Wind Energy Research Lease on the Atlantic Outer Continental Shelf: Gulf of Maine Environmental Assessment
Draft Essential Fish Habitat Assessment

For the National Marine Fisheries Service
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U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs

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List of Acronyms

Term	Definition
ADIOS	Automated Data Inquiry for Oil Spills
BMP	best management practice
BOEM	Bureau of Ocean Energy Management
CFR	Code of Federal Regulations
DMR	Maine Department of Marine Resources
DPS	Distinct Population Segment
EA	environmental assessment
eDNA	environmental DNA
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
ESA	Endangered Species Act
FLiDAR	floating light detection and ranging
FMP	fishery management plan
FR	*Federal Register*
G&G	geological and geophysical
GAA	geographic analysis area
GPS	global positioning system
HAPC	Habitat Area of Particular Concern
HRG	high-resolution geophysical
IHA	Incidental Harassment Authorization
IPF	impact-producing factor
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
OCS	Outer Continental Shelf
PCD	Project Design Criteria
PSAT	pop-up satellite archival tags
PSO	protected species observer
PTOW	Pine Tree Offshore Wind
RAP	research activities plan
RFCI	Request for Call Information

Term	Definition
SOC	standard operating condition
SPI	sediment profile imaging
TSS	traffic separation schemes
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

1 Introduction

In the Magnuson-Stevens Fishery Conservation and Management Act (MSA), Congress recognized that one of the greatest long-term threats to the viability of commercial and recreational fisheries is the continuing loss of marine, estuarine, and other aquatic habitats. Congress also determined that habitat considerations should receive increased attention for the conservation and management of fishery resources of the United States. As a result, one of the purposes of the MSA is to promote the protection of essential fish habitat (EFH) in the review of projects conducted under federal permits, licenses, or other authorities that affect or have the potential to affect such habitat.

The MSA requires federal agencies to consult with the Secretary of Commerce, through the National Marine Fisheries Service (NMFS), with respect to “any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH identified under this Act” (16 United States Code [U.S.C.] 1855(b)(2)). This process is guided by the requirements of the EFH regulation at 50 Code of Federal Regulations (CFR) 600.905. The Bureau of Ocean Energy Management (BOEM) will be the lead federal agency for the consultation and will coordinate with any other federal agencies that may be issuing permits or authorizations for this Project, as necessary, for one consultation that considers the effects of all relevant federal actions, including in offshore and inshore coastal environments (e.g., issuance of permits by the U.S. Army Corps of Engineers [USACE]).

Pursuant to the MSA, each Fishery Management Plan (FMP) must identify and describe EFH for the managed fishery, and the statute defines EFH as “those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity” 16 U.S.C. 1853(a)(7) and 1802(10). The National Oceanic and Atmospheric Administration's (NOAA’s) regulations further define EFH, adding that “waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species' full life cycle.

The EFH final rule published in the *Federal Register* (*FR*) on January 17, 2002, defines an adverse effect as: “any impact which reduces the quality and/or quantity of EFH.” The rule further states that:

> An adverse effect may include direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat and other ecosystems components, if such modifications reduce the quality and/or quantity of EFH. The EFH final rule also states that the loss of prey may have an adverse effect on EFH and managed species. As a result, actions that reduce the availability of prey species, either through direct harm or capture, or through adverse impacts on the prey species' habitat may also be considered adverse effects on EFH. Adverse effects on EFH may result from action occurring within EFH or outside EFH and may include site-specific or habitat-wide impacts, including individual, cumulative, or synergistic consequences of actions.

The Energy Policy Act of 2005, Public Law No. 109-58, added Section 8(p)(1)(C) to the Outer Continental Shelf Lands Act, which grants the Secretary of the Interior the authority to issue leases, easements, or rights-of-way on the Outer Continental Shelf (OCS) for the purpose of renewable energy development (43 U.S.C. 1337(p)(1)(C)). The Secretary delegated this authority to the former Minerals Management Service, now BOEM. On April 22, 2009, BOEM (formerly the Bureau of Ocean Energy Management, Regulation, and Enforcement) promulgated final regulations implementing this authority at 30 CFR 585. Relevant regulations regarding EFH include the MSA.

This EFH assessment has been prepared pursuant to the MSA, as amended by the Sustainable Fisheries Act of 2007 (16 U.S.C. 1801-1884) to evaluate the potential effects of the site assessment and characterization activities described herein on EFH and EFH species under the jurisdiction of the NMFS.

2 Proposed Action

The Proposed Action is the issuance of a wind energy research lease and associated potential project easements within an approximately 68,320-acre (276-km^2) area in the OCS in the Gulf of Maine (Research Lease Area). The potential project easements would all be located within the Gulf of Maine and include corridors that extend from the lease area to the onshore energy grid. The Proposed Action would result in site assessment activities on the lease and site characterization activities (**Table 2-1**) in and around the lease and potential project easements. Site assessment activities include the temporary placement (i.e., deployment, maintenance, and decommissioning) of a meteorological ocean buoy. Site characterization activities include geophysical, geotechnical, biological, and archaeological surveys and monitoring activities.

The research lease would not authorize any activities on the OCS but would grant the State of Maine the exclusive rights to submit, for BOEM's potential approval, a research activities plan (RAP) for wind energy-related research activities offshore Maine. Prior to the approval of any plan authorizing the construction and operation of wind energy-related research facilities, BOEM would prepare a plan-specific environmental analysis and would comply with all required consultation requirements.

Under the Proposed Action, BOEM would require each lessee to avoid or minimize potential impacts on the environment by complying with various requirements. These requirements, which are summarized in **Section 6**, are referred to as standard operating conditions (SOCs) and mitigation and would be implemented through lease stipulations.

2.1 Geographic Analysis Area

The Gulf of Maine is among the most diverse and productive temperate marine environments in the world. Covering a wide geographical range from Cape Cod Bay in Massachusetts all the way north to the Canadian border and the Bay of Fundy, the Gulf of Maine contains many unique features.

BOEM used a localized GAA to evaluate impacts from the Proposed Action for resources that are fixed in nature (i.e., their location is stationary such as benthic and archaeological resources), or for resources where impacts from the Proposed Action would only occur in waters in and directly around the Research Lease Area and other survey areas. GAAs for resources that are highly mobile (e.g., finfish) cover broader areas. The GAA for finfish, invertebrates, and EFH extends from Isle Au Haut, ME to Plymouth Bay, MA[1]. This area will encompass most of the EFH that is important to managed finfish and invertebrate species and their EFH that might utilize or migrate through the proposed research lease area and potential cable corridors (**Figure 4-1**).

The temporal scope of analysis is the start of site assessment and site characterization activities related to the Proposed Action activities that began in September 2022 and may continue until September 2028, assuming that a RAP would be approved within 5 years of lease issuance.

[1] The boundaries of GAAs are defined generally but are not necessarily specifically delineated in this EFH Assessment to avoid disclosing confidential business information.

2.2 Site Assessment and Characterization Activities

Table 2-1. Site assessment and site characterization activities for the Proposed Action

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
Site Assessment Activities					
FLiDAR Buoy-based Acoustic Monitoring[1] – Deployment and Maintenance	Pine Tree Offshore Wind (PTOW) would deploy a FLiDAR buoy in the Research Lease Area to collect and transmit information on wind, waves, currents, sea level, and other meteorological parameters in real time. The FLiDAR buoy diameter is 9.5 ft (2.9 m), with an overall height of 23 ft (6.8 m), and approximate weight of 5,512 lb (2,500 kg). The buoy would be moored with a single gravity anchor estimated to be approximately 6,000 lb (2,722 kg) and is not expected to exceed a footprint of 32 ft^2 (3 m^2).	Four total vessel trips anticipated for deployment, maintenance (2 trips), and decommissioning. Anticipated 24-month buoy deployment (March 2024 through February 2026).	Boston, MA or Portland, ME	Crew boat up to 200 ft (61 m) in length.	Fugro SEAWATCH Wind FLiDAR buoy equipped with an independent tracker and dual global positioning system (GPS) to allow for real-time position monitoring. Primary power from solar panels with backup energy supplied by methanol fuel cells in the hull.
FLiDAR Buoy-based Acoustic Monitoring – Decommissioning	Decommissioning is basically the reverse of the deployment process. Equipment recovery would be performed with the support of a vessel equivalent in size and capability to that used for deployment. Typically for	See previous row.	See previous row.	See previous row.	See previous row.

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	small buoys, a crane-lifting hook would be secured to the buoy. A water/air pump system would de ballast the buoy, causing it to tip into the horizontal position. The mooring chain and anchor would be recovered to the deck using a winching system. The buoy would then be transported to shore. Buoy decommissioning is expected to be completed within 1 to 2 days.				
Site Characterization Activities					
Geophysical Reconnaissance Surveys[2]	PTOW would conduct geophysical reconnaissance surveys of the Research Lease Area, potential export cable routes, and wet storage area identified in the State of Maine's research lease application. The surveys would cover a broader area and collect relatively lower-resolution data to identify specific locations for subsequent high-resolution geophysical surveys.	15 multi-day trips by 24-hour vessel. Each multi-day trip would be approximately 7–14 days depending on many factors, including weather downtime, vessel replenishment, and crew changes. 60 daily trips by 12-hour vessel. September 2023 through November 2023.	Portland, ME	24-hour vessel, with length of approximately 164 ft (50 m), for offshore locations. 12-hour vessel, with length of approximately 49 ft (15 m), for nearshore and inshore locations.	Hull-mounted multibeam echosounder with backscatter measurement (proxy for seafloor hardness) and a parametric sub-bottom profiler (e.g., Innomar) with directional chirp signal with operation frequency of 30–115 kHz. The sensors are of such frequency and amplitude level to not require Incidental Harassment Authorization for marine mammals.
High-Resolution Geophysical Surveys[2,3]	PTOW would conduct high-resolution geophysical surveys of the Research Lease Area,	15 multi-day trips by 24-hour vessel. Each multi-day trip would be approximately 7–14	Portland, ME	24-hour vessel, with length of approximately 164 ft (50 m) for	Multibeam echosounder, side-scan sonar, parametric sub-bottom profiler, magnetometer, and

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	potential export cable routes, and wet storage area identified in the State of Maine's research lease application. The surveys would collect bathymetrical (seafloor depth), morphological (topography), and geological data to inform various charting, interpretation, analyses, and reporting efforts for the State of Maine's research project, including assessment of archaeological resources.	days depending on many factors, including weather downtime, vessel replenishment, and crew changes. 60 daily trips for 12-hour vessel. March 2024 through October 2024.		offshore locations. 12-hour vessel, with length of approximately 49 ft (15 m) for nearshore and inshore locations.	ultrahigh-resolution seismic imaging.
Geotechnical Surveys[2,3]	PTOW would conduct geotechnical surveys of the Research Lease Area, potential export cable routes, and wet storage area identified in the State of Maine's research lease application. They surveys would sample or test seabed characteristics to inform design specifications of and locations suitable for placement of anchors and cable infrastructure.	30 multi-day trips. Each multi-day trip would be approximately 7–14 days depending on many factors, including weather downtime, vessel replenishment, and crew changes. March 2024 through October 2024.	Portland, ME	Vessel with a length of approximately 246–262 ft (75–80 m).	Shallow geotechnical coring (piston or vibracores) and cone penetration testing. The number and location of test sites would be determined based on the results of the geophysical reconnaissance survey, likely up to several hundred test sites.
Benthic Surveys[3]	PTOW would conduct detailed benthic surveys of the Research Lease Area, potential export cable	Expected to require 30 multi-day trips, conducted as part of G&G surveys.	Portland, ME	See geophysical reconnaissance and G&G surveys.	Benthic grabs (Hamon grab or Van Veen grab), sediment profile imaging/plan view cameras,

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	routes, and wet storage area identified in the State of Maine's research lease application. The surveys would be used to characterize seafloor habitats of the RFCI area, export cable routes, and wet storage area identified in the State of Maine's research lease application.	September 2023 through October 2023.			and underwater video. The number and location of benthic grab sites would be determined based on the results of the geophysical reconnaissance survey, likely up to several hundred grab sites.
Seafloor Habitat Characterization Sampling and Surveys	DMR would conduct sampling and surveys of the Research Lease Area, potential export cable routes, and wet storage area identified in the State of Maine's research lease application to characterize seafloor habitat and benthic infauna species composition. Data collected would include water column profiles; average seafloor values for temperature, pH, chlorophyll, dissolved oxygen, and salinity; surficial sediment information; seafloor video; benthic species composition; bathymetry; and backscatter.	Once annually. Number of trips per annual survey depends on steam time of contracted vessel. Beginning in Quarter 1 2023 and continuing until approval of the RAP.[4]	Boothbay, ME	45-foot (14-meter) research vessel capable of deploying/retrieving sampling equipment at depth.	Seafloor sampling with benthic grab. Multibeam sonar surveys. The number and location of benthic grab sites would be determined based on the results of the geophysical reconnaissance survey, likely up to several hundred grab sites.
Physical Oceanographic Monitoring	DMR would conduct monitoring to characterize the physical	Beginning in July 2023 and continuing until approval of the RAP.[4]	Undetermined. Portland, ME assumed for	45-foot (14-meter) research vessel capable of	Shore-based radar stations. Underwater glider.

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	oceanographic conditions and surface wind conditions in and around the Research Lease Area. Above-water and surface data would be collected from existing shore-based radar stations with 3.1-mile (5-km) resolution operated by the State of Massachusetts. Two additional radar stations with 1.2-mile (2-km) resolution would be installed along the Maine coast in the first year after lease issuance. In following years, one to three additional radar stations may be installed. Subsurface water data on water column temperature, salinity, chlorophyll a concentration, and suspended particulate concentration would be collected with an underwater glider following a bowtie or sawtooth pattern around the Research Lease Area.	Monitoring from shore-based radar stations would occur continuously. Glider deployments would occur monthly or less frequently based on data needs.	analysis.	deploying/retrieving sampling equipment at depth.	
Digital Aerial Surveys	PTOW would work with HiDef and Biodiversity Research Institute to conduct high-definition digital aerial surveys of the	12 flights total, conducted monthly. April 2023 through March 2024, with possible extension	Flights from Plymouth, MA	Fixed-wing aircraft	High-resolution digital video cameras mounted on a fixed-wing aircraft flying at an altitude of approximately 1,312 feet (400 meters) and

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	Research Lease Area to sample and map seasonal occurrence and activity of birds, bats, marine mammals, sea turtles, and large fish. Surveys would focus on birds and document the number of individuals, distribution, behaviors (e.g., foraging, flying, resting), and flight height and direction (if applicable). Four surveys would be extensions to BOEM's quarterly bird surveys; there would be eight standalone surveys.	through March 2025.			ground speed of approximately 137 mph (220 kph or 120 knots), providing imagery at 0.6-inch (1.5-centimeter) ground sample distance. Initially, surveys would cover the entire RFCI area, but may be reduced to cover the Research Lease Area plus a 2.5-mile (4-km) buffer.
Visual Wildlife Surveys	Biodiversity Research Institute, in cooperation with the Gulf of Maine Research Institute, would conduct visual surveys along fixed transects to confirm marine mammal, bird, and sea turtle species utilization of the Research Lease Area, with emphasis on endangered and threatened species. The surveys would also assess information variability and uncertainty associated with baseline surveys. All observers would document species ID, location, group size, distance and bearing	Number of trips per month depends on the vessel type, steam time, and port location. Beginning in 2023 and continuing until approval of the RAP.[4]	Undetermined. Portland, ME assumed for analysis.	Depends on contracted industry vessel. Crew boat less than 65 ft (19 m) in length with elevated platform for observations assumed for analysis.	Surveys would be conducted by two bird observers, trained by the Maine Department of Inland Fisheries and Wildlife for protected species and bird observations, and four marine mammal observers, trained as protected species observers. Vessels would follow fixed transects and would not deviate to intercept marine mammals; vessel speed would not exceed 11.5 mph (18.5 kph or 10 knots).

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	from vessel, flight height for birds, and behavior for each sighting as well as sea state, time of day, glare, and fishing activity in the area.				
Passive Acoustic Monitoring of Marine Mammals and Ambient Noise	DMR would conduct passive acoustic monitoring to characterize marine mammal utilization of the Research Lease Area and to quantify levels of ambient noise. The mooring suites would be spaced across the Research Lease Area and vicinity to incorporate into a larger network across the Gulf of Maine used for location and tracking work.	Number of trips needed to deploy and service mooring suites depends on steam time of contracted vessel. Beginning July 2023 and continuing until approval of the RAP.[4]	Boothbay, ME	45-foot (14-meter) research vessel capable of deploying/retrieving sampling equipment at depth.	Acoustic data collected via nine SoundTrap ST600 hydrophones equipped with FPOD devices. Recorded data would be analyzed for all whale calls, especially the presence of North Atlantic right whale calls, with a primary focus on their 100–300-Hertz upcalls. Sound traps would sample at a rate of 48 kHz (24-kHz effective analysis range). FPODs enable detection of odontocete (toothed whale) species with core detection bands generally under 140 kHz.
Motus Tracking	Motus is an international collaborative network established by researchers that has tagged birds and bats with automated radio telemetry tags. A Motus Wildlife Tracking System-compatible receiver station would be deployed on the FLiDAR buoy by PTOW to provide data on the occurrence of tagged birds	Expected to require 2 trips, conducted as part of FLiDAR buoy deployment and decommissioning. 24-month deployment (March 2024 through February 2026).	Portland, ME	See FLiDAR buoy-based acoustic monitoring.	Motus Wildlife Tracking System-compatible receiver station.

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	or bats in the Research Lease Area coupled with information on the season, time of day, and weather conditions. The receiving station would operate at a common frequency compatible with other Motus installations in the region.				
Active Acoustic Surveys and Environmental DNA (eDNA) Sampling of Marine Fish and Invertebrates	Gulf of Maine Research Institute would conduct active acoustic surveys along fixed transects in the Research Lease Area and vicinity to evaluate marine fish, particularly small pelagics, and invertebrate species and taxon abundance and distribution in the water column and in proximity to the benthos.	One 12-hour vessel trip per month. Beginning in September 2022 and continuing until approval of the RAP.[4]	Portland, ME	RV Merlin, a 37-foot (11-meter) converted offshore tuna harpoon vessel.	Simrad EK60 echosounder system with three split-beam transducers (38, 120, and 200 kHz). Water samples collected with a General Oceanics Niskin Water Sampler and run through eDNA analysis would be used to field verify the acoustic data.
Passive Acoustic Monitoring of Large Pelagic and Benthic Fish	DMR opportunistically tags fish with passive acoustic tags to characterize seasonal distribution, movement patterns, and habitat use of highly migratory (e.g., tuna, sharks) and benthic (e.g., cod, hake, haddock, redfish, dogfish) fishes. Pop-up satellite archival tags may be used in future years for longer-range monitoring of larger	The number of trips would depend on the contracted vessel, port location, and number of tags or receivers deployed per trip. Beginning in Quarter 3 of 2022 and continuing until approval of the RAP.[4]	Undetermined. Portland, ME assumed for analysis.	45-foot (14-meter) research vessel capable of deploying/retrieving sampling equipment at depth.	15 VEMCO VR2AR Receivers would be moored with custom weights and floated approximately 50 ft (15 m) above the seafloor to detect tags. Each receiver would be equipped with an acoustic release, eliminating the use of vertical lines that may pose risks to marine mammals and turtles. Pop-up satellite archival tags do not require

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	species such as basking sharks. Receivers capable of detecting the presence of tagged fish would be deployed in a grid across the Research Lease Area with a few additional receivers placed adjacent to the Research Lease Area in areas of high species abundance.				detection by the acoustic array and would pass data via a satellite link at a pre-selected time.
Bottom Trawl Surveys for Marine Fish and Invertebrates	DMR would conduct bottom trawl surveys to evaluate marine fish and invertebrate species composition in proximity to the benthos. Each season, 30–38 tows would be conducted within and up to 12 nm (22 km) outside of the Research Lease Area. Surveys would not be conducted under regular commercial fishing.	1–6 vessel trips per season depending on steam time, port location, and ability of contracted vessel to overnight offshore. Beginning as soon as September 2023 and continuing for 2 years, or until approval of the RAP.[4]	Boothbay, ME	70-foot (21-meter) stern rigged single screw bottom trawler.	Protocols and equipment would be consistent with those used for the Maine-New Hampshire Inshore Trawl Survey for sorting, weighing, and measuring protocols. Net metric data would be collected at each tow to ensure the net is fishing comparably at each location. Survey equipment would consist of a 57–70-foot (17–21-meter) modified shrimp trawl net with Thyborøn™ type 25 THYson trawl doors approximately 21 ft^2 (2 m^2) in size, weighing 606 pounds (275 kg) each, and towed at a speed of 2.9 mph (4.6 kph or 2.5 knots).
Plankton and Larval Lobster Surveys	DMR would conduct vertical and neuston tows to characterize the zooplankton community,	During the first year after lease issuance, 1 or 2 vessel trips per month. In subsequent	Boothbay, ME	45-foot (14-meter) research vessel capable of deploying/retrieving	Vertical tows would follow Fisheries and Oceans Canada's Atlantic Zone Monitoring Program

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	examine aggregation patterns throughout the water column, and quantify abundance and seasonal timing of lobster and other crustacean larvae. Tows would be conducted within and up to 3 nm (5.6 km) outside of the Research Lease Area. Surveys would not be conducted under regular commercial fishing.	years, the port and number of trips per month would depend on contracted vessel. Beginning in July 2023 and continuing until approval of the RAP.[4]		sampling equipment at depth.	protocols. Neuston tows would follow DMR's larval survey protocol. Selection of survey locations would consider seasonal wind patterns in order to establish a baseline to examine potential impacts on stratification downstream from potential future turbine installations.
Lobster Trawl Surveys	DMR would conduct lobster surveys to characterize the lobster population, including the presence of large egg-bearing and oversized lobsters, to assess movement patterns of lobsters, and to test ropeless fishing gear. Traps would be set within and up to 12 nm (22 km) outside the Research Lease Area and hauled three times per quarter. Surveys would not be conducted under regular commercial fishing.	Six trips by 12-hour vessel per quarter. Beginning as soon as September 2023 and continuing for 2 years, or until approval of the RAP.[4]	Bristol, ME	50-foot (15-meter) commercial lobster boat, single screw.	Trawls would be equipped with 12 traps, alternating vented and ventless, and would be set with one regular endline and one ropeless fishing unit. The exact gear specifications would be determined based on conversations with industry members.
Gillnet Surveys	PTOW would conduct gillnet surveys to sample fish populations. Each season, 20–30 trawls would be conducted within	6 vessel trips per quarter. September 2023 through September 2025.	Portland, ME	50–75-foot (15–21-meter) single screw commercial fishing vessel.	The gillnet survey may be conducted using gillnets that are typical of the commercial fishery in Maine. Each gillnet string

Survey or Monitoring Activity	Description	Activity Frequency and Timing	Port	Vessel Type	Equipment or Method
	and around the Research Lease Area. Surveys would not be conducted under regular commercial fishing.				would consist of six, 300-foot (91-meter) net panels of 12-inch (30-centimeter) mesh with a hanging ratio of 1/2 (50%) and using net tie-downs.[6]

Sources: DMR, 2023a; Stantec, 2023.
[1] Avian and bat acoustic detectors, as well as a marine mammal hydrophone and fish detection system, would be installed on the FLiDAR buoy prior to deployment. The acoustic detectors and hydrophone will collect data on species (or species group) occurrence. It is currently anticipated that the avian and bat acoustic detectors would be Wildlife Acoustics SM4 units, a SonoVault hydrophone would be used for acoustic monitoring of marine mammal vocalizations, and a VEMCO Positioning system would be used to monitor fish.
[2] All vessels would have protected species observers onboard to monitor for impacts on marine mammals and wildlife.
[3] Avian and bat acoustic detectors may be installed on survey vessels to opportunistically collect seasonal bat activity data within the G&G survey areas, including species occurrence, timing of occurrence, and weather conditions (as recorded by instrumentation on the vessel) at the time of recording. The detectors would be powered by internal batteries and mounted as high as possible on the exterior shipboard side of each vessel’s upper deck to enhance bat activity detection and minimize exposure to saltwater and acoustic interference from wave action and other ship operations. It is currently anticipated that the avian and bat acoustic detectors would be Wildlife Acoustics SM4 units.
[4] This EA makes the conservative assumption that the RAP would be approved within 5 years of lease issuance, or approximately September 2028.
[5] Installation of shore-based radar stations would occur independent from the Proposed Action. Potential effects of these onshore activities are not analyzed in this EA.
[6] After discussion with interested parties, a decision was made to limit the gillnet survey to a single mesh size of 12-inches (30 centimeters) to target monkfish and skates of commercial sizes. While it was recognized that deploying experimental gillnets with multiple mesh sizes could potentially sample a wider range of species and size classes, this would also necessitate deploying more strings of gillnets, which could increase the potential for interactions with protected species. The standard soak time of approximately 48 hours is proposed based on input from industry, to maximize catch and standardize catch rates, while also ensuring the gear fishes properly during the soak (i.e., not collapsed from saturation), to minimize depredation of catch, and to improve the logistics of the survey. Soak time would remain consistent throughout the duration of the survey, to the extent practicable. fishable gillnet lines will be determined through consultation with the participating fishermen. Ten to fifteen gillnet lines per area will be randomly selected for each sampling event, resulting in 20 to 30 gillnet strings conducted per sampling event. The sample size, location, and timing of sampling events are subject to change to reduce the potential for interactions with protected species and avoid space-use conflicts with active fisheries.
DMR = Maine Department of Marine Resources; FLiDAR = floating light detection and ranging; ft^2 = square foot; kg = kilogram; kHz = kilohertz; km = kilometer; kph = kilometers per hour; m^2 = square meter; MA = Massachusetts, ME = Maine; mph = miles per hour; nm = nautical mile; PTOW = Pine Tree Offshore Wind

2.3 Non-routine Events

Reasonably foreseeable non-routine and low-probability events and hazards that could occur during site characterization and site assessment related activities include the following: (1) severe storms, such as hurricanes and extratropical cyclones; (2) allisions and collisions between structures or vessels used for site assessment or site characterization activities and other marine vessels or marine life; (3) spills from collisions or fuel spills resulting from generator refueling; and (4) recovery of lost survey equipment.

Impacts on the Proposed Action from storms, allisions and collisions, and spills have been previously described and analyzed in other relevant EAs (**Table 2-2**). Although these previous documents do not specifically address the Gulf of Maine area, the assessment of potential impacts presented in those documents applies equally to the Proposed Action as the risks of these events are not materially different in the Gulf of Maine. Accordingly, the potential impacts from non-routine events are described in those EAs and are briefly described below but not analyzed in detail.

Table 2-2. Relevant existing NEPA and consulting documents

Reference	Link
Avanti Corporation, Industrial Economics, Inc. 2019. National Environmental Policy Act documentation for impact-producing factors in the offshore wind cumulative impacts scenario on the North Atlantic continental shelf. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management. 201 p. Report No.: OCS Study BOEM 2019-036.	https://www.boem.gov/sites/default/files/environmental-stewardship/Environmental-Studies/Renewable-Energy/IPFs-in-the-Offshore-Wind-Cumulative-Impacts-Scenario-on-the-N-OCS.pdf
MMS (Minerals Management Service). 2007. Programmatic environmental impact statement for alternative energy development and production and alternate use of facilities on the Outer Continental Shelf. Final environmental impact statement. Herndon (VA): U.S. Department of the Interior, Minerals Management Service. 4 vols. Report No.: OCS EIS/EA MMS 2007-046.	https://www.boem.gov/renewable-energy/guide-ocs-alternative-energy-final-programmatic-environmental-impact-statement-eis
BOEM (Bureau of Ocean Energy Management). 2021. Project design criteria and best management practices for protected species associated with offshore wind data collection. Sterling (VA): U.S. Department of the Interior, Bureau of Ocean Energy Management, Office of Renewable Energy Programs, Atlantic OCS Region. 18 p.	https://www.boem.gov/sites/default/files/documents//PDCs%20and%20BMPs%20for%20Atlantic%20Data%20Collection%2011222021.pdf
BOEM (Bureau of Ocean Energy Management). 2022. Decision Memorandum. Gulf of Maine Request for Competitive Interest (RFCI). Washington (DC): U.S. Department of the Interior, Bureau of Ocean Energy Management.	https://www.boem.gov/renewable-energy/state-activities/gome-rfci-decision-memo

2.3.1 Storms

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

2.3.2 Allisions and Collisions

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

As explained in BOEM’s decision memorandum regarding the RFCI on August 17, 2022, in order to minimize the potential for conflicts identified by USCG in locating Maine’s proposed project in proximity to the existing TSS, BOEM will consider issuance of no more than one lease within the Research Lease Area, and that lease will neither exceed 10,000 acres (40 km^2) nor support more than 12 floating wind turbine generators. BOEM also expanded the RFCI or Research Lease Area beyond the preferred location (referred to as the Narrowed Area of Interest) identified in the State of Maine’s request for the research lease to provide more siting options should the preferred location be determined unsuitable. These measures are anticipated to minimize the potential for conflicts during all stages of the project, including site assessment and site characterization activities, which would result in only a temporary and negligible increase in vessel traffic in proximity to the TSSs.

2.3.3 Spills

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

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

Vessels are expected to comply with U.S. Coast Guard (USCG) requirements relating to prevention and control of oil spills, and most equipment on the FLiDAR buoys would be powered by batteries charged by small wind turbines and solar panels. BOEM expects that each of the vessels involved with site characterization and site assessment activities would minimize the potential for a release of oils and/or chemicals in accordance with 33 CFR part 151, 33 CFR Part 154, and 33 CFR Part 155, which contain guidelines for implementation and enforcement of vessel response plans, facility response plans, and shipboard oil pollution emergency plans. Based on the size of the spill, it would be expected to dissipate very rapidly and would then evaporate and biodegrade within a day or two (at most), limiting the potential impacts to a localized area for a short duration

2.3.4 Recovery of Lost Survey Equipment

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

Marine debris, such as lost survey equipment, that is not able to be retrieved because it is either small or buoyant enough to be carried away by currents or is completely or partially embedded in the seafloor (for example, a broken vibracore rod) could create a potential hazard for bottom-tending fishing gear or cause additional bottom disturbance. A broken vibracore rod that cannot be retrieved may need to be cut and capped 3.3 to 6.6 ft (1 to 2 m) below the seafloor. For the recovery of marine debris, BOEM will work with the lessee/operator to develop a recovery plan as described in the NMFS Programmatic Endangered Species Act (ESA) consultation for data collection activities (Anderson 2021). Selection of a mitigation strategy would depend on the nature of the lost equipment, and further consultation may be necessary.

Impact-producing factors (IPFs) associated with recovery of marine debris such as lost survey equipment may include vessel traffic, noise and lighting, and routine vessel discharges from a single vessel. Recovery operations may also cause bottom disturbance and habitat degradation.

3 Existing Environment

The affected environment includes the Research Lease Area as well as potential benthic survey areas in nearshore and estuarine waters along the Maine coast between the Research Lease Area and the shoreline. From tidal areas to roughly 9 nautical miles (nm) (16.7 km) at water depths of approximately 295 feet (90 meters) the sediment is rocky with sand and gravel deposits, including the Kennebec paleo-delta. Muddy sediment deposits are also observed over large areas. High-relief features exist beyond 9 nm (16.7 km) (Burgess, 2022). Water within the GAA reaches depths of approximately 5,000 feet (1,524 meters) along the southeastern edge (University of New Hampshire, 2023). The predominant sediment type within the Research Lease Area is silt (0.002–0.06 millimeters). This area is generally flat with depressions and slopes, with water depths ranging from 518–620 feet (158–189 meters) (Pentony, 2022).

3.1 Water Quality

A contaminant is defined as any foreign, undesirable physical, chemical, or biological substance in the environment, and includes anything from sawdust to nutrients, suspended solids, pesticides, and industrial chemicals. It has been estimated that 100 to 500 thousand chemicals are now in regular industrial use and most have the potential to enter the marine environment through a variety of sources.

Beginning in the late 1700s, the rivers, estuaries and marine waters of the Gulf of Maine watershed were used to transport logs, harvest fish and power sawmills. As the population of the region increased and other industries developed, they were used as waste dumps for a wide range of activities including logging operations, sawmills, fish processing plants, private septic systems, municipal sewage plants, pulp mills, agricultural drainage and aquaculture operations. Growth in coastal populations around the Gulf of Maine, increased development, and changes in land use have all contributed towards increased contaminant levels in coastal waters in the region. There are about 2,024 active point sources of contaminants in the region, of which 378 are wastewater treatment plants and 93 are power plants.

The Gulf of Maine Council on the Marine Environment has identified sewage, nutrients and mercury as the three contaminant problems of the greatest concern for the Gulf of Maine region. In addition, there is a concern that microbial pathogens (bacteria, viruses and protozoa) may cause human diseases from exposure to contaminated shellfish and water.

Gulfwatch is a chemical contaminants monitoring program organized and administered by the Gulf of Maine Council. Since 1993, Gulfwatch has measured contaminants in blue mussels (*Mytilus edulis*) to assess the types and concentration of contaminants in coastal waters of the Gulf of Maine. It is one of the few monitoring programs and the only one in the Gulf of Maine to be coordinated across international borders (Gulf of Maine Association 2023).

The Main Department of Environmental Protection, Marine Environmental Monitoring Program (MEMP) was established in 1991 to monitor the “extent and effect of industrial contaminants and pollutants on marine and estuarine ecosystems and to determine compliance with and attainment of water quality standards". Monitoring efforts are focused on ambient water quality, nutrients, and eutrophication indicators, in particular near wastewater discharges.

3.2 Benthic Resources

The Gulf of Maine is partitioned into several regions, distinguished by depth, geologic features, and oceanographic patterns. The Bay of Fundy in the very northern region is known to have the highest tidal flux worldwide, ranging up to a maximum mean height of 52.5 ft (16 m) in the inner reaches of the bay (East Coast Aquatics 2011). While the southern region including Georges Bank has the highest fish diversity and is one of the most productive fishing areas in the northwest Atlantic Ocean (Incze et al. 2010). Other named features include Cashes Ledge, Jeffreys Ledge, Wilkinson Basin, Jordan Basin, and Platts Bank (Petony 2022). The Gulf of Maine consists of numerous deep basins, deep channels, and shallow banks, as remnants from glacial deposition and erosion. These deep channel habitats include the Northeast and Great South Channels. The inflow of water from the Northeast Channel and the outflow of the Great South Channel creates a large counterclockwise eddy (Burgess 2022). This counterclockwise gyre meets with the clockwise gyre over Georges Bank and creates among the most variable water temperatures in the North Atlantic Ocean year to year (East Coast Aquatics 2011). The benthic features enable the flow of colder waters from the north and promote strong stratification patterns. According to the 2023 state of the Ecosystem report, seasonal sea surface temperatures in 2022 were above average throughout the year, with some seasons exceeding the record warm temperatures observed in 2012 (NOAA Fisheries 2023a). This instability in the Gulf Stream may lead to alterations of biological cycles and seasonal movement patterns (NOAA Fisheries 2023a).

The affected environment includes the Proposed Research Lease Area as well as nearshore and estuarine waters along the Maine coast (**Figure 4-1**). From tidal areas to roughly 9 nmi (17 km) (295 ft [90 m] in water depth) the sediment is rocky with sand and gravel deposits, including the Kennebec paleo-delta. Muddy sediment deposits are also observed over large areas. High relief features exist beyond the 9 nmi (17 km) (Burgess 2022). The predominant sediment type within the Research Lease Area is silt (0.002 to 0.06 mm). This area is generally flat with depressions and slopes, with water depths ranging from 518 to 620 ft (158 to 189 m) (Petony 2022).

The habitats within the Research Lease Area may also support deep-sea corals and sponges. Unlike shallow-water corals which require sunlight, deep-sea corals and sponges are suspension-feeders that rely on planktonic and organic matter to obtain their energy. Octocorals, including sea pens, are common in colder and deeper waters. In 2014, octocoral garden communities were discovered in the northern Gulf of Maine in water depths of 200 to 250 meters (Auster et al. 2013, 2015; NOAA Fisheries 2018). Dense aggregations of one or more species of deep-sea octocorals are referred to as coral gardens (Fountain et al., 2019). Many coral species function as ecosystem engineers and provide habitat for many other species, including juvenile fish. Recent surveys allude to the fact that coral presence may be higher than expected, despite benthic disturbance from nearby fishing activities such as bottom-trawling and dragging. NOAA’s Deep-Sea Coral Research and Technology Program compiles a national database of the known Locations of deep-sea corals and sponges in U.S. waters (NOAA 2023; Hourigan et al. 2015), however, there is currently no information available on the presence or absence of these features within the Research Lease Area (Pentony 2022).The Maine Coastal Mapping Initiative routinely conducts surveys within the Gulf of Maine including Casco Bay, particularly since 2015 (Benson and Enterline 2021; Dobbs 2017). The surveys conducted in 2015 and 2016 encompassed or were nearby to the Proposed Research Lease Area (Kennebec paleo-delta) and covered approximately 57 mi^2 (148 km^2) of the seafloor, along with benthic samples at 54 locations (Dobbs 2017). Dobbs (2017) found that sand was the most common sediment type found, with 83 percent of the samples containing more than 20 percent sand and 51 percent predominantly sand, according to Folk classifications. The samples nearshore at a depth of 164 ft (50 m) or less generally had the greatest sand concentration (Dobbs 2017). Gravel-sized particles were also common in the southern and eastern regions of the survey area in depths ranging from 98 to164 ft (30 to 50 m) and comprised an average of 11 percent by weight in all the samples (Dobbs 2017).

Nearshore habitats include shallow water estuaries and bays which are mostly soft bottom sediments but also include shellfish beds and submerged aquatic vegetation. These various habitats provide food and shelter for high trophic species and boost local biodiversity, while also serving as nursery grounds for local fish species (Stevenson et al. 2014; Kritzer et al. 2016). Stevenson et al. (2014) evaluated the importance of these nearshore habitats for 16 of the most common commercially important species and their prey. Their analysis showed that sand and gravel/cobble habitats are used by the majority of species and life stages, followed by mud, eelgrass, macroalgae, boulder, salt marsh channels, and shell (mussel) beds. Shallow water habitats in the Gulf of Maine provide valuable ecological services for a variety of species. Mud, gravel/cobble, and vegetated habitats are particularly important as juvenile nursery grounds for species such as Atlantic cod (*Gadus morhua*), American lobster (*Homarus americanus*), winter flounder (*Pseudopleuronectes americanus*), soft-shell clams (*Mya arenaria*), and blue mussels (*Mytilus edulis*) (Stevenson et al. 2014). The lobster fishery, dominant in value, license and impact of Maine coastal communities generally targets areas of high seafloor complexity, and transition habitats or edge environments (Burgess 2022). Juvenile lobsters are common in shallow waters, while adults can be found in habitats as deep as 2,297 ft (700 m), where they are not as dependent on sheltering from predators (Stevenson et al. 2014).

Mussel beds are found in the upper sub-tidal to intertidal coastal zones along the Maine coastline. Beginning from an attachment to a patch of hard substrate or eelgrass, the conspecific aggregations begin to grow as they attach to each other, forming a reef. Oysters (*Crassostrea virginica*) also attach to hard substrates but are not common in the Gulf of Maine (Stevenson et al. 2014). Atlantic sea scallops (*Placopecten magellanicus*), another highly profitable commercial species, are generally found in deeper waters (Fitzgerald 2021).

Eelgrass (*Zostera marina*), the most common species of eelgrass in the Gulf of Maine, takes root in a range of substrates. Most frequently found in mud to coarse sand, eelgrass can even thrive in cobble and boulder habitats as long as there are ample light conditions (Stevenson et al. 2014). Eelgrass, which is typically found in water depths from 3.3 to 26 ft (1 to 8 m), well outside of the depth range of the Research Lease Area and therefore is not expected to be present in the Research Lease Area but could be present in shallow waters along potential export cable routes. Macroalgae are also an important resource to the local food web. Hard bottom macroalgal habitats composed of smaller brown algae (e.g., *Fucus* spp. And *Ascophyllum nodosum*), red algae (e.g., *Phyllophora* spp.) in the intertidal and sub-tidal zones, and kelp beds composed of brown algae (e.g., *Laminaria saccharina*, *Alaria esculenta*, and *Agarum clathratum*).

Based on the Census of Marine Life findings, there are approximately 2,645 named species of invertebrates in the Gulf of Maine (Incze et al. 2010). This includes several managed invertebrate species such as the northern shortfin squid, longfin inshore squid, and Atlantic sea scallop. Many more invertebrates, such as shrimps, crabs, amphipods, gastropods, and polychaete worms, are not managed but contribute to food webs from offshore or nearshore ecosystems (Malek et al. 2016). The habitats within the Research Lease Area may also support deep-sea corals, however there is currently no information available on the presence or absence of these features (Petony 2022).

Benthic resources are subject to pressure from ongoing activities and conditions, especially climate change, commercial fishing using bottom-tending gear (e.g., dredges, bottom trawls, traps/pots), and sediment dredging for navigation. These routine activities are expected to continue for the foreseeable future and would impact benthic habitats and the community composition.

3.3 Finfish, Invertebrates, and EFH

The affected environment encompasses coastal (marine and estuarine) and demersal and pelagic habitats in the open ocean that provides habitat for over 118 finfish families consisting of 252 species (Collette and Klein-MacPhee, Eds. 2002), and 2,645 named invertebrate species (Incze et al. 2010). This estimate of finfish is limited to a 902 ft (275 m) bathymetric contour initially set by Bigelow and Schroder (1953).

A general description of the affected environment for the Gulf of Maine is provided in the GAA description in **Section 2.1**. Many finfish and invertebrate species found in the Gulf of Maine are important due to their value as commercial and recreational fisheries.

Several managed invertebrate species occur in the Gulf of Maine, including American lobster, ocean quahogs, northern shortfin squid, longfin inshore squid, Atlantic sea scallop, red crab, and Jonah crab. Other invertebrates, such as copepods, krill, amphipods, isopods, ostracods, mysid shrimp, and unclassified mollusks are managed under the Mid-Atlantic Fishery Management Council's 2016 Unmanaged Forage Species Omnibus Amendment (MAFMC 2017). These managed invertebrate species are important components of the food webs within the offshore and nearshore ecosystems (Malek et al. 2016).

EFH for fish and shellfish resources of the Gulf of Maine Research Lease Area were characterized using broad ecological/habitat categories: soft bottom, hard bottom, and pelagic. The offshore analysis area primarily includes EFH for soft bottom species (Atlantic sea scallop, inshore squid, offshore squids, bluefish, hakes, skates, cod, and flatfishes) and several highly migratory species such as tunas, and sharks. Habitat Areas of Particular Concern (HAPC) within the Gulf of Maine include Jeffreys & Stellwagen Bank HAPC, inshore juvenile cod (less than 66 ft [20 m] depths); and summer flounder submerged aquatic vegetation nursery areas and the Sand Tiger shark (Plymouth, Tuxbury, Kingston Bay) HAPC (**Figure 4-1**). The designated HAPC for Sand Tiger shark is at the very southern tip of the GAA (Plymouth, Massachusetts; **Figure 4-1**). The NOAA designated HAPC for inshore juvenile cod is located throughout the Gulf of Maine (**Figure 4-1**). The habitat for juvenile cod includes structurally complex, i.e., eel grass, algae, rocky benthic habitat and contiguous sandy habitats between intertidal areas and the 20-m bathymetric contour throughout the GAA. HAPC for summer flounder is additionally found throughout the Gulf of Maine and includes native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH. In locations where native seagrass and macroalgae species have been eliminated from an area, exotic aquatic plant species are included (NOAA Fisheries 2023b). Within the Gulf of Maine and the GAA, New England Fishery Management Council (NEFMC) and NOAA Fisheries have designated multiple Habitat Management Areas (HMAs). The closest HMAs shown on **Figure 4-1** are the Jeffreys Bank to the east and Cashes Ledge Groundfish Closure area south of the GAA. As depicted on **Figure 4-1**, the GAA is not within any of these designated HMAs. The only potential impacts on HMAs would be in the Gulf of Maine Cod Protection Closure areas. The Cod Protection Closure Areas are sectors of the Gulf of Maine that extend to and encompass the coastal and nearshore areas (NOAA Fisheries, 2022a) The areas are closed during various periods throughout the year to support Atlantic cod recovery efforts.

Estuarine (inshore) portions of the analysis area are characterized mostly by sedimentary, soft bottom but also support salt marshes, oyster reefs, and mussel beds, as well as stands of eelgrass and kelp beds (Stevenson et al. 2014). Fishes segregate into these habitats by species and life stages. Managed species present in inshore waters include squids, cunner, tautog, bluefish, summer flounder, and winter flounder (Stevenson et al. 2014). Many of these species are present as juveniles or subadults. Inshore habitats of the region are productive and support common prey species such as shrimps, bay anchovy, Atlantic herring, Atlantic menhaden, butterfish, killifishes, and Atlantic silversides (Raposa and Schwartz 2009, Lapointe 2013).

Finfish, invertebrates, and EFH in the Gulf of Maine are subject to pressures from ongoing activities, especially harvest, bycatch, dredging and bottom trawling, and climate change (NOAA Fisheries 2023b, Lapointe 2013, Gustavson, 2011). Climate change is also predicted to affect U.S. northeast fishery species (Hare et al. 2016) and the Gulf of Maine particularly; some stocks may increase habitat, and some may see habitat reduced. Dredging for navigation, marine minerals extraction, and/or military uses, as well as commercial fishing using bottom trawls and dredge fishing methods (sea scallops), disturbs seafloor habitat on a recurring basis. Commercial and recreational fishing using other methods results in mortality of finfish and invertebrates through harvest and bycatch. In the most recent ecosystem evaluation for the Gulf of Maine (31 December 2022), no managed species were reported as overfished (NOAA Fisheries 2022b).

4 Designated EFH

EFH is designated for 34 finfish and invertebrate species within the GAA, the potential export cable routes, and coastal habitats (**Appendix A**). Both substrate and water habitats are cited as EFH within both the Research Lease Area and areas where export cables could be routed.

Approximately 252 finfish species (Collette and Klein-MacPhee, Eds. 2002) and approximately 2,645 named invertebrate species (Incze et al. 2010) utilize the coastal (marine and estuarine), demersal and pelagic habitats within the Gulf of Maine. This estimate is limited to a 902 ft (275 m) bathymetric contour initially set by Bigelow and Schroder (1953). Benthic or pelagic EFH has been designated in the Research Lease Area for one or more life stages of the 34 EFH managed species. Species with EFH in the GAA were identified using the NOAA Fisheries EFH Mapper (2023b), NEFMC (2017), MAFMC FMPs, NMFS (2017), and NOAA Fisheries EFH source documents.

4.1 Habitat Areas of Particular Concern (HAPC)

The fishery management councils also identify EFH HAPCs. HAPCs are discrete subsets of EFH that provide important ecological functions or are especially vulnerable to degradation. No designated HAPCs are located within the Research Lease Areas; however, the Juvenile Cod 20-m HAPC and the Summer flounder overlap with potential export cable route and vessel routes to the ports that will support the Research Lease Area within the GAA (**Figure 4-1**). The HAPC for Sand tiger shark is located in the southern extreme area of the GAA located in the Plymouth, Duxbury, Kingston Bay, Massachusetts area (**Figure 4-1**). The potential for the proposed site assessment and characterization activities to impact the Sand tiger shark HAPC is negligible if not unmeasurable.

4.1.1 Atlantic Cod 20-m Juvenile HAPC

The Atlantic Cod 20-m Juvenile HAPC is defined as practically continuous along the coasts of Maine, New Hampshire, and Massachusetts extending from the shoreline to 66 ft (20 m). The HAPC was designated in 2016 through the NEFMC (NEFMC 2017). The designation of this HAPC help protect and preserve complex rocky-bottom habitat that supports a diverse emergent epifauna and benthic invertebrates (NEFMC 2017). This habitats within this depth range provide juvenile cod with protection from predation, and a resource to important prey species. This habitat is not only important for the first year of development for cod but also functions as a nursey habitat for many other groundfish species within the Gulf of Maine (NEFMC 2017).

4.1.2 Summer Flounder HAPC

Summer flounder (*Paralichthys dentatus*) HAPC is defined as all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH. If native species of submerged aquatic vegetation are eliminated, then exotic species such as the common reed (*Phragmites australis*) should be protected because of functional value.

Juvenile and adult summer flounder have both been documented as having a preference for sandy habitats (Timmons 1995; Bigelow and Schroeder 1953; Schwartz 1964; Smith 1969) but are also commonly found in mudflats and seagrass beds within coastal bays and estuaries (Packer et al. 1999; MAFMC 1998; Wyanski 1990). In general, adult and older juveniles can be found in shallow, inshore and estuarine waters during the summer and fall and then move offshore to deeper waters in the winter and spring, although some juveniles will remain in the bays and estuaries for the winter (Packer et al. 1999; Smith and Daiber 1977; Able and Kaiser 1994; Reid et al. 1999). Within the GAA, adults and juveniles may utilize habitats within the potential export cable routes during winter months. Impacts of Project activities on juvenile and adult summer flounder HAPC are analyzed in **Section 5**. Summer flounder HAPC has not been spatially defined by NOAA but includes native species of macroalgae, seagrasses, and freshwater and tidal macrophytes within summer flounder EFH.

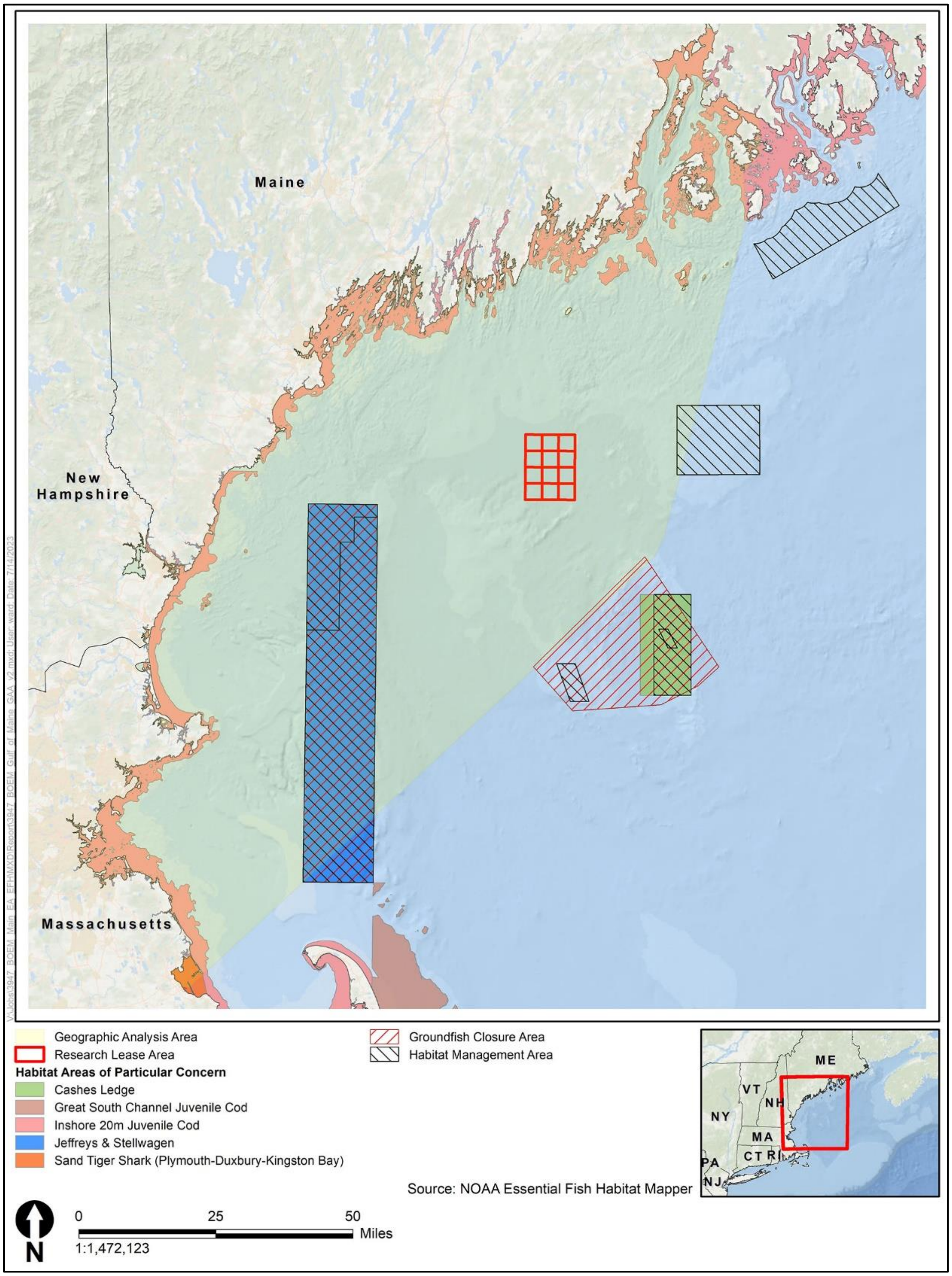

Figure 4-1. HAPCs located within the Geographic Action Area extending from the Isle Au Haut, Maine to Plymouth Bay, Massachusetts

4.2 Species Groups

Species groups are groups of EFH species and life history stages that predominantly share the same habitat type. Benthic/epibenthic species groups are sorted into two habitat types (softbottom or complex) based on the benthic habitat with which the species is most typically associated, with the potential for any species to be found in heterogenous complex as that habitat type could include both softbottom and Complex Habitat.

Prey species are included as species groups because they are consumed by managed fish and invertebrate species as prey, and thus are a component of EFH.

Sessile Benthic/Epibenthic – Softbottom (includes slow-moving benthic/epibenthic species and life stages; could include heterogenous Complex Habitat)

- Atlantic herring – *Clupea harengus* (eggs)
- Atlantic sea scallop – *Placopecten magellanicus* (eggs, larvae, juveniles, adults)
- Longfin inshore squid – *Loligo pealeii* (eggs)
- Skates – Rajidae (eggs)

Mobile Benthic/Epibenthic – Softbottom (could include heterogenous Complex Habitat)

- Monkfish – *Lophius americanus* (eggs, larvae)
- Ocean pout – *Macrozoarces americanus* (eggs, juveniles, adults)
- Red hake – *Urophycis chuss* (juveniles)
- Skates – Rajidae (neonates, juveniles, adults)
- Windowpane flounder – *Scophthalmus aquosus* (juveniles, adults)
- Witch flounder – *Glyptocephalus cynoglossus* (juveniles, adults)

Sessile Benthic/Epibenthic – Complex Habitat (includes slow-moving species and life stages; could include heterogenous Complex Habitat)

- Longfin inshore squid (*Loligo pealeii*) (egg mops, adults)
- Skates – Rajidae (eggs)

Mobile Benthic/Epibenthic – Complex Habitat (could include heterogenous Complex Habitat)

- American plaice – *Hippoglossoides platessoides* (adults)
- Atlantic cod – *Gadus morhua* (eggs, larvae, juveniles, adults)
- Atlantic herring – *Clupea harengus* (juveniles, adults)
- Barndoor skate – *Dipturus laevis*
- Haddock – *Melanogrammus aeglefinus* (juveniles, adults)
- Little skate – *Leucoraja erinacea* (juveniles, adults)
- Pollock – *Pollachius virens* (juveniles, adults)
- Red hake – *Urophycis chuss* (juveniles, adults)
- Silver hake – *Merluccius bilinearis* (juveniles, adults)

- Smooth dogfish – *Mustelus canis* (juveniles, adults)
- Spiny dogfish *Squalus acanthias* (juveniles, adults)
- Summer flounder – *Paralichthys dentatus* (eggs, larvae, juveniles, adults)
- Winter skate – *Leucoraja ocellata* (neonates juveniles, adults)
- Winter flounder – *Pseudopleuronectes americanus* (eggs, larvae, juveniles, adults)
- Yellowtail flounder – *Limanda ferruginea* (juveniles, adults)

Pelagic

- American plaice – *Hippoglossoides platessoides* (eggs, larvae, juveniles)
- Atlantic bluefin tuna – *T. thynnus* (eggs, larvae, juveniles, adults)
- Atlantic butterfish – *Peprilus triacanthus* (eggs, larvae, juveniles, adults)
- Atlantic herring – *Clupea harengus* (larvae, juveniles, adults)
- Atlantic mackerel – *Scomber scombrus* (eggs, larvae, juveniles, adults)
- Basking shark – *Cetorhinus maximus* (juveniles, adults)
- Bluefish – *Pomatomus saltatrix* (eggs, larvae, juveniles, adults)
- Blue shark – *Prionace glauca* (juveniles, adults)
- Common thresher shark – *Alopias vulpinus* (juveniles, adults)
- Haddock – *Melanogrammus aeglefinus* (eggs, larvae, juveniles, adults)
- Longfin inshore squid – *Loligo pealeii* (larvae, juveniles, adults)
- Pollock – *Pollachius virens* (eggs, larvae)
- Porbeagle shark – *Lamna nasus* (neonates, juveniles, adults)
- Red hake – *Urophycis chuss* (eggs)
- Windowpane flounder – *Scophthalmus aquosus* (eggs, larvae)
- Witch flounder – *Glyptocephalus cynoglossus* (eggs, larvae)
- White hake – *Urophycis tenuis* (eggs, larvae, juveniles, adults)

Prey Species – Benthic/Epibenthic

- Bivalves such as blue mussel (*Mytilus edulis)*, eastern oyster (*Crassostrea virginica*), hard clams (*Mercenaria mercenaria*), soft-shell clams (*Mya arenaria*)
- Annelid worms
- Crustaceans – e.g., amphipods, shrimps, crabs

Prey Species – Pelagic

- Anchovy, bay (*Anchoa mitchilli*) and striped (*A. hepsetus*)
- River herring (alewife [*Alosa pseudoharengus*], blueback herring [*A. aestivalis*], American shad [*Alosa sapidissima*])

- Sand lance (*Ammodytes americanus*)

4.3 NOAA Trust Resources

The Atlantic States Marine Fisheries Commission, in cooperation with the states and NOAA Fisheries, manages more than 19 fish and invertebrate species separately from the MSA; many of these species are also identified as NOAA Trust Resources. Of these species, activity related to the Proposed Action may potentially affect those listed in **Table 4-1**.

NOAA Trust Resources have also been identified within the Action Area and potential export cable routes. These resources are summarized in **Table 4-1** and discussed in detail in **Section 7**, *NOAA Trust Resource Species*.

Table 4-1. NOAA Trust Resources within the Action Area

Species	Scientific Name	Life Stage Within the Geographic Action Area			
		Egg	Larvae	Juvenile	Adult
American eel	*Anguilla rostrata*		●	●	●
American shad	*A. sapidissima*			●	●
Atlantic croaker	*Micropogonias undulatus*	●	●	●	●
Blue crab	*Callinectes sapidus*	●	●	●	●
Bobtail squid	*Sepiolidae* spp.	●	●	●	●
Forage species (Atlantic menhaden, bay anchovy)	*Brevoortia tyrannus, Anchoa mitchilli*		●	●	●
River herring (alewife, blueback herring)	*Alosa pseudoharengus, A. aestivalis*			●	●
Sand lance	*Ammodytes americanus, A. dubius*	●	●	●	●
Spotted hake	*Urophycis regia*	●	●	●	●
Striped bass	*Morone saxatilis*			●	●
Tautog	*Tautoga onitis*			●	●
American shad	*Alosa sapidissima*				
American red lobster	*Homarus americanus*	●	●	●	●
Bivalves (eastern oyster, blue mussel, soft-shell clam, northern quahog)	*Crassostrea virginica*, *Mytilus edulis,* *Mya arenaria* *Mercenaria mercenaria*	●	●	●	●

5 Adverse Effects

This EFH Assessment analyzes the effects of routine activities associated with assessment activities on the lease and site characterization activities (**Table 2-1**) on the lease and potential project easements within the Proposed Action area and the wider GAA where applicable as defined in **Section 2.1**. It does not consider construction and operation of any wind energy facilities on the research lease, which would be evaluated separately if a lessee submits a RAP.

The Project area encompasses the impacts resulting from the Proposed Action area wind energy research lease and associated potential project easements within an approximately 68,320-acre (276-km^2) area in the OCS in the Gulf of Maine (Research Lease Area). The potential project easements would all be located within the Gulf of Maine and include corridors that extend from the lease area to the onshore energy grid. Potential adverse effects on EFH may include noise, light seafloor disturbance, entanglement, routine vessel discharges, and vessel traffic and space-use conflicts used by EFH-designated species during specific life stages, and their habitat. If a Project component is likely to result in a short-term (less than 2 years), long-term (2 years to < life of Project), or permanent (life of Project) impairment of designated EFH or HAPC for a managed species and life stage, this would constitute an adverse effect on EFH.

The following sections present and outline the conceivable impacts of the Proposed Action on EFH during site assessment and characterization and decommissioning of the Proposed wind energy research lease and associated potential project easements. Temporal classifications of impacts include short-term (less than 2 years), long-term (2 years to < life of the Project), or permanent (life of the Project) effects.

5.1 Site Assessment Activities

5.1.1 Noise

5.1.1.1 Background on Fish and Invertebrate Hearing

Many fishes and invertebrates produce sounds for basic biological functions like attracting a mate and defending territory. A recent study revealed that sound production in fishes has evolved at least 33 times throughout evolutionary time, and that most ray-finned fishes are likely capable of producing sounds (Rice et al. 2022). Fish may produce sounds through a variety of mechanisms, such as vibrating muscles near the swim bladder, rubbing parts of their skeleton together, or snapping their pectoral fin tendons (Ladich and Bass 2011; Rice et al. 2022). Marine invertebrates have been documented producing sounds ranging from the ubiquitous snapping shrimp “snaps” (Johnson et al. 1947) to spiny lobster “rasps” (Patek 2002) to mantis shrimp “rumbles” (Staaterman et al. 2011). Some sounds are also produced as a byproduct of other activities, such as the scraping sound of urchins feeding (Radford et al. 2008a) and even a “coughing” sound made when scallops open and close their shells (Di Iorio et al. 2012).

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

2013, 2015; Montgomery 2006; Radford et al. 2007; Simpson et al. 2005; Vermeij et al. 2010) or to induce molting into their juvenile forms (Stanley et al. 2015).

All fish and invertebrates are capable of sensing the particle motion component of underwater sound. The inner ear of fishes is similar to that of all vertebrates. Each ear has three otolithic end organs, which contain a sensory epithelium lined with hair cells, as well as a dense structure called an otolith (Popper et al. 2021). Particle motion is the displacement, or back and forth motion, of water molecules and as it moves the body of the fish (which has a density similar to seawater), the denser otoliths lag behind, creating a shearing force on the hair cells which sends a signal to the brain via the auditory nerve (Fay and Popper 2000). Many invertebrates have dense structures know as statoliths, which sit within a body of hair cells, and when the animal is moved by particle motion, it results in a shearing force on the hair cells, similar to that described for fish (Budelmann 1992; Mooney et al. 2010). Some invertebrates also have sensory hairs on the exterior of their bodies, allowing them to sense changes in the particle motion field around them (Budelmann 1992); the lateral line in fishes plays a similar role in fish hearing (McCormick 2011). Available research shows that the primary hearing range of most particle-motion sensitive organisms is below 1 kHz (Popper et al. 2021).

In addition to particle motion detection shared across all fishes, some species are also capable of detecting the pressure component of underwater sound (Fay and Popper 2000). Special adaptations of the swim bladder in these species (e.g., anterior projections, additional gas bubbles, or bony parts) bring it in close proximity to the ear, and as the swim bladder expands and contracts, pressure signals are radiated within the body of the fish making their way to the ear in the form of particle motion (Popper et al. 2021). These species can typically detect a broader range of acoustic frequencies (up to 3 to 4 kHz; Wiernicki et al. 2020); and are therefore considered to be more sensitive to underwater sound than those that can only detect particle motion. Hearing sensitivity in fishes is generally considered to fall along a spectrum: the least-sensitive (sometimes called "hearing generalists") are those that do not possess a swim bladder and only detect sound through particle motion, limiting their range to sounds below 1 kHz, while the most sensitive ("hearing specialists") possess specialized structures enabling pressure detection which expands their detection frequency range (Popper et al. 2021). A few species in the herring family can detect ultrasonic (>20 kHz) sounds (Mann et al. 2001), but this is considered very rare among the bony fishes. Another important distinction for species that do possess swim bladders is whether it is open or closed; species with open swim bladders can release pressure through a connection to the gut, while those with closed swim bladders can only release pressure very slowly, making them more prone to injury when experiencing rapid changes in pressure (Popper et al. 2019). It should also be noted that hearing sensitivity can change with age; in some species like black sea bass, the closer proximity between the ear and the swim bladder in smaller fish can mean that younger individuals are more sensitive to sound than older fish (Stanley et al. 2020). In other species, hearing sensitivity seems to improve with age (Kenyon 1996).

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

5.1.1.2 Effects of Noise from Site Assessment Vessel Activities

As described in **Section 2.2**, the only site assessment activities which would produce noise that could have potential adverse effects on fish, invertebrates, and EFH are the vessel transits. As outlined **Sections 5.2.1** and **5.2.6**, a total of four vessel trips is proposed in support of the site assessment activities in the proposed Research Lease Area. Vessel traffic and resultant noise-related impacts are not generally attributed as a compounding factor for noise impacts on the EFH of managed species. The cavitation of vessel propellors produces low-frequency, nearly continuous sound that is audible by most fishes and invertebrates and could mask important auditory cues, including conspecific communication (Haver et al. 2021; Parsons et al. 2021). Stanley et al. (2017) demonstrated that the communication range of both haddock and cod (species with swim bladders but lacking connections to the ear) would be significantly reduced in the presence of vessel noise, which is frequent in their habitat in Cape Cod Bay. Generally speaking, species that are sensitive to acoustic pressure would experience masking at greater distances than those only sensitive to particle motion. Rogers et al. (2021) and Stanley et al. (2017) theorize that fish may be able to use the directional nature of particle motion to extract meaning from short-range cues (e.g., other fish vocalizations) even in the presence of distant noise from vessels.

Avoidance of vessels and vessel noise has been observed in several pelagic, schooling fishes, including Atlantic herring (Vabø et al. 2002), Atlantic cod (Handegard 2003) and others (De Robertis and Handegard 2013). Fish may dive toward the seafloor, move horizontally out of the vessel's path, or disperse from their school (De Robertis and Handegard 2013). These types of changes in schooling behavior could render individual fish more vulnerable to predation but are unlikely to have population-level effects. A body of recent work has documented other, more subtle behaviors in response to vessel noise, but has focused solely on tropical reef-dwelling fish. For example, damselfish antipredator responses (Ferrari et al. 2018; Simpson et al. 2016) and boldness (Holmes et al. 2017) seem to decrease in the presence of vessel noise, while nest-guarding behaviors seem to increase (Nedelec et al. 2017). There is some evidence of habituation, though: Nedelec et al. (2016) found that domino damselfish increased hiding and ventilation rates after two days of vessel sound playbacks, but responses diminished after one to two weeks, indicating habituation over longer durations. These changes in schooling behavior could render individual fish more vulnerable to predation but are unlikely to have population-level effects.

The limited research on invertebrates' response to vessel noise has yielded inconsistent findings thus far. Some crustaceans seem to increase oxygen consumption (Wale et al. 2013) or show increases in some hemolymph (an invertebrate analog to blood) biomarkers like glucose and heat-shock proteins, which are indicators of stress (Filiciotto et al. 2014). Other species (American lobsters and blue crabs) showed no difference in hemolymph parameters but spent less time handling food, defending food, and initiating fights with competitors (Hudson et al. 2022). While there does seem to be some evidence that certain behaviors and stress biomarkers in invertebrates could be negatively affected by vessel noise, it is difficult to draw conclusions from this work since it is limited to the laboratory, and in most cases, particle motion was not measured as the relevant cue.

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

Simply due to the physical nature of vessel noise, it is unlikely to cause barotrauma or auditory damage in fishes, but could lead to behavioral changes, increased stress, or masking. However, as discussed above, species that are sensitive to sound pressure in addition to particle motion will face a higher risk of behavioral disturbance or masking compared to species who are only sensitive to particle motion. Overall, adverse impacts of vessel noise on fish prey species within EFH are expected to be **indirect** and very **short term**, as vessels noise will be transient and localized in nature. Only a few individuals would be affected at any given time, and they are likely to return to normal behaviors after the vessel has passed through the zone of influence for hearing and particle motion sensing capabilities of a managed species.

5.1.2 Lighting

Light can attract managed species of finfish and invertebrates, potentially affecting distributions in a highly localized area. Light can also disrupt natural cycles such as spawning. Activities related to the operations supporting FLiDAR buoy deployment, operations, maintenance, and decommissioning/removal would result in additional light from vessels and the FLiDAR buoy navigation lights. Downward-directed deck lighting would have a much greater effect than the navigational lights required on vessels or FLiDAR buoy. Vessels would be lit during construction, operations, maintenance and decommissioning and would follow USCG and BOEM lighting guidelines. The impact of lighting from these assessment activities would likely be **indirect, short term,** and mostly unmeasurable in comparison to operations of other vessels within the GAA (commercial and recreational fishing, military operations, or shipping activities). The impacts related to lighting from the vessel and FLiDAR buoy operations would be short term and transitory in nature compared to the number of other vessels operating (commercial and recreational fishing, military operations, or shipping activities) within the GAA.

5.1.3 Seafloor Disturbance

The FLiDAR buoy system will be towed or carried aboard a service vessel to the installation location and either lowered to the surface from the deck of the vessel or placed over the final location where the mooring anchor is dropped (BOEM 2012). The single gravity anchor for the proposed Fugro SEAWATCH Wind FLiDAR buoy is estimated to weigh about 6,000 lb (2,722 kg) and is not expected to exceed a footprint of 32 ft^2 (3 m^2) with some added area related to the anchor chain sweep. The types of impacts likely to occur would result in burial from displaced seabed sediments or crushing impacts on infauna and habitat loss or conversion to an artificial reef substrate (anchor) attracting demersal finfish and invertebrate species. Deployment and removal of the FLiDAR buoy may also cause a punctuated initial increase in local suspended sediments; however, these impacts would be limited to the surrounding area and would be short term in duration. Impacts related to the anchor chain sweep would not be as severe as the anchor but would be repeated throughout the buoy deployment as the anchor chain moves relative to the affect the current regime and wind directions has on the connected buoy. The loss and conversion of the softbottom sand habitat would impact the sensitive life stages of demersal eggs, larvae, and adult life stages of invertebrate managed species such as longfin inshore squid, and Atlantic sea scallop. Managed finfish species that could be affected are neonates for the skates (little skate, smooth skate, winter skate) and flatfish (American plaice, summer flounder, winter flounder, yellowtail flounder). The impact related to anchor installation and presence during the 24-month operation of the FLiDAR buoy systems would be temporary and the seafloor impacted could potentially return to pre-existing conditions without mitigation once the FLiDAR buoy and anchoring system is removed (Dernie et al. 2003). Impacts related to seafloor disturbance would be **direct but minimal** since the seafloor area impacted is very small (32 ft^2 [3 m^2] plus a few square meters of anchor sweep) localized, and **short term**, and would return to pre-existing conditions once the buoy and anchor system are removed.

5.1.4 Entanglement

Entanglement related to site characterization would be associated with an EFH species being wrapped, intertwined, or ensnared with the anchor-line or tackle of the FLiDAR buoy anchor systems. This type of interaction would most likely occur during the initial anchor deployment or during a slack current or tidal ebb event. The potential for this risk is very low but not impossible. The risk for entanglement with an anchor line supporting the FLiDAR buoy anchor systems is directed on marine megafauna such as whales, larger sea turtles, and potentially basking sharks. The potential for a basking shark to become entangled in the FLiDAR buoy anchor line is conceivable but very unlikely and would not result in a population-level effect. The potential for entanglement would result in a **direct adverse impact** but with a very low probability of occurrence. An entanglement impact if it were to occur for the basking shark would be a permanent **adverse impact** and likely would result in a **mortality event** for that individual and nonexistent for other EFH species within the Project Action Area.

5.1.5 Routine Vessel Discharges

Vessels to be utilized for the site assessment activities are required to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and U.S. Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) Vessel General Permit standards, both of which aim to prevent the release of contaminated water discharges. Vessel operations related to the Research Lease Area site assessment is estimated to require four total cruises which will only slightly increase the routine vessel discharges within the project GAA. As such, routine releases from assessment activities related to the Research Lease Area would not be expected to contribute appreciably to overall impacts on EFH; adverse impacts related to the release of contaminated discharges or invasive species on the EFH resources are considered **indirect** and **short term** if not unmeasurable within the GAA.

5.1.6 Vessel Traffic and Space-use Conflicts

The main IPF related to vessel traffic and space-use conflicts for EFH managed species will be the presence and noise related to vessel traffic. The presence and noise produced by the vessels to be utilized during the site assessment will be short in duration and will occur in four separate punctuated short transits to and from port facilities over a 24-month period which includes installation to FLiDAR buoy and later subsequent removal from the Research Lease Area. The increase in vessel traffic is expected to be **indirect** and **short term** if not unmeasurable on the EFH of the managed species within the Research Lease Area and proposed export cable routes.

5.2 Site Characterization Activities

5.2.1 Noise

As described in **Section 2.3**, the site characterization activities which would produce noise that could have potential adverse effects on fish, invertebrates, and EFH include the vessel transits, geotechnical, and HRG surveys.

5.2.1.1 Effects of Noise from Site Characterization Vessel Activities

Based on the available information for the proposed site characterization activities, it is estimated that up to 1,042 separate punctuated cruises will transit to and from port facilities over a 60-month period which includes installation to FLiDAR buoy and later subsequent removal from the Research Lease Area (**Section 2.3**). While the volume of vessel traffic differs from that described for the site assessment vessel activities in **Section 5.2**, the noise levels produced and potential effects on fish, invertebrates, and EFH would be expected to be the same as described in **Section 5.2.2.2**. The proposed 755 vessel transits would occur over a 60-month period, which would equate to approximately 2 or 3 daily vessel transits between the port facilities and the Research Lease Area. Given the non-impulsive nature of this noise source, no injury is likely to occur for any species and the range over which behavioral distances may occur for both sound pressure and particle motion is expected to be relatively small. Additionally, as the vessels would be transiting while in the Project area, animals in proximity to the source would only be exposed for a relatively short duration and would be expected to return to normal behaviors once the vessel has moved out of range. Overall, the **adverse** impacts of vessel noise on fish prey species within EFH are expected to be **indirect and short term**, as they will be transient and localized in nature. Only a few individuals would be affected at any given time, and they are likely to return to normal behaviors after the vessel has passed through the zone of influence for hearing and particle motion sensing capabilities of a managed species.

5.2.1.2 Effects of Noise from Site Characterization Geotechnical Activities

As described in **Section 2.3**, geotechnical surveys for site characterization include the use of piston or vibracores and cone penetration testing which may produce noise at levels which exceed the behavioral disturbance threshold for fishes. Data measured during use of a pneumatic vibracore indicated that this is a non-impulsive, intermittent source with the greatest noise levels at frequencies below 3 kilohertz and a back-calculated source level, expressed as SPL, estimated to be 187 dB re 1 µPa m (Chorney et al. 2011). Simply due to the physical nature of geotechnical equipment noise, it is unlikely to cause barotrauma or auditory damage in fishes, but the estimated source level is above the behavioral disturbance threshold of 150 dB re 1 µPa for fish recommended by the Fisheries Hydroacoustic Working Group (2008) and NMFS (2023), so it could lead to behavioral changes, increased stress, or masking. However, geotechnical surveys would only occur between March and October 2024 (**Section 2.3**) and the relatively short duration of these surveys would lower the risk of effects on behaviors relevant for foraging or spawning and would not be likely to lead to any long-term masking in EFH habitat. Overall, adverse impacts of geotechnical survey noise on fish prey species within EFH are expected to be **indirect** and **short term**, as they will be transient and localized in nature. Only a few individuals would be affected at any given time, and they are likely to return to normal behaviors after the geotechnical surveys have been completed.

5.2.1.3 Effects of Noise from Site Characterization Geophysical Activities

All the geophysical survey equipment used during the proposed geophysical reconnaissance surveys will operate at frequencies >180 kilohertz (**Section 2.3**) so this activity is not likely to adversely affect fish, invertebrates, or EFH in the Project area. However, the proposed HRG surveys will use a parametric SBP system with operational frequencies between 30 and 115 kHz and ultrahigh-resolution imaging equipment which has not been specified at this time but may produce noise in lower frequencies (<5 hertz). However, as discussed in **Section 5.2.2.1**, the broadest range of frequency sensitivity is seen in fish that are able to detect sound pressure (i.e., fish with swim bladders) and their hearing sensitivity only extends up to 3 kilohertz.

Of the sources that may be used during HRG surveys under the Proposed Action, only the ultrahigh-resolution imaging equipment may emit sounds at frequencies that are within the hearing range of most fish (Crocker and Fratantonio 2016; Ruppel et al. 2022). However, though this source is audible for some fishes, it is important to consider other factors such as source level, beamwidth, and duty cycle when assessing the potential risk of adverse effects (Ruppel et al. 2022). Because the source levels for this equipment are currently unknown, it is estimated that they may exceed the threshold for auditory but would be lower than that estimated for boomer and sparker equipment for which the propagated sound field from these sources is very small (Ruppel et al. 2022). Behavioral impacts could occur over slightly larger spatial scales. For example, using the SPL threshold of 150 dB re 1 µPa for behavioral disturbance (Fisheries Hydroacoustic Working Group 2008; NMFS 2023) and spherical spreading loss, equipment with source levels of 190 dB re µPa m would fall below this threshold approximately 328 ft (100 m) from the source. This means that the lowest-powered sparkers, boomers, and bubble guns, which are expected to have higher source levels than the ultrahigh-resolution imaging equipment used for the proposed HRG surveys, would not result in behavioral disturbance beyond approximately 328 ft (100 m) in a deep-water oceanic environment (Crocker and Fratantonio 2016). Additionally, HRG surveys would only be conducted between March and October 2024 so this relatively short duration for these surveys would lower the risk of effects on behaviors relevant for foraging or spawning and would not be likely to lead to any long-term masking in EFH habitat. Overall, adverse impacts of HRG survey noise on fish prey species within EFH are expected to be **indirect** and **short term**, as they will be transient and localized in nature. Only a few individuals would be affected at any given time, and they are likely to return to normal behaviors after the HRG surveys have been completed.

5.2.2 Lighting

Activities related to the site characterization operations would result in additional light from support vessels during the 24-hour operations. The survey vessels would be lit during the nocturnal period of the survey operations and would follow USCG and BOEM lighting guidelines. As summarized in **Section 5.2.3**, the impacts related to lighting from vessels supporting site characterization operations would be **indirect, short term,** and transitory in nature when compared to the number of other vessels operating (commercial and recreational fishing, military operations, or shipping activities) within the GAA. The adverse impacts of lighting from these characterization activities would be **indirect** and **short term** to EFH of managed species within the proposed Research Lease Area and proposed export cable routes.

5.2.3 Seafloor Disturbance

Biological and G&G surveys within the Research Lease and export cable routes will require varying levels of benthic seafloor disturbance to collect the data required to characterize the benthic resources within the proposed Research Lease Area and export cable routes.

Biological sampling methods expected to disrupt the seafloor include benthic grabs (e.g., Hamon grab or Van Veen), sediment profile imagery (SPI), and bottom trawls surveys, (e.g., otter and beam trawls, lobster traps). Benthic grab samplers used for assessing infauna assemblages remove on average about 1.1 ft^2 (0.1 m^2) of the upper 4 to 6 in (10 to 15 cm) of seafloor sediment. The total area of seabed disturbed by infaunal grab sampling efforts (e.g., collection of a core or grab sample) is estimated to range from 11 to 108 ft^2 (1 to 10 m^2) for the Proposed Action. The SPI sampling devices penetrates a slightly smaller area but does not remove or collect any sediment. The SPI frame and camera prism does impact a larger footprint (approximately 16 ft^2 [1.5 m^2]) per image sampling site but no organisms are removed from the site and the SPI camera and frame is only in contact with the seafloor for less than 3 to 10 minutes during image collection per sample site. A similar level of disturbance is to be expected from sampling within the export transmission cable routes. These spatially small disturbed surface areas may temporarily displace bottom feeding demersal EFH finfish or squids (longfin inshore or northern shortfin squid) and may remove or injure individual Atlantic sea scallops. These samples may also remove or injure demersal eggs, such as those deposited by winter flounder, longfin inshore squid, wolffish, or the egg cases deposited by various skate species. Infauna and epifauna that contribute to the prey base for demersal species such as hakes and skates may be affected by bottom sampling. While the biological sampling will result in some benthic disturbance and direct mortality of soft bottom assemblages, the dispersed nature and limited number of these surveys will impact only a small area of available soft bottom habitat with the GAA and are not expected to have adverse effects on EFH of managed species.

The damage to demersal habitats related to bottom trawling, especially repeated trawling over fishing grounds, is well documented (Collie et al. 1997; Mazor et al. 2021). Chains and heavy doors used by bottom trawls dig into the seafloor. Bottom trawl sampling expected for the proposed Gulf of Maine Research Lease is expected to follow the guidelines described by BOEM (2019). For the proposed Research Lease a modified shrimp trawl will be used to assess and characterize the finfish and invertebrate assemblages within the Lease area. Approximately 30 to 38 shrimp trawl tows would be completed each sampling season (spring and fall of each year). The proposed sampling period is proposed to be 2 years, for a total of four surveys. The expected total of tows to be collected would therefore be 152 trawl efforts (38 trawls × 4 surveys). These individual tows would be short duration (less than 20 min), cover small areas of the seafloor (less than 6.04 acres [2.45 ha]), and be spread widely over the Research Lease Area from inshore waters out to the 12 nmi territorial sea limit. The period between each trawl survey would range from 4 to 6 months between May and September for each survey year. Within the survey efforts soft bottom assemblages disturbed by trawl sample would be expected to recover in short time frames (approximately 100 days [Collie et al. 2000]). Trawls surveys would be expected to impact the demersal EFH managed species the most. The trawl sampling effort may disturb, damage, remove, or injure demersal eggs, such as those deposited by winter flounder, longfin inshore squid, wolffish, or the egg cases deposited by the skate species listed in **Appendix A**. The trawl sampling effort would additionally impact the juvenile and adult life stages of managed species of Mobile Benthic/Epibenthic Softbottom, Complex habitat fish and invertebrates outlined in **Section 4.3**, *Species Groups*. Infauna and epifauna that contribute to the prey base for demersal species such as hakes and skates may be affected by the trawl sampling as the benthic infauna recovers from the seafloor disturbance caused by the trawl doors. The impacts related to the trawl sampling would be **short term** and transitory in nature and spread over a large spatial area within the Research Lease Area and the proposed export cable routes. The trawl sampling would result in a **direct,** very **short-term adverse** impact to EFH managed species and prey species within the Research Lease Area and export cable routes but the demersal finfish, invertebrates, and infaunal benthic assemblages would recover without mitigation efforts.

Lobster trawl surveys would be an additional impact related to the seafloor disturbance. The proposed monitoring effort involves six survey efforts per quarter for a two-year monitoring effort. Each monitoring effort would include a trawl of 12 lobster traps alternating vented and ventless traps. The lobster trawls would be set with one regular endline and one ropeless fishing unit. The exact gear specifications would be determined based on conversations with commercial fishermen and DMR staff. The disturbance of the seafloor would be minor and short term. Lobster trawls are generally deployed for less than 72 hours. Once removed from the substrate any displacement of benthic organisms would most likely revert to the previous conditions within a few weeks. Adverse impacts related to seafloor disturbance would be **direct,** but very **short term** (less than 72 hours per lobster trap footprint) since the seafloor area impacted is very small (12 lobster traps) and localized and would not be repeated within the same footprint for each lobster trawl effort.

5.2.4 Entanglement

Entanglement related to site characterization would be associated with an EFH species being wrapped, intertwined, or ensnared with a vessel anchor-line, tackle from the shrimp trawl nets, gillnets, or lobster trap trawls buoys. Entanglement would most likely occur during net or trap deployment and retrieval or when gear and tackle are slack and able to wrap or ensnare larger finfish (bluefish, bluefin tuna), or foraging sharks (spiny dogfish, blue sharks, common thresher shark, porbeagle shark) or the slow-moving filter feeding pelagic basking shark. The potential for occurrence of this risk is very low but not impossible. The potential for the EFH managed species previously listed to become entangled in the sampling equipment is conceivable but very unlikely and would result in a **direct,** but very **short-term** adverse impact for the EFH managed species near and within the proposed Research Lease Area and proposed export cable routes if an entanglement were to occur.

5.2.5 Routine Vessel Discharges

Vessels to be utilized for the site assessment activities are required to adhere to existing Maine Department of Environmental Protection and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and EPA NPDES Vessel General Permit standards, both of which aim to prevent the release of contaminated water discharges. Vessel operations related to the Research Lease site assessment is estimated to require four total cruises which will only slightly increase the routine vessel discharges with the GAA. As such, routine releases from assessment activities related to the Research Lease Area would not be expected to contribute appreciably to overall impacts on EFH; adverse impacts related to the release of contaminated discharges or invasive species on the EFH resources are considered **indirect** and very **short term** if not unmeasurable within the GAA.

5.2.6 Vessel Traffic and Space-use Conflicts

The main IPF related to vessel traffic and space-use conflicts for EFH managed species will be the presence and noise related to survey vessel traffic. The presence and noise produced by the vessels to be utilized during the site characterization will be short in duration and will occur during the proposed 1,042 separate punctuated cruises transiting to and from port facilities over a 60-month period which includes installation to FLiDAR buoy and later subsequent removal from the Research Lease Area. The increase in vessel traffic is expected to be a **direct and very short term** if not unmeasurable adverse impact on the EFH of managed species within the Research Lease Area and proposed export cable routes.

5.3 Non-routine Events

5.3.1 Storms

As presented in **Section 2.4.1,** major storms like Noréasters and subtropical hurricanes have the potential to impact the FLiDAR buoy, the structures are designed to withstand these extreme conditions. Though unlikely, structural failure of a FLiDAR buoy could result in a temporary hazard to navigation or impacts to benthic resources if the FLiDAR buoy were to flounder and sink. If either of these scenarios were to occur the impacts related to a failure in the FLiDAR buoy systems would be a **direct, short-term** adverse impact to the EFH of the managed species within the research lease, export cable routing and wider GAA.

5.3.2 Allisions and Collisions

Collisions between vessels and allisions between vessels and FLiDAR buoys are considered unlikely because vessel traffic is controlled by multiple routing measures, such as safety fairways, TSSs, and anchorages. These higher traffic areas were excluded from the Research Lease Area. Risk of allisions with FLiDAR buoys would be further reduced by USCG-required marking and lighting. If either of these scenarios (an allision or collision) were to occur the adverse impacts related to these occurrences would be **direct** and **short term** to the demersal EFH of the managed species within the research lease, export cable routing and wider GAA.

5.3.3 Spills

Accidental releases may increase as a result of future offshore survey activities. As discussed in the Gulf of Maine EA (Section 3.2.3, Water Quality), releases could expose coastal and offshore waters to contaminants in the event of a spill or release during routine vessel use, collisions and allisions. The risk of any type of accidental release would be increased primarily during survey operations. These vessels are required to adhere to existing Maine Department of Environmental Protection and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR 151.2025) and USEPA NPDES Vessel General Permit standards, both of which aim to prevent the release of ballast waters contaminated with an invasive species. Implementation of these waste management and mitigation measures, as well as marine debris awareness training, would reduce the likelihood of an accidental release. As such, accidental releases related to the characterization survey operations would not be expected to contribute appreciably to overall impacts on EFH; impacts related to an accidental spill on EFH resources or managed species would be very limited in volume and considered to be **indirect** and very **short term**.

5.3.4 Recovery of Lost Survey Equipment

Recovery of lost sampling gear could involve the loss of G&G survey equipment, or sampling gear for the biological surveys such as bottom grabs, shrimp trawls, gillnets or lobster traps lost during the proposed surveys listed in **Table 2-1**. It is important to recover the equipment as soon as possible to reduce the potential of causing added negative impacts to the environment through entanglement and entrapment of organisms or damage to sensitive habitats (eelgrass beds, mussel beds, or hard bottom habitats) within the Research Lease Area or cable project easement. Recovery methods may entail using small remotely operated vehicles or dragging grapnel lines depending on the sensitivity of the equipment, the sensitivity of the habitat in which the equipment was lost, and the need to recover the equipment in an intact and undamaged condition. If during survey operations a piece of biological sampling equipment (benthic grab, gravity corer, or survey sonde) is lost and accurate coordinates are recorded the potential for utilizing a remotely operated vehicle may be applicable for recovery. This methodology for equipment recovery would result in the least number of adverse impacts to the environment.

The recovery of lost nets and lobster trawls would most likely be performed using a grapnel anchor string. This methodology would disturb the seafloor within the track of the grapnel tow. The grapnel runs would impact mainly the Sessile Benthic/Epibenthic – Softbottom species group and their eggs, larvae, and adult life stages of invertebrate managed species such as longfin inshore squid and the Atlantic sea scallop. Much like the trawling survey the grapnel runs could disturb, damage, remove, or injure demersal eggs, such as those deposited by, winter flounder, longfin inshore squid, wolffish, or the egg cases deposited by the skate species listed in **Appendix A**. The grapnel recovery operations would additionally impact the juvenile and adult life stages of managed species of Mobile Benthic/Epibenthic Softbottom, Complex habitat fish and invertebrates outlined in **Section 4.3**, *Species Groups*. The impacts related to grapnel runs would be very localized and temporally short and would recover completely without mitigation (Dernie et al. 2003). Such recovery efforts are expected to occur infrequently and are expected to have **direct,** very **short-term** adverse impacts to the demersal EFH of the managed species or life stages if this type of equipment recovery is required.

6 Avoidance, Minimization, and Mitigation

6.1 Standard Operating Conditions

SOCs for the Proposed Action are described in Section 5 of the EA. BOEM's primary mitigation strategy has and will continue to be avoidance. For example, the exact location of the FLiDAR buoy would be adjusted to avoid adverse effects to biologically sensitive habitats, if present. Overall adverse impacts to finfish and invertebrates from biological surveys are anticipated to be **direct** and very **short term** to the demersal EFH of the managed species. Thus, BOEM is proposing to prohibit fisheries surveys until all required ESA consultations are concluded.

6.2 Mitigation and Environmental Monitoring

The avoidance, minimization, and mitigation measures proposed to be utilized during the site assessment and site characterization activities are outlined in the Project Design Criteria (PDCs), and Best Management Practices (BMPs) for Protected Species Associated with Offshore Wind Data Collection document (BOEM 2021). The PDCs and BMPs were designed under consultation with NMFS which resulted in a Letter of Concurrence under Section 7 of the ESA (**Appendix B**). The PDCs and BMPs pertain to site characterization (HRG, geotechnical, and biological surveys) and site assessment/data collection (deployment, operation, and retrieval of meteorological and oceanographic data buoys) activities associated with Atlantic OCS leases (BOEM 2021). BOEM will implement the measures outlined in the document to avoid, minimize, and mitigate the potential effects of routine activities associated with assessment activities on the lease and site characterization activities within the Research Lease Area.

6.3 Alternative Project Designs that Could Avoid/Minimize Impacts

No projects alternatives have been proposed or designed for the Research Lease Area or associated potential project easements. The only alternative proposed for this research lease is the No Action Alternative. Under the No Action Alternative, BOEM would not issue a wind energy research lease or associated potential project easements to the State of Maine. No site assessment or site characterization activities requiring BOEM approval would be conducted. Although some site characterization surveys that are conducted on unleased or ungranted areas of the OCS do not require BOEM approval and could still be conducted under the No Action Alternative, these activities are less likely to occur without a research lease.

6.4 Adaptive Management Plans

BOEM has not prepared or proposed an Adaptive Management Plan to offset potential impacts related to the Research Lease Area or associated export cable routes.

7 NOAA Trust Resources

This section includes a discussion on the fish, shellfish, crustaceans, or their habitats, that are not managed under a federal FMP. Some of the NOAA Trust species, including diadromous fishes, serve as prey for a number of federally managed species and are therefore considered a component of EFH pursuant to the MSA. Nineteen species of NOAA Trust Resources have been identified within the general vicinity of the Research Lease Area and export cable routes. **Table A-1** provides information representing the species and life stages within the Research Lease Area and export cable routes. The impacts as outlined in **Section 5** concerning the site assessment and site characterization as well as the impact determination will be much the same as the impacts for the NOAA Trust species and result in **direct** and **indirect** adverse impacts with short-term temporal effects.

8 Conclusions/Determination(s)

Thirty-five (35) species of finfish (22), elasmobranchs (10), and invertebrates (3) were identified with designated EFH within the GAA. The life stages and EFH-designated species are discussed in **Section 4**. The scope of the project site assessment and characterization are described in Chapter 2, would result in some negligible and minor adverse effects on the EFH species listed in **Table 4-1**. Impact analyses of Project activities on EFH are analyzed in **Section 5**. Impacts associated with site assessment and characterization are deemed to be short term with negligible to minor impacts. The main source of adverse effects will be seafloor disturbance due to the installation of the FLiDAR buoy anchor system. No permanent impacts are related to the installation of the anchor system since the buoy and anchor are to be removed after a 24-month deployment. Therefore, BOEM expects the overall adverse impact on the EFH of finfish and invertebrate managed species would be **direct** and **indirect** and **short term** because the effect would be localized and temporary. BOEM would be mandating the application of PDCs and BMPs outlined in **Section 6.2** set forth by BOEM and NMFS under in a Letter of Concurrence under Section 7 consultation which should further reduce impacts (but would most likely not change the impact determinations).

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Appendix A EFH-designated species within the Gulf of Maine Wind Energy Research Lease Area

Table A-1. EFH-designated species within the Gulf of Maine Wind Energy Research Lease Area

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
		•	•	•	•	•	•		**General habitat description:** EFH for each life history stage is found in the Gulf of Maine, on the southern portion of Georges Bank, and outside of the Gulf of Maine along the continental slope to a maximum depth of 1,969 ft (600 m) depth north of the Delaware Bay Latitude (NEFMC 2017). **Larvae**: Pelagic habitats in the Gulf of Maine, on the southern portion of Georges Bank (NEFMC 2017). **Juveniles:** Sub-tidal coastal and offshore benthic habitats in the Gulf of Maine between 164–656 ft (50–200 m) (NEFMC 2017). EFH for juveniles consists of seafloor habitats of complex rocky reef substrates with structure-forming epifauna (e.g., sponges, corals), and soft sediments with cerianthid anemones (NEFMC 2017). Young-of-the-year juveniles are found on boulder reefs, while older juveniles are found in dense cerianthid habitats. Juveniles do not use unstructured mud habitat and prefer mainly hard bottom in the deep basins (NEFMC 2017). **Adults:** Offshore benthic habitats in the Gulf of Maine, primarily in depths between 459–984 ft (140–300 m). EFH for adult redfish occurs on finer grained bottom sediments and variable deposits of clays, silts, gravel, and boulders with associated structure- forming epifauna (e.g., corals, sponges, cerianthid anemones, sea pens [NEFMC 2017]).
•	•	•	•	•	•	•	•		**General habitat description:** EFH for each life history stage is found in the Gulf of Maine including the high salinity zones (salinity >25.0 ppt) of the bays and estuaries within the Gulf of Maine (NEFMC 2017). **Eggs:** Pelagic habitats Gulf of Maine and on Georges Bank (NEFMC 2017). **Larvae:** Pelagic habitats in the Gulf of Maine, on Georges Bank, and in southern New England including bays and estuaries (NEFMC 2017). **Juveniles:** Sub-tidal benthic habitats in the Gulf of Maine and the western portion of Georges Bank, between 131–591 ft (40–180 m) including bays and estuaries (NEFMC 2017). EFH for juvenile American plaice consists of soft bottom substrates (mud and sand), but they are also found on gravel and sandy substrates bordering bedrock (NEFMC 2017). **Adults:** Sub-tidal benthic habitats in the Gulf of Maine and the western portion of Georges Bank, between 131–984 ft (40–300 m) and including coastal bays and estuaries (NEFMC 2017). EFH for adult American plaice consists of soft bottom substrates (mud and sand), but they are also found on gravel and sandy substrates bordering bedrock (NEFMC 2017).
						•	•		**General habitat description:** Bluefin tuna inhabit northeastern waters to feed and move south to spawning grounds in the spring. Bluefin tuna is considered a Species of Concern because they support important recreation and commercial fisheries, and population size is unknown (NOAA 2020). **Adults:** EFH for adult bluefin tuna is pelagic waters from the mid-coast of Maine to the Mid-Atlantic (NOAA 2020).
•	•	•		•	•	•	•		**General habitat description**: Butterfish are found within the Gulf of Maine throughout the year and are present in nearshore areas in the fall, and therefore may be impacted by cable installation (NOAA 2010). **Eggs**: EFH is designated for butterfish eggs in pelagic habitats with depths under 4,921 ft (1,500 m) and average temperatures between 48 to 71°F (9 to 22°C) in inshore estuaries and embayments from Massachusetts Bay to Chesapeake Bay, and in patches on the continental shelf/slope from Maine southward to Cape Hatteras, North Carolina (NOAA 2010). **Larvae**: EFH for butterfish larvae is designated as pelagic habitats in inshore estuaries and embayments from Boston Harbor to Chesapeake Bay and over the continental shelf, from the Gulf of Maine to Cape Hatteras (NOAA 2010). **Juveniles/Adults**: EFH for juvenile and adult butterfish is pelagic habitats in inshore estuaries and embayments from Massachusetts Bay to Pamlico Sound on the inner and outer continental shelf from the Gulf of Maine to Cape Hatteras (NOAA 2010). EFH for adult Atlantic butterfish is generally found over bottom depths between 33 and 820 ft (10 and 250 m) where bottom water temperatures are between 40 and 81.5°F (4.5 and 27.5°C) and salinities are above 5 ppt (NOAA 2010).

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
●	●	●	●	●	●	●	●		**General habitat description:** Atlantic Cod EFH includes all coastal habitats that contain structurally complex benthic resources, including eelgrass, mixed sand, and gravel, and rocky habitats (NEFMC 2017). These habitats are particularly important for juvenile Atlantic cod as it provides protection from predation and readily available prey sources (NEFMC 2017). **Eggs:** EFH for Eggs include pelagic habitats in the Gulf of Maine, on Georges Bank, the Mid-Atlantic region, and in the high salinity zones (salinity (>25.0 ppt) of the bays and estuaries. Cod spawn primarily in bottom habitats composed of sand, rocks, pebbles, or gravel during fall, winter, and early spring (NOAA 2022a). Cod eggs are found in the fall, winter, and spring in water depths less than 361 ft (110 m [NEFMC 2017]). Larvae: EFH for larval cod is pelagic waters (depths of 98–230 ft [30–70 m]) from the Gulf of Maine to the Mid-Atlantic and are primarily observed in the spring (Lough 2004). **Juveniles:** Intertidal and sub-tidal benthic habitats in the Gulf of Maine, southern New England, and on Georges Bank, to a max depth of 394 ft (120 m), including high salinity zones in the bays and estuaries within the Gulf of Maine. Structurally-complex habitats, including eelgrass, mixed sand and gravel, and rocky habitats (gravel pavements, cobble, and boulders). In inshore waters, Y-O-Y juveniles prefer gravel and cobble habitats and eelgrass beds as refugia, but in the absence of predators also utilize adjacent un-vegetated sandy habitats for feeding (NEFMC 2017). **Adults:** Sub-tidal benthic habitats in the Gulf of Maine, south of Cape Cod, and on Georges Bank, between 98–525 ft (30–160 m), including high salinity zones in the bays and estuaries (NEFMC 2017). EFH for Adult Cod includes structurally complex hard bottom habitats composed of gravel, cobble, and boulder substrates with and without emergent epifauna and macroalgae. Adult cod are also found on sandy substrates and frequent deeper slopes of ledges along shore (NEFMC 2017).
●	●	●	●	●	●	●	●		**General habitat description**: Larvae are free-floating and generally observed between August and April in areas with water depths from 164–295 ft. Juvenile and adult herring are found in areas with water depths from 66–427 ft. **Eggs:** Herring eggs adhere to the bottom; therefore, EFH is designated as inshore and offshore benthic habitats mainly in the Gulf of Maine, Georges Bank, and Nantucket Shoals in depths of 16–295 ft on coarse sand, pebbles, cobbles, and boulders and/or macroalgae (NEFMC 2017). **Larvae:** EFH for larval Atlantic herring is pelagic waters in the Gulf of Maine, Georges Bank, and southern New England (NEFMC 2017). **Juveniles/Adults:** EFH for juvenile and adult herring is pelagic and bottom habitats in the Gulf of Maine, Georges Bank, southern New England, and the Mid-Atlantic region (NEFMC 2017).
●	●	●	●	●	●	●	●		**General habitat description**: Eggs float in the upper 33–49 ft (10–15 m) of the water column, while larvae can be found in depths ranging from 33–427 ft (10–130 m) (Studholme et al. 1999).The depth preference of juvenile mackerel shifts seasonally as they are generally found higher in the water column (66–164 ft [20–50 m]) in the fall and summer, deeper (66–230 ft [20–70 m]) in the winter, and widely dispersed (98–295 ft [30–90 m]) in the spring (NOAA 2022b; Studholme et al. 1999). **Eggs/Larvae**: EFH for mackerel (egg and larval stages) is pelagic habitats in inshore estuaries and embayments from Great Bay to Long Island, inshore and offshore waters of the Gulf of Maine, and on the continental shelf from Georges Bank to Cape Hatteras (NEFMC 2017). **Juveniles**: EFH for juvenile Atlantic mackerel is designated in pelagic waters with bottom depths of 33–361 ft (10–110 m] (NEFMC 2017). **Adults**: EFH for adult mackerel includes pelagic habitats the same region as for juveniles, but in waters with bottom depths <230 ft (70 m) (NEFMC 2017).
●	●	●	●	●	●	●	●		**General habitat description**: All life stages have the same EFH spatial designation, which extends across much of the greater Atlantic region. During the larval stage, scallops are free-swimming and occur within the water column and near the seafloor. Hard substrate is particularly important as it provides essential habitat for settling larvae, which were found to have higher survival rates when attaching to hard surfaces rather than shifting sand or macroalgae (NEFMC 2017). **Eggs**: Because sea scallop eggs are heavier than seawater and remain on the seafloor until the larval stage, EFH is designated in benthic habitats in inshore areas and the continental shelf (NEFMC 2017). **Larvae**: EFH for the larval stage (referred to as “spat”) includes benthic and pelagic habitats in inshore and offshore areas throughout the region. Any hard surface can provide an essential habitat for settling pelagic larvae (“spat”), including shells, pebbles, gravel, and macroalgae and other benthic organisms. Spat that settle on shifting sand do not survive (NEFMC 2017). **Juveniles/Adults**: EFH for juvenile and adult sea scallops include sand and gravel substrates in the benthic habitats in depths of 59–361 ft (18–110 m) (NEFMC 2017).

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
●	●	●	●	●	●	●	●		**General habitat description:** Atlantic Wolffish EFH extends from waters north of 41˚N latitude and east of 71˚W longitude in depths of water ranging from 33 ft (10 m) in the northern portions of the Gulf of Maine (NEFMC 2017). **Eggs**: EFH for Wolffish eggs is sub-tidal benthic habitats at depths <328 ft (<100 m). Wolffish egg masses are hidden under rocks and boulders in nests. **Larvae:** Larvae EFH is pelagic and sub-tidal benthic habitats. Wolffish larvae remain near the bottom for up to six days after hatching, but gradually become more buoyant as the yolk sac is absorbed (NEFMC 2017). **Juveniles** (<25.6 in [<65 cm] total length): Juvenile EFH consists of sub-tidal benthic habitats at depths of 230–604 ft (70–184 m). Juveniles do not have a strong substrate preference (NEFMC 2017). **Adults**: (≥25.6 in [≥65 cm] total length): Wolfish EFH consists sub-tidal benthic habitats at depths less than 568 ft (173 m). Adult Atlantic wolffish have been observed spawning and guarding eggs in rocky habitats in <98 ft (<30 m) of water in the Gulf of St. Lawrence and Newfoundland and in deeper (164–328 ft [50–100 m) boulder reef habitats in the Gulf of Maine. Egg masses have been collected on the Scotian Shelf in depths of 328–427 ft (100–130 m), indicating that spawning is not restricted to coastal waters. Adults are distributed over a wider variety of sand and gravel substrates once they leave rocky spawning habitats, but are not observed over muddy bottom (NEFMC 2017).
				●		●			**General habitat description:** Barndoor skates have a relatively wide range which extends from Newfoundland to North Carolina. In southern New England, both juveniles and adults were most frequently observed in the summer, with few rare sightings of adults during the winter (Packer et al. 2003a). **Juveniles/Adults:** EFH includes benthic habitats on the continental shelf in depths between 131 and 1,312 ft (40 and 400 m), and on the continental slope in depths up to 2,461 ft (750 m) within Georges Banks and southern New England. Substrates included in the EFH are mud, sand, and gravel (NEFMC 2017).
		●	●	●	●	●	●		**General habitat description**: Basking sharks are generally observed in the northwestern and eastern Atlantic coastal regions from April to October and are thought to follow zooplankton distributions (Sims et al. 2003). Basking shark aggregations have been observed south and southeast of Long Island, east of Cape Cod, and along the coast of Maine (NMFS 2017). Basking sharks are considered a Species of Concern because of interactions with vessels, being caught as bycatch, and low reproductive rates, which leads to slow recovery (NMFS 2017). **Neonate/Juveniles/Adults**: EFH for juvenile and adult basking sharks is designated in the US Atlantic east coast pelagic waters from the Gulf of Maine to the northern Outer Banks of North Carolina (NMFS 2017).
●		●		●	●	●	●		**General habitat description:** Bluefish inhabit pelagic waters in and north of the Mid-Atlantic Bight for much of the year but make seasonal migrations south in the winter (Shepherd and Packer 2006). **Eggs/Larvae:** Eggs are found in mid-shelf waters ranging from 98 to 230 ft in Gulf of Maine to Cape Hatteras. Eggs are not found in estuarine waters. Larvae are found in oceanic waters (Able and Fahay 1998; Shepherd and Packer 2006). **Juvenile:** EFH is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida (Shepherd and Packer 2006). **Adults:** Adults are found in oceanic, nearshore, and continental shelf). Adults are observed in the inland bays from May through October and are not associated with a specific substrate (Stone et al. 1994). The species migrates extensively and is distributed based on season and size of the individuals within the schools (Shepherd and Packer 2006). There are two predominant spawning areas on the east coast: one during the spring that is located offshore from southern Florida to North Carolina and the other during summer in the Mid-Atlantic Bight (Wilk 1982).
		●	●	●	●	●			**General habitat description:** The blue shark is a pelagic, highly migratory species, occurring in temperate and tropical inshore and offshore waters, and ranging from Newfoundland and the Gulf of St. Lawrence south to Argentina (NMFS 2017). Blue sharks prefer deep, clear waters with temperatures ranging from 50°F to 68°F (10 to 20°C [Castro 1983]), and are observed in New England from late May through October. **Neonates:** EFH follows the continental shelf south of Georges Bank to the outer extent of the U.S. EEZ in the Gulf of Maine. **Juveniles/Adults:** EFH for juvenile and adult blue sharks is waters from the southern part of the Gulf of Maine to Cape Hatteras (NMFS 2017).
		●	●	●	●	●	●		**General habitat description**: Common thresher sharks occur in coastal and oceanic waters but are more common within 15–45 ft (4.6–13.7 m) of water depth (NMFS 2017). **All life stages:** EFH for all life stages is coastal and pelagic waters within the Gulf of Maine to Caps Hatteras, NC and in other localized areas off the Atlantic coast (NMFS 2017).

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
●	●	●	●	●	●	●	●		**General habitat description**: Haddock occurs throughout the Gulf of Maine at various stages of its life history. **Eggs**: Pelagic habitats in coastal and offshore waters in the Gulf of Maine, southern New England, and on Georges Bank (NMFS 2017). **Larvae:** EFH consists of pelagic habitats in coastal and offshore waters in the Gulf of Maine, the Mid-Atlantic, and on Georges Bank (NMFS 2017) **Juveniles:** EFH for juvenile haddock consists of sub-tidal benthic habitats between 131–459 ft (40–140 m) in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region, and as shallow as 66 ft (20 m) along the coast of Massachusetts, New Hampshire, and Maine. Y-O-Y juveniles settle on sand and gravel on Georges Bank, but are found predominantly on gravel pavement areas within a few months after settlement. As they grow, they disperse over a greater variety of substrate types (NEFMC 2017). **Adults:** Sub-tidal benthic habitats between 164–525 ft (50–160 m) in the Gulf of Maine, on Georges Bank, and in southern New England. EFH for adult haddock occurs on hard sand (particularly smooth patches between rocks), mixed sand and shell, gravelly sand, and gravel substrates. They also are found adjacent to boulders and cobbles along the margins of rocky reefs in the Gulf of Maine (NEFMC 2017).
				●	●	●	●		**General habitat description**: Demersal species that has a range from Nova Scotia to Cape Hatteras and is highly concentrated in the Mid-Atlantic Bight and on Georges Bank. Found year-round on Georges Bank and tolerates a wide range of temperatures (Packer et al. 2003a). Prefers sandy or pebbly bottom but can also be found on mud and ledges (Collette and Klein-MacPhee 2002). **Juveniles/Adults**: EFH is similar for both life stages and includes intertidal and sub-tidal benthic habitats in coastal waters of the Gulf of Maine and in the mid-Atlantic region. EFH primarily occurs on sand and gravel substrates, but also is found on mud (NEFMC 2017).
●	●			●	●	●	●		**General habitat description**: Longfin inshore squids lay eggs in masses referred to as “mops” that are demersal and anchored to various substrates and hard bottom types, including shells, lobster pots, fish traps, boulders, submerged aquatic vegetation, sand, and mud (NOAA 2010). Female longfin squid lay these egg mops during three-week periods, which can occur throughout the year (Hendrickson 2017). **Eggs**: EFH for longfin inshore squid eggs is inshore and offshore bottom habitats from Georges Bank to Cape Hatteras (NOAA 2010). **Juveniles/Adults**: EFH for juveniles and adults, also referred to as pre-recruits and recruits, is pelagic habitats inshore and offshore continental shelf waters from Georges Bank to South Carolina and in inshore waters of the Gulf of Maine depths between 20–656 ft (6–200 m) where bottom water temperatures are 47 – 57°F (8.5–14°C) and salinities are 24–36.5 ppt (NOAA 2010).
●	●	●	●	●	●	●	●		**General habitat description**: Abundant throughout the Gulf of Maine and Georges Bank. Prefer hard sand, pebbly bottom, gravel, and broken shells benthic habitats (Collette and Klein-MacPhee 2002, NEFMC 2017). **Eggs/Larvae**: Pelagic waters in the Gulf of Maine, Georges Bank, southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017). Eggs occur at sea surface temperatures below 64°F (18°C) and in water depths from 49–3,280 ft (15–1,000 m); whereas larvae occur at water temperatures of 59°F (15°C) and in water depths from 82–3,280 ft (25–1,000 m). Eggs are most often observed from March through September, and larvae are most often observed from March through September (Steimle et al. 1999b, NEFMC 2017). **Juveniles/Adults**: Demersal lifestages that inhabit bottom habitats with substrates of a sand-shell mix, algae-covered rocks, hard sand, pebbly gravel, or mud along the OCS in the Mid-Atlantic (NEFMC 2017). Juveniles occur at water temperatures below 55°F (13°C), at depths from 82–656 ft (25–200 m), and at salinities from 29.9 to 36.7 ppt. Adults occur at water temperatures below 59°F (15°C), at depths from 82–656 ft (25–200 m), and at salinities from 29.9 to 36.7 ppt (Steimle et al. 1999b, NEFMC 2017).

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
●						●	●		**General habitat description:** Northern shortfin squid are found in oceanic and neritic habitats and adults undergo long distance migrations between boreal, temperate and subtropical waters. The northern shortfin squid is found in waters mainly along the continental shelf edge from of the U.S. and Canada, between Newfoundland and Cape Hatteras, North Carolina (Hendrickson and Holmes 2004, NOAA 2010). **Eggs:** Egg masses are pelagic and found mainly in the pelagic habitat along the continental slope. **Pre-recruits**: During the winter pre-recruits migrate offshore and are abundant along the shelf edge and migrate into neritic water in at depth of 198 ft (60 m) and greater between Georges Bank and Cape Hatteras and are most abundant along the shelf edge (Hendrickson and Holmes 2004, NOAA 2010). **Adults:** Adult northern shortfin squid utilize the shelf edge (at depths around 1,200 ft (366 m) between, Gulf of Maine, Georges Bank, and Cape Hatteras during the winter and spring months (Hendrickson and Holmes 2004). As the water column along the continental slope warms up in the summer and autumn months adults are found both inshore and throughout the continental shelf (NOAA 2010).
●	●	●	●	●	●	●	●		**General habitat description:** Ocean pout are present in southern New England from late summer to winter and prefer habitats that contain sandy mud, sticky sand, broken bottom, or on pebbles and gravel (Collette and Klein-MacPhee 2002). This species spawns in protected habitats, such as rock crevices and man-made artifacts (Steimle et al. 1999b, NEFMC 2017). **Eggs:** EFH for ocean pout eggs includes hard bottom habitats in the Gulf of Maine, Georges Bank, and in the Mid-Atlantic Bight, as well as high-salinity zones in estuaries. Eggs are typically found in water depths <328 ft (100 m [Steimle et al. 1999b, NEFMC 2017]). **Juveniles/Adults:** EFH for juveniles is intertidal and subtidal benthic habitats in the Gulf of Maine and on the continental shelf north of Cape May, New Jersey, on the southern portion of Georges Bank, and in the high-salinity zones of bays and estuaries north of Cape Cod (NEFMC 2017). **Adults:** Adult EFH is subtidal benthic habitats in the Gulf of Maine, on Georges Bank, in coastal and continental shelf waters north of Cape May, New Jersey, and in the high-salinity zones of bays and estuaries north of Cape Cod. Adult habitat includes mud and sand, particularly in association with structure forming habitat types like shell, gravel, or boulder (Steimle et al. 1999b, NEFMC 2017).
●	●	●	●	●	●	●	●		**General habitat description**: Pollock eggs are buoyant upon fertilization and occur in the water column (Cargnelli et al. 1999c). The larval stage lasts between three and four months and is also pelagic. **Eggs:** EFH for pollock eggs is pelagic inshore and offshore habitat in the Gulf of Maine, Georges Bank, and southern New England (NEFMC 2017). **Larvae**: EFH designations for larvae are similar to those for eggs and includes pelagic inshore and offshore habitats in the Gulf of Maine, Georges Bank, and but larvae can be found farther south in the Mid-Atlantic region, with bays and estuaries also included in these regions (NEFMC 2017). **Adults:** Offshore pelagic and benthic habitats in the Gulf of Maine and the southern portion of Georges Bank between 236 and 984 ft (80 and 300 m), and in shallower sub-tidal habitats in Long Island Sound, Massachusetts Bay, and Cape Cod Bay. Essential habitats for adult pollock are the tops and edges of offshore banks and shoals (e.g., Cashes Ledge) with mixed rocky substrates, often with attached macro algae (NEFMC 2017).
		●		●		●			**General habitat description:** Porbeagle sharks commonly inhabit deep, cold, temperate waters and forage primarily on fish and cephalopod species (NMFS 2017). Porbeagle shark is a Species of Special Concern due to substantial population declines caused by overfishing (NMFS 2017). **All life stages:** EFH for porbeagle shark includes offshore and coastal waters of the Gulf of Maine (excluding Cape Cod and Massachusetts Bay) and offshore waters from Georges Bank to New Jersey. Porbeagle sharks are epipelagic in the summer months swimming in the upper 656 ft (200 m) of the water column and move to deeper waters in the winter to depths of 656–3,281 ft (200–1,000 m [NMFS 2017]).
●	●	●	●	●	●	●	●		**General habitat description:** Juvenile red hake are pelagic and congregate around floating debris for a time before descending to the bottom (Steimle et al. 1999a). Although adult red hake are generally demersal, they can be found in the water column (Steimle et al. 1999a). **Eggs/Larvae:** EFH for red hake eggs and larvae is surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras. **Juveniles:** EFH for juvenile red hake is bottom habitats with a substrate of shell fragments. **Adults:** Adult EFH includes benthic habitats in the Gulf of Maine and the outer continental shelf and slope in depths of 164–2,461 ft (50–750 m) and as shallow as 66 ft (20 m) in a number of inshore estuaries and embayments as far south as Chesapeake Bay. Shell beds, soft sediments (mud and sand), and artificial reefs provide EFH for adult red hake.

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
●		●		●		●	●		**General habitat description:** This groundfish species prefers deep water environments and are concentrated in deep basins in the Gulf of Maine and along the continental slope in winter and spring. Silver hake associate with all bottom types, from gravel to fine silt and clay, but mainly with silts and clay (Lock and Packer 2004). **Eggs/Larvae:** EFH for eggs and larvae include pelagic habitats from the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017). **Juveniles:** Juveniles inhabit sand waves, flat sand with amphipod tubes, and shells, and in biogenic depressions. Juvenile EFH includes pelagic and benthic habitats (e.g., sandy substrates) in selected coastal bays and estuaries and on the continental shelf as far south as Cape May, New Jersey. Juveniles inhabit depths greater than 33 ft (10 m) in coastal waters in the Mid-Atlantic and between 131 and 1,312 ft (40 and 400 m) in the Gulf of Maine, Georges Bank, and middle continental shelf in the Mid-Atlantic. **Adults:** Adults are observed in water temperatures below 71.6°F (22°C) and at depths between 65 and 885 ft (20 and 270 m) in benthic habitats of all substrate types. Adults occur in the Gulf of Maine, on Georges Bank, and on the continental shelf off southern New England, and the Mid Atlantic south to Cape Hatteras (NEFMC 2017).
				●	●	●	●		**General habitat description:** Smooth skate EFH includes bay and estuaries (juveniles) to depths of 2,953 ft (900 m) within the Gulf of Maine south of Cape Cod but not extending into S. New England (NEFMC 2017). **Juveniles:** Juvenile EFH consists of benthic habitats between 328–1,312 ft (100–400 m) in the Gulf of Maine and on the continental slope to depths of 2,953 ft (900 m), and in high salinity zones of bays and estuaries along the Maine coast (NEFMC 2017). EFH for juvenile is on soft mud in deeper areas, but also on sand, shell hash, gravel, and pebbles on offshore banks in the Gulf of Maine (NEFMC 2017). **Adults:** Adult EFH includes benthic habitats between 328–1,312 ft (100–400 m) in the Gulf of Maine and on the continental slope to depths of 2,953 ft (900 m) (NEFMC 2017).
				●	●	●	●		**General habitat description**: The spiny dogfish is widely distributed throughout the world, with populations existing on the continental shelf of the northern and southern temperate zones, which includes the North Atlantic from Greenland to northeastern Florida, with concentrations from Nova Scotia to Cape Hatteras. Based on seasonal temperatures, spiny dogfish migrate up to 994.2 mi (1,600 km) along the east coast (Bullard 2014). **Juveniles/Adults:** EFH for juvenile and adult spiny dogfish is waters on the continental shelf from the Gulf of Maine through Cape Hatteras (NOAA 2023). NEFSC bottom trawl surveys collected spiny dogfish juveniles at depths ranging from 36 to 1,640 ft (11–500 m). Adults are found in deeper waters inshore and offshore from the shallows to 2,953 ft (900 m) deep (Bullard 2014).
●	●	●	●	●	●	●	●	OECC	**General habitat description:** Eggs are generally observed between October and May, while larvae are found from September through February. Juvenile summer flounder inhabit inshore areas such as salt marsh creeks, seagrass beds, and mudflats in the spring, summer, and fall and move to deeper waters offshore in the winter. Adults inhabit shallow coastal and estuarine areas during the warmer seasons and migrate offshore during the winter (Packer and Hoff 1999, MAFMC 1998). **Eggs/Larvae**: EFH for eggs and larvae is pelagic waters found over the continental shelf from the Gulf of Maine to Cape Hatteras. **Juveniles/Adults**: EFH for juvenile and adult summer flounder is demersal waters over the continental shelf from the Gulf of Maine to Cape Hatteras. HAPC is designated as areas of all native species of macroalgae, seagrasses, and freshwater and tidal macrophytes in any size bed, as well as loose aggregations, within adult and juvenile summer flounder EFH (Packer and Hoff. 1999, MAFMC 1998).
				●	●	●	●		**General habitat description:** Thorny skate EFH includes bay and estuaries (juveniles) to depths of 2,953 ft (900 m) within the Gulf of Maine south of Cape Cod but not extending into S. New England (NEFMC 2017). **Juveniles:** Benthic habitats between 115–1,312 ft (35–400 m) in the Gulf of Maine, on the continental slope to a depth of 2,953 ft (900 m), and in shallower water in the high salinity zones in bays and estuaries north of Cape Cod. EFH for juveniles is found a diverse suite of benthic habitats, including sand, gravel, broken shells, pebbles, and soft mud (NEFMC 2017). **Adults:** Benthic habitats between 263–984 ft (80–300 m) in the Gulf of Maine and extending south of Cape Cod on the continental slope to a depth of 2,953 ft (900 m) (NEFMC 2017). EFH for adult thorny skates is found on a wide variety of bottom types, including sand, gravel, broken shells, pebbles, and soft mud (NEFMC 2017).

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
●	●	●	●	●	●	●	●		**General habitat description:** This groundfish species prefers deep water environments and is predominantly found along the edge of the OCS between Cape Hatteras and Cape Cod, becoming more prevalent on the coastal shelf and inshore waters moving northward into the Gulf of Maine (Chang et al. 1999). **Eggs**: EFH for White hake eggs is pelagic habitats throughout the Gulf of Maine, including Massachusetts and Cape Cod bays, and the outer continental shelf and slope (NEFMC 2017, Chang et al. 1999). **Larvae:** Larvae EFH is the pelagic habitats in the Gulf of Maine, in southern New England, and on Georges Bank. Early stage white hake larvae have been collected on the continental slope, but cross the shelf-slope front and use nearshore habitats for juvenile nurseries (NEFMC 2017, Chang et al. 1999). **Juveniles:** Intertidal and sub-tidal estuarine and marine habitats in the Gulf of Maine, on Georges Bank, and in southern New England, including mixed and high salinity zones in a number of bays and estuaries north of Cape Cod, to a maximum depth of 984 ft (300 m). Pelagic phase juveniles remain in the water column for about two months. In nearshore waters, EFH for benthic phase juveniles occurs on fine-grained, sandy substrates in eelgrass, macroalgae, and un-vegetated habitats (NEFMC 2017). **Adults:** Sub-tidal benthic habitats in the Gulf of Maine, including depths >82 ft (>25 m) in certain mixed and high salinity zones portions of a number of bays and estuaries, between 328–1,312 ft (100–400 m) in the outer gulf. EFH for adult white hake occurs on fine-grained, muddy substrates and in mixed soft and rocky habitats (NEFMC 2017). Spawning takes place in deep water on the continental slope (NEFMC 2017).
	●	●	●	●	●	●	●		**General habitat description**: Windowpane flounder are usually associated with non-complex benthic habitats (Collette and Klein-MacPhee 2002) from the Gulf of Saint Lawrence to Florida (Gutherz 1967). Spawning occurs from April to December along areas of the northwest Atlantic (NEFMC 2017). **Eggs**: EFH for eggs is surface waters around the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras (NEFMC 2017). **Larvae**: EFH for larvae is pelagic waters around the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras (NEFMC 2017). **Juvenile/Adults**: EFH for juvenile and adult life stages is bottom habitats that consist of mud or fine-grained sand substrate around the perimeter of the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras (NEFMC 2017).
●	●	●	●	●	●	●	●		**General habitat description:** This groundfish fish species inhabits coastal waters from the Strait of Belle Isle, Newfoundland to Georgia (Collette and Klein-MacPhee 2002). Winter flounder are abundant in New Jersey waters and prefers muddy, sandy, cobbled, gravely, or boulder substrates (Pereira et al. 1999), and. spawns over sandy bottom in shallow habitats (NEFMC 2017). **Eggs/Larvae:** Eggs are typically found over mud, muddy sand, sand, gravel, macroalgae, and SAV. Pelagic larvae hatch in nearshore waters and estuaries or are transported shoreward from offshore spawning sites where they metamorphose and settle to the bottom as juveniles (Pereira et al. 1999, NEFMC 2017). **Juveniles/Adults**: Juveniles and adults are found in Estuarine, coastal, and continental shelf benthic habitats, as well as the mixed and high salinity zones in Gulf of Maine bays and estuaries (NEFMC 2017). EFH extends from the intertidal zone to depths of 197 ft (60 m) for juveniles and 300 ft (70 m) for adults. Juveniles are found inshore on muddy and sandy sediments in and adjacent to eelgrass and macroalgae, in bottom debris, and in marsh creeks. Adult EFH occurs on muddy and sandy substrates, and on hard bottom on offshore banks (Pereira et al. 1999, NEFMC 2017).
				●	●	●	●		**General habitat description**: Demersal species that has a range from the southern coast of Newfoundland to Cape Hatteras and has concentrated populations on Georges Bank and the northern section of the Mid-Atlantic Bight (Packer et al. 2003b, NEFMC 2017). The winter skate has very similar temperature ranges and migration patterns as the little skate (NEFMC 2017). **Juveniles/Adult**s: EFH for juvenile and adult winter skate includes sand and gravel substrates in sub-tidal benthic habitats in depths from the shore to 295 ft (90 m) from eastern Maine to Delaware Bay, on the continental shelf in southern New England and the mid-Atlantic region, and on Georges Bank (NEFMC 2017).

Eggs		Larvae/Neonates		Juveniles		Adults		HAPC	EFH Description
Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route	Research Lease Area	Export Cable Route		
●	●	●	●	●	●	●	●		**General habitat description:** Witch flounder a groundfish species range from the Gulf of Maine to Cape Hatteras, North Carolina (Cargnelli et al. 1999), and tend to concentrate near the southwest portion of the Gulf of Maine (Collette and Klein-MacPhee 2002). Spawning occurs from May through September and peaks in July and August. **Eggs**: EFH for eggs is surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the Mid-Atlantic south to Cape Hatteras (NEFMC 2017). **Larvae**: EFH for larvae is surface waters to 820 ft (250 m) in the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the Mid-Atlantic Bight south to Cape Hatteras (NEFMC 2017). **Juveniles/Adults**: They are found over mud, clay, silt, or muddy sands at depths ranging from 66–5,135 ft (20–1,565 m) although the majority are found at 295–984 ft (Cargnelli et al. 1999, NEFMC 2017).
●	●	●	●	●	●	●	●		**General habitat description:** This groundfish species range along the Atlantic coast of North America from Newfoundland to the Chesapeake Bay, with the majority located on the western half of Georges Bank, the western Gulf of Maine, east of Cape Cod, and southern New England (Collette and Klein-MacPhee 2002). Present on Georges Bank from March to August. Spawning occurs in both inshore areas as well as offshore on Georges Bank in July (NEFMC 2017). **Eggs:** EFH for eggs is the coastal and continental shelf pelagic habitats in the Gulf of Maine, on Georges Bank, and in the Mid-Atlantic region as far south as the upper Delmarva peninsula, including the high salinity zones of the bays and estuaries throughout the central Massachusetts to Cape Cod bay (NEFMC 2017). **Larvae**: Coastal marine and continental shelf pelagic habitats in the Gulf of Maine, and from Georges Bank to Cape Hatteras, including the high salinity zones of the bays and estuaries throughout the central Massachusetts to Cape Cod bay (NEFMC 2017). **Juveniles:** Sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic, including the high salinity zones of the bays and estuaries throughout the central Massachusetts to Cape Cod bay (NEFMC 2017). EFH for juvenile yellowtail flounder occurs on sand and muddy sand between 66–263 ft (20–80 m) (NEFMC 2017). **Adults:** Sub-tidal benthic habitats in coastal waters in the Gulf of Maine and on the continental shelf on Georges Bank and in the Mid-Atlantic including the high salinity zones of the bays and estuaries throughout the central Massachusetts to Cape Cod bay (NEFMC 2017). EFH for adult yellowtail flounder occurs on sand and sand with mud, shell hash, gravel, and rocks at depths between 82–295 ft (25–90 m) (NEFMC 2017).

Appendix B Summary of Avoidance, Minimization and Mitigation Measures

Project Stage	Location	Adverse Effect	Avoidance, Minimization, and Mitigation
FLiDAR Buoy-based Acoustic Monitoring –Deployment and Maintenance, and Decommissioning	Offshore Project area	Lighting - indirect, short term, and mostly unmeasurable Seafloor disturbance - direct but minimal Entanglement - direct adverse impact but with a very low probability of occurrence Vessel discharges – indirect, short term Vessel traffic and space-use conflicts – indirect, short term	Vessels of all sizes must operate at 11.5 mph (18.5 kph or 10 kn) or less between November 1 and April 30 and while operating port to port and operating in the lease area, or in the transit area to and from ports in Maine, New Hampshire, and Massachusetts. Ensure any mooring systems used during data collection activities are designed to prevent potential entanglement or entrainment of listed species, and in the unlikely event that entanglement does occur, ensure proper reporting of entanglement events according to the measures specified below: 1. Ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables, or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species. 2. Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose. 3. When practicable, buoys should be lowered and raised slowly to minimize risk to listed species and benthic habitat. No buoys should be deployed or retrieved if large whales or sea turtles are sighted within 1,640 ft (500 m) of the buoy being deployed/retrieved.
Geophysical Reconnaissance Surveys and High-Resolution Geophysical Surveys	Offshore Project area	Noise – indirect, short term Lighting – indirect, short term Seafloor disturbance – direct, very short term	To avoid injury of and minimize any potential disturbance to protected species, implement the following measures for all vessels using boomer, sparker, bubble gun, and chirp sub-bottom profiler categories of equipment. Shutdown, pre-start clearance, and ramp-up procedures are not required during HRG

Project Stage	Location	Adverse Effect	Avoidance, Minimization, and Mitigation
		Entablement – direct, very short term Vessel discharges – indirect, very short term	survey operations using only other sources (e.g., ultra-short baselines, fathometers, parametric shallow penetration sub-bottom profilers, hull-mounted non-parametric SBP, side-scan sonars, pingers, acoustic releases, echosounders, and instruments attached to submersible vehicles (HOV/AUV/ROVs). The Shutdown Zone(s) must be monitored by third-party PSOs at all times when boomer, sparker, bubble gun, or Chirp sub-bottom profiler categories of equipment are being operated and all observed ESA-listed species must be recorded. A “ramp up” of the boomer, sparker, or bubble gun survey equipment must occur at the start or re-start of geophysical survey activities when technically feasible. A ramp up must begin with the power for the geophysical survey equipment ramped up half power for 5 minutes, and then to full power.
Geotechnical Surveys	Offshore Project area	Noise – indirect, short term Lighting – indirect, short term Seafloor disturbance – direct, very short term Entablement – direct, very short term Vessel discharges – indirect, very short term	All vessel anchoring and any seafloor-sampling activities are restricted from seafloor areas with deep/cold-water coral reefs and shallow/mesophotic reefs. All vessel anchoring and seafloor sampling must also occur at least 492 ft (150 m) from any known locations of threatened or endangered coral species. All sensitive live bottom habitats (eelgrass, cold-water corals, etc.) should be avoided as practicable. All vessels in coastal waters will operate in a manner to minimize propeller wash and seafloor disturbance and transiting vessels should follow deep-water routes (e.g., marked channels), as practicable, to reduce disturbance to sturgeon habitat. No geotechnical or bottom disturbing activities will take place during the spawning/rearing season within freshwater reaches of rivers where Atlantic or shortnose sturgeon spawning occurs.
Benthic Surveys	Offshore Project area	Noise – indirect, short term Lighting – indirect, short term Seafloor disturbance – direct, very short term Entablement – direct, very short term Vessel discharges –	All vessel anchoring and any seafloor-sampling activities are restricted from seafloor areas with deep/cold-water coral reefs and shallow/mesophotic reefs. All vessel anchoring and seafloor sampling must also occur at least 492 ft (150 m) from any known locations of threatened or endangered coral species. All sensitive live bottom habitats (eelgrass, cold-water corals, etc.) should be avoided as practicable. All vessels in coastal waters will operate in a manner to minimize propeller wash and seafloor

Project Stage	Location	Adverse Effect	Avoidance, Minimization, and Mitigation
		indirect, very short term	disturbance and transiting vessels should follow deep-water routes (e.g., marked channels), as practicable, to reduce disturbance to sturgeon habitat.
Physical Oceanographic Monitoring	Offshore Project area	None	None
Digital Aerial Surveys, Visual Wildlife Surveys, and Passive Acoustic Monitoring of Marine Mammals and Ambient Noise	Offshore Project area	None	None
Motus Tracking	Offshore Project area	None	None
Active Acoustic Surveys and Environmental DNA (eDNA) Sampling of Marine Fish and Invertebrates	Offshore Project area	Short term minor to individuals tagged	None
Passive Acoustic Monitoring of Large Pelagic and Benthic Fish	Offshore Project area	None	None
Bottom Trawl Surveys for Marine Fish and Invertebrates	Offshore Project area	Short-term disturbance of habitat	The Lessee must ensure that all trap/pot/gillnet gear follow required best practices, including: All sampling gear will be hauled at least once every 30 days, and all gear will be removed from the water and stored on land between sampling season. a. No surface floating buoy lines will be used. b. All groundlines will be composed of sinking line. Buoy lines will use weak links (less than 1,700-pound [771-kilogram] breaking strength). Gillnet strings will be anchored with a Danforth-style anchor with a minimum holding strength of 22 lb (10 kg). Knot-free buoy lines will be used to the extent practicable.
Plankton and Larval Lobster Surveys	Offshore Project area	None	None

Project Stage	Location	Adverse Effect	Avoidance, Minimization, and Mitigation
Lobster Trawl Surveys, Gillnet Surveys	Offshore Project area	Short-term disturbance of habitat	The Lessee must ensure that all trap/pot/gillnet gear follow required best practices, including: All sampling gear will be hauled at least once every 30 days, and all gear will be removed from the water and stored on land between sampling season. a. No surface floating buoy lines will be used. b. All groundlines will be composed of sinking line. Buoy lines will use weak links (less than 1,700-pound [771-kilogram] breaking strength). Gillnet strings will be anchored with a Danforth-style anchor with a minimum holding strength of 22 lb (10 kg). Knot-free buoy lines will be used to the extent practicable.