until they reach a length of ~100 cm, when they can be found in more temperate waters (Musick and Limpus 1997; Plotkin 2002; Eckert et al. 2012). Adults remain oceanic but many individuals have been shown to be seasonally associated with continental shelves and slopes (Eckert 2006; Doyle et al. 2008; Dodge et al. 2014). Leatherback foraging is affected by the distribution of its prey (e.g., James and

Herman 2001; Houghton et al. 2006; Hays et al. 2009; Heaslip et al. 2012). While detailed movement patterns in the Northwest Atlantic are not fully understood, these turtles migrate along the U.S. East Coast, passing through the South and MAB as they travel to and from key foraging areas off southern New England (Rider et al. 2022). Their movements in the northwestern Atlantic Ocean are thought to follow the Gulf Stream, as jellyfish—their primary prey—are concentrated where this current meets the colder Labrador Current (James et al. 2005).

Leatherback sea turtles are frequently observed in New England waters, particularly off MA, from May through November, with peak sightings occurring in August (Kraus et al. 2016). A hot spot analysis showed high sighting rates south of Nantucket during summer and early autumn (Kraus et al. 2016). During the summer and fall, they are often found in waters around Cape Cod, Martha's Vineyard, and Nantucket (DoN 2005; Kraus et al. 2016; Dodge et al. 2014, 2022); they have also been reported there during spring (DoN 2005). Kraus et al. (2016) reported a hotspot at the proposed drill sites south of Nantucket, with sighting rates per unit effort as high as 112 leatherbacks per 1000 km. Ten leatherback turtles were seen in the proposed Expedition area south of Nantucket during a seismic survey in August 2009 (Holst and Robertson 2009). Dodge et al. (2014) also reported extended habitat use by leatherbacks south of Nantucket.

Leatherbacks tagged off Cape Cod primarily stayed along the U.S. continental shelf before dispersing later, with individuals tracked near the proposed drill sites (Dodge et al. 2014). Similarly, tagging studies have shown that leatherbacks tracked off Cape Breton and mainland Nova Scotia during the summer tend to remain along the northeastern U.S. and eastern Canada before beginning their southward migration in October (James et al. 2005). Some tags have remained attached long enough to track their return journey north, revealing that turtles departing nesting sites between February and March typically reach waters north of 38ºN by June, often returning to areas within a few hundred kilometers of where they were observed the previous year (James et al. 2005). Leatherback turtles are likely to occur near the proposed drill sites from May through November.

3.4.2 Green Sea Turtle (*Chelonia mydas*)

Green sea turtles are widely distributed in tropical and subtropical waters, spending most of their lives in coastal foraging areas (Seminoff et al. 2015). Nesting occurs in more than 80 countries worldwide (Valverde and Holzwart 2017). In the North Atlantic, major nesting sites are located in the Gulf of Mexico, Central America, the Caribbean Sea, and Florida; however, nesting has been reported in much smaller numbers in Georgia, South Carolina and North Carolina (Seminoff et al. 2015). In 2016, the species was divided into 11 DPSs globally for ESA-listing purposes; the Northwest Atlantic DPS occurs off the U.S. East Coast (NMFS 2016c). Critical habitat for the North Atlantic DPS of green turtles has been proposed for waters off the U.S. East Coast and the northern Gulf of Mexico (NMFS 2023). The areas contain nearshore reproductive, foraging, resting, migratory, and *Sargassum* habitat. However, there is no critical habitat near the proposed drill sites.

Adult green turtles demonstrate a strong preference for warm, shallow, and productive waters while avoiding colder, deeper areas, while oceanic waters are mainly used by juveniles and migrating adults. Seasonal migrations by adult turtles between nesting and foraging areas can cover thousands of kilometers (Lageux 2001). However, adults are rarely observed offshore beyond the continental shelf unless migrating to nesting sites (DiMatteo and Sparks 2023). Important feeding areas for adult green turtles in U.S. waters are primarily located off Florida and southern Texas (Witherington et al. 2006; NMFS and USFWS 2007). Predicted densities are highest year-round off the coasts of Georgia and Florida, particularly in the Florida

Keys, where abundant seagrass beds provide essential foraging habitat (Herren et al. 2018; Welsh and Mansfield 2022).

Although sightings in the northeastern U.S. are uncommon, DoN (2005) suggested that small numbers of green turtles can be found from spring to fall as far north as Cape Cod Bay and in offshore waters near the southern edge of Georges Bank. Their presence in the area is strongly influenced by sea surface temperature, with turtles typically appearing when water temperatures reach 11–14°C (Braun-McNeill et al. 2008). Tracking and modelling of neonate green turtle movements suggest that newly hatched turtles move north along the U.S. East Coast in deep water and mainly forage in water >200 m (Putman et al. 2019; Mansfield et al 2021). Long Island Sound and inshore waters of North Carolina appear to be important to juveniles during the summer (NMFS and USFWS 2007), but they are known to forage in Nantucket Sound (Lazell 1980) and as far north as Cape Cod Bay (Witherington et al. 2006). Rehabilitated cold-stunned green turtles that were released off Long Island and tracked using a satellite tag were tracked south of Martha's Vineyard during summer (Robinson et al. 2020).

Green sea turtles begin migrating north toward MA in March, with sightings in and around the region occurring from June through October (DiMatteo and Sparks 2023). As northern waters cool in October, turtles begin migrating south to avoid the risk of cold-stunning. In MA, cold-stunned juvenile green turtles are often found along the southern and eastern shores of Cape Cod Bay and the northwestern shores of Nantucket in December and January as water temperatures drop; during the last decade, 343 green turtle encounters have been recorded in Massachusetts, including 341 cold-stunned individuals (STSSN 2025). Green turtles could occur near the proposed drill sites from June through October.

3.4.3 Kemp's Ridley Sea Turtle (*Lepidochelys kempii*)

Kemp's ridley turtle has a more restricted distribution than other sea turtles, with adults primarily located in the Gulf of Mexico (Spotila 2004). Only juvenile and immature Kemp's ridley turtles appear to move beyond the Gulf of Mexico into more northerly waters along the U.S. East Coast (Spotila 2004). Nesting occurs primarily along the central and southern Gulf of Mexico coast during May–late July (Morreale et al. 2007). There have also been some rare records of females nesting on Atlantic beaches of Florida, North Carolina, and South Carolina (Plotkin 2002). After nesting, female Kemp's ridley turtles travel to foraging areas along the coast of the Gulf of Mexico, typically in waters <50 m deep from Mexico's Yucatan Peninsula to southern Florida; males tend to stay near nesting beaches in the central Gulf of Mexico year-round (Morreale et al. 2007).

Hatchlings are carried by the prevalent currents off the nesting beaches and do not reappear in the neritic zone until they are about two years old (Musick and Limpus 1997). Those juvenile and immature Kemp's ridley turtles that migrate northward past Cape Hatteras probably do so in April, returning southward in November (Musick et al. 1994; DiMatteo and Sparks 2023). North of Cape Hatteras, juvenile and immature Kemp's ridleys prefer shallow-water areas, particularly along North Carolina and in Chesapeake Bay, Long Island Sound, and Cape Cod Bay (Musick et al. 1994; Morreale et al. 1989; Danton and Prescott 1988; Spotila 2004; Frazier et al. 2007). However, densities around Cape Cod are expected to be low (Putman et al. 2019). DoN (2005) reported a sightings off Cape Cod and south of Martha's Vineyard during summer, as well as numerous strandings, including one on Nantucket, during fall.

During surveys off southern Nantucket and Martha's Vineyard from October 2011 to June 2015, four Kemp's ridley sea turtles were observed during the month of August only (Kraus et al. 2016). A rehabilitated cold-stunned Kemp's ridley turtle that was released off Long Island and tracked using a satellite tag was tracked west of the proposed drill sites during summer (Robinson et al. 2020). Kemp's ridley sea turtles are most often observed in the MA when cold-stunned individuals wash ashore in November and December; over the past decade, Massachusetts has recorded 6,009 stranded Kemp's ridley turtles, including 5,962 cold-stunning events (STSSN 2025). Lazell (1980) also reported summer records and strandings of Kemp's ridley turtles from MA to the Gulf of Maine. Kemp's ridley turtles could occur near the proposed drill sites from May through November.

3.4.4 Loggerhead Sea Turtle (*Caretta caretta*)

The loggerhead sea turtle is widely distributed, occurring in tropical, subtropical, and temperate waters of the Atlantic, Pacific, and Indian oceans (Valverde and Holzwart 2017). Its distribution extends into more temperate waters than other sea turtles; it is the most abundant turtle in U.S. waters (Witherington et al. 2006; Valverde and Holzwart 2017). Adults generally forage in coastal and shelf waters but can pass through oceanic waters during migrations. In 2011, the species was divided into nine DPSs globally for ESA-listing purposes (NMFS 2011); the Northwest Atlantic Ocean DPS occurs off the U.S. East Coast. NMFS proposed (2013) and designated (2014) 38 areas of critical habitat in the range of the Northwestern Atlantic Ocean DPS of the loggerhead turtle, from Virginia to the Gulf of Mexico. The areas contain one or more nearshore reproductive habitats, wintering areas, breeding areas, constricted migratory corridors, and *Sargassum* habitat. However, there is no critical habitat near the proposed drill sites.

In the northeastern Atlantic Ocean, loggerhead sea turtles nest primarily in the southeastern U.S., particularly Florida, during April–September (Valverde and Holzwart 2017). However, loggerheads are also reported to nest in Georgia, South Carolina, and North Carolina, with very small numbers also nesting in Virgina (NMFS and USFWS 2023). Ceriani et al. (2019) estimated the total number of adult females (51,319) based on the number of nests observed in Florida between 2014–2018. For nesting beaches north of Florida between 2010 and 2015, Shamblin et al. (2021) estimated a total of 8,074 nesting females based on genetic capture-mark-recapture.

Modelling of young sea turtle dispersal after hatching showed relatively high numbers of loggerhead turtles (0.5 yr) along the U.S. East Coast, with high densities expected just south of the proposed drill sites (Putman et al. 2019). After leaving the pelagic stage, juvenile loggerheads forage in estuaries, bays, and coastal waters, with some migrating seasonally as far north as Long Island (Shoop and Kenney 1992 *in* Musick and Limpus 1997; Avens et al. 2003).

Loggerheads are typically present in New England waters from June through November, migrating offshore toward the continental shelf to feed in nutrient-rich waters (DiMatteo et al. 2024). Kraus et al. (2016) reported the peak occurrence in the waters off southern Martha's Vineyard and Nantucket during August–September, with sightings also during April, May, and July. DoN (2005) also reported the greatest number of sightings during summer, with lower numbers occurring in the area during fall and spring. High sightings per unit effort (up to 72 turtles per 1000 km) were reported south of Nantucket during summer and fall, north of 41°N, including near the proposed MV-08A drill site. One loggerhead turtle was seen in the proposed Expedition area south of Nantucket during a seismic survey in August 2009 (Holst and Robertson 2009).

Lazell (1980) noted that loggerheads are common in New England and the Gulf of Maine. Most females tagged on North Carolina nesting beaches migrated north to forage off New Jersey, Maryland, and Delaware in summer before moving south to wintering grounds off the southeastern U.S. (Hawkes et al. 2007). Some individuals overwinter in mid-Atlantic deep waters where food productivity remains high, particularly off North Carolina, Virginia, and Florida (Hawkes et al. 2007). However, individuals can also become trapped in inshore areas, leading to hypothermia and increased strandings in Cape Cod Bay and

Long Island Sound during late fall (Burke et al. 1991 *in* DoN 2005). Rehabilitated cold-stunned loggerhead turtles that were released off Long Island and tracked using a satellite tag were tracked southwest of Martha's Vineyard during November–December (Robinson et al. 2020). Loggerheads are the second most commonly cold-stunned turtle species in MA, with 564 strandings recorded over the past decade (STSSN 2025). Loggerheads could occur near the proposed drill sites from June through November.

3.5 Marine-Associated Birds

Four ESA-listed marine-associated bird species could occur in or near the Expedition area: the ***endangered*** roseate tern, Bermuda petrel, and black-capped petrel, and the ***threatened*** piping plover (Table 5). General information on the taxonomy, ecology, distribution and movements, and acoustic capabilities of marine-associated families are given in § 3.5.1 of the NSF PEIS.

3.5.1 Roseate Tern (*Sterna dougallii*)

The roseate tern has a worldwide distribution mainly in tropical and subtropical oceans. Roseate tern is a strictly marine species, either coastal or more pelagic in nature, feeding on small fish. In nearshore waters it forages over tide-rips, sand shoals and sandbars, and in deeper offshore waters it feeds over schools of predatory fish which flush prey fish species to the surface (BirdLife International 2025a). It is a shallow plunge diver and usually does not fully submerge beneath the surface. Breeding roseate terns typically feed close to their breeding colony in shelf waters, although recent tracking evidence suggests that they may travel up to 30 km from their colonies (Loring et al. 2019). Veit et al. (2016) suggest that the western edge of the Nantucket Shoals including the proposed drilling sites may be important areas for common terns and roseate terns in spring (during the month of May), prior to initiation of breeding.

In North America, roseate terns breed on islands in southern Nova Scotia, along the northeast coast of the U.S. from New York to Maine, and throughout the Caribbean, as well as Florida (USFWS 1998, 2010, 2020; Conley et al. 2017; BirdLife International 2025a). Over 90% of the Northeastern population breeds in two colonies in Massachusetts (Bird Island and Ram Island) and one colony in New York (Great Gull Island) (Gochfeld and Burger 2020). During the post-breeding period (July–September), a large proportion of the entire Northwest Atlantic population is concentrated in a limited geographic area of coastal MA near Cape Cod, Martha's Vineyard, and Nantucket prior to their southward migration to South America (Atwood 2022). Recent tracking studies suggest that roseate turn occurrence in waters off MA peaks in mid-July and August, when individuals move between staging locations on islands in Nantucket Sound, Block Island, and Montauk, including potential movements through New England wind energy areas (Loring et al. 2019). Roseate terns migrate north and south through the Expedition area in spring and fall, respectively. The northward migration is expected to take place mainly during May. It is unknown if migrating roseate terns transverse directly through the Expedition area or linger en route. Non-breeding sub-adult roseate terns could also occur within the Expedition area beyond the migration period.

3.5.2 Bermuda Petrel (*Pterodroma cahow*)

The Bermuda petrel was thought to be extinct by the 17th century until it was rediscovered in 1951, at which time the population consisted of 18 pairs; by 2011, the population had reached 98 nesting pairs (Birdlife International 2025). Currently, all known breeding pairs breed on islets in Castle Harbour, Bermuda (Madeiros et al. 2012). In the non-breeding season (mid-June–mid October), it is thought that birds move west to follow the warm waters on the edge of the Gulf Stream. During this time, the Bermuda petrel has been observed in Gulf Stream waters from North Carolina to MA (Madeiros et al. 2014).

TABLE 5. The habitat, occurrence, regional population sizes, and conservation status of protected marine-associated birds that could occur in or near the proposed Expedition area in the Northwest Atlantic Ocean.

Species	Occurrence in Expedition Area[1]	U.S. ESA[2]	IUCN[3]	CITES[4]
Roseate Tern	Scarce, migrating individuals head north during spring	EN	LC	NL
Bermuda Petrel	Rare, pelagic	EN	EN	NL
Black-capped Petrel	Uncommon, pelagic	EN	EN	NL
Piping Plover	Coastal	T	NT	NL

NL = Not Listed.
[1] Occurrence based on available data and professional opinion.
[2] U.S. Endangered Species Act; EN = Endangered; T = Threatened.
[3] International Union for the Conservation of Nature Red List of Threatened Species, version 2024-2: EN = endangered, NT = near threatened, LC = least concern.
[4] Convention on International Trade in Endangered Species.

Results from geolocator tags showed that individuals have been recorded outside of the Gulf Stream, north to the Bay of Fundy, into the Gulf of St. Lawrence and over the Grand Banks of Canada (Madeiros 2009; Birdlife International 2025b). Bermuda petrels surface feed, securing small fish, cephalopods, and other small marine life by sitting on the water and dipping bill into surface waters. There are two sightings of Bermuda petrel along the continental slope near Georges Canyon and one sighting near Welker Canyon (eBird 2025). Small numbers of Bermuda petrels could be encountered in the proposed Expedition area throughout the year, although they are unlikely to occur near the proposed drilling sites because the core of the range is located to the northeast (Madeiros et al. 2014).

3.5.3 Black-capped Petrel (*Pterodroma hasitata*)

The black-capped petrel nests in the countries of Haiti and the Dominican Republic from October to May (Carboneras et al. 2020). The nest is at the end of a burrow dug into the soft earth; the birds enter and leave the nest only under the cover of darkness. Deforestation due to human dependence on wood-based cooking fuel and clearing for agricultural purposes are the biggest risks to the black-capped petrel. The population is estimated at no more than 1000 breeding pairs, but perhaps as few as 500, with a total population of 2000–4000 birds (BirdLife International 2025c). The black-capped petrel is highly pelagic, occurring in offshore waters beyond the shelf edge from the Caribbean to North Carolina with the highest concentrations observed in deeper offshore waters off the coasts of South Carolina, northern Georgia, and the Cape Hatteras region of North Carolina (Jodice et al. 2015). There are a few sightings beyond the Gulf Stream waters as far north as MA along the edge of the continental shelf (Flood and Fisher 2013; eBird 2025). It is primarily nocturnal and crepuscular, feeding on squid, fish and crustaceans at the surface of the water. The distribution of black-capped petrel is most influenced by the position of the Gulf Stream, a dynamic current system, and not sea surface temperature or depth (BirdLife International 2025c). They are known to frequent the western edge of the Gulf Stream from June through September (Satgé et al. 2024). The black-capped petrel can be expected in low densities within the Expedition area year-round.

3.5.4 Piping Plover (*Charadrius melodus*)

The Atlantic Coast population of the piping plover breeds on coastal beaches from Newfoundland to North Carolina during March–August, and it winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, and in the Caribbean (USFWS 1996). Its marine nesting habitat consists of sandy beaches, sandflats, and barrier islands (Birdlife International 2025d). Feeding areas include intertidal portions of ocean beaches, mudflats, sandflats, and shorelines of coastal ponds, lagoons, or salt marshes (USFWS 1996). Wintering plovers are generally found on barrier islands, along sandy peninsulas, and near coastal inlets (USFWS 1996).

Piping plovers arrive at nesting areas in MA from mid-March to early May (Elliott-Smith and Haig 2020) and depart these nesting areas by late August (Elliott-Smith and Haig 2020). Nesting piping plovers were tagged in Cape Cod to track their fall migration; the majority of these birds departed in July on their fall migration in a south-southwesterly direction, some passing near the Expedition area (Loring et al. 2019, 2020). Piping plovers could occur near the proposed drill sites.

3.6 Fish and Marine Invertebrates, Essential Fish Habitat, and Habitat Areas of Particular Concern

Off the east coast of Cape Cod, a temperature gradient forms during the summer months, creating a boundary so that colder water fish occur to the north and warmer water fish occur to the south (Freeman and Walford 1974 *in* MMS 2009). The temperature gradient fluctuates north and south over an area of 32–64 km along the Cape Cod shoreline. Warm and cold spots have been identified off Cape Cod, specifically the warmer shallow waters of Nantucket Sound and the cooler waters over Nantucket Shoals (Yu and Yang 2022). Because of the temperature gradient along Cape Cod and its geographic location, Nantucket Sound serves as a migratory pathway for some warm-water species as they move into Cape Cod Bay and Massachusetts Bay.

Southern New England support a diverse fish community and exhibits a range of productivity, environmental conditions, habitat structures, and fish assemblages (Cook and Auster 2007). There is a mix of demersal, coastal pelagic, and oceanic pelagic migratory species (BOEM 2024). Many of the fish in this area are migratory, moving north or inshore in the summer, and south or offshore in the winter. Seasonal temperature fluctuation is one of the primary factors influencing the distribution of fish species in this region (Sherman et al. 1996; DoN 2005). Areas north of the Expedition area are dominated by temperate species, such as gadids (cod, haddock, and hake) and various species of flounder, which occur on a year-round basis (Azarovitz and Grosselein 1987 *in* DoN 2005). In contrast, fish species in the MAB are largely seasonal migrants with few temperate species (15%) and very few true residents (<5%) (Sherman et al 1996; DoN 2005). The majority of the MAB species are subtropical-tropical species (Froese and Pauly 2024), and many of them migrate into northern areas when water temperatures increase (Azarovitz and Grosselein 1987 *in* DoN 2005). The seasonal influx of southern fish into northern areas is most apparent in late summer or early fall when at least 33% of the species on Georges Bank and 20% of species in the Gulf of Maine are subtropical-tropical species (Azarovitz and Grosselein 1987 *in* DoN 2005). Increases in sea surface temperatures have been correlated to observed shifts in species compositions and a subsequent shift to pelagic consumers from benthic (Collie et al. 2008).

Trawl surveys conducted near the proposed Expedition area (in the Massachusetts wind energy area) recovered 101 taxa of which 40 are managed fisheries (Guida et al. 2017). Dominant taxa during the summer and fall included longfin squid (*Doryteuthis pealeii*), scup (*Stenotomus chrysops*), and spiny dogfish (*Squalus acanthias*). In the winter and spring, catches were dominated by Atlantic herring (*Clupea* *harengus*). Little skate (*Leucoraja erinacea*), winter skate (*Leucoraja ocellata*), and silver hake (*Merluccius bilinearis*) were dominant catches year-round. Demersal fish assemblages (including skates, dogfishes, hakes, seabasses, drums, tautog (*Tautoga onitis*), scup, and flatfish) in the area exhibit depth and temperature related distributions (Overholtz and Tyler 1985; Gabriel 1992; Mahon et al. 1998; BOEM 2014a *in* BOEM 2024).

Nantucket Sound is a northern border for some summer migrant species including black sea bass (*Centropristis striata*), scup, and summer flounder (*Paralichthys dentatus*). In winter and early spring, some fish species are known to concentrate on shoal areas in Nantucket Sound for spawning or feeding, and some move from shoal areas to deeper water or channel areas. Over the past four decades, black sea bass and scup have exhibited a significant poleward distribution shift with the center of spring biomass shifted by 150–200 km (Bell et al. 2015). The winter flounder (*Pseudopleuronectes americanus*) is a species that is known to move from shoal areas to deeper water and channel areas in summer months, when shallower water in shoal areas has warmer water temperatures. In fall, when the water temperatures start to cool, the winter flounder moves back to shoal areas (MMS 2009). The Northeast Atlantic continental shelf waters also support a variety of highly migratory pelagic fishes (e.g., tunas, billfishes, swordfish, and sharks). The distribution of highly migratory species are often associated with thermal oceanic fronts (Block et al. 1998). The highly migratory species tend to undergo season-dependent inshore-offshore migrations by occupying warmer offshore waters in winter and inshore feeding and spawning areas during spring and summer (DoN 2005).

The continental shelf waters off the U.S. East Coast also support a variety of macroinvertebrates (e.g., molluscs and crustaceans). The distribution of macroinvertebrates is largely influenced by the availability of benthic habitats (Theroux and Grosselein 1987 *in* DoN 2005). Guida et al. (2017) conducted Van Veen grabs in the Massachusetts wind energy area and identified 151 infaunal taxa of which the most frequently observed invertebrate taxa were arthropods, amphipods, bivalves, and polychaetes. Macroinvertebrates collected from beam trawls included sand shrimp, sand dollars, pandalid shrimp, and fig sponges (Guida et al. 2017). Other macroinvertebrates found in the area included commercially important sea scallops and American lobster, and crabs (lady crab, spider crab, and Atlantic rock crab).

Habitat forming corals and sponges have been found in southern New England and MAB. Scleractinian, alcyonarian, gorgonian, and pennatularian corals can be found in nearshore shallow water areas of the inner continental shelf as well as deeper waters along the continental slope, canyons, deep channels, and seamounts of the Northwest Atlantic (Watling 2001). Members of these coral communities can be found near the rocky shorelines and inner continental shelf waters around Martha’s Vineyard (see Fig. 4-2 *in* DoN 2005). Deep-water corals occur across the continental shelf in the Northwest Atlantic but are most common on the continental slope and in submarine canyons, gullies, and on seamounts (Breeze et al. 1997; NOAA 2025a). None of these corals are listed under the ESA.

3.6.1 ESA-Listed Fish Species

There are five fish species listed under the ESA that could occur in the proposed Expedition area, including the ***endangered*** Gulf of Maine DPS of the Atlantic salmon, various DPSs of Atlantic sturgeon, and shortnose sturgeon, as well as the ***threatened*** oceanic whitetip shark and giant manta ray (Table 6).

TABLE 6. The habitat, occurrence, and conservation status of fish species of conservation concern that could occur in or near the proposed Expedition area in the Northwest Atlantic Ocean.

Species	**Habitat[1]**	**Occurrence in Expedition Area[2]**	**US ESA[3]**	**IUCN[4]**	**CITES[5]**
Atlantic Salmon *Gulf of Maine DPS*	Marine, freshwater, brackish, anadromous	Likely	E	NT	NL
Shortnose Sturgeon	Freshwater, estuarine, shallow coastal water <50 m; spends little time in ocean[6]	Unlikely	E	EN[6]	I
Atlantic Sturgeon *New York Bight DPS*	Freshwater, estuarine, shallow coastal water <50 m, seasonal migrations along the coast, wide-ranging	Possibly	E	VU	II
Gulf of Maine DPS			T	VU	II
Chesapeake Bay DPS			E	VU	II
Carolina DPS			E	EN	II
South Atlantic DPS			E	EN	II
Giant Manta Ray	Coastal, pelagic, migratory; deep-diving, areas of upwelling.	Unlikely	T	EN	II
Oceanic Whitetip Shark	Pelagic, open ocean, migratory	Unlikely	T	CR	II

NL = Not Listed.
1 Froese and Pauly (2024), unless otherwise indicated.
2 Occurrence based on available data and professional opinion.
3 U.S. Endangered Species Act; E = Endangered; T = Threatened.
4 International Union for the Conservation of Nature Red List of Threatened Species, version 2024-2: CR = critically endangered, EN = endangered, NT = Near Threatened, VU = vulnerable.
5 Convention on International Trade in Endangered Species of Wild Fauna and Flora: Appendix I = Threatened with extinction; Appendix II = not necessarily now threatened with extinction but may become so unless trade is closely controlled.
6 NOAA Fisheries 2025f.

3.6.1.1 Atlantic Salmon (*Salmo salar*)

Historically, Atlantic salmon ranged from Long Island Sound to Greenland in the Northwest Atlantic (NOAA Fisheries 2021b); however, currently the only native salmon in the U.S. are found in rivers in Maine (NOAA Fisheries 2025g). The Atlantic salmon is an anadromous species that exhibits an extremely complex life history involving use of both freshwater and marine habitats, and extensive oceanic migrations (NOAA Fisheries 2025g). Atlantic salmon spawn in freshwater in the fall (NOAA Fisheries 2025g), typically from October through November, with a peak in late October (Scott and Scott 1988). The eggs remain in gravel substrates and hatch during winter, with fry emerging from the gravel in spring (NOAA Fisheries 2025g). Juvenile salmon, or parr, remain in fresh water two to three years in New England rivers, depending on growth and locality (NOAA Fisheries 2025g). When parr exceed 13 cm in length, they develop into smolts and migrate to the marine environment in spring. At sea migrations can be extensive (NOAA Fisheries 2025g). Tagging studies on Atlantic salmon have shown that New England salmon stocks migrate as far north as Greenland (Sheehan et al. 2023).

Atlantic salmon may spend one or more years at sea. After the first winter at sea, ~10%, typically males, become sexually mature and return to natal rivers to spawn (NOAA Fisheries 2025g). Those remaining at sea feed in the coastal waters of West Greenland and Canada, typically off the coasts of Newfoundland and Labrador but as far south as Long Island Sound (NOAA Fisheries 2025g). Historically, these foraging areas were targeted by commercial Northeast Atlantic gillnet fisheries (NOAA Fisheries 2025g), which are now under moratoria. After their second winter at sea, most U.S. salmon return to freshwater systems to spawn (NOAA Fisheries 2025g), most notably in large cool rivers with extensive gravel-bottom headwaters, which are essential to early life stages (Scott and Scott 1988). Critical habitat for the Gulf of Maine DPS of Atlantic salmon includes perennial river, stream, estuary, and lake habitat along the Gulf of Maine.

U.S. Atlantic salmon populations are delineated into three discrete DPSs for the purposes of management including the (1) Long Island Sound DPS, (2) Central New England DPS, and (3) Gulf of Maine DPS (NMFS and USFWS 2020b; NOAA Fisheries 2025g). The Long Island Sound and Central New England DPSs were extirpated in the 1800s (NOAA Fisheries 2025g). The Gulf Maine DPS represents the last wild population of U.S. Atlantic salmon (NOAA Fisheries 2025g). This DPS is part of a population in the North American Atlantic that historically ranged from northern Quebec southeast to Newfoundland and southwest to Long Island Sound (NOAA Fisheries 2025g). In 2023, 1,854 salmon returned to U.S. rivers of which only 18 individuals were documented outside of the Gulf of Maine DPS (all in the Central New England DPS and none in the Long Island DPS) (Hawkes 2024). Restoration and stocking efforts are employed in several New England rivers. In 2023, ~3,645,500 juvenile salmon (age classes egg to year one smolt) and 4,210 adults were stocked in U.S. rivers (Hawkes 2024). Restoration efforts in southern New England have ceased (NOAA Fisheries 2021b), as these efforts have been largely unsuccessful. For example, only four Atlantic salmon returned to spawning areas in the Connecticut River (Callan 2024). During marine phases, Atlantic salmon may migrate into coastal waters as far south as Long Island.

3.6.1.2 Shortnose Sturgeon (*Acipenser brevirostrum*)

The shortnose sturgeon is a large, long-lived, demersal, anadromous species that spawns in coastal rivers along the east coast of North America from Canada to Florida. Shortnose sturgeon stock abundance steadily declined throughout the 20th century as a result of overfishing, pollution, and habitat destruction (NMFS 1998; Shepherd 2006; NOAA Fisheries 2025f). In some systems, shortnose sturgeon abundance may be increasing to levels that would allow reconsideration of their endangered status (Shepherd 2006). Significant numbers of shortnose sturgeon occur in the Hudson River (~38,000 individuals), Delaware River (~12,047 adults in 2006), and the Saint John River in New Brunswick, one of the largest in North America (NOAA Fisheries 2025f).

The shortnose sturgeon is distributed along the east coast of North America from the St. John River, Canada, to the St. Johns River, Florida (NOAA Fisheries 2025f). NMFS recognizes three "metapopulations" of shortnose sturgeon (northern, mid-Atlantic, and southern) inhabiting 41 rivers and bays systems and spawning in 19 of those rivers over its distributional range (NOAA Fisheries 2025f). Their distribution within this range is discontinuous with a 400-km gap separating the northern and mid-Atlantic metapopulations from the southern metapopulation (NOAA Fisheries 2025f). The proposed Expedition area is in the mid-Atlantic metapopulation and is adjacent to three known sturgeon rivers that terminate in the Long Island Sound – the Connecticut River, Deerfield River, and Housatonic River (NOAA Fisheries 2025f).

Shortnose sturgeon prefer the nearshore marine, estuarine, and riverine habitat of large river systems, and apparently do not make long-distance offshore migrations (NOAA Fisheries 2025f). Adults migrate upriver in the spring (April to May) to spawn in the Mid-Atlantic and quickly return downstream after spawning (NOAA Fisheries 2025f). Spawning generally occurs in the lower sections of rivers, with eggs deposited on hard bottom surfaces (Shepherd 2006). Juvenile sturgeon remain in fresh water for their first summer before migrating to estuaries in winter (Shepherd 2006). It typically takes Hudson River shortnose sturgeon 7 to 10 years to mature, and males spawn every 1 to 2 years after maturing, while females typically spawn every 3 to 5 years (NOAA Fisheries 2025f). Migrations into marine waters rarely occur (NMFS 1998). Thus, it is unlikely that this species would occur in the proposed Expedition area.

3.6.1.3 Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)

The Atlantic sturgeon is a long-lived, anadromous species found in rivers and coastal waters from as far north as Canada and as far south as Florida (NOAA Fisheries 2025h). While similar in appearance to shortnose sturgeon, Atlantic sturgeon is larger and can grow to ~16 ft long and weigh up to 800 pounds (NOAA Fisheries 2025h). There are five DPSs of the Atlantic sturgeon – the ***threatened*** Gulf of Maine DPS, and the ***endangered*** Carolina, Chesapeake Bay, New York Bight, and South Atlantic DPS (NOAA Fisheries 2025h). The Expedition area is closest to the endangered New York Bight DPS; however, based on tracking studies, individuals from any of these DPS could occur near the proposed drill sites. Known Atlantic sturgeon rivers near the Expedition area include the Connecticut River and the Housatonic River that both flow into Long Island Sound. Thirty-three rivers are designated as critical habitat from Maine to Florida, with the majority occurring south of the Chesapeake Bay (NMFS 2017). While the marine environment is critical for the Atlantic sturgeon life cycle, no coastal or marine waters have been designated as critical habitat.

The Atlantic sturgeon is a late maturing fish (11–21 years in the Hudson River), that returns to its natal rivers to reproduce (NOAA Fisheries 2025h). Of the 38 historic spawning rivers, currently breeding has only been documented in 22 rivers (NOAA Fisheries 2025h). Spawning times differ between DPSs; for example, adults spawn in the spring and early summer in rivers from Delaware to Canada while sturgeon in the southern range spawn in late summer and fall (NOAA Fisheries 2025h). Males typically return every year to spawn while females return every other year or every third year (NOAA Fisheries 2025h). In northern rivers, following spawning, males can remain in the river or lower estuary until fall, and females usually exit the rivers within 4–6 weeks (NOAA Fisheries 2025h). Juveniles move downstream and inhabit brackish waters for 1 to 5 years before moving into nearshore coastal waters (NOAA Fisheries 2025h). In the fall and spring, Atlantic sturgeon aggregate in bays and estuaries, but in winter they typically disperse into the marine environment (HDR 2023). Most Atlantic sturgeon captured in sampling surveys were caught in depths <20 m (Dunton et al. 2010).

Tagging studies have found that once juvenile Atlantic sturgeon leave their natal rivers they travel extensively along the east coast and as far north as Iceland (NOAA Fisheries 2025h). Sturgeon tagged in New Jersey were recaptured in an area from New Hampshire to North Carolina (Eyler et al. 2009). Frisk et al. (2019) found that tagged sturgeon migrated to deeper waters offshore in November and December but were infrequently detected in the same areas in the summer months. Atlantic sturgeon could occur in the Expedition area.

3.6.1.4 Giant Manta Ray (*Manta birostris*)

The giant manta ray is a migratory species found worldwide in offshore, oceanic, and occasionally estuarine waters in tropical, subtropical, and temperate regions between 35°N and 35°S latitudes (NOAA Fisheries 2025i). Giant manta rays are known for long seasonal migrations. Along the U.S. East Coast, giant manta rays are typically found in waters from 19 to 22 °C and will follow the Gulf Stream warm waters north of 35°N in late summer and early fall (Farmer et al. 2022). However, sightings in New England are rare. A total of eight giant manta ray were caught as bycatch in the MAB, northeast coastal Atlantic, and the Gulf of Mexico pelagic longline fishery between 2020 through 2022 (NMFS 2024a). There are no current or historic estimates of its global abundance (NMFS 2024a). The giant manta ray is a long-lived species with a low reproductive rate, generally producing a single pup every two to three years. The giant manta ray filter feeds on planktonic organisms and often migrates to productive areas such as areas of upwelling or seamounts. While feeding, it is often found in the top 10 m of the water column, but tagging studies have recorded this species making dives of 200 to 450 m, and they are capable of diving to 1000 m (NOAA Fisheries 2025i). It is unlikely that this species would be encountered in the Expedition area.

3.6.1.5 Oceanic Whitetip Shark (*Carcharhinus longimanus*)

The oceanic whitetip shark is a highly migratory species primarily found in oceanic waters of tropical and subtropical regions, typically between 30°N and 35°S; however, in the western North Atlantic, the oceanic whitetip shark occurs from Maine to Argentina (Young et al. 2017). Once considered common, global population estimates are incomplete, but fishing pressures across its range have caused significant declines (NMFS 2024b). The oceanic whitetip shark is long-lived (up to 25 years) and late-maturing (NOAA Fisheries 2025j). Females reach maturity at six to nine years and produce a litter of pups biennially. The oceanic whitetip shark is a top predator, and primarily feeds on fish and squid, although it will opportunistically feed on a wide variety of animals. The oceanic whitetip is typically found offshore in deep water, but prefers surface waters above 20°C and primarily occurs in the top 200 m of the water column (NOAA Fisheries 2025j). Rarely occurring in waters less than 100 m (BOEM 2024), it is unlikely that this species would be encountered in the project area.

3.6.2 Essential Fish Habitat

Under the 1976 *Magnuson Fisheries Conservation and Management Act* (renamed *Magnuson Stevens Fisheries Conservation and Management Act* in 1996), Essential Fish Habitat (EFH) is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity". "Waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities (NOAA 2002). The *Magnuson Stevens Fishery Conservation and Management Act* (16 U.S.C. §1801–1882) established Regional Fishery Management Councils and mandated that Fishery Management Plans (FMPs) be developed to manage exploited fish and invertebrate species responsibly in federal waters of the U.S. When Congress reauthorized the act in 1996 as the *Sustainable Fisheries Act*, several reforms and changes were made. One change was to charge NMFS with designating and conserving EFH for species managed under existing FMPs.

The entire eastern seaboard from the coast to the limits of the EEZ is EFH for one or more species or life stage for which EFH has been designated. The life stages and associated habitats for those species with EFH that would occur within the Expedition area are described in Appendix C. Two fishery management councils created by the 1976 Magnuson Fisheries Conservation and Management Act are responsible for the management of fishery resources, including designation of EFH, in federal waters of New England: the Mid-Atlantic Fishery Management Council (MAFMC) and the New England Fishery Management Council (NEFMC). Highly migratory species (HMS) that occur in the proposed Expedition area, such as sharks, and tunas, are managed by NOAA Fisheries under the Atlantic HMS Fisheries Management Plan (FMP). The Atlantic States Marine Fisheries Commission partners with the federal councils in managing coastal fish resources and coordinates the conservation and management of 27 nearshore fish species. The MAFMC manages more than 65 species and seven FMPs (MAFMC 2025). These FMPs manage 15 species including summer flounder, scup, black sea bass, mackerel (Atlantic and chub), squid (longfin and *Illex*), butterfish, Atlantic surf clams, ocean quahogs, Atlantic bluefish, golden and blueline tilefish. Two species are jointly managed with the NEFMC – spiny dogfish and monkfish (MAFMC 2025). The NEFMC is responsible for managing 28 EFHs (NEFMC 2025). Many of these species are part of the Northeast multispecies (groundfish) fishery including Atlantic cod, Acadian redfish, Atlantic wolffish, flatfish (witch, winter, windowpane, yellowtail, American plaice, and Atlantic halibut), hakes (silver, white, and red), ocean pout, and Atlantic pollock (NEFMC 2025). Several EFH areas have specific gear requirements including type, mesh size, and devices to reduce habitat impacts and prevent bycatch. The NEFMC has restricted gillnet gear in two closure areas outside of the Expedition area (Nantucket Lightship and Closed Area 1) and has restricted fishing gear in the coral management zones south of Georges Bank (NEFMC 2025).

3.6.3 Habitat Areas of Particular Concern

Habitat Areas of Particular Concern (HAPCs) are a subset of EFH that provide important ecological functions, are especially vulnerable to degradation, or include habitat that is rare (NOAA 2020). HAPCs are designated by regional fishery management councils (FMCs) established by the *Magnuson-Stevens Fishery Conservation and Management Act* (16 U.S.C. §1801-1882). The summer flounder submerged aquatic vegetation HAPC, managed by the MAFMC, overlaps with the Expedition area (Fig. 2). The summer flounder HAPC includes all native species of macroalgae, seagrass, and freshwater and tidal macrophytes of any bed size or loose aggregations within the juvenile and adult EFH (MAFMC 1999). The NEFMC designated the Southern New England HAPC (89 Fed. Reg. 7633), which comprises all large-grained complex habitat, specifically cod spawning habitats and complex benthic habitat within and around the wind lease areas of southern New England (NEFMC 2025), including the area around the proposed drill sites (Fig. 2). This HAPC was designated during framework adjustments to the groundfish, scallops, monkfish, skate, and Atlantic herring FMPs (NOAA 2024a). The juvenile Atlantic cod HAPC for the New England coastline extends out to the 20-m isobath and includes structurally complex habitats including all hard-bottom habitats, eelgrass, rocky habitats, mixed sand and gravel, and emergent epifauna (NEFMC 2017).

3.7 Fisheries

Commercial and recreational fisheries data are collected by NMFS, including species, gear type and landings mass and value, all of which are reported by state of landing (NOAA Fisheries 2025k,l). Fish stocks in federal waters are managed by FMCs. Each FMC is mandated to develop fishery management plans (FMPs) to manage exploited fish and invertebrate species responsibly in U.S. federal waters. FMPs developed by NEFMC include northeast multispecies (groundfish), scallop, goosefish/monkfish, herring, small mesh multispecies (whiting), dogfish, red crab, skates, and Atlantic salmon (NEFMC 2025). The Atlantic salmon FMP consists of a single provision that prohibits the possession of this species and any directed or incidental (bycatch) commercial fishery in federal waters (NEFMC 2025).

The MAFMC has developed seven FMPs: Atlantic mackerel-squid-butterfish, bluefish, spiny dogfish, summer flounder-scup-black sea bass, Atlantic surf clam-ocean quahog, tilefish, and monkfish (MAFMC 2025). The two FMCs jointly manage the monkfish and dogfish fisheries (MAFMC 2025; NEFMC 2025). NMFS participates in fishery management efforts by providing fisheries data and analysis and by managing HMP species, including over 80 species of sharks, tunas, and billfishes (DoN 2005). The federal FMCs also work in conjunction with the Atlantic States Marine Fisheries Commission (ASMFC). The ASMFC coordinates the management and conservation of 27 Atlantic coastal fish species/groups (ASMFC 2025). State agencies, such as the Massachusetts Department of Marine Fisheries (MassDMF), are also responsible for the protection and enhancement of marine fishery resources and for the promotion and regulation of commercial and recreational fishing (MMS 2009).

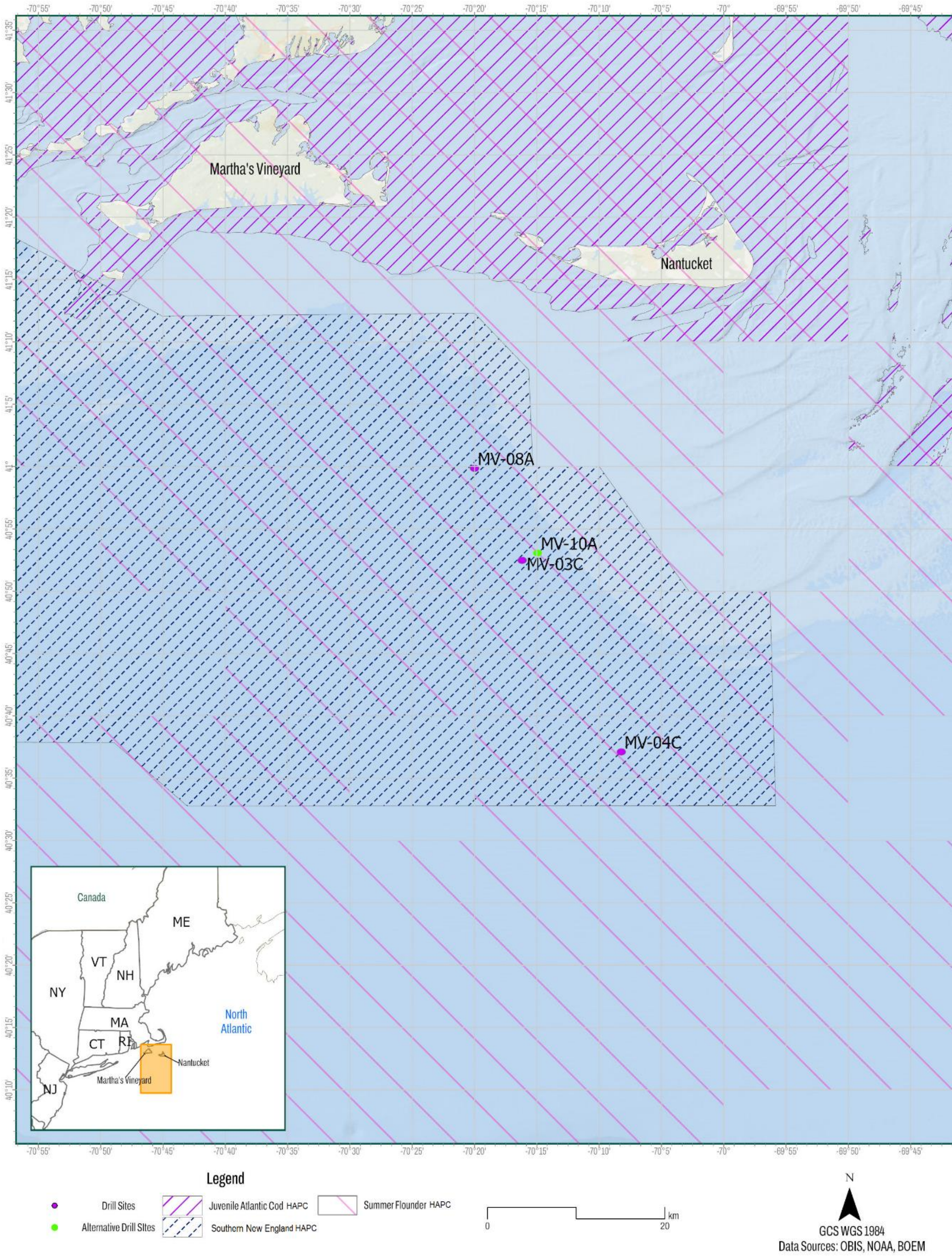

FIGURE 2. Location of the proposed Expedition 501 drill sites south of Nantucket, MA, and Habitat Areas of Particular Concern (HAPC).

3.7.1 Commercial Fisheries

The continental shelf waters off the U.S. East Coast supports substantial finfish resources, including forage fish, groundfish, and HMS. In addition, there are several invertebrate resources in the region. Commercial fisheries in the area typically concentrate on the 50-m contour off Long Island and Georges Bank (BOEM 2021). The fish and invertebrate resources support many active commercial and recreational fisheries. Table 7 summarizes the public information for the dominant species/groups in 2023 commercial landings of the four states (MA, RI, CT, and NY) adjacent to the proposed Expedition area (NOAA Fisheries 2025k). Nearly 90% of the overall catch weight landed (98,149 mt) consisted of pelagic species (Atlantic herring, *Clupea harengus harengus*; and Atlantic mackerel, *Scomber scombrus*), groundfish (skates; goosefish, *Lophius americanus*; haddock, *Melanogrammus aeglefinus*; and silver hake, *Merluccius bilinearis*), and invertebrates (Atlantic sea scallop, *Placopecten magellanicus*; longfin inshore squid, *Loligo pealeii*; ocean quahog clam, *Arctica islandica*; and American lobster, *Homarus americanus*). Species descriptions for the top ten commercial species landed in states adjacent to the Expedition area in 2023 are provided in Appendix D.

New Bedford, MA, is one of the top commercial fishery ports in the U.S., landing 88.4 million pounds valued at $443.2 million in 2022 (NOAA Fisheries 2025k). Annual commercial finfish catches made by fishermen are dominated largely by squid, goosefish, summer flounder, Atlantic mackerel, black sea bass, scup, bluefish (*Pomatomus saltatrix*), striped bass (*Morone saxatilis*), menhaden (*Brevoortia tyrannus*), butterfish (*Peprilus triacanthus*), winter flounder, king whiting (*Menticirrhus saxatilis*), and bonito (*Sarda sarda*). Important commercial shellfish include conch, ocean quahog, Atlantic surf clam (*Spisula solidissima*), hard clam (=quahog; *Mercenaria mercenaria*), horseshoe crab (*Limulus polyphemus*), and lobster (MMS 2009). From 2013 to 2023 an average of ~65,000 mt of commercial finfish (including squid) and ~25,000 mt of commercial shellfish catches were landed in MA according to NMFS (NOAA Fisheries 2025k).

3.7.2 Recreational Fisheries

Recreational fisheries in the Northwest Atlantic can be divided into inshore and offshore components. The inshore recreational fishery involves rod-and-reel fishing from boats, beaches, marshes, docks, and piers. Larger boats, including charters and party boats, are used for offshore fishing. From MA to New Jersey, recreational fishing trips generally peak in the summer months and are lowest during the winter (DoN 2005). The number of participants in the recreational fishery can be substantial and varies annually. In 2023, preliminary estimates indicate that ~6.6 million recreational fishing trips targeted game fish in MA waters. The majority of fishing trips (>4.8 million) occurred in inland saltwater and brackish water bodies, such as bays, estuaries, and sounds. Nearly 1.3 million trips occurred within 5.5 km of shore (excluding inland waters), and ~398,000 trips extended into federal waters >5.5 km from shore (NOAA Fisheries 2025l). Recreational fishers commonly fish in areas with characteristics that attract aggregations of game fish. These "hotspots" tend to have structural habitats, such as shoals, rocks, and reefs (natural and artificial). Hydrographic features, such as currents and nutrient-rich waters, also tend to concentrate fishes and anglers (DoN 2005). Hotspots may occur from coastal areas to beyond the shelf break. A large portion of the recreational catch in federal waters of the northeast Atlantic states consists of bluefish, Atlantic mackerel, and cod. Other species caught by anglers include pollock (*Pollachius virens*), haddock, Atlantic halibut (*Hippoglossus hippoglossus*), hake, and bluefin tuna. Cod, pollock, flounder, and hake are mostly caught by boats fishing in federal waters. In federal waters off MA, gadids (Atlantic cod and other cods and hakes), other tunas and mackerels (including Atlantic mackerel), striped bass, and black sea bass were the species predominately caught by recreational fishers in 2023 (NOAA Fisheries 2025l; Table 8).

TABLE 7. Top ten commercial fisheries species landed during 2023 in MA, RI, NY, and CT (NOAA 2025k).

Species	**Landing Weight (mt)**	**% of Total Landing Weight**
Longfin Loligo Squid *Loligo pealeii*	15,262	13.8
Atlantic sea scallop *Placopecten magellanicus*	11,503	10.4
American lobster *Homarus americanus*	7,798	7.0
Goosefish *Lophius americanus*	5,828	5.3
Ocean quahog clam *Arctica islandica*	5,624	5.0
Winter skate *Leucoraja ocellata*	5,535	5.0
Haddock *Melanogrammus aeglefinus*	4,448	4.0
Silver hake *Merluccius bilinearis*	4,352	3.9
Scup *Stenotomus chrysops*	4,149	3.7
Jonah crab *Cancer borealis*	3,647	3.3

TABLE 8. 2023 MA recreational fisheries species and catch weights (Source: NOAA Fisheries 2025l).

Inland Waters (bays, estuaries)		**State Waters**		**Federal Waters**	
Species	**Weight (kg)[1]**	**Species**	**Weight (kg)[1]**	**Species**	**Weight (kg)[1]**
Striped bass	752,670	Striped bass	1,385,509	Other tunas/mackerels	1,225,622
Tautog	650,517	Tautog	711,001	Other cods/hakes	189,544
Scup	620,026	Scup	637,716	Atlantic mackerel	133,691
Bluefish	392,137	Atlantic mackerel	593,600	Striped bass	71,331
Black sea bass	349,119	Bluefish	586,853	Black sea bass	53,254
Atlantic mackerel	223,006	Black sea bass	364,794	Bluefish	52,401
Summer flounder	90,258	Summer flounder	121,640	Pollock	46,110
Herrings	80,092	Atlantic cod	88,220	Summer flounder	19,480
Winter flounder	52,707	Cunner	86,507	Atlantic cod	18,023
Atlantic cod	50,802	Herrings	85,547	Scup	17,038
Other fishes[2]	100,931	Other fishes[3]	195,179	Other fishes[4]	44,910
Total	3,362,265	Total	4,856,566	Total	1,871,404

[1]Catch weights are minimum values for (1) fish brought back to the dock and identified by a trained individual, and (2) fish that are used for bait, released dead, or filleted (i.e., fish are killed and identified by individual anglers). Catch weights do not include fish that were caught and released alive.
[2]Includes dogfish sharks (39,159 kg), little tunny/Atlantic bonito (18,595 kg), sea robins (13,404 kg), other tunas/mackerels (13,026 kg), pollock (5,440 kg), dogfish sharks (5,335 kg), cunner (4,654 kg), kingfishes (1,268 kg), weakfish (36 kg), and pinfishes (14 kg).
[3]Includes other winter flounder (58,039 kg), other cods/hakes (55,819 kg), other tunas/mackerels (25,622 kg), little tunny/Atlantic bonito (18,595 kg), pollock (15,893 kg), sea robins (14,162 kg), dogfish sharks (5,335 kg), cunner (4,654 kg), kingfishes (1,268 kg), weakfish (36 kg), and pinfishes (14 kg).
[4]Includes tautog (13,610 kg), other rockfishes (12,646 kg), red hake (6,651 kg), sculpins (2,787 kg), little tunny/Atlantic bonito (2,709 kg), cunner (2,558 kg), herrings (2,389 kg), dogfish sharks (1,381 kg), skates/rays (105 kg), "other fishes" (55 kg), and sea robins (19 kg).

Approximately 18% of the ~10,090 mt of fish harvested during the 2023 MA recreational fisheries occurred in federal waters; the remaining 81% of catches occurred in state waters, largely concentrated in inland waterbodies. Striped bass and tautog dominated recreational catches in MA state waters, followed by scup, Atlantic mackerel, and bluefish (NOAA Fisheries 2025l; Table 8). In addition, black sea bass, herrings, and flounders (summer and winter) were prominent catches in inland waters (NOAA Fisheries 2025l; Table 8).

Sharks are targeted recreationally with rod and reel in inshore and offshore waters. Most sharks are caught from small- to medium-sized boats, whereas large sharks (e.g., great white and mako, *Isurus oxyrinchus*) are harvested using larger ocean-going vessels. Charter boats hired out for shark fishing are mostly active from May to September. Other large pelagics, such as bluefin tuna, swordfish, and billfishes (e.g., marlins and sailfish) are big game fish on the Atlantic coast. The recreational fishery for billfishes largely occurs off MA and southward, mostly in summer months (DoN 2005). Popular fishing areas south of Martha's Vineyard and Nantucket include "The Dump", "The Owl", "The Star", and "31 Fathom Hole" (BOEM 2021). Species typically targeted there include tunas (e.g., yellowfin, bluefin, albacore), mahi-mahi, white marlin, and sharks (e.g., mako and thresher).

Organized fishing tournaments are popular along the U.S. East Coast and can involve a large number of participants targeting a variety of fish species. Each tournament generally has its own set of rules regarding time limits and geographical boundaries. The typical distance traveled by offshore tournament participants is ~140 km from the tournament host site. The number of tournaments and participants is dynamic and can vary annually (DoN 2005). Some examples of organized fishing tournaments in the area include the Oak Bluffs Monster Shark Tournament (mid-July), Oak Bluffs Top Gun Marlin and Tuna Tournament (late July, early August), the Martha's Vineyard Striped Bass and Bluefish Derby (mid-September to mid-October), and Massachusetts' Weigh-In Derby and Catch & Release Derby.

3.7.3 Tribal Fisheries

Subsistence fishing by the region's Native American tribes have historically occurred in nearshore marine and estuarine environments and primarily targeted invertebrate species (e.g., shellfish) and fish such as cod (Bowen 2020). Currently, subsistence fisheries mainly occur in inshore areas (BOEM 2021). For example, Chappaquiddick Island off Martha's Vineyard is a fishing and clamming area for the Chappaquiddick Wampanoag Tribe (BOEM 2021). Marine mammals (e.g., whales and seals) were also traditionally hunted in the area (Speck and Dexter 1948; Bowen 2020; BOEM 2021). The Mohegan Tribe of Connecticut, Mashantucket Pequot Tribal Nation, Narragansett Indian Tribe, Mashpee Wampanoag Tribe, and Wampanoag Tribe of Gay Head (Aquinnah) have emphasized their long historical association with the sea and the southern New England Islands, and the critical role of fishing and shellfish gathering (BOEM 2021). However, we are not aware of any tribal fisheries currently occurring near the proposed drill sites.

3.8 SCUBA Diving, Shipwrecks, and Other Cultural Sites

The waters surrounding the proposed drill sites are known to contain a wealth of archaeological resources spanning pre-Contact to protohistoric periods and post-Contact maritime activity. During the pre-Contact period (16,500–450 Years Before Present or yBP), the area south of Martha's Vineyard and Nantucket was a subaerial coastal plain inhabited by Paleoindian and Early Archaic people (BOEM 2024). Rising sea levels after the last glacial maximum submerged this landscape by 10,000 yBP, preserving potential archaeological sites. The region has a high potential for submerged pre-Contact cultural resources, including coastal base camps and habitations along relic river terraces dating to pre-Clovis (pre-13,000 yBP), Paleoindian (12,500–10,000 yBP), and Early Archaic (10,000–7,500 yBP) periods (BOEM 2024).

Marine geophysical remote sensing studies performed within New England wind energy area identified several submerged landform features with the potential to contain Native American archaeological resources (BOEM 2024). In addition to their archaeological potential, Native American tribes in the region consider remnant ancient, submerged landscape features to be traditional cultural properties and resources representing places where their ancestors lived (BOEM 2024). Chappaquiddick

Wampanoag Tribe asserts that submerged ancient landforms on the shelf off Martha's Vineyard and Nantucket are integral to its cultural practices (Thomas 2020 *in* BOEM 2021). The Mohegan Tribe of Connecticut, Mashantucket Pequot Tribal Nation, Narragansett Indian Tribe, Mashpee Wampanoag Tribe, and Wampanoag Tribe of Gay Head (Aquinnah) have emphasized their long historical association with the sea and islands off southern New England, including submerged ancient landforms in Nantucket Sound (BOEM 2021).

Post-Contact period (post-450 yBP) archaeological resources are dominated by shipwrecks reflecting the region's role in colonial trade, whaling, and WWII naval activity, with wrecks ranging from 18th-century wooden fishing vessels to 20th-century steel freighters (Bright et al. 2013). The MA wind energy area lies within historic shipping lanes used from the 17th to 20th centuries, resulting in a high density of wrecks. There are 762 known or reported wrecks offshore MA, including 25 shipwrecks within the boundaries of the wind energy area (Bright et al. 2013). Shipwrecks attract recreational divers to the waters off MA, where enthusiasts explore submerged shipwrecks and harvest lobsters and scallops. Locations of dive sites and shipwrecks near the proposed drill sites are shown in Appendix E. Recreational diving typically occurs at depths <100 m, but most sites appear to be in Nantucket and Vineyard Sound and not near the drill sites.

IV ENVIRONMENTAL CONSEQUENCES

4.1 Proposed Action

4.1.1 Direct Effects on Marine Mammals and Sea Turtles and Their Significance

The material in this section describes the potential effects of project activities on marine mammals and sea turtles during Expedition 501. Potential effects include those from drilling/coring sounds, vessel presence (including collisions)/sound, helicopter presence/sound, and drilling muds/discharges. Potential effects of IODP expeditions on marine resources were covered by the IODP-USIO PEIS. Here we summarize the available information on potential effects and include recent relevant literature.

4.1.1.1 Potential Effects of Drilling/Coring Sounds

The proposed Expedition would deploy land-based mining-style drilling/coring from a standing, elevated liftboat, L/B *Robert*. Drilling and/or coring activities would introduce sound at mostly low-frequencies into the marine environment at the drill bit at the end of the drill pipe. However, the drilling sound source is regarded as insignificant compared to the vessel noise (see Section 4.1.1.3), particularly when the drill bit descends into the seabed and away from the seafloor. Mining-style wireline coring is very similar to marine geotechnical coring, the main difference being mining-style coring equipment does not need heave-compensation to deal with marine swell. As a consequence, the coring equipment tends to be thinner and lighter than marine, derrick-based equivalents. This allows for the whole drilling/coring system to be much smaller and thus quieter than marine equivalents. In addition, the greatest sound source associated with marine drilling is from the continuous use of thrusters as part of dynamic positioning systems. This sound source would be absent while drilling during Expedition 501, as the project would utilise a fixed platform.

Drilling noise is considered continuous and non-impulsive, with sound levels varying little over time. The LF160 features a low noise engine and pumps, both of which are located far from the drilling area and within an acoustic enclosure. The drill rig has an A-weighted sound power level of 112 dB and an A-weighted SPL of 89 dB. Gales (1982) measured sounds from a range of drilling platforms and found that fixed platforms produced relatively low levels of noise during drilling. This is because the machinery is located well above the water line, and there is a relatively small contact area between the legs of structure and the water. This is unlike drilling from a drillship, which typically produces more noise since the machinery is contained within the hull, which is coupled to the water via a greater surface area. Monitoring data identified a 40 dB shift (increase) over ambient sound levels when the SODV *JOIDES Resolution* was drilling with quiet periods occurring when core samples were being recovered (NSF 2008). Willis et al. (2010) reported that nearshore drilling noise peaked in the low-frequency range and occurred when drilling through hard rock. For jack-up drilling platforms, which are larger than liftboats, the Center for Marine Acoustics (2023) reported that SPLs can range from 85 to 145 dB re 1 μPa. Todd et al. (2020) reported SPLs of 120 dB re 1 μPa produced by jack-up platforms, but they noted that SPLs can vary by 15–20 dB depending on the activity (e.g., holding vs. drilling). Huang et al. (2023) reported sound source levels of 158.9 dB re 1 μPa rms @ 1 m for a drilling jack-up platform at a fundamental frequency of 41 Hz.

The sound emitted by the smaller scale of the proposed set up (liftboat with mobile mining drill rig) is expected to be much lower than the aforementioned sound levels for jack-up drilling platforms because (1) the GRT of a typical jack-up rig is ~25,000, while the L/B *Robert* is less than 1/6 that (3,915 GRT), and (2) the project's mobile mining-style rig is at least an order of magnitude smaller compared to derrick-based drill rigs, and would emit lower sound levels than traditional jack-up drilling. Thus, it is reasonable to assume that noise from the Expedition's drilling operations would be much reduced compared to a jack-up, and would likely result in sound production below the underwater onset of behavioral disturbance level of 120 dB re 1 μPa. Thus, any potential effects from sound on marine animals at the proposed drill sites are expected to be insignificant. In general, the effects of underwater sounds could include one or more of the following: masking of natural sounds, behavioral disturbance, and at least in theory, temporary or permanent hearing impairment, or non-auditory physical or physiological effect.

***Masking*.—**All marine mammals produce sounds used in foraging, mating, rearing of young, social interaction, and group cohesion (Erbe et al. 2016). The quality of life of marine mammals is dependent on the effectiveness of these communications. Introduced anthropogenic sounds may interfere with marine mammal communications by masking them from the individuals. Masking can occur if the frequency of the anthropogenic sound source is similar to that used by the animal and if the sound is present for a significant portion of the time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Erbe et al. 2016; Tenessen and Parks 2016; Jones et al. 2017; Putland et al. 2017; Cholewiak et al. 2018; Dunlop 2018). Specifically, higher levels of introduced sound at frequencies similar to those used by marine mammals or sea turtles could mask their communication and thereby reduce their effectiveness.

***Disturbance*.—**Few studies have been conducted on the effects of continuous sounds from drilling on marine mammals. Reactions to sound, if any, depend on species, state of maturity, experience, current activity, reproductive state, time of day, and many other factors (Richardson et al. 1995; Wartzok et al. 2004; Southall et al. 2007; Weilgart 2007; Ellison et al. 2012, 2018). If a marine mammal does react briefly to an underwater sound by changing its behavior or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the stock or population (e.g., New et al. 2013a). However, if a sound source displaces marine mammals from an important feeding or breeding area for a prolonged period, impacts on individuals and populations could be significant (Lusseau and Bejder 2007; Weilgart 2007, 2023; New et al. 2013b; Nowacek et al. 2015; Forney et al. 2017). Kastelein et al. (2019) surmised that if disturbance by noise would displace harbor porpoises from a feeding area or otherwise impair foraging ability for a short period of time (e.g., 1 day), they would be able to compensate by increasing their food consumption following the disturbance.

The available studies on potential effects of drill noise on marine mammals have shown that marine mammals may be able to detect the noise at a distance of up to 170 m (e.g., Huang et al. 2023). The relative responsiveness of baleen and toothed whales to drilling sounds are variable. Although some mysticetes, odontocetes, and pinnipeds have been shown to react behaviorally to drilling under some conditions, at other times mammals of all three types have shown no overt reactions. For example, Richardson et al. (1995) found that dolphins and other toothed whales showed little behavioral responses to drill rigs and their support vessels. Similarly, humpbacks did not show a response to drillship broadband sounds of 116 dB re 1 µPa (Malme et al. 1985). However, in the presence of exploratory drilling operations, bowhead whales changed their calling rates; they increased call rates as introduced sound increased and then decreased call rates as introduced sound peaked (Blackwell et al. 2017). Gray whales showed a 50% probability of avoidance behavior at 1.1 km for drillships (Malme et al. 1984). Ringed seals are often observed near drillships actively drilling (summarized by Richardson et al. 1995). When a projector transmitted drilling sound into the water at received levels of 130 dB re 1 µPa, ringed and bearded seals approached and dove within 50 m of the projector (Richardson et al. 1995).

Only localized, short-term behavioral effects are likely to occur during drilling operations. Disturbance includes a variety of effects, including subtle to conspicuous changes in behavior, movement, and displacement. Based on NMFS (2001, p. 9293), National Research Council (NRC 2005), and Southall et al. (2007), we believe that simple exposure to sound, or brief reactions that do not disrupt behavioral patterns in a potentially significant manner, do not constitute harassment or "taking". By potentially significant, we mean, 'in a manner that might have deleterious effects to the wellbeing of individuals or their populations'. Thus, here we conclude that marine mammals near the Expedition area would not be significantly disturbed by noise above the disturbance thresholds for continuous sounds (e.g., shipping, drilling) of SPL_{rms} 120 dB re 1 µPa as stipulated by NMFS (2016d). Given that the acoustic zone of influence of the Expedition at one time or location would likely be a small proportion of the feeding, breeding, or migration area of species, marine mammals would not be expected to be displaced from important habitats or during important activities or be affected in a manner that causes adverse effects to individuals or populations.

***Hearing Impairment*.—** It is highly unlikely that marine mammals would suffer hearing damage from exposure to planned Expedition activities given the threshold values for auditory injury or Permanent Threshold Shift (PTS; Table 9). In fact, the sound source levels are expected to be below the 120 dB disturbance threshold. Huang et al. (2023) found drilling noise (non-impulsive sound) from a jack-up platform, a much bigger platform than L/B *Robert*, to be below the level that would induce PTS in cetaceans up to 40 m away from the sound source, but that the sounds could be detected by marine mammals at a distance of 170 m.

***Sea Turtles*.—**There is substantial overlap in the frequencies that sea turtles detect and the low-frequencies of drilling operations, specifically below 1,000 Hz (see Harms et al. 2023). The limited available data indicate that sea turtles can hear low-frequency sounds (see NSF PEIS) and may respond to drilling sounds. When exposed to low-frequency acoustic stimuli, turtles were observed to change swimming direction and/or speed (see Harms et al. 2023). However, given that the acoustic zone of influence of the Expedition at one time or location would likely be a small proportion of the feeding, breeding, or migration area of species, sea turtles would not be displaced from important habitats or during important activities or be affected in a manner that causes adverse effects to individuals or populations in the region. In addition, drilling operations are unlikely to reach PTS threshold levels (see Table 9) for sea turtles.

TABLE 9. Acoustic threshold levels for permanent threshold shift onset for marine mammals and sea turtles.

Hearing Group	PTS Onset Threshold Levels for Non-impulsive Sound
	dB SEL_{cum}
Low-frequency Cetaceans[1]	197
High-frequency Cetaceans[1]	201
Very high-frequency Cetaceans[1]	181
Phocids (in water)[1]	195
Phocids (in air) [1]	154
Sea Turtles[2]	220

Notes:
dB SEL_{cum} has a reference value of 1 μPa^2s in water and 20 μPa^2s in air.
[1] Guidelines released by National Marine Fisheries (NMFS) in July 2016 (NMFS 2016d), amended in 2018 (NMFS 2018), and updated in 2024 (NMFS 2024c).
[2] Guidelines from U.S. Navy (2017).

4.1.1.2 Potential Effects of Drilling Discharges

Drill cuttings and water-based drilling fluids would be released at the seafloor for all boreholes. During the Expedition, the water-based drilling fluid Pure-Bore® would be used, which is a biodegradable, non-toxic additive composed mainly of water, bentonite clay, and starch. Sediment would be recovered from at least one borehole per site, and boreholes would be drilled to a relatively shallow depth (~550 m). The release of drill cuttings would likely increase the turbidity of the water around the borehole. However, increased turbidity is unlikely to have any direct effects on marine mammals and sea turtles, but rather indirect effects associated with their prey (see Section 4.1.4, below).

Drilling operations are unlikely to produce concentrations of heavy metals in muds and cuttings that could be harmful to marine mammals or sea turtles (Neff et al. 1980 *in* Hinwood et al. 1994). In addition, drilling fluids and cuttings are not expected to adversely affect water quality because of rapid mixing once discharged and the assimilative capacity of the sea. Thus, the impact from the released cuttings is expected to be low and unlikely to affect marine mammals or sea turtles.

4.1.1.3 Potential Effects of Vessels

Potential effects on marine mammals and sea turtles from the vessels proposed for use during the Expedition (liftboat and supply vessels) could include disturbance by vessel presence, masking or disturbance by vessel noise, entanglement with equipment, and injury or mortality from vessel strikes.

***Vessel Presence*.—**Marine mammal responses to vessels are variable and range from avoidance at long distances to little or no response (Richardson et al. 1995). Responses depend on the speed, size, and direction of travel of the vessel relative to the animal (Richardson et al. 1995; Erbe et al. 2019). Some species, such as the harbor porpoise, are displaced by vessels or otherwise change their behavior in response to vessel sounds (e.g., Wisniewska et al. 2018; Roberts et al. 2019). Baleen whales often change their normal behavior and swim rapidly away from vessels that have strong or changing sound emission characteristics, in particular when a vessel is moving towards a whale (Richardson et al. 1995). Stationary vessels or slow-moving vessels generally elicit little response from baleen whales (Richardson et al. 1995).

Many odontocetes show considerable tolerance of vessel traffic, although they sometimes react at long distances if confined by ice or shallow water, if previously harassed by vessels, or have had little or no recent exposure to ships (Richardson et al. 1995). Odontocetes reactions can range from avoidance to occasionally approaching vessels. Dolphins of many species tolerate and sometimes approach vessels (e.g., Anderwald et al. 2013). Some dolphin species approach moving vessels to ride the bow or stern waves (e.g., Williams et al. 1992). Physical presence of vessels, not just ship noise, has been shown to disturb the foraging activity of bottlenose dolphins (Pirotta et al. 2015). Sightings of striped dolphin, Risso's dolphin, sperm whale, and Cuvier's beaked whale in the western Mediterranean were negatively correlated with the number of vessels in the area (Campana et al. 2015).

Baleen whales are likely more sensitive to low-frequency sounds produced by vessels than odontocetes (e.g., MacGillivray et al. 2014). Although responses of baleen whales to vessels is variable, Stone et al. (1992) found that fin whales had shorter dive and surfacing times when whale-watch vessels were nearby. Physical presence of vessels, not just ship noise, has also been shown to disturb the foraging activity of blue whales (Lesage et al. 2017b). North Atlantic right whales have been observed being approached by slow moving vessels but swim away from fast approaching vessels (Watkins 1986). Seals often show limited or no behavioral response to vessel presence but have also exhibited avoidance behaviors at times. Hazel et al. (2007) observed that sea turtles had difficulty avoiding vessels (small boats with outboard motors) traveling at speeds greater than 4 km/h. There are limited data on responses of sea turtles to vessels, but Tyson et al. (2017) suggested that a juvenile green sea turtle dove during vessel passes and remained still near the sea floor.

The Expedition would not pose a major physical obstruction to marine mammals or sea turtles. The project is time limited (~100 days), and the platform would leave the area once the Expedition concludes. No structures other than the borehole observatories on the ocean floor would be left behind that would cause a physical obstruction or disturbance to marine mammals or sea turtles. In addition, L/B *Robert* would be stationary during most of the Expedition; the liftboat would only be moving during transits to and from the Expedition area and between the proposed drill sites. Thus, the physical presence of the liftboat and supply vessels is expected to have a limited, temporary impact on marine mammals and sea turtles.

***Vessel Strikes*.—**Another concern with vessel traffic is the potential for striking marine mammals or sea turtles (e.g., Redfern et al. 2013). As the speed and numbers of ships transiting marine waters has increased through time, so have the instances of collision between ships and cetaceans. Eleven cetacean species are known to be hit by ships, with fin whales being most frequently struck, but right, humpback, sperm, and gray whales are also regularly reported in collisions (Laist et al. 2001). There are less frequent records of collisions with blue, sei, and minke whales (Laist et al. 2001). The rate of collision mortality varies by species (Garrison et al. 2025), but can also vary by age class due to age-specific behavior, with juvenile whales representing a higher proportion of strikes (Stepanuk et al. 2021). Seals and dolphins are less likely to experience mortality from vessel strikes than large whales (Southall et al. 2021).

Ship strikes of baleen whales in New England waters may pose a significant impact to cetaceans, particularly to endangered baleen whales. Death and major injury induced by ship strikes is one of the primary factors limiting the recovery of North Atlantic right whales (Knowlton and Kraus 2001; Pirotta et al. 2023). They are particularly vulnerable as they spend a majority of their time (67–98%) in the upper 10 m of the water column (Garrison et al. 2022). Nearly 36% of recorded deaths from 1970 to 1999 were attributed to ship strikes (Knowlton and Kraus 2001). From 2018 through 2022, an average of 1.5 annual vessel strikes with North Atlantic right whales were detected, but up to 4.0 annual mortalities were estimated for that period, for a total of 20 right whale mortalities from strikes between 2018 to 2022 (Hayes et al. 2024). North Atlantic right whales apparently show no response to vessel sounds, but swim to the surface in response to signals designed to alert whales of vessels; however, this response likely increases a whale's likelihood of collision (Nowacek et al. 2004). Collisions with ships travelling at speeds above 14 kt are expected to result in critical injury for right whales (Laist et al. 2001). Monitoring of ship traffic and speeds in North Atlantic Right Whale critical habitat during 1999–2002 suggested that ships were travelling at average speeds of 14.3 and 15.7 kt in northern and southern critical habitat areas, respectively, and that the majority (69%) of ships tracked transited the northern critical habitat (Ward-Geiger et al. 2005). A vessel strike risk analysis for eastern U.S. waters concluded that the highest mortality risk for right whales in southern New England occurred in the cooler months (November–May), when right whale occurrence peaks in the region (Garrison et al. 2022). Several regulations are currently in place to reduce the risk of right whale collisions with vessel (see Section 3.2.2 above).

Garrison et al. (2025) found that large vessels (≥20–107 m) had a predicted lethality for struck large whales of 38% at 5 knots, 54% at 10 knots, and 69% at 15 knots. Reducing ship speed has been shown to be an effective mitigation measure to reduce mortality and/or avoid ship strikes (Wiley et al. 2016; Currie et al. 2017; Garrison et al. 2025). Laist et al. (2014) and van der Hoop et al. (2015) suggested that confirmed ship strike deaths of North Atlantic right whales have declined since 2008 partially due to the implementation of SMAs. However, van der Hoop et al. (2015) noted that while strikes decreased within active SMAs, they increased outside SMAs. Elsewhere, Currie et al. (2017) found a significant decrease in close encounters with humpback whales in the Hawaiian Islands, and therefore reduced likelihood of ship strike, when vessels speeds were below 12.5 kt. However, McKenna et al. (2015) noted the potential absence of lateral avoidance demonstrated by blue whales and perhaps other large whale species to vessels.

The L/B *Robert* has a length of 56 m and a maximum speed of 6 knots, and the supply vessel M/V *Rana Miller* is ~46 m long with a cruising speed of 10 knots. At these speeds, and given the seasonal timing of the Expedition, the risk of collisions with marine mammals or sea turtles exists but would be small. Lookouts would further minimize the risk of collisions with whales and sea turtles during the Expedition. In addition, L/B *Robert* would be stationary for nearly the entire Expedition, and the overall transit distance to and from the port of Bridgeport and the proposed drill sites (~550 km) would be relatively low compared to other vessel traffic in the region.

***Entanglement*.—**The presence of gear in the water (e.g., ropes, etc.) can pose a risk to marine animals as entanglements can negatively impact their health and survival. Entangled animals could experience restricted movement, additional exhaustion and stress, suffer injuries, starve, or drown. Entangled North Atlantic right whales exhibited comparatively poorer body condition and lower survival rates compared with non-entangled whales (Crum et al. 2025). As only whales in good body condition can reproduce, entanglements (in fishing gear) reduced the expected number of calves by 12.9% between 1994 and 2021 and the expected number of living females by 18.5% by the end of 2021 (Crum et al. 2025). Sea turtles (in particular leatherbacks) also frequently get entangled in fixed gear vertical lines (e.g., buoy lines to lobster pots) in the northeastern U.S. (NOAA Fisheries 2025o).

However, the Project would not deploy any netting or any apparatus that covers a wide area of the seabed or water column. The Expedition’s only contact with the water column would be the three legs of L/B *Robert*, the single rigid drill pipe deployed from a small drilling rig on the liftboat, and the command modules resting on the seabed. None of these contacts are likely to pose an entanglement risk to marine mammals or sea turtles, even if they venture close to the platform. Thus, the risk of the proposed action entangling marine mammals or sea turtles is expected to be negligible.

***Vessel Noise*.—**Vessel noise from L/B *Robert* could affect marine animals in the proposed Expedition area. The main source of sound produced by the liftboat is likely to be from the onboard equipment (e.g., diesel engines, generators, mud pumps, ventilation fans). Some energy from these sources would be transmitted down the steel legs and into the water column. Sounds produced by large vessels generally dominate ambient noise at frequencies from 20–300 Hz (Richardson et al. 1995). However, some energy is also produced at higher frequencies (Hermannsen et al. 2014; Kyhn et al. 2019; Landrø and Langhammer 2020). Houghton et al. (2015) proposed that vessel speed is the most important predictor of received noise levels, and Putland et al. (2017) also reported reduced sound levels with decreased vessel speed. Vessel noise produced by L/B *Robert* would be reduced, as this vessel has a maximum speed of 6 knots, it would be stationary during most of the Expedition, and the platform would be lifted above the water during drilling operations. Similarly, the cruising speed for the supply vessel would be 10 knots.

Ship noise, through masking, can reduce the effective communication distance of a marine mammal (or sea turtle) if the frequency of the sound source is close to that used by the animal, and if the sound is present for a significant fraction of time (e.g., Richardson et al. 1995; Clark et al. 2009; Jensen et al. 2009; Gervaise et al. 2012; Hatch et al. 2012; Rice et al. 2014; Dunlop 2015; Erbe et al. 2016; Jones et al. 2017; Putland et al. 2017; Cholewiak et al. 2018). In addition to the frequency and duration of the masking sound, the strength, temporal pattern, and location of the introduced sound also play a role in the extent of the masking (Branstetter et al. 2013, 2016; Finneran and Branstetter 2013; Branstetter and Sills 2022). In order to compensate for increased ambient noise, some cetaceans are known to increase the source levels of their calls in the presence of elevated noise levels from shipping, shift their peak frequencies, or otherwise change their vocal behavior (e.g., McKenna 2011; Parks et al. 2011, 2012, 2016a,b; Castellote et al. 2012; Melcón et al. 2012; Azzara et al. 2013; Tyack and Janik 2013; Luís et al. 2014; Sairanen 2014; Papale et al. 2015; Bittencourt et al. 2016; Dahlheim and Castellote 2016; Gospić and Picciulin 2016; Gridley et al. 2016; Heiler et al. 2016; Martins et al. 2016; O'Brien et al. 2016; Tenessen and Parks 2016; Fornet et al. 2018). Similarly, harbor seals increased the minimum frequency and amplitude of their calls in response to vessel noise (Matthews 2017); however, harp seals did not increase their call frequencies in environments with increased low-frequency sounds (Terhune and Bosker 2016).

Baleen whales are thought to be more sensitive to low-frequency sounds than are toothed whales (e.g., MacGillivray et al. 2014), possibly causing minor localized avoidance around the Expedition vessels. Reactions of gray and humpback whales to vessels have been studied, and there is limited information available about the reactions of right whales and rorquals (fin, blue, and minke whales). Reactions of humpback whales to boats are variable, ranging from approach to avoidance (Payne 1978; Salden 1993). Baker et al. (1982, 1983), and Baker and Herman (1989) found humpbacks often move away when vessels are within several kilometers. Humpbacks seem less likely to react overtly when actively feeding than when resting or engaged in other activities (Krieger and Wing 1984, 1986). Girola et al. (2023) found that male humpback whales did not adjust their song sound levels in the presence of vessel noise. Increased levels of ship noise have been shown to affect foraging by humpback whales (Blair et al. 2016) and killer whales (Williams et al. 2021). Fin whale sightings in the western Mediterranean were negatively correlated with the number of vessels in the area (Campana et al. 2015). Minke whales and gray seals have shown slight displacement in response to construction-related vessel traffic (Anderwald et al. 2013).

Vessel sounds have also been shown to elicit behavioral responses in harbor porpoise such as increased swimming speed and porpoising (e.g., Dyndo et al. 2015), reduced foraging and echolocation (e.g., Teilmann et al. 2015; Wisniewska et al. 2018), and avoidance behavior (Benhemma-Le Gall et al. 2021). There are few data on the behavioral reactions of beaked whales to vessel noise, though they seem to avoid approaching vessels (e.g., Würsig et al. 1998) or dive for an extended period when approached by a vessel (e.g., Kasuya 1986). Based on a single observation, Aguilar Soto et al. (2006) suggest foraging efficiency of Cuvier's beaked whales may be reduced by close approach of vessels.

A negative correlation between the presence of some cetacean species and the number of vessels in an area has been demonstrated by several studies (e.g., Campana et al. 2015; Culloch et al. 2016; Oakley et al. 2017). Based on modeling, Halliday et al. (2017) suggested that shipping noise can be audible more than 100 km away and could affect the behavior of a marine mammal at a distance of 52 km in the case of tankers. However, the vessels proposed for use during the Expedition are much smaller and quieter than a tanker. Vessel sounds during the proposed Expedition would not be expected to cause anything more than localized and temporary behavioral changes in marine mammals or sea turtles and would not be expected to result in any adverse effects on individuals or at the population level. In addition, in all oceans of the world, large vessel traffic is currently so prevalent that it is commonly considered a usual source of ambient sound.

4.1.1.4 Potential Effects of Aircraft

A helicopter would be used to transport personnel and/or supplies to and from L/B *Roberts*. Helicopters introduce low-frequency noise into the water column, in particular during take-off and landing. The transmission of helicopter produced sound into the marine environment is correlated to the altitude of the aircraft and sea surface conditions (Richarson et al. 1995). The liftboat has a helipad capable of supporting a Sikorsky S-92. An analysis of the external noise level of a Sikorsky helicopter (model S-70A-9) found that SPLs were in excess of 109 dB re 20µPa (C-weighted) with the engines on and rotors turning (King et al. 1996). The proposed helicopter, Leonardo AW 169, is expected to produce similar or less noise than a Sikorky helicopter. Helicopter presence or sounds could potentially disturb marine mammals or sea turtles near the aircraft's path, but sounds from helicopters are most likely to affect the behavior of marine mammals and sea turtles when the aircraft is taking off or landing.

Responses of cetaceans to helicopter overflights are variable, but there are few studies. The individual state of the animal can influence the reaction to aircraft disturbance. In the presence of aircraft, cetaceans often dive, decrease surfacing periods, change activity state, or breach (Luksenburg and Parsons 2009). Animals at rest appear to have a higher sensitivity to disturbance than animals foraging, socializing, or travelling (Würsig et al. 1998; Luksenburg and Parsons 2009).

Hewitt (1985) and Au and Perryman (1982) found no behavioral reaction by various dolphin species to helicopters at a 370 m altitude. Dietz (1992) found that non-feeding beluga whales reacted more to airborne noise (e.g., fixed-wing aircraft and helicopters) than feeding animals and that there were few reactions when the sound source was more than 500 m in altitude. Sperm whale responses to aircraft are thought to be minimal, but reactions of baleen whales to aircraft are more variable (see Richardson et al. 1995). Bowhead whales exhibited changes in direction and diving behaviors in response to helicopters engaged in aerial photogrammetry at an altitude of 150 m, but returned to the area the following day (Koski et al. 1988). Minke whales in the Ross Sea were observed to change direction at helicopter altitudes of 229 m (Leatherwood et al. 1982). Gray whales showed a 50% probability of avoidance behavior (e.g., change in direction) at 80 m for helicopter flight path (Malme et al. 1984).

Hauled-out pinnipeds may be disturbed and enter the water in response to a helicopter overflight during transit to/from L/B *Robert*; such reactions would be short-term, and animals typically haul out again later the same day after the disturbance has passed. Johnson (1977) found responses by seals varied with aircraft height; if aircraft passed over a beach at an altitude of 120 m, the seals would vacate the beaches for more than 2 hours. Bowles and Stewart (1980) found that a helicopter passing at 305 m altitude produced a movement response from harbor seals during 7 of 25 overflights at San Miguel Island, CA. Kelly et al. (1986) reported a no-observed-adverse-effects-level altitude of 457 m or higher for ringed and bearded seals. During pipe-driving and construction activities, ringed seals exhibited little to no reaction to industrial noise except for approaching helicopters (Blackwell et al. 2004).

Sea turtles can hear in and out of the water and can be affected by the low-frequency sounds from helicopters. Lester et al. (2013) found that behavioral responses of semi-aquatic turtles to vessel sounds were variable Kastelein et al. (2023) found that in a laboratory environment Atlantic green turtles and hawksbill turtles exposed to recorded sounds with frequencies between 0.2 and 1 kHz reacted by changing direction or increasing speed while swimming. However, it is unlikely that sea turtles would be adversely affected by the infrequent helicopter traffic to and from L/B *Roberts*.

Marine mammals and sea turtles in the Expedition area likely would have been previously exposed to helicopter traffic, as there are several airports in the area including three on Martha's Vineyard, one at the tip of Long Island, two on Narragansett Bay, and one on Cape Cod. Helicopter tours are also offered in the area or can be chartered. Thus, marine mammals and sea turtles may have become tolerant of sounds associated with overflights. Any potential behavioral effects from helicopter traffic associated with the Expedition are expected to be minimal, in particular given the infrequent helicopter flights to and from L/B *Robert.* In addition to slight behavioral reactions, vocalizations could be masked thereby reducing the effectiveness of communication by marine mammals an sea turtles in the area. However, disturbance or masking by helicopter sounds during the Expedition is expected to be insignificant in light of from other aircraft and vessel traffic in the area.

4.1.1.5 Mitigation Measures

BMP, monitoring, and mitigation measures would be implemented during Expedition 501. The analysis of the potential impacts takes account of the planned mitigation measures. It would not be meaningful to analyze the effects of the planned activities without mitigation, as the mitigation measures are a basic part of the activity and would be implemented under the Proposed Action.

4.1.1.6 Conclusions for Marine Mammals and Sea Turtles

The proposed Expedition would involve drilling/coring, which introduces continuous, non-impulsive sounds into the ocean. Routine vessel operations, as well as drilling with a small land-based drill rig, are conventionally assumed not to affect marine mammals sufficiently to constitute "taking" pursuant to the MMPA and ESA. Thus, proposed activities are not likely to adversely affect ESA-listed marine mammal or sea turtle species. The relatively short-term exposures are unlikely to result in any long-term negative consequences for the individuals or their populations. Additionally, because of the distance from the proposed drill sites from North Atlantic right whale critical habitat (>60 km) and sea turtle critical habitat (more than 300 km to the south), the proposed activities would have no effect on critical habitat.

4.1.2 Effects on Marine Invertebrates, Fish, and Fisheries, and Their Significance

Potential impacts of drilling/coring sound, discharges, and disturbance of the sea floor by the liftboat legs on marine invertebrates and fish, and fisheries, are summarized here. Potential impact of vessel sound on marine fish and invertebrates is briefly discussed, but is generally thought to be negligible, especially if the animal is mobile and the vessel is transiting.

4.1.2.1 Potential Effects of Drilling/Coring Sound

Drilling introduces sound into the water column; these sounds have been described in Section 4.1.1.1 above. Drilling also introduces sound into the ocean floor, and sound levels change depending on the type of lithology being drilled. Sound levels from a jack-up drilling vessel, which are larger than liftboats, were on average above 90 dB re 1 $\mu Pa_{0\text{-peak}}$ across a large range of the frequency spectrum at 7.5 m from the sound source with an estimated source level of 135.8 dB_{peak} re 1 µPa at 1 m (Willis et al. 2010). Peak noise during drilling was emitted in the low-frequency range and occurred when drilling through hard rock, with sound levels peaking at 107 dB re 1 $\mu Pa_{0\text{-peak}}$ at 7.5 m from the source (Willis et al 2010). During soft sediment coring or hard-rock drilling, the sound levels were 95 dB re 1 $\mu Pa_{0\text{-peak}}$ up to 179 m away from the sound source (Willis et al. 2010).

Popper et al. (2019) and Popper and Hawkins (2021) recently reviewed the hearing ability of fishes and found that the potential impacts of sound exposure could include pathological, physiological, and behavioral effects. Recent studies on the effects of sound on marine invertebrates, fish, and fisheries are summarized below. However, many data gaps remain regarding the effects of underwater sound exposure on marine invertebrates and fishes (Hawkins et al. 2015, 2020; Carroll et al. 2017; Popper and Hawkins 2019; Wale et al. 2021; Popper et al. 2022), including how particle motion rather than SPL affect invertebrates and fishes that are exposed to sound (Hawkins and Popper 2017; Popper and Hawkins 2018, 2019). It is important to note that while all invertebrates and fishes are likely sensitive to particle motion, no invertebrates and not all fishes (e.g., sharks) are sensitive to the sound pressure component. Sound-induced substrate vibrations may affect the fishes and aquatic invertebrates that live in, on, or close to the seafloor, but sensitivities are largely unknown (Roberts and Elliott 2017; Hawkins et al. 2021; Roberts and Howard 2021).

***Marine Fish*.—**The possible behavioral changes of fishes and their associated use of habitat when exposed to a continuous sound is difficult to predict due to the variations in sound source characteristics, inter- and intraspecific differences in sound detection, effects of sound exposure, and available behavioral response information for fishes and invertebrates (Slabbekoorn et al. 2010; Popper et al. 2014; Hawkins et al. 2015; Popper and Hawkins 2018, 2019). Continuous sounds, such as drilling, may result in behavioral effects of avoidance, attraction, or startle responses by fish (Clark et al. 2016). Fish have been shown to respond to underwater noise by avoidance when noise levels are above 160 to 180 dB re 1 µPa (Evans and Nice 1996; Gordon et al. 2004).

Spiga et al. (2017) found that European seabass did not have show any startle response when exposed to recorded drilling noise in a laboratory setting. However, seabass exposed to drilling noise did exhibit higher stress levels (Spiga et al. 2017). Mauro et al. (2020) concluded that noise exposure during drilling may have significant effects on fish behavior which may subsequently affect fitness and survival, but fishes and invertebrates remaining in the area would likely habituate to the continuous sound and avoidance and startle responses would decrease over time. Several studies have examined the response of fish to other sources of continuous sounds. Atlantic cod exposed to a marine vibrator with SPLs ranging from ~115 to 145 dB re 1 $\mu Pa^2 s$ decreased their activity levels and increased their swimming depth (McQueen et al. 2024). Small yellow croaker (*Larimichthys polyactis*) exposed to boat and experimental tank noise for 30 minutes at a SPL of 120 dB re 1 μPa_{rms} showed altered swimming behavior, endoplasmic reticulum stress, disrupted lipid metabolism, and collagen degradation in the sonic muscle (Zhang et al. 2024). Goldfish exposed to white noise with an SPL of 170 dB re 1 μPa_{rms} for 48 hours exhibited a loss of sensory hair cells (recoverable), resulting in a temporary threshold shift (TTS) of ~16 dB (Smith et al. 2006 *in* Popper et al. 2014). The study found that recovery from the TTS took seven days and affected sensory cells were replaced in eight days. Radford et al. (2014), Putland et al. (2017), and de Jong et al. (2020) noted that masking of key environmental sounds or social signals could also be a potential negative effect from sound on fish. Radford et al. (2016) found that seabass would eventually habituate, and their response would lessen in the presence of anthropogenic noise in the water column over time (12 weeks).

However, the potential for adverse effects from the Expedition is expected to be low because of the short-term nature of the drilling program. Given the localized (small footprint) and temporary nature of the drilling activity, displacement of fish from habitats and population level disturbances are considered unlikely.

***Marine Invertebrates*.—**Effects of anthropogenic sounds on marine invertebrates are varied, ranging from no overt reactions to behavioral/physiological responses including stress, injuries, mortalities (Wale et al. 2013a, b; Aguilar de Soto 2016; Edmonds et al. 2016; Carroll et al. 2017; Weilgart 2017b; Solé et al.

2023; Davies et al. 2024), and stress (Celi et al. 2013; Vazzana et al. 2020). The seabed is an effective transmitter of low-frequency energy (Nedelec et al. 2021), and particle motion from substrate vibrations could affect marine invertebrates (Hawkins et al. 2021). Solan et al. (2016) reported behavioral effects on sediment-dwelling invertebrates during sound exposure. Several studies have found that substrate-borne vibration and sound elicit behavioral responses in crabs (e.g., Roberts et al. 2016) and mussels (Roberts et al. 2015). Olivier et al. (2023) found that when scallop post larvae (*Pecten maximus*) were exposed to recorded drilling noise, the daily rate of shell growth increased while diminishing the total fatty acid concentration. Wang et al. (2022) reported that the amphipod *Corophium volutator* exhibited lower bioturbation rates when exposed to low-frequency noise, and they found potential stress responses by the bivalve *Limecola balthica*.

The potential for adverse effects on marine invertebrates is expected to be low because of the short-term nature of the drilling program. Given the localized and temporary nature of the drilling activity, displacement of marine invertebrates from habitats and population level disturbances due to sound are considered unlikely.

***Fisheries.*—**Recreational, commercial, and tribal fishing activities are present near the Expedition area. Potential effects from noise on fisheries include the potential for fish and marine invertebrates to be displaced from the area. Thus, fisheries could potentially experience a change in distribution of target species as these species may be startled by the drilling sounds. This in turn could result in increased operating costs (e.g., additional fuel to travel to alternate locations, additional crew days), lower revenue (e.g., move to a less- productive area, target less-valuable species). However, in light of other activities in the area, including other vessel traffic, the potential effects of drilling sounds on fisheries from the proposed Expedition are anticipated to be minimal.

4.1.2.2 Potential Effects of Drilling Discharges

The water-based drilling fluid Pure-Bore®, a biodegradable, non-toxic additive composed of mainly water, bentonite clay, and starch would be used during the Expedition. Project activities are expected to result in minimal fluid and cutting discharge due to the relatively shallow drill depth (~550 mbsf) and the fact that coring would recover material for analysis that otherwise would have been discharged into the environment. Discharges to the seafloor would be cuttings that are associated with drilling the borehole. Larger particles and flocculated material typically settle quickly after discharge, forming a deposition area that is generally localized to the drill site (Cordes et al. 2016; Ragnarsson et al. 2017; Gates et al. 2017).

Although drill muds and cuttings have low toxicity and bioaccumulation effects, potential changes in risk of injury, mortality, and health effects on benthic communities may result from burial, sediment alteration, and oxygen depletion from degradation of organic components (Kjeilen-Eilertsen et al. 2004; Smit et al. 2008; Neff 2010; Ellis et al. 2012; Paine et al. 2014; Tait et al. 2016; DFO 2019). Increases in sedimentation on the seafloor may disrupt or displace marine invertebrates and fish. Mobile fish and invertebrates have a low potential for injury as they are able to move away from plumes of suspended drill cuttings (IOGP 2016). Benthic invertebrates that are sessile or have low mobility are more likely to be subject to burial or suspended sediment effects relative to mobile organisms that can avoid deposition areas.

Smothering from drill cuttings may lead to mortality from the weight of discharges or inability to dig through the deposition layer from underneath (Kjeilen-Eilertsen et al. 2004; Trannum 2017). Deposited drill cuttings may also have lower nutrient levels relative to native sediments resulting in effects to health with lower growth rates for species living on the discharged particles (Kjeilen-Eilertsen et al. 2004). Sediment alterations may reduce suitability of habitat for larval survival with changes in particle size, sediment stability, and chemical and physical cues (Kjeilen-Eilertsen et al. 2004). Sediment alterations may also reduce reworking of sediments and bioturbation. The combination of these effects may result in a change in fauna community composition over time (Kjeilen-Eilertsen et al. 2004; Cordes et al. 2016; IOGP 2016).

Drilling mud and cutting discharges may result in a temporary increase in suspended particulate matter and turbidity in the water column. Potential effects to the water column are generally not expected to affect the water quality on a larger or regional scale; the release of fine-sized particles in the water column would be confined to an area within several hundred meters of the borehole site. Water quality would be expected to return to background levels within hours after cessation of discharges (Smit et al. 2006; Koh and Teh 2011; IOGP 2016). Increased turbidity levels associated with the drill cuttings discharge have been suggested to decrease light exposure and may have effects on photosynthesis activities in phytoplankton (IOGP 2016). However, the elevated levels of turbidity required for reducing photosynthesis activities would likely be limited to within 25 m of the discharge source (IOGP 2016).

Turbidity and suspended solids in the water column may affect respiration and feeding in zooplankton and ichthyoplankton; however, these effects are typically localized to the immediate area surrounding the discharge site (IOGP 2016). Suspension-feeding benthic invertebrates, including bivalves, sponges, and corals, filter the water column for food, and are therefore considered more sensitive to exposure by suspended drill cuttings. Some species may have mechanisms for tolerating suspended sediments including reduced respiration and feeding, and sediment clearing (Smith et al. 2006; Smit et al. 2008; Bell et al. 2015). Increased enzyme activity and reduced gonad weight have also been observed in caged scallops and blue mussels placed within 250 m of water-based mud discharge and exposed to estimated suspended cuttings levels of 0.15 mg/L (Berland et al. 2006 *in* Bakke et al. 2013). The potential effects in the water column are generally considered non-persistent and temporary with the rapid dilution and dispersal of drill cuttings. While there are potential effects of suspended drill cuttings on sessile invertebrates, they are generally considered short-term and episodic (Bakke et al. 2013) and are unlikely to have population level effects considering the localized nature of effects.

Discharges during operations have the potential to result in a change in sedimentation and water quality around the drill sites. However, drilling operations would not be expected to adversely affect fish and marine invertebrates, as no adverse effects on water quality is expected because no toxins would be released, rapid mixing would occur once discharged, and because of the assimilative capacity of the sea. Any effects are predicted to be limited in extent and duration and are not predicted to have long-term environmental effects or impact on marine invertebrates, fish, or fisheries.

4.1.2.3 Potential Effects of Liftboat, Supply Vessels, and Aircraft

When the vessel is in transit, marine fish are not expected to be exposed to the continuous underwater vessel sound levels for durations that would result in injury or mortality (Popper et al. 2014). Fish species in the water column would likely temporarily avoid immediate areas near the vessel, further reducing the risk of injury or mortality because of vessel strikes or propeller blade contact. Jézéquel et al. (2021) reported that shipping noise can mask sounds produced by European lobster (*Homarus gammarus*), and that they may change sound production in response to noise. Bevans and Buckingham (2017) found that sounds of a hovering light-weight helicopter (13 Hz to 2.5 kHz) were detectable in the water column. Underwater sounds produced by helicopters are typically stronger just below the water surface (Richardson et al. 1995). Marine fish near the surface may be startled by the sounds of the helicopter and exhibit avoidance behavior.

The deployment of the legs/pads on the seafloor may also result in avoidance of the area by fish or marine invertebrates during initial placement or smothering of sessile invertebrates. The leg pads are flat and non-buoyant which allows for more secure anchoring in the sediment. The pads can penetrate several meters into the seafloor depending on the sediment type (NTSB 2023). Initial leg placement may result in disturbing the surficial sediments; however, the effects are predicted to be temporary and localized (a few meters). Additionally, the presence of the legs/pads would result in the temporary, localized addition of hard substrate.

Elevated marine fish diversity and abundance has been associated with subsea infrastructure (Macreadie et al. 2011; Cordes et al. 2016; Lacey and Hayes 2019). The introduction of hard substrate (e.g., the legs and pads) could cause an artificial reefs effect which could enhance foraging opportunities by some invertebrate and fish assemblages if hard substrate is locally scarce (Wolfson et al. 1979; Fabi et al. 2002, 2004). However, it is predicted that the liftboat would not be at any one site long enough and would have a low spatial footprint, so that there would be no long-term ecological effects.

Phototactic plankton may be attracted to artificial lighting around the liftboat and may further attract planktivorous species (Keenan et al. 2007; Cordes et al. 2016). A change in risk of mortality and injury may occur from increased predation opportunities by fish and other species resulting from increased underwater illumination (Keenan et al. 2007). While transiting to the site, vessels would likely have little to no impact on fish or marine invertebrates. While on station and transferring goods, vessels could act as a temporary refugia for marine fish. The presence of the helicopter would likely have little to no effect on marine fish or invertebrates.

4.1.2.4 Effects on Fisheries

The Expedition area is located within the Southern New England HAPC which includes areas of important cod spawning grounds and complex habitat. Neither the presence of the liftboat nor project operations would interfere with the implementation of the HAPC rules. Fishing gear may become entangled on the legs of the liftboat during operations resulting in the damage or loss of equipment. Permanent structures installed on the seafloor (e.g., observatories) could potentially snag and damage fishing equipment but this is unlikely. Fishing access in the vicinity of the liftboat would be discouraged within 2 km for safety reasons, and vessels may have to alter course when the liftboat is stationary. Additionally, fish could potentially avoid the area during drilling operations. This displacement of fishing boats and fish may result in increased operation cost, lower revenue, and avoidance of the area by fishers.

4.1.2.5 Conclusions for Invertebrates, Fish, Fisheries, EFH, and HAPC

There could be changes in behavior and other non-lethal, temporary impacts, on fish and marine invertebrates during the Expedition, but considering the relatively short-term Expedition, and small area of the sea affected, overall impacts on individuals are expected to be minimal, and there would be no significant impacts of the Expedition on local populations. Although drilling operations could cause temporary, localized, reduced fish catch to some species, the effects on fisheries are not expected to be adverse or significant. Interactions between the proposed Expedition and fishing operations in the Expedition area are expected to be limited, although temporary displacement of fishers from the area is a possibility. Fishing activities could occur a safe distance from the L/B *Robert*. Conflicts would be avoided through Notice to Mariners and direct communication with the fishing community during the Expedition.

Given the proposed activities, impacts would not be anticipated to be significant or likely to adversely affect (including ESA-listed) marine invertebrates, fish, and their fisheries, or critical habitat. The proposed Expedition would occur beyond state waters and the 12 nmi limit. Although the proposed activities may affect EFH and HAPC, no long-term adverse effects on EFH or HAPC are expected. Any bottom disturbance from coring is expected to be minimal, and activities overall would be of short-term duration (~100 days).

4.1.3 Direct Effects on Marine-Associated Birds and Their Significance

4.1.3.1 Potential Effects of Drilling/Coring Sound

The underwater hearing of seabirds (including loons, scaups, gannets, and ducks) has been investigated by Crowell (2016), and the peak hearing sensitivity was found to be between 1500 and 3000 Hz. The best sensitivity of underwater hearing for great cormorants was found to be at 2 kHz, with a hearing threshold of 71 dB re 1 μPa_{rms} (Hansen et al. 2017). Great cormorants were also found to respond to underwater sounds and may have special adaptations for hearing underwater (Johansen et al. 2016; Hansen et al. 2017). Field studies of the effects of underwater sound on bird hearing or behavior have not investigated sound from drilling operations, instead focusing on geophysical surveys, i.e., much louder, impulsive sounds.

Most of the sound produced by offshore drilling operations typically arises from the use of thrusters to maintain the drilling platform in position over the bore hole. However, the use of a liftboat eliminates the need for thrusters and their associated sound. Therefore, sound from drilling operations would only include the ship's diesel-electric engines and mechanical equipment used to operate the drill string, and the sound from drilling through certain lithology. Potential effects of noise from drilling equipment operations on board drilling vessels on seabirds are discussed in § 4.6.5 of the IODP-USIO PEIS. The PEIS concluded that there would be no significant impacts of NSF-funded marine drilling research on seabirds or their populations. Given the proposed short-term and temporary nature of the activities, no effects to ESA-listed marine-associated birds would be anticipated from the proposed action.

4.1.3.2 Potential Effects of Drilling Discharges

Cuttings and drilling fluid would be released at the seafloor and therefore would be deposited at depths below the maximum diving range of most marine birds expected to occur in the Expedition area. Because of the low probability of interaction with marine birds and the small footprint at the bore hole, drilling discharges would have a minimal direct impact on seabirds.

4.1.3.3 Potential Effects of Liftboat Presence

The liftboat may attract marine-associated birds. Densities of some species of marine birds are frequently significantly higher around offshore platforms than away from platforms or before the installation of the platforms. This suggests that the birds are attracted to foraging opportunities or to the shelter found downwind of platforms (Tasker et al. 1986; Baird 1990; Wiese and Montevecchi 1999). Discharged gray and black water and victual waste may cause organic enrichment around the vessel that may have either positive or negative effects on local fish and invertebrate prey of seabirds (Peterson et al. 1996). Offshore platforms may also provide new habitat for birds, such as roosting and resting habitat for gulls (Burke et al. 2012), stopover locations for migrating landbirds (Russell 2005; Bruinzeel and van Belle 2010), or hunting grounds for predators such as large gulls and peregrine falcons in passage migration that take advantage of concentrations of birds around the platforms (Russell 2005). At night, gulls often also forage on fish attracted to the surface by artificial light emissions from platforms. Drilling platforms often develop artificial reefs when reef-forming organisms attach to the hard surfaces on the platform and its anchoring mechanisms. Such artificial reefs could enhance foraging opportunities if hard substrate required by some invertebrate and fish assemblages is locally scarce (Wolfson et al. 1979; Fabi et al. 2002, 2004). However, the liftboat would be in place for a short period of time, so the likelihood of artificial reef formation is low. In contrast, other species of marine birds are displaced by offshore platforms (Amec 2011; Baird 1990; Bramford et al. 1990). The effect of displacement from habitat around a platform is likely to be minimal due to its small footprint except where platforms are found in high concentrations or at biologically productive sites associated with oceanographic features (Hedd et al. 2011; Ronconi et al. 2015). Any attraction and disturbance effects on marine birds would be short-term, transient, and localized in nature because the liftboat would be situated in one location for a short period of time (less than 1 month) and would have a small footprint.

The Expedition would not deploy any netting, loose ropes, or any apparatus that would cover a wide area of the seabed. The only contact with the water column would be the three legs of L/B *Robert*, the single rigid drill pipe deployed from a small drilling rig on the liftboat, and the command modules resting on the seabed. None of these contacts would pose an entanglement risk to seabirds, even if they venture close to the platform. Thus, the risk of the Expedition entangling seabirds is negligible.

The liftboat is unlikely to pose a collision risk to seabirds. During transit, swimming seabirds' habitual avoidance of moving vessels would make the likelihood of the vessel striking birds resting on the sea surface low (Fliessbach et al. 2019). Flying birds would have a low probability of striking the liftboat except during periods of low visibility. In addition, to reduce the potential of bird strandings on the vessels, downward-pointing deck lighting would be used and curtains/shades would be drawn on cabin windows at night to minimize light emissions.

4.1.3.3 Potential Effects of Helicopters Overflights

Noise from helicopter flights to and from the liftboat has the potential to cause disturbance to marine birds in vicinity of the liftboat (Anderson et al. 2007). However, there are unlikely to be any significant concentrations of seabirds in the Expedition area, i.e., there are no nesting colonies in the Expedition area and there are no oceanographic features that attract concentrations of seabirds through enhanced foraging opportunities, such as the continental shelf break. In addition, any disturbance would be infrequent, localized, and temporary. As a result, the impact from helicopter overflights on seabirds is likely to be minimal. Helicopters may pose a collision risk for seabirds. However, the disturbance caused by helicopter noise typically causes birds to disperse well ahead of helicopters (Anderson et al. 2007). In addition, at the low altitudes at which seabirds are active, helicopters are on approach or departure, during which helicopter air speed is relatively slow, allowing birds to avoid them. As a result, the probability of helicopters striking birds is low.

4.1.2.5 Conclusions for Seabirds

There could be changes in behavior and other non-lethal, short-term, temporary impacts on marine-associated birds. However, given the proposed activities, impacts would not be anticipated to be significant or likely to adversely affect (including ESA-listed) seabird species or their populations.

4.1.4 Indirect Effects on Marine Mammals, Sea Turtles, Marine-Associated Bird, Fish and Their Significance

The proposed research activities would not result in any permanent impact on habitats used by marine mammals, sea turtles, seabirds, fish, or marine invertebrates or to the food sources they use. The main impact issue associated with the proposed activity would be temporarily elevated anthropogenic sound levels and bottom disturbance, and the associated direct effects on these species, as discussed above.

The liftboat's legs would contact the seafloor, but each leg would have a small footprint on the sea floor. Therefore, there would be little impact on the sea floor. In addition, some prey species for marine mammals, sea turtles, and marine-associated birds could be exposed to drill cuttings and turbidity in the water column in localized areas around the sites. However, they would not be affected to an extent that would result in a change in the quantity or quality of marine mammal, sea turtle, and seabird prey. None of the marine mammals or seabirds that regularly occur in the Expedition area are known to feed on benthos; thus, potential effects on marine mammals, sea turtles, and seabirds due to disposal of drill muds and cuttings and associated waste materials are considered unlikely.

The drilling sounds could result in changes in habitat quality and use by marine biota. These changes are predicted to be low in magnitude, generally localized to each drill site. During the proposed operations, only a small fraction of the available habitat would be disturbed at any given time. Disturbance to fish species and invertebrates would be short-term, and fish would return to their pre-disturbance behavior once the activity ceased. Thus, the proposed activities would have little impact on the abilities of marine mammals or sea turtles to feed in the Expedition area. No significant indirect impacts on marine mammals, sea turtles, or marine-associated birds would be expected.

4.1.5 Direct Effects on Cultural Resources and Their Significance

The coast and nearshore areas are of cultural importance to indigenous peoples for fishing, hunting, gathering, and ceremonial purposes. As noted above in Section 4.1.2.4, impacts would not be anticipated to be significant or likely to adversely affect marine invertebrates, marine fish, and their fisheries, including subsistence fisheries. Interactions between the proposed Expedition and fishing operations are expected to be limited. Although fishing would not be precluded in the Expedition area, a safe distance (2 km) would need to be kept from L/B *Robert*. Conflicts would be avoided through Notice to Mariners and direct radio communication with subsistence fishers during the surveys. As tribal fishing grounds are located nearshore, Expedition activities are not predicted to affect subsistence fishing activities due to their distance from shore (>30 km).

There are numerous shipwrecks in the Expedition area; however, these are not at the drill sites and would be avoided. Operation sounds would have no effects on solid structures; no significant impacts on shipwrecks would be expected. The proposed activities are of short duration (~100 days), and no adverse impacts to cultural resources or SCUBA diving activities are anticipated.

4.1.6 Reasonably Foreseeable Effects

Reasonably foreseeable effects refer to the impacts on the environment that result from a combination of the proposed action and other projects and human activities that could occur within the Expedition area. These effects can result from multiple causes, multiple effects, effects of activities in more than one locale, and recurring events. Human activities, when conducted separately or in combination with other activities, could affect marine animals in the proposed Expedition area. However, understanding these effects is complex because of the animals' extensive habitat ranges, and the difficulty in monitoring populations and determining the level of impacts that may result from certain activities.

Here we focus on activities (e.g., research, vessel traffic, and fisheries) that could impact animals specifically in the proposed study area. However, the combination of the proposed activities with the existing operations in the region would be expected to produce only a negligible increase in overall disturbance effects on marine mammals. For these reasons, significant impacts to marine resources are not anticipated from the proposed Expedition.

4.1.6.1 Research Activities

Past research activities in the general area of the expedition include a relatively small number of geophysical surveys, the most recent of which was in 2022 (NCEI 2025). A high-resolution, multi-channel seismic survey collected data in the Expedition area in 2009 (Holst and Robertson 2009). A controlled-source electromagnetic survey was also conducted along a transect connecting the proposed drill sites (Gustafson et al. 2019). No drilling has been conducted within 100 km of the proposed sites (Dugan et al. 2025). Other scientific seismic research activities and other studies may be conducted in this region in the future. At the present time, the proponents of the Expedition are not aware of other marine research activities planned to occur in the proposed research during 2025.

4.1.6.2 Military Activities

The proposed Expedition area is also located within the U.S. Navy's Narragansett Bay Operating Area (OPAREA). This OPAREA is part of the U.S. Navy's Atlantic Fleet Testing and Training (AFTT) Study Area, for which an EIS has been developed to assess the potential environmental effects of training and testing activities that occur in, over, and on the western Atlantic Ocean, Gulf of Mexico, and parts of the Caribbean Sea. The types of activities that could occur in the OPAREA include aircraft carrier, ship and submarine operations; anti-air and surface gunnery, missile firing, anti-submarine warfare, mine warfare, and amphibious operations; all weather flight training, air warfare, refueling, UAV flights, rocket and missile firing, and bombing exercises; and fleet training and independent unit training (DoN 2018). An Undersea Warfare Center, the Newport Testing Range, is located within the OPAREA and is used for anti-submarine warfare training and testing of new technologies and assessing weapon performance with new systems and platforms. The types of activities that could occur in the testing range include testing of anti-submarine warfare mission packages, sonar, torpedoes (non-explosive), radar, countermeasures, payload deployers, towed equipment, unmanned aerial systems, unmanned surface vehicles, unmanned underwater vehicles, and vehicle signature evaluations (DoN 2024). Thus, naval activities could occur within the proposed Expedition area; however given the small footprint of the proposed action, there is unlikely to be any conflict.

4.1.6.3 Offshore Energy Development

The proposed Expedition area is located within BOEM's Outer Continental Shelf (OCS) North Atlantic Planning Area for proposed geological and geophysical (G&G) activities, for which a Final PEIS was published in February 2014 (BOEM 2014) and a Record of Decision (ROD) was signed in July 2014. The 2014 ROD was the last oil and gas document signed for the development of the Mid-Atlantic and South Atlantic region. At present, there are no oil and gas leases in the Atlantic area that overlap the proposed Expedition area. On January 20, 2025, an Executive Order was issued for temporary cessation and immediate review of federal wind leasing and permitting practices; as noted previously, the proposed drill sites are adjacent to and/or overlap slightly with the BOEM wind lease areas. Construction by Revolution Wind, South Fork Wind, and Vineyard Wind has occurred in the wind lease areas and turbines have already been erected. The proposed Expedition is considered to have insignificant impacts on the marine environment when compared to these construction activities.

4.1.6.4 Vessel Traffic

The proposed study area is adjacent to some of the busiest shipping routes in the U.S. A total of 215 million tons of waterborne cargo were handled at ports in Massachusetts, Rhode Island, Connecticut, New York, and New Jersey in 2022, including exports, imports, and intrastate shipments (WCSC 2022). New Jersey and New York recorded the highest waterborne tonnage at 149 and 32 million tons, respectively (WCSC 2022). Of the 150 busiest U.S. ports by waterborne tonnage in 2022 (WCSC 2022), eight are between Massachusetts and New Jersey: New York, New York & NJ (4th), South Jersey, NJ (30th), New Haven, CT (53rd), Providence, RI (65th), Albany, NY (75th), Boston, MA (76th), and Port Jefferson, NY (111th), and Bridgeport, CT (143rd). The shipping lanes off the U.S. Atlantic coast are oriented in north-south and east-west directions. The north-south vessel traffic is predominately domestic commercial shipping activity and occurs along the entire eastern coastline in inshore and offshore waters; the more variable international shipping are mainly dictated by the vessel's final destination. Several regulations now limit the risk of North Atlantic right whale ship strikes, including speed restrictions, re-direction of shipping lanes, and vessel contacts with shore-based stations.

Based on data available through the Automated Mutual-Assistance Vessel Rescue (AMVER) system managed by the U.S. Coast Guard, 4 or fewer commercial vessels per month travelled through several one-degree cells (60 minutes of latitude by 60 minutes of longitude) in and around the proposed Expedition area from July to October 2024 (USCG 2025). Live vessel traffic information is available from MarineTraffic (2025), including vessel names, types, flags, positions, and destinations. Various types of vessels were in the proposed Expedition area when MarineTraffic (2025) was accessed on 4 February 2025, mostly offshore supply vessels, fishing vessels, and tankers. Additional vessel types were found closer to shore including passenger and coast guard vessels. Collisions of vessels with marine mammals have been reported for the U.S. North Atlantic, with most collisions with large whales involving humpbacks, followed by North Atlantic right whales (Hayes et al. 2024).

The total distance that would be traveled by L/B *Robert* (~550 km for transit to and from port and between the proposed drill sites) would be minimal relative to total transit lengths for vessels operating in the proposed study area at the time of Expedition 501. Thus, the projected increases in vessel traffic attributable to implementation of the proposed activities would constitute only a negligible portion of the total existing vessel traffic in the analysis area, and only a negligible increase in overall ship disturbance effects on marine mammals.

4.1.6.5 Fisheries Interactions

Fisheries in the region are described in § III. The primary contributions of fishing to potential reasonably foreseeable impacts on marine mammals and sea turtles involve direct removal of prey items and noise (Reeves et al. 2003).

Section 118 of the MMPA requires all commercial fisheries to be placed in one of three categories based on the level of incidental take of marine mammals relative to the Potential Biological Removal (PBR) for each marine mammal stock. Category I, II, and III fisheries are those for which the combined take is ≥50%, 1%–50%, and <1%, respectively, of PBR for a particular stock. Three Category I fisheries listed in 2024 have distributions that include the proposed Expedition area (89 FR 12257). The Category I fisheries[1] are the Atlantic Ocean large pelagics longline fishery (19), the northeast sink gillnet fishery (13), and the northeast American lobster trap and pot fishery (3). A further ten fisheries are listed as Category II fisheries (89 FR 12257): northeast drift gillnet fishery (none documented), the mid-Atlantic mid-water, including pair trawl (2), mid-Atlantic bottom trawl (6), northeast mid-water trawl, including paired trawl fishery (5), the northeast bottom trawl fishery (9), MA mixed species trap/pot (none documented), Atlantic blue crab trap and pot fishery (16), Atlantic mixed species trap and pot fishery (2), mid-Atlantic menhaden purse seine (2), and U.S. mid-Atlantic mixed species stop seine/weir/pound net, except the NC roe mullet stop net (1). The remaining fisheries within the proposed Expedition area are listed as Category III or have no listing (89 FR 12257).

***Marine mammals*.—**Off the east coast of the U.S., marine mammals are bycaught in commercial longline, trawl, and gillnet fisheries (Lewison et al. 2014). In Atlantic waters of the U.S., numerous cetaceans (mostly delphinids) and pinnipeds suffer serious injury or mortality each year from fisheries.

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[1] Number of marine mammal species or stocks incidentally killed or injured during commercial operations in parentheses.

Hayes et al. (2024) reported fishery-related mortality and serious injuries (M/SI) during 2021 in U.S. Atlantic waters of 111 harbor porpoise, 39 common dolphins, 3 Risso's dolphins, 2 Atlantic white-sided dolphins, 1.4 bottlenose dolphins, as well as 1027 gray seals, 241 harbor seals, and 66 harp seals. The mean annual detected M/SI for fisheries for 2017–2021 involving baleen whales for the North Atlantic was 8.6 minke whales, 7.75 humpback whales, 3.95 North Atlantic right whales, 1.45 fin whales, and 0.4 sei whales; the total estimated annual mortality M/SI for right whales was 10.8 (Hayes et al. 2024).

Sea turtles.—Off the east coast of the U.S., sea turtles are bycaught in commercial longline (Lewison et al. 2014) and pound net fisheries (Epperly et al. 2007; McNeill et al. 2018). Bycatch estimates calculated for fisheries in the southeast region of the U.S. (including off North Carolina) for 2005 showed that loggerhead turtles were the most commonly bycaught species, with 5209 individuals, followed by Kemp's ridley turtles with 4222 individuals, 659 green turtles, and 537 leatherback turtles (NMFS 2011). The annual average bycatch in gillnet, otter trawl, and scallop dredge fisheries was 342 loggerhead turtles in the Mid-Atlantic region between 2007 and 2014 (Benaka et al. 2019). For 2012–2016, Murray (2018) estimated that the total bycatch for sea turtles in sink gillnet gear for the Georges Bank and Mid-Atlantic regions was 705 loggerheads, 145 Kemp's ridley, 27 leatherback, and 112 unidentified turtles. In the bottom otter trawl gear fisheries in the Mid-Atlantic region for 2014–2018, it was estimated that the total bycatch was 571 loggerheads, 46 Kemp's ridley, 20 leatherback, and 16 green turtles (Murray 2020). For 2019, Garrison and Stokes (2021) estimated a total of 90.8 interactions with leatherbacks and 67.4 interactions with loggerhead for the longline fishery. Loggerhead and green turtles are the most commonly bycaught species in the pound net fisheries; however, mortality is not high as the turtles can usually surface to breathe (Epperly et al. 2007; McNeill et al. 2018).

***Seabirds*.—**Entanglement in fishing gear and hooking can also lead to mortality of seabirds. On the east coast of the U.S., seabird bycatch was recorded in longline and gillnet fisheries (Lewison et al. 2014). In 2015, 2572 seabirds representing 10 species were taken as bycatch in commercial fisheries across seven Greater Atlantic regions (Benaka et al. 2019). Most of the bycatch took place in the Mid-Atlantic and New England gillnet fisheries, with 2215 birds bycaught in 2015. A total of 76% of the 2015 bycatch was of great shearwaters taken by gillnets; northern fulmars, red-throated loons, and herring gulls were also commonly taken.

4.1.6.6 Tourism

Tourism is an important industry for the states adjacent to the proposed Expedition area. For example, tourism is the third largest industry in Massachusetts, with a total economic contribution to its economy exceeding $23.6 billion in 2023 (MOTT 2025). An estimated 50.2 million domestic visitors and 2.1 million international visitors came to Massachusetts in 2023 (MOTT 2025). The tourism industry supported 154,330 full-time, part-time, and seasonal jobs. Cape Cod and the islands of Martha's Vineyard and Nantucket receive a large percentage of their revenue from the tourism industry. An estimated six million visitors travel to Cape Cod annually, with the majority (nearly $^2/_3$) arriving typically from April through October (MMS 2009). Visitors are attracted to the area's high quality recreational activities, including many marine-based activities. In Nantucket Sound, recreational marine activities include fishing, sailing, cruising, boat racing, jet skiing, kayaking, and canoeing. All types of recreational watercraft from the smallest runabout to very large yachts and sailboats can be encountered in Nantucket Sound. The majority of the recreational activity occurs in coastal areas, but the larger power boats and sailboats can range into offshore waters. The recreational activities are often conducted in waters shared by commercial vessels, such as passenger ferries, barges carrying liquid and dry bulk goods, commercial and charter fishing boats, research vessels, and the occasional cruise ship. Recreational scuba diving is also common in New England waters, focused primarily on wreck diving or spearfishing. Many popular dive sites are located in waters <40 m deep and accessible directly from Massachusetts and New Jersey beaches or small boats (DoN 2005).

The Steamship Authority (2025) provides year-round ferry service to the islands of Martha's Vineyard and Nantucket across Nantucket Sound and currently operates nine vessels. From May to September, there are up to 23 roundtrip passages per day between Woods Hole and two ports on Martha's Vineyard, and up to 5 fast ferry trips and 7 traditional ferry trips per day between Hyannis and Nantucket. In 2023, the Steamship Authority made 24,661 trip and carried ~2.9 million passengers, 593,234 vehicles and small trucks, 97,635 large commercial trucks (Steamship Authority 2023). Passenger and vehicle traffic generally peak in the summer months. Other passenger ferries servicing the islands of Martha's Vineyard and Nantucket originate from Cape Cod, Rhode Island, and New York (MMS 2009).

Many visitors to MA engage in whale watching and other wildlife viewing cruises in coastal waters. According to Hoyt (2001), in New England, there are at least 36 whale watch operators, with 17 operators and 30–35 vessels in Massachusetts. Many trips originate from Gloucester and several towns along the Cape Cod coast, including Provincetown, Hyannis, and Plymouth. Many operators make multiple trips per day, with each trip lasting 1.5−4 h. Whale watching tours are generally focused within 40 km of shore and operate from April through October (MOTT 2025); Stellwagen Bank is often the primary destination of tours that primarily seek humpback whales.

4.1.6.7 Marine Mammal Unusual Mortality Events

As of January 2025, there are four Active UMEs for the U.S. Atlantic; UMEs were declared for humpbacks and North Atlantic right whales in 2017, for the Atlantic minke whale in 2018, and for the Atlantic Florida manatee in 2021 (NOAA Fisheries 2025p). Since 2017, an increase in numbers of dead or seriously injured right whales have been reported along the east coast of Canada and the U.S. A total of 151 dead, seriously injured, or sublethally injured/ill right whales have been reported, including 41 mortalities. There is evidence of human interaction, in particular vessel strikes and entanglements (NOAA Fisheries 2025q). An increase in mortality of humpbacks has been reported since January 2016, from Maine through Florida, with a total of 243 strandings to date (NOAA Fisheries 2025r). Some of the whales examined had evidence of human interaction either through ship strikes or entanglement, but the evidence is not consistent for all individuals; NOAA notes that more research is needed (NOAA 2025r). Since January 2017, there has also been increased mortality of minke whales from Maine through Georgia; a total of 196 have been reported to date. There is evidence of human interaction or diseases but the evidence is not consistent between all individuals that have been examined; NOAA notes that more research is needed (NOAA 2025s). Since December 2020, an increase in the number of strandings of manatees has occurred along the coast of Florida; many animals were emaciated and the UME is attributed to starvation due to loss of seagrass (MMC 2025).

4.1.7 Unavoidable Impacts

Unavoidable impacts to the species of marine mammals and sea turtles occurring in the proposed study area would be limited to short-term, localized changes in behavior of individuals. No long-term or significant impacts would be expected on any of these individual marine mammals or sea turtles, or on the populations to which they belong. Effects on recruitment or survival would be expected to be (at most) negligible.

4.1.8 Coordination with Other Agencies and Processes

This Draft EA has been prepared by LGL on behalf of IODP[3] and NSF pursuant to NEPA. Potential impacts to marine mammals, endangered species, and critical habitat have also been assessed in the document; therefore, it will be used to support the ESA Section 7 and EFH consultation processes with NMFS and other U.S. and international regulatory processes as appropriate. NSF and the PIs contacted NMFS regarding compliance with the MMPA. NMFS confirmed on 20 December 2024 that an IHA was not necessary for the proposed activity as "takes" pursuant to the MMPA would not be anticipated. Through the U.S. Department of State, the BGS is seeking clearance for the proposed marine scientific research. As part of that process, U.S. federal agencies review the activity and identify any requirements for operations.

4.2 No Action Alternative

An alternative to conducting the proposed activity is the "No Action" Alternative, i.e., do not conduct the Expedition. If the research were not conducted, the "No Action" alternative would result in no disturbance to marine species attributable to the proposed activity; however, valuable data about the marine environment would be lost. Geological data of scientific value that would provide new insights to offshore freshwater resources would not be collected, and the collection of new data, interpretation of these data, and introduction of new results into the greater scientific community and applicability of these data to other similar settings would not be achieved. No permits and authorizations would be needed from regulatory bodies, as the Proposed Action would not be conducted.

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APPENDIX A

FIGURE A-1. L/B *Robert* (Source: SEACOR Marine).

FIGURE A-2. M/V *Rana* (Source: Miller's Launch, Inc.).

FIGURE A-3. Boart Longyear LF160 Drill Rig, up to 10.6 m high. This land-based mining rig would be temporarily installed on the L/B *Robert* for the proposed action (Source: Boart Longyear).

APPENDIX B

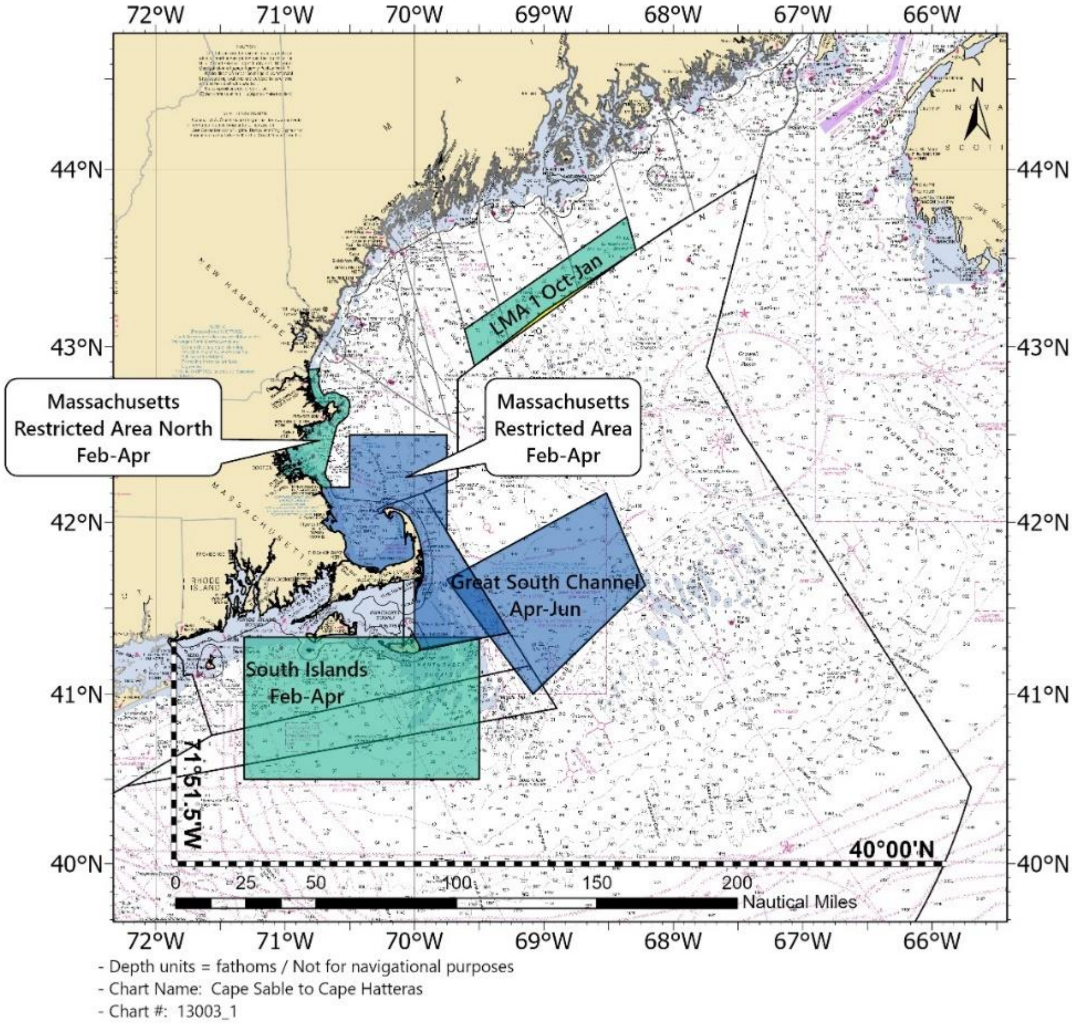

FIGURE B-1. Restricted fisheries areas with respect to the 2021 Atlantic Large Whale Take Reduction Plan Modifications; LMA = Outer Cape Lobster Management Area (Source: NOAA Fisheries 2022).

APPENDIX C

TABLE C-1. Marine species with Essential Fish Habitat (EFH) overlapping the proposed Expedition area.

Species	Life stage[1] and habitat[2]			
	E	L/N	J	A
Acadian redfish *Sebastes fasciatus*		P	B	
Pollock *Pollachius pollachius*		P		
Haddock *Melanogrammus aeglefinus*	P	P	P	
Atlantic cod *Gadus morhua*	P	P	P	P
Atlantic Wolffish *Anarhichas lupus*	B	B/P	B	B
Ocean Pout *Zoarces americanus*				B
Bluefish *Pomatomus saltatrix*[5]			P	P
Butterfish *Peprilus triacanthus*[6]	P	P	P	
Black sea bass *Centropristis striata*[4]	P	D	D	D
Atlantic herring *Clupea harengus*	B	P	P	P
Atlantic mackerel *Scomber scombrus*[6]	P	P		
Offshore hake *Merluccius albidus*		P		
Red hake *Urophycis chuss*	P	P	B	
Silver hake *Merluccius bilinearis*	P	P	B/P	
White hake *Urophycis tenuis*	P		P	
Scup *Stenotomus chrysops*[4]			D	D
Monkfish *Lophius americanus*	P	P		
Summer flounder *Paralichthys dentatus*[4]				B
Windowpane flounder *Scophthalmus aquosus*	P	B	B	B
Winter flounder *Pseudopleuronectes americanus*		P	B	B
Witch flounder *Glyptocephalus cynoglossus*		P		
Yellowtail flounder *Limanda ferruginea*	P	P	B	B
Albacore tuna *Thunnus alalunga*			P	P
Bluefin tuna *Thunnus thynnus*			P	P
Yellowfin tuna *Thunnus albacres*			P	P
Skipjack tuna *Katsuwonus pelamis*			P	P
Winter skate *Leucoraja ocellata*			B	B
Barndoor skate *Dipturus laevis*			B	B
Little Skate *Leucoraja erinacea*			B	B
Porbeagle shark *Lamna nasus*		P	P	P
Common thresher shark *Alopias vulpinus*		P	P	P
Blue shark *Prionace glauca*		P	P	P
Dusky Shark *Carcharhinus obscurus*		P	P	P
Shortfin mako shark *Isurus oxyrinchus*		P	P	P
Basking shark *Cetorhinus maximus*		P	P	P
White shark *Carcharodon carcharias*		P	P	P
Spiny dogfish *Squalus acanthias*[7]				P
Smoothhound shark Complex (Atlantic Stock) *Mustelus canis*		P	P	P
Tiger shark *Galeocerdo cuvier*			P	P
Sand tiger shark *Carcharias taurus*			P	P
Atlantic sea scallop *Placopecten magellanicus*	B	B/P	B	B
Atlantic Surf clam *Spisula solidissima*[3]			B	B
Ocean Quahog *Arctica islandica*[3]			B	B
Longfin inshore squid *Doryteuthis (Amerigo) pealeii*[6]	B		P	
Galapagos shark *Carcharhinus galapagensis*[8]				
Narrowtooth shark *Carcharhinus brachyurus*[8]				
Smalltail shark *Carcharhinus porosus*[8]				
Sevengill shark *Heptranchias perlo*[8]				
Sixgill shark *Hexanchus griseus*[8]				
Bigeye sixgill shark *Hexanchus nakamurai*[8]				
Bigeye sand tiger shark *Odontaspis noronhai*[8]				

Species	Life stage[1] and habitat[2]			
	E	L/N	J	A
Caribbean sharpnose shark *Rhizoprionodon porosus*[8]				
Smooth hammerhead shark *Sphyrna zygaena*[8]				

Source: NOAA 2017; NEFMC and NMFS 2017

[1] E = eggs; L/N = larvae for bony fish and invertebrates, neonate for sharks; J = juvenile; A = adult

[2] P = pelagic; D = demersal; B = benthic

Sources: [3] MAFMC, NMFS, and NEFMC 1998; [4] MAFMC, NMFS, NEFMC, and SAFMC 1998a; [5] MAFMC, NMFS, NEFMC, and SAFMC 1998b; [6] MAFMC and NMFS, 2011; [7] MAFMC and NMFS, 2014; [8] Atlantic Highly Migratory Species EFH where no spatial data currently exist but may overlap with Expedition area.

APPENDIX D

Below are species descriptions for the top ten commercial species landed in U.S. States (NY, CT, RI, MA) in 2023 adjacent to the Expedition area.

Longfin inshore squid.—The longfin inshore squid is a schooling cephalopod distributed in continental shelf and slope waters from Newfoundland to the Gulf of Venezuela. It occurs in commercial abundance from southern Georges Bank to Cape Hatteras (Jacobson 2005). Seasonal migrations are related to bottom water temperatures. The longfin inshore squid moves offshore during late autumn to overwinter along the edge of the continental shelf and returns inshore during spring and early summer (Jacobson 2005).

Longfin inshore squid spawn year-round with seasonal and geographical peaks that vary temporally and spatially. Most eggs are spawned from late spring to early summer in the Mid-Atlantic region (Jacobson 2005). Around Woods Hole, spawning begins from late April to May (Lange 1982 *in* DoN 2005). Spawning grounds along the Atlantic coast of North America appear restricted to coastal waters and embayments, such as Narragansett and Delaware bays (Jacobson 2005).

The population of longfin inshore squid from southern Georges Bank to Cape Hatteras is managed by the MAFMC under the Atlantic Mackerel-Squid-Butterfish FMP (MAFMC 2025). The domestic fishery, described by Hendrickson and Jacobson (2006), occurs primarily in southern New England and mid-Atlantic waters, with some fishing also occurring along the edge of Georges Bank. Fishing patterns generally reflect seasonal longfin inshore squid distribution patterns, and effort is generally directed offshore during October–April and inshore during May–September. The fishery is dominated by small-mesh otter trawlers, but nearshore pound-net and fish-trap fisheries occur during spring and summer. According to McKiernan and Pierce (1995 *in* MMS 2009), nearly all of the squid taken in MA waters are from Martha's Vineyard Sound and Nantucket Sound.

Atlantic sea scallop.—The Atlantic sea scallop is a bivalve mollusc that inhabits the continental shelf from the north shore of the Gulf of St. Lawrence south to Cape Hatteras. Adults are generally found on coarse substrate, usually gravel, shells, and rock, in areas with some water movement, which is critical for feeding, oxygen, and waste removal. They are typically found at depths ranging from 18 to 110 m, but northern populations tend to be found in shallower water (Packer et al. 1999).

The timing of spawning can vary with latitude, starting in summer in southern areas and in fall in northern areas. A major annual spawning period occurs in late summer–fall (August–October), although spring or early summer (June–July) spawning also occurs at specific locations. Scallop beds generally spawn synchronously in a short time, going from completely ripe to completely spent in less than a week. Spawning may be triggered by a number of factors, including rapid temperature change, presence in the water of sperm from other scallops, agitation, or tides (Packer et al. 1999). Spawning occurs off Georges Bank in late September and early October (MacKenzie et al. 1978 *in* DoN 2005).

Atlantic sea scallops are managed under NEFMC's Sea Scallop Management Plan (NEFMC 2025). The species is managed as a single unit throughout its range in U.S. waters, with five stock components recognized: eastern Georges Bank, the Great South Channel, the Gulf of Maine, the New York Bight, and the waters adjacent to Delaware, Maryland, and Virginia. Scallops are harvested primarily through the use of scallop dredges and trawls (NEFMC 2025). Scallop harvesting with dredges apparently is not carried out in southern New England, but there can be harvesting with bottom trawls (DoN 2005).

American lobster.—The American lobster is distributed in the Northwest Atlantic from Labrador to Cape Hatteras, from coastal waters out to depths of 700 m. Coastal lobsters are concentrated in rocky areas where shelter is available, and occasionally in high densities in mud substrates. Offshore populations are most abundant along the continental shelf edge in the vicinity of marine canyons. Lobsters exhibit a complex life cycle in which mating occurs following molting of the female. The extruded eggs are carried under the female's abdomen during a 9–11 month incubation period. The eggs hatch during late spring or early summer and the pelagic larvae undergo four molts before resembling adults and settling to the bottom. Approximately 20–25 molts over a course of 5–8 years occur before reaching minimum legal harvest size (NOAA Fisheries 2025m).

The American lobster fishery occurs in inshore and offshore waters, primarily using traps (i.e., lobster pots) and, to a lesser extent, bottom trawls. The offshore trap-fishing grounds include continental shelf areas from MA to New Jersey and along the shelf break from Lydonia Canyon to Norfolk Canyon. The majority of lobsters (80%) are harvested in nearshore areas. Lobster fishing occurs year-round both offshore and inshore, with peak fishing occurring during May–December (DoN 2005). The catch has been declining since reaching its peak in 1997 (21.8 million pounds) to the lowest recorded catch (2.7 million pounds) in 2018 (ASMFC 2020). As inshore abundance has declined, the fishery has predominately shifted to offshore.

Goosefish.—The demersal goosefish or monkfish is a relatively warm-water anglerfish that ranges from Quebec to northeastern Florida, but is generally uncommon in nearshore waters south of North Carolina (Scott and Scott 1988; Froese and Pauly 2024). Adult goosefish favor open, sandy bottoms, and spend the majority of their time resting on the bottom, often in a depression or partially covered in sediment (Steimle et al. 1999).

Overall, goosefish spawning occurs from spring through early fall with a peak in May–June. Spawning times vary depending on region (Steimle et al. 1999), with southern populations spawning earlier (early spring off the Carolinas) than northern populations (May-June in the Gulf of Maine; into September in Canadian waters). Spawning locations are not well known, but are believed to extend from inshore shoals to offshore (Connolly 1920 *in* Steimle et al. 1999; Scott and Scott 1988)

An unusual aspect of the goosefish life history is that females produce relatively large (1.6–1.8 mm) eggs that are shed within buoyant, ribbon-like, non-adhesive, mucoid veils or rafts that may be 6–12 m long, 0.15–1.5 m wide, and >5 kg in mass. The egg veils float freely at the surface and are subject to the actions of wind, currents, and waves (Connolly 1920 *in* Steimle et al. 1999). Hatch timing is temperature dependent and ranges from 6–7 days at 15ºC to ~100 days at 5ºC (Scott and Scott 1988). Goosefish live in the water column during the egg and larval stages and shift to a benthic existence during their juvenile and adult stages (Steimle et al. 1999).

The fishery is currently managed under the Monkfish FMP by NEFMC and MAFMC (NEFMC 2025) with two stocks recognized: (1) a northern stock found in the Gulf of Maine and northern Georges Bank, and (2) a southern stock that ranges from southern Georges Bank to Cape Hatteras (Almeida et al. 1995; Richards 2000). The primary gear types used to catch goosefish are bottom trawls, sink gillnets, and scallop dredges. Goosefish landings occur over a wide area, including southern New England, and occur year-round. The trawl fishery targets goosefish in the canyons and on steep edges of the continental shelf break in the northern portion of the MAB. The targeted dredge fishery largely lands goosefish in MA (DoN 2005).

Ocean quahog.—The ocean quahog is a bivalve mollusk found in temperate and boreal waters on both sides of the North Atlantic. In the western Atlantic, ocean quahogs are distributed on the continental shelf from Newfoundland to Cape Hatteras. Adults are usually found in dense beds over level bottoms, just below the surface of the sediment, which ranges from medium- to fine-grained sand. Pelagic larvae can be found throughout the water column, and benthic juveniles are found offshore in sandy substrates (Cargnelli et al. 1999).

Spawning is protracted, lasting from spring to fall and sometimes into January (Cargnelli et al. 1999) with peak spawning starting in August and ending by October (Serchuk et al. 1982). Multiple annual spawning events may occur at the individual and population levels.

The ocean quahog is managed under the Surf Clam-Ocean Quahog FMP of the MAFMC (MAFMC 2025). Clams are harvested mainly with hydraulic clam dredges in the MAB region. The fishery is active year-round with most vessels operating during the summer months (DoN 2005).

Winter skates.—Winter skate are one of the seven species of skates listed in the northeast skate complex by NEFMC which also includes, barndoor skate, little skate, thorny skate (*Amblyraja radiate*), smooth skate (*Malacoraja senta*), clearnose skate (*Raja eglanteria*), and rosette skate (*L. garmani*). The northeast skate complex is distributed along the coast of the northeast U.S. from the intertidal zone to depths >700 m (NEFMC 2025).

Skates are harvested in two different fisheries: (1) a fishery that supplies lobster harvesters with skates to use as bait for traps, and (2) a wing (fin) fishery that supplies skate meat for human consumption (NEFMC 2025). Skate landings occur year-round with a peak during summer. The bait fishery largely uses bottom trawls to target skates in federal waters <140 km off RI. Landings for the wing fishery mainly result from the bycatch in gear types associated with the groundfish, goosefish, and scallop fisheries. Some sink gillnets are used to target skates during the goosefish fishery (DoN 2005).

Haddock.—Ranging from Greenland to Cap May, New Jersey in the northwest Atlantic, haddock are most abundant on Georges Bank and the Gulf of Maine. This is a demersal, temperate species that occupies waters 10–450 m deep but is typically found in 80 to 200 m water depth (Cohen et al. 1990). Haddock have restricted movements mainly to and from spawning grounds (Cohen et al. 1990). These are omnivorous fish that feed mainly on benthic organisms including crustaceans, molluscs, echinoderms, worms, and other fishes (Cohen et al. 1990). In U.S. waters, the haddock is managed under the Northeast Multispecies FMP as two separate stocks occurring in the Georges Bank and Gulf of Maine areas (NEFMC 2025). This FMP includes 13 other benthic species/groups, including flounder and white hake. The primary gear types used in this fishery are trawl nets, gillnets, bottom longlines, and rod and reel.

Silver hake.—The benthic silver hake or whiting occurs in waters from Newfoundland to North Carolina (Klein-MacPhee 2002) at depths of 55 to >900 m (Froese and Pauly 2024). During periods of feeding and spawning, the species is often found in dense schools. Nocturnal hunters, silver hake can be found throughout the entire water column in pursuit of prey. They are believed to rest on the bottom during the day (Klein-MacPhee 2002). Spawning occurs year-round with peaks typically occurring between May and August (Klein-MacPhee 2002; Col and Traver 2006). Spawning occurs in continental shelf waters, particularly in areas along the southeastern and southern slopes of Georges Bank, around Nantucket Shoals, and south of Martha's Vineyard to Cape Hatteras (Klein-MacPhee 2002). Shallow areas are occupied by silver hake in spring, with spawning occurring during late spring and early summer. The species migrates to deeper waters of the outer continental shelf and slope in autumn (Col and Traver 2006).

The silver hake is currently managed as two stocks in U.S. coastal waters: a northern stock in the Gulf of Maine and northern Georges Bank, and a southern stock extending from southern Georges Bank to the MAB (Col and Traver 2006). Both stocks are managed under NEFMC's "small mesh multispecies" program of the Northeast Multispecies FMP (NEFMC 2025).

Scup.—Scup are distributed from Nova Scotia to Florida but considered rare south of North Carolina. This species schools inshore during the summer months and offshore in winter (Froese and Pauly 2024). Scup feed on invertebrates including amphipods, worms, sand dollars, and juvenile squid (Froese and Pauly 2024). The species is co-managed by the MAFMC under the Summer Flounder-Scup-Black Sea Bass FMP (MAFMC 2025) and the ASMFC (ASMFC 2025). Scup are harvested with trawl nets, and scup pots and traps. The fishery occurs year-round but the quota is separated into three harvest periods Winter I (January-April), Summer (May-October), and Winter II (November-December).

Jonah Crab.—Jonah crab are found along the eastern coast of North America from Canada to Florida. Life cycle and behavior studies conducted on Jonah carb are limited but it is hypothesized that females of this species seasonally migrate between the nearshore (in spring and summer) and offshore (in the fall and winter). Historically, these crabs have been caught as bycatch in the lobster fishery. However, as lobster catches have decreased and crab species prices increased, landings of Jonah crabs have increased in recent years. The species is now managed by the ASMFC, and NOAA Fisheries has approved measures for an FMP. However, stock assessments for this fishery are data-limited (ASMFC 2023). It is unknown whether the stock is currently overfished (ASMFC 2023; NOAA Fisheries 2025n). However, landings have declined since 2020 and conditions are closely resembling the Canada Jonah Crab fishery crash from the early 2000s (ASMFC 2023).

Fishing Gear

A wide variety of fixed and mobile fishing gear is used to harvest commercial species in or near the Expedition area (Table A-1). The most common fixed-gear types include pots and traps, gillnets, and longlines. Trawls, purse seines, and dredges are commonly used mobile gear types. Commercial fishers with federal permits largely use otter trawls (to target squid and groundfish), fish weirs, gillnets, and fish pots. In the vicinity of the Expedition area, trawls (bottom and mid-water), gillnets (sink), dredges (scallop and clam), longlines, and pots are typical gear (BOEM 2021). Commercial fishers with State permits also use fish weirs and fish pots for finfish species (322 CMR: Division of Marine Fisheries). Conch pots and clam dredges are dominant gear types used in commercial shellfish fisheries (MMS 2009).

TABLE D-1. Types of gear and level of gear-specific fishing used within and near the proposed Expedition area (adapted from DoN 2005).

Gear Type	Fishery	Project Area Fishing Effort
Trawls (bottom)	Multispecies/groundfish, skate, goosefish, spiny dogfish, clam, Atlantic sea scallop, American lobster, northern shrimp, winter trawl, mackerel, squid, bluefish, scup	High level of fishing effort from coastal waters to shelf break (except year-round fishing closure area)
Trawls (mid-water)	Atlantic herring, winter trawl flynet	Very low effort in coastal waters off southern Martha's Vineyard
Dredge (clam)	Ocean quahog, Atlantic surf clam, goosefish	Low- to high-effort level in mid-shelf waters
Dredge (scallop)	Atlantic sea scallop	None
Pots and Traps	American lobster, deep-sea red crab, black seabass, scup	Low level of effort from coastal waters to shelf break
Purse Seines	Atlantic herring, tuna	Moderate level of effort
Gillnets (Sink)	Multispecies/groundfish, skate, goosefish, spiny dogfish, highly migratory species, mackerel, bluefish	High level of effort in predominately coastal waters
Bottom Longline	Multispecies/groundfish, spiny dogfish, highly migratory species, tilefish	Low level of effort near shelf break

APPENDIX E

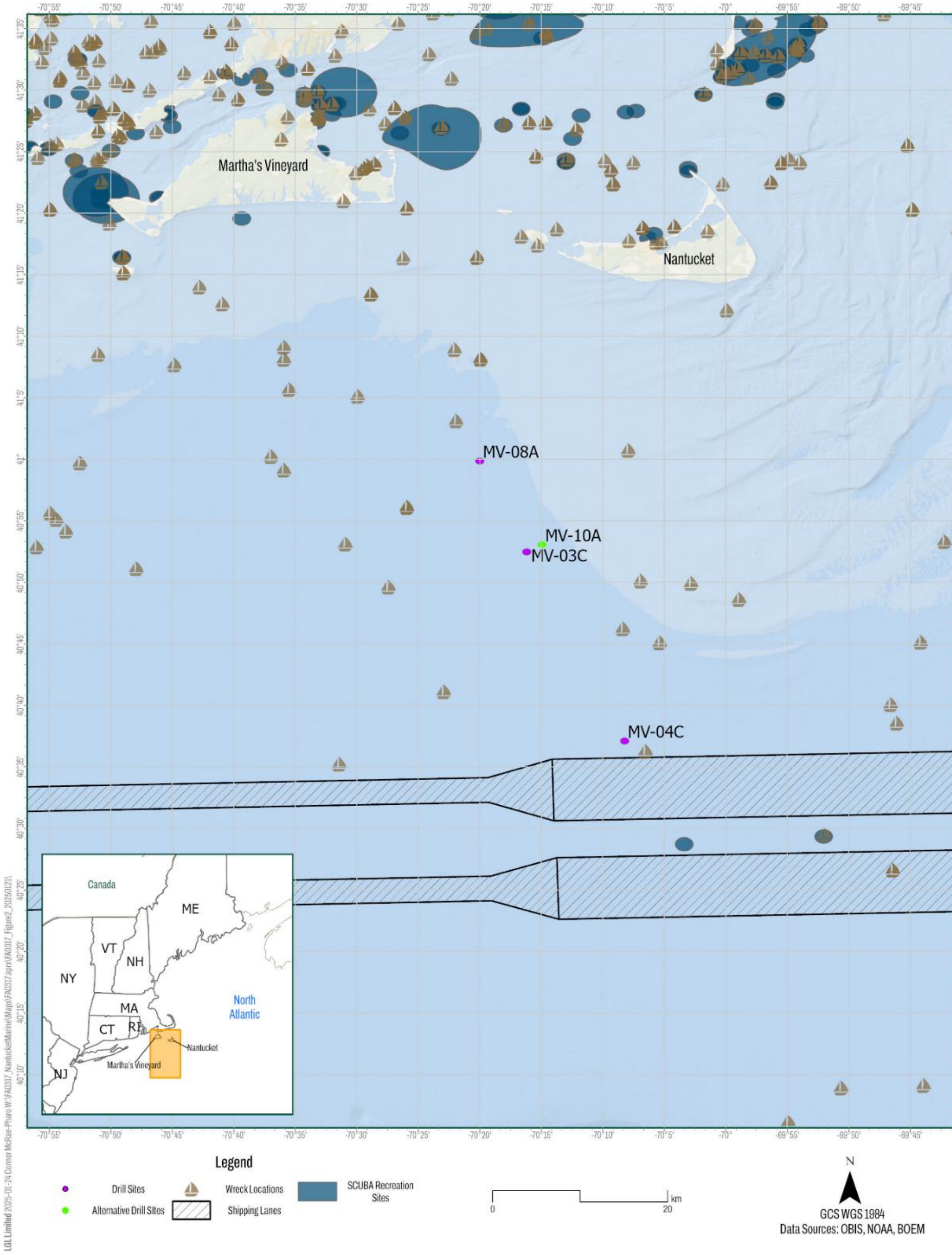

FIGURE E-1. Shipwrecks and dive sites near the proposed drill sites in the Northwest Atlantic Ocean (Sources: NOAA 2024b; ArcGIS 2025).