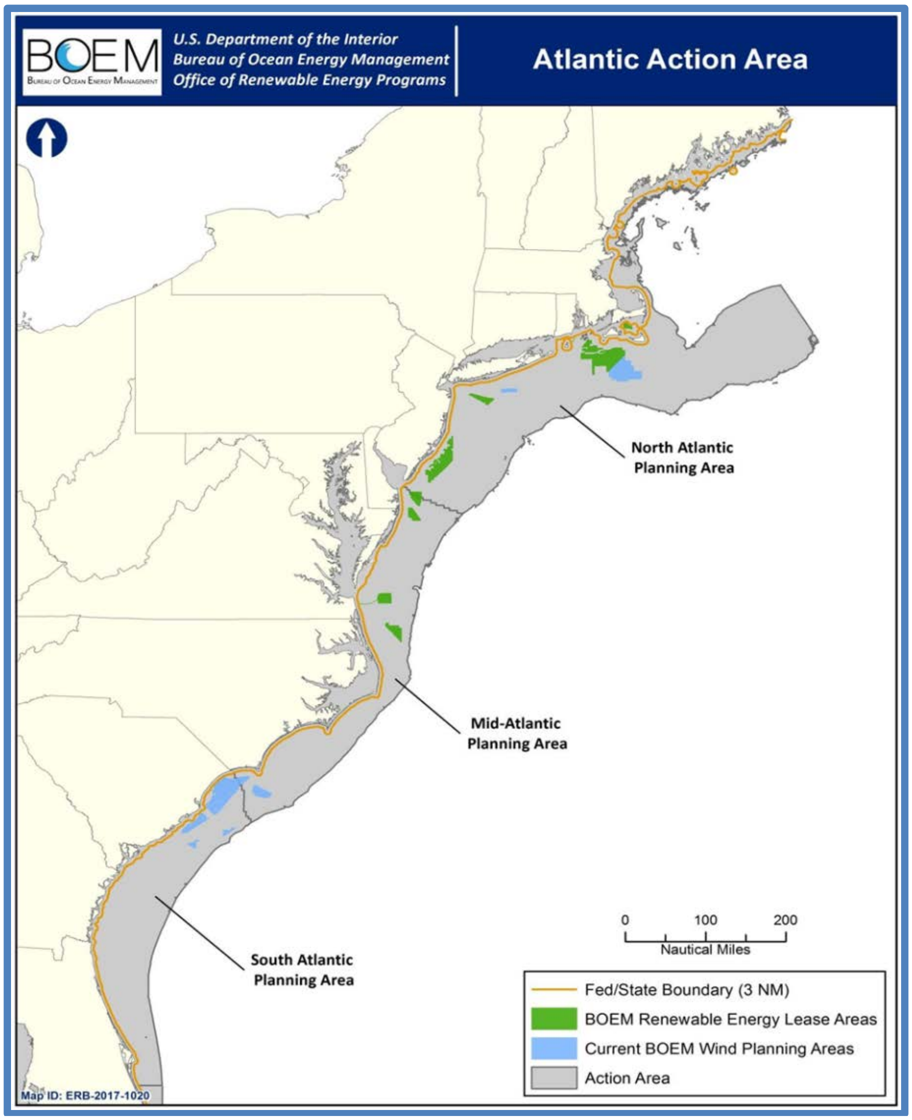
Data Collection and Site Survey Activities for Renewable Energy on the Atlantic Outer Continental Shelf

Biological Assessment



U.S. Department of the Interior
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Biological Assessment

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Bureau of Ocean Energy Management
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ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
μPa	micropascal
μPa^2-s	micropascal squared second
μs	microsecond
ac	acres
ADCP	acoustic doppler current profiler
AIS	automatic identification system
BA	biological assessment
BOEM	Bureau of Ocean Energy Management
BMP	best management practice
BSEE	Bureau of Safety and Environmental Enforcement
CCL	curved carapace length
C.F.R.	Code of Federal Regulations
CHIRP	Compressed High Intensity Radar Pulse
cm	centimeters
CODAR	Coastal Ocean Dynamic Applications Radar
COP	construction and operation plan
CPT	cone penetrometer test
CWA	Clean Water Act
dB	decibels
dB_{peak}	peak sound pressure
DOE	Department of Energy
DOI	Department of the Interior
DP	dynamic positioning
DPS	Distinct Population Segments
EA	Environmental Assessment
EIS	Environmental Impact Statement
EPA	U.S. Environmental Protection Agency
EPAct	Energy Policy Act
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FLiDAR	floating LiDAR [light detection and ranging]
FR	*Federal Register*
ft	feet

ft^2	square feet
FWS	U.S. Fish and Wildlife Service
G&G	geological and geophysical
GAP	General Activities Plan
ha	hectares
HRG	high-resolution geophysical
Hz	hertz
in.	inch/inches
IPF	Impact Producing Factor
ITA	Incidental Take Authorization
kg	kilograms
kHz	kilohertz
kJ	kilojoules
km	kilometers
km^2	square kilometers
km/hr	kilometers per hour
lb	pound
LiDAR	light detection and ranging
L_{rms}	mammal hearing weighted (M-weighted) sound levels
m	meters
m^2	square meters
M-weighted	mammal hearing weighted
MARAD	U.S. Maritime Administration
MARPOL	International Convention for the Prevention of Pollution from Ships
mg/L	milligrams per liter
mi	miles
mi^2	square miles
mm	millimeters
MMPA	Marine Mammal Protection Act
ms	milliseconds
MW	megawatts
NARW	North Atlantic right whale
NEAMAP	Northeast Area Monitoring and Assessment Program
NEFSC	Northeast Fisheries Science Center
NEPA	National Environmental Policy Act

nm	nautical miles
NMFS	National Marine Fisheries Service
NO_2	nitrogen dioxide
NOAA	National Oceanic and Atmospheric Administration
NOMAD	Naval Oceanographic and Meteorological Automated Device
NWP	Nationwide Permit
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OREP	Office of Renewable Energy Programs
PATON	private aids to navigation
PDC	project design criteria
PEIS	Programmatic Environmental Impact Statement
PSO	protected species observer
PTS	Permanent Threshold Shift
RGP	Regional General Permit
RMS	root mean square
ROV	remotely operated underwater vehicle
SAP	Site Assessment Plan
SCL	straight carapace length
SEL	sound exposure level
SEL_{cum}	cumulative sound exposure level
SMA	Seasonal Management Area
SOC	Standard Operating Condition
SODAR	sonic detection and ranging
SPL	sound pressure level
TTS	Temporary Threshold Shift
USACE	U.S. Army Corp of Engineers
U.S.C.	U.S. Code
USCG	U.S. Coast Guard
WEA	Wind Energy Area

EXECUTIVE SUMMARY

The Department of the Interior (DOI) Bureau of Ocean Energy Management's (BOEM) Office of Renewable Energy Programs (OREP) has prepared a Biological Assessment (BA) for data collection activities in wind energy areas on the Atlantic Outer Continental Shelf (OCS). This BA has been prepared in accordance with the Endangered Species Act (ESA) regulatory requirements in the Code of Federal Regulations (C.F.R.) at 50 C.F.R. 402.12 to evaluate the potential effects of federally proposed actions on endangered and threatened species and designated critical habitat. An accompanying letter to the National Marine Fisheries Service (NMFS) requested programmatic interagency consultation under Section 7 of the ESA to ensure that any renewable activities authorized, funded, or carried out by BOEM are not likely to jeopardize listed species, or destroy or adversely modify critical habitat designated for those species (50 C.F.R. 402.01; and United States Code (U.S.C.) at 16 U.S.C. § 1536).

The scope of this BA covers site survey and data collection activities (Section 2) in the action area (Section 3) (also referred to as site characterization and site assessment activities) in support of renewable energy development on the Atlantic OCS, and the potential effects of these activities on listed species (Section 4). The BA describes the data collection and associated activities as the proposed action, and conducts an analysis of the potential effects (Section 5) on listed species and designated critical habitat under the jurisdiction of NMFS. The Bureau of Safety and Environmental Enforcement (BSEE), U.S. Army Corp of Engineers (USACE), Department of Energy (DOE), and the U.S. Environmental Protection Agency (EPA) are co-action agencies for the proposed action.

The proposed action includes project design criteria (PDCs) and best management practices (BMPs) (Section 2) for any activities that BOEM has concluded in this BA to have a potentially adverse effect on listed species. BOEM will implement BMPs through issuance of leases and review of proposed plans through standard operating conditions (SOCs). The analysis of effects (Section 5) considers the effectiveness of these BMPs to avoid or minimize any potentially adverse impacts. The purpose of the proposed BMPs are described in more detail in the analysis of effects and are found in Appendix A and summarized in Section 2.9. BOEM's plan for future coordination with NMFS under this programmatic framework is also included. Following the analysis of this BA, BOEM also has determined that a number of impact-producing factors associated with data collection activities, including vessel operations, accidental release of marine debris, drilling noise, and other benthic sampling activities, may potentially affect listed species (see summary Table 1). Critical habitat is designated for North Atlantic right whales and the North Atlantic distinct population segment (DPS) of loggerhead sea turtles in the action area, but none will be affected.

Table 1. Summary analysis of effects from the proposed action (OCS renewable energy site characterization and site assessment activities and BMPs) on ESA-listed species in the Action Area.

Impact Producing Factor	Route of Effect	Potential Effect	BMP	Effects Determinations for Threatened and Endangered Species		
				Whales[a]	Sea Turtles[b]	Fish[c]
Metocean Buoy Installation						
Installation of metocean buoys, wave gliders, and other data collection devices	Turbidity/seafloor disturbance	Foraging/prey availability	N	NE	NLAA	NLAA
	physical presence of moorings/buoys	Entanglement	Y	NLAA	NLAA	NE
Emissions and discharges	Onboard generators and fuel storage	Air and Water Quality	N	NLAA	NLAA	NLAA
Benthic, Geophysical, and Geotechnical Surveys						
HRG surveys	Noise	Disturbance	Y	NLAA	NLAA	NLAA
Piston/gravity/vibra/box cores, cone penetrometer	Turbidity/water quality	No effect	N	NLAA	NLAA	NLAA
	Noise	Disturbance	Y	NLAA	NLAA	NLAA
Core sampling	Turbidity/water quality	No effect	N	NE	NE	NE
	Drill noise	Disturbance	Y	NLAA	NLAA	NLAA
	Vessel operation	Disturbance	Y	NLAA	NLAA	NE
Site clearance verification surveys	foundation removal, seafloor disturbance, turbidity	Foraging/prey availability	N	NE	NE	NLAA
	Side-scan sonar (≥200 kHz)	No effect	N	NE	NE	NE
Vessel Operations						
Vessel transits and operations	Strikes	Injury	Y	NLAA	NLAA	NE
	Noise	Disturbance	N	NLAA	NLAA	NLAA
Vessel Engines and Thrusters	Noise	Disturbance	Y	NLAA	NLAA	NE
	Impingement	No Effect	N	NE	NE	NE
Vessel Anchoring	Seafloor disturbance, turbidity	Foraging/prey availability	N	NLAA	NLAA	NE
Marine Debris						
Accidental release of marine debris	Ingestion, entanglement	Injury	Y	NLAA	NLAA	NLAA

[a]North Atlantic right whales, fin whales, sei whales, and sperm whales
[b]Northwest Atlantic DPS of loggerhead sea turtles, green North Atlantic DPS, Kemp's ridley, and leatherback sea turtles
[c]Atlantic sturgeon, Atlantic salmon, shortnose sturgeon, smalltooth sawfish

NE = "No effect" means ESA-listed species or critical habitat will not be affected, directly or indirectly.
NLAA = "May affect, but not likely to adversely affect" means that all effects are beneficial, insignificant, or discountable.
LAA = "May affect, and is likely to adversely affect" means that one or more individuals of an ESA-listed species or one or more essential features of critical habitats are likely to be exposed to the actions and are likely to result in "take" or adverse effects, respectively.

Considering the analysis of potential effects from the proposed action, including implementation of BMPs, BOEM has made the following determination regarding effects to listed species. The

PDCs and BMPs proposed include protected species observers (PSOs), vessels trike avoidance, exclusion zones, and other best practices avoid and minimize the potential for adverse affects from occurring (see Appendix A). BOEM has determined that PDCs and BMPs reduce the potential for adverse affects from exposure to the proposed action to discountable levels.

Based on the source characteristics of high-resolution geophysical (HRG) equipment, HRG surveys will not have any potential effect on the hearing abilities of large whales but may result in some localized disturbance. The proposed BMPs that will require exclusion zones and monitoring requirements will minimize the duration of this potential disturbance. All other activities will have no effect or will have discountable or insignificant effects with implementation of the proposed BMPs as part of the proposed action. The impact producing factors (IPFs), geographic location, time of year, and other important species-specific information were considered in the impact determinations. As a result, additional PDCs are proposed that pertain only to Cape Cod Bay and Southern Critical Habitat for NARWs (see Appendix A).

1 INTRODUCTION AND BACKGROUND

The purpose of this BA is to evaluate the effects survey and data collection activities associated with offshore renewable energy may have on listed species of whales, sea turtles, fish and critical habitats. This analysis covers potential activities in the three Atlantic Renewable Energy Regions over the next 10 years. The proposed action is to conduct data collection activities in support of renewable energy development on the OCS. The need for the proposed action is to use the information obtained through data collection activities to make informed business and engineering decisions regarding the development of renewable energy projects. BOEM also funds data collection projects, such as seafloor mapping[1], passive acoustic monitoring[2], protected species surveys[3], and fish telemetry[4] studies through the Environmental Studies Program (ESP). Lessees may also fund wildlife surveys as part of their data collection activities on and surrounding a lease. Section 7 consultations are typically completed on the issuance of scientific research permits under Section 10(a)(1)(A) of the ESA. Future wildlife, benthic, and seafloor mapping surveys are included in the proposed action. Data collection occurs throughout all phases of offshore lease development in support of renewable energy development. These activities are collectively referred to as site characterization and site assessment activities. Site characterization surveys are conducted from a vessel and may include sonar surveys, geotechnical sampling, magnetometer surveys, biological surveys, and archeological surveys. Site assessment activities are conducted with scientific instrumentation attached to buoys to collect oceanographic, meteorological, and biological data on the lease. Consequently, the proposed action also includes the temporary installation, operation, and decommissioning of site assessment structures fixed to the seafloor.

The Energy Policy Act (EPAct) of 2005, Public Law (P.L.). 109-58, added Section 8(p)(1)(C) to the Outer Continental Shelf Lands Act (OCSLA), which grants the Secretary the authority to issue leases, easements, or rights-of-way on the OCS for the purpose of renewable energy development (43 U.S.C. § 1337(p)(1)(C)). DOI announced the final regulations for the OCS Renewable Energy Program in April 2009, which was authorized by the EPAct. The OCSLA, as amended, mandates the Secretary of the Interior (Secretary), through BOEM, to manage the siting and development of OCS of renewable energy facilities. BOEM is delegated the responsibility for overseeing offshore renewable energy development in Federal waters (30 C.F.R. 585). Through these regulations, BOEM oversees responsible offshore renewable energy development.

The renewable energy regulations provide a framework for issuing leases, easements and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas. Under the renewable energy regulations, the issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision-making process. BOEM's wind energy program occurs in four distinct phases, as shown in Figure 1. The issuance of leases and subsequent approval of wind energy development on the OCS is a staged decision-making process that involves: (1) BOEM's planning and analysis; (2) lease issuance; (3) approval of a Site Assessment Plan (SAP), and (4) approval of a Construction and Operations Plan (COP).

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[1] https://www.boem.gov/Comprehensive-Seafloor-Substrate-Mapping-and-Model-Validation-in-the-Atlantic/
[2] https://www.boem.gov/Determining-Offshore-Use-by-Marine-Mammals-Maryland-PAM/
[3] https://www.boem.gov/Atlantic-Marine-Assessment-Program-for-Protected-Species-II/
[4] https://www.boem.gov/Endangered-Atlantic-Sturgeon-Habitat-Use-in-Mid-A-Wind-Energy-Areas/

A General Activities Plan (GAP) is required for rights-of-way under a similar staged approval process for installation of electrical cable in the seabed or for substations supporting an OCS wind energy facility on unleased OCS land or across land leased to a third party.

Figure 1. Phases of BOEM's Wind Energy Planning/Authorization Process.

The competitive lease process for OCS renewable energy leases is set forth at 30 C.F.R. 585.210 through 585.225, and the non-competitive process is set forth at 30 C.F.R. 585.230 through 585.232 and was slightly modified by a recent rulemaking on May 16, 2011 (*Federal Register*, 2011b). Most leases on the Atlantic OCS will be issued on a competitive track based on leasing history in the Atlantic thus far. BOEM does not consider the issuance of a lease to constitute an irreversible and irretrievable commitment of agency resources toward the authorization of a commercial wind power facility. This is primarily because the issuance of a lease only grants the lessee the exclusive right to use the leasehold to: (1) gather resource and site characterization information, (2) develop its plans, and (3) subsequently seek BOEM approval of its plans for the development of the leasehold.[5] The purpose of conducting the surveys and installing meteorological measurement devices is to assess the wind resources in the proposed lease area and to characterize the environmental and socioeconomic resources and conditions. A lessee collects this information to determine whether the site is suitable for commercial development and inform its plan submittals. Additional analyses under the National Environmental Policy Act (NEPA) and consultation under the ESA would be required before BOEM makes any decisions made regarding construction of wind energy facilities on its leases.

The BMPs will be implemented at different leasing stages and data collection activities during different development stages (Figure 2). Although any new biological opinions will only cover surveys on leases granted in the future, BOEM will work with current lessees to modify any changes to the SOCs of survey plans or through mutually agreed upon lease modifications and stipulations to implement the current version of the BMPs.

[5] See the proposed renewable energy commercial lease form at 76 FR 55090.

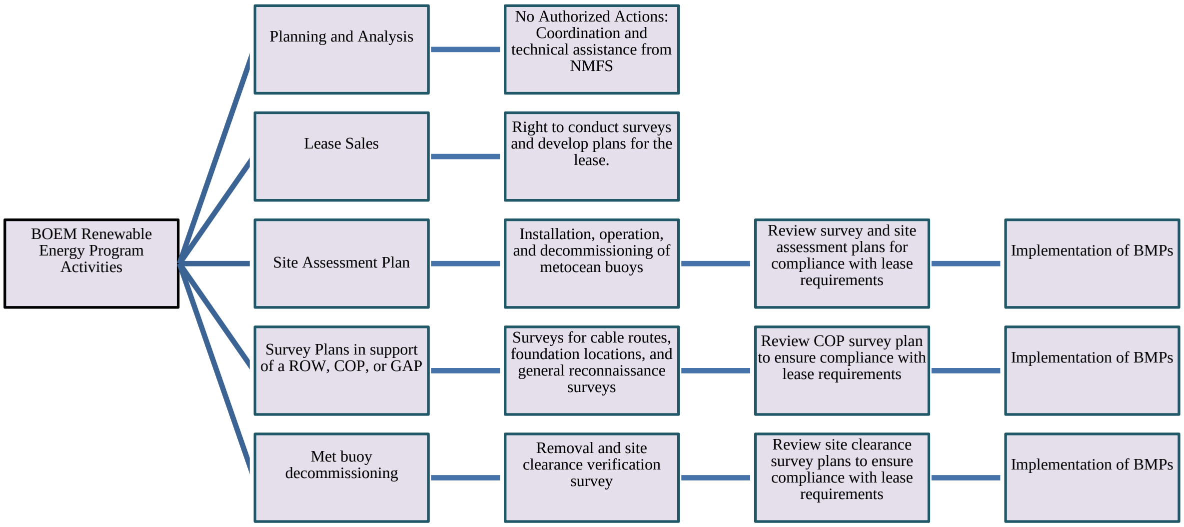

Figure 2. BOEM's Office of Renewable Energy Programs lease stages, activities, and review stages for endangered and threatened covered in this BA.

With respect to the programmatic activities covered in this BA, BOEM regulations require that a lessee provide the results of shallow hazard, geological, geotechnical, biological, and archaeological surveys with its SAP and COP (see 30 C.F.R. 585.610(b) and 30 C.F.R. 585.626(a)). All current leases are covered under previous biological opinions issued for these actions. BOEM does not issue permits for site characterization activities. The exclusive right to conduct surveys is granted at the time of lease issuance; therefore, the BMPs for surveys on current leases are guided by previous biological, opinions.

Co-Action Agencies

The BSEE, USACE, DOE, and EPA are cooperating agencies for the development of the Environmental Impact Statement (EIS) for the Vineyard Wind project under NEPA. These Federal agencies will also be co-action agencies for the ESA consultation. Pursuant to 50 C.F.R. 402.07, BOEM has accepted designation as the lead federal agency for the purposes of fulfilling interagency consultation under Section 7 of the ESA. Additionally, as provided for in 50 C.F.R. § 600.920(b), BOEM has accepted designation as the lead agency for the purposes of fulfilling Essential Fish Habitat consultation obligations under Section 305(b) of the Magnuson-Stevens Fisheries Conservation & Management Act. No other federal agencies other than the co-action action agencies will have authorized actions that may affect listed species under the proposed action.

BSEE

On May 19, 2010 the Secretary of the Interior signed a Secretarial Order to divide regulatory responsibilities on the OCS. The Secretarial Order envisioned that there would be a future division of administrative responsibility for renewable energy. Following such a division, BOEM would continue to oversee the identification and leasing of offshore areas for renewable energy development and evaluation of proposed development plans; while BSEE would enforce safety, environmental, and conservation compliance during project construction and future operations. On October 1, 2010, the resulting creation of BOEM and BSEE focused on dividing regulatory responsibility for the offshore mineral development program and left regulatory responsibility for renewable energy entirely with BOEM. The Bureaus are presently working together to implement this division of responsibility. BOEM will retain authority to issue leases; supervise pre-construction activities; and approve, approve with modification, or disapprove any pre-construction and construction activities on the lease. BSEE will be in charge of the review of Facility Design and Fabrication and Installation Reports, oversee inspections/enforcement actions as appropriate, oversee certified verification efforts, oversee facility removal inspections/monitoring, and oversee bottom clearance confirmation. Once the transfer of authority occurs, there may be possible changes in the Bureaus responsibilities regarding implementation and enforcement of BMPs and other requirements; however, no substantive changes that affect the proposed action are expected.

Department of Energy

The U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy (EERE) provides federal funding (financial assistance) in support of renewable energy technologies. EERE's Wind Energy Technologies Office invests in energy science research and development activities that enable the innovations needed to advance U.S. wind systems, reduce the cost of electricity, and accelerate the deployment of wind power, including offshore wind. And, EERE's Water Power Technologies Office enables research, development, and testing of emerging technologies to advance marine energy. EERE could potentially provide financial assistance in support of renewable energy projects that would include activities consistent with those evaluated in this Biological Assessment within the Action Area.

DOE's financial assistance in support of renewable energy projects could occur not only as part of federally-led projects, but for projects sited in state waters as well. For example, DOE is proposing providing federal funding to the University of Maine in support of the construction and operation of an offshore wind project, 'Aqua Ventus', in the Gulf of Maine. The Maine Offshore Wind Energy Research Center (Monhegan Test Site) is approximately 2.5 miles south of Monhegan Island in Lincoln County, Maine and about 12 miles off the mainland. Data collection activities that may be supported by DOE may include geotechnical and geophysical surveys of the cable route.

EPA

Section 328(a) of the Clean Air Act (CAA) (42 U.S.C. § 7401 *et seq.*) as amended by Public Law 101-549 enacted on November 15, 1990, required the EPA to establish air pollution control requirements for OCS sources subject to the OCSLA for all areas of the OCS, except those located in the Gulf of Mexico west of 87.5 degrees longitude (near the border of Florida and Alabama),[6] in order to attain and maintain Federal and State ambient air quality standards and comply with

[6] Public Law 112-74, enacted on December 23, 2011, amended § 328(a) to add an additional exception from EPA regulation for OCS sources "located offshore of the North Slope Borough of the State of Alaska."

the provisions of part C of title I of the Act.[7] To comply with this statutory mandate, on September 4, 1992, EPA promulgated "Outer Continental Shelf Air Regulations" at 40 C.F.R. part 55. 57 Fed. Reg. 40,791. 40 C.F.R part 55 also established procedures for implementation and enforcement of air pollution, control requirements for OCS sources. 40 C.F.R. § 55.2 states:

> OCS source means any equipment, activity, or facility, which:
> (1) Emits or has the potential to emit any air pollutant;
> (2) Is regulated or authorized under OCSLA (43 U.S.C. § 1331 *et seq.*); and,
> (3) Is located on the OCS or in or on waters above the OCS.
> This definition shall include vessels only when they are:
> (1) Permanently or temporarily attached to the seabed and erected thereon and used for the purpose of exploring, developing, or producing resources therefrom …; or
> (2) Physically attached to an OCS facility, in which case only the stationary sources aspects of the vessels will be regulated.

OCS sources, pursuant to this definition, can include wind energy development sources which are authorized under OCSLA at 43 U.S.C. § 1337(p)(1)(C).[8] On April 22, 2009, BOEM announced final regulations for the OCS Renewable Energy Program. These regulations, codified at Title 30 of the C.F.R. part 585, provide a framework for issuing leases, easements, and rights-of-way for OCS activities that support production and transmission of energy from sources other than oil and natural gas. BOEM issues commercial leases and approves COPs to construct, operate, and decommission offshore wind projects. Thus, where these projects emit or will have the potential to emit air pollutants and are located on the OCS or in or on waters above the OCS, the projects will be subject to the 40 C.F.R. part 55 requirements, including the 40 C.F.R. § 55.6 permitting requirements.

USACE

The USACE has regulatory responsibilities under Section 10 of the Rivers and Harbors Act of 1899 to approve/permit any structures or activities conducted below the mean high water line of navigable waters of the United States. The USACE also has responsibilities under Section 404 of the Clean Water Act (CWA) to prevent water pollution, obtain water discharge permits and water quality certifications, develop risk management plans, and maintain such records. A general condition of a Nationwide Permit (NWP) for water quality stipulates that where states, authorized tribes, or the EPA, where applicable, have not previously certified compliance of a NWP with CWA Section 401, an individual 401 Water Quality Certification must be obtained or waived (33 C.F.R. 330.4(c)). The USACE District Engineer, state, or tribe may require additional water quality management measures to ensure that the authorized activity, such as site characterization, does not result in more than minimal degradation to water quality.

[7] Part C of title I contains the Prevention of Significant Deterioration of Air Quality (PSD) requirements.

[8] The Energy Policy Act of 2005 (Pub. L. No. 109-58) amended OCSLA to add subsection (p)(1)(C), granting the Secretary of Interior the authority to issue leases, easements, or rights-of-way on the OCS for activities that "produce or support production, transportation, or transmission of energy from sources other than oil and gas" which includes renewable energy development, including wind energy development. The Department of Interior delegated this authority to the Minerals Management Service (now the Bureau of Ocean and Energy Management (BOEM)).

A USACE NWP 5 or Regional General Permit (RGP) for Scientific Measurement Devices is required for devices and scientific equipment whose purpose is to record scientific data through such means as meteorological stations (which would include buoys); water recording and biological observation devices, water quality testing and improvement devices, and similar structures. In New England States, RGPs are required instead of the NWP. As stated in both types of permit, "*upon completion of the use of the device to measure and record scientific data, the measuring device and any other structures or fills associated with that device (e.g., foundations, anchors, buoys, lines, etc.) must be removed to the maximum extent practicable and the site restored to preconstruction elevations,*" as prescribed by Section 404 of the CWA (U. S. Army Corps of Engineers 2012). Prospective permittees must also determine the status of the CWA Section 401 water quality certification provided by the EPA.

Previous Assessments and Endangered Species Act Consultations on Offshore Renewable Energy Activities in the Atlantic

BOEM has conducted several prior NEPA environmental analyses that it used to inform this BA. EAs have been prepared for the issuance of leases off the following states:

1) New Jersey, Delaware, Maryland, and Virginia (BOEM 2012) available at http://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/Smart_from_the_Start/Mid-Atlantic_Final_EA_012012.pdf;
2) New Jersey and Delaware (Minerals Management Service 2009), available at http://www.boem.gov/uploadedFiles/FinalEA_MMS2009-025_IP_DE_NJ_EA.pdf;
3) Rhode Island and Massachusetts (Bureau of Ocean Energy Management 2013a) available at http://www.boem.gov/uploadedFiles/BOEM/Renewable_Energy_Program/State_Activities/BOEM%20RI_MA_Revised%20EA_22May2013.pdf;
4) Massachusetts (Bureau of Ocean Energy Management 2014) available at http://www.boem.gov/Revised-MA-EA-2014/;
5) Georgia (BOEM 2014) available at http://www.boem.gov/2014-017/;
6) North Carolina (BOEM 2015) available at http://www.boem.gov/NC-EA-Camera-FONSI/; and
7) New York (BOEM 2016) available at https://www.boem.gov/NY-EA-FONSI-2016/.

BOEM has also completed several Section 7 consultations with NMFS relating to HRG surveys, geotechnical surveys, and construction of metocean buoys previously in the Atlantic. These consultations cover a number of different action areas, and have separate incidental take statements and reasonable and prudent measures. This consultation is being conducted due to: (1) the need for consistency among these opinions; (2) new information available; and (3) lessons learned through implementation of the renewable energy program that warrant a re-evaluation of the program's effects and BMPs. BOEM has prepared this BA to cover all leases granted over the next 10 years in Atlantic Renewable Energy Regions and data collection activities that may occur. Completion of Section 7 consultation associated with this BA is expected to supersede and replace the following consultations (insofar as they relate to future renewable energy leases and related surveys, as well as any future plan approvals):

- September 20, 2011 Programmatic Informal Consultation in Mid-Atlantic Wind Energy Areas.

- April 10, 2013 Biological Opinion on Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf in Massachusetts, Rhode Island, New York and New Jersey Wind Energy Areas, NER-2012-9211.
- July 19, 2013 Biological Opinion on Programmatic Geological and Geophysical Activities in the Mid and South Atlantic Planning Areas from 2013 to 2020.
- March 11, 2016 Biological Opinion on Lease Issuance for Wind Resources Data Collection on the Outer Continental Shelf Offshore Georgia, as amended on August 2016.

This BA only covers program activities under BOEM's OREP and does not supersede or replace previous assessments or consultations completed for the Oil and Gas Program or the Marine Minerals Program that were also covered in the July 19, 2013 biological opinion on Atlantic Geological and Geophysical activities. BOEM understands that the analyses, incidental take exemptions, and reasonable and prudent measures for renewable activities covered in all the above-listed biological opinions will remain in effect until this consultation is completed and a biological opinion issued.

Scope of the Proposed Action

Offshore wind developers will pursue data collection activities under BOEM leases issued in the Atlantic Renewable Energy Regions. BOEM will not approve SAPs, COPs, or general activities GAPs without adequate survey data on the lease, including geophysical, biological, and archeological information. Among other things, BOEM's OREP requires HRG and geotechnical data to identify potential cable routes, evaluate proposed foundation designs, and identify sensitive benthic resources. Several actions could trigger site characterization and site assessment activities, including:

1) BOEM's own planning and analysis;
2) issuance of an OCS lease;
3) approval of a SAP submitted to install and collect data from meteorological buoys on OCS leases;
4) approval of a COP, which will be consulted on separately, may necessitate additional preconstruction surveys covered in this BA to identify and characterize specific foundation locations and monitor and confirm conditions at existing proposed cable and foundation sites; and
5) approval of a GAP for technology testing or rights-of-way (ROW) for installation of electrical transmission cables will also be consulting on separately, but may likewise necessitate additional preconstruction surveys covered in this BA.

Some data collection surveys associated with renewable energy activities may occur within state waters (e.g., surveys for potential cable routes and biological resources) that are beyond BOEM's authority. The scope of this BA does not include site characterization and site assessment activities conducted by States in support of offshore renewable energy development, unless a State is a lessee. The equipment and methods described in this BA will be the same as those that occur as a result of federal OCS leasing. State-funded surveys, conducted in support of OCS renewable energy leases, are considered interrelated actions to the proposed action; however, BOEM has no authority or jurisdiction over these State initiatives absent a state-owned BOEM lease. Informal coordination between State and Federal agencies may occur; however, there may not be a federal nexus for any such activities.

Lessees may, but are not required to, obtain incidental take authorization (ITA) under the Marine Mammal Protection Act (MMPA) for activities that occur both within and outside of BOEM's jurisdiction that may "take" marine mammals; ITAs must be obtained from NMFS. At the time those authorizations are issued, the incidental take statement of the biological opinion would be amended for any authorized incidental take of listed species of whales that may be anticipated to occur in Federal waters.

BOEM, in conjunction with BSEE, has developed PDCs and BMPs to minimize or eliminate potential effects on species of marine mammals, sea turtles, and fish listed as threatened or endangered under the ESA. The BMPs have been developed through years of experience with BOEM's conventional energy program, refinement through the renewable energy program needs, the availability of new information, and consultations with NMFS. These BMPs are included as part of the proposed action for potential impacts identified in this BA, and include vessel strike avoidance measures, marine debris awareness training, PSOs, monitoring and exclusion zones for protected species, and other mitigation and monitoring measures that will be discussed in more detail in this BA.

The construction, operation, and decommissioning of structures associated with offshore wind power generation and transmission of power are not covered in the scope of this action. BOEM intends to conduct an independent assessment and consultations for the construction, operation, and decommissioning of offshore wind facilities. BOEM will prepare an EIS for these actions under NEPA. Consultation will be initiated with NMFS once a complete COP or GAP is received by BOEM. Similarly, a decommissioning plan is required prior to removing any offshore wind facilities that will be approved by BOEM. However, the data collection and survey activities associated with COPs, GAPs, and decommissioning plans are routine activities conducted over the lifetime of a lease and are included in the scope of this BA.

The proposed action covers data collection activities resulting for leases awarded over a 10-year period from issuance of a biological opinion. BOEM does not issue permits for site characterization survey activities. The exclusive right to conduct surveys is granted at the time of lease issuance; therefore, the BMPs for surveys on current leases are guided by previous biological opinions. Any new biological opinions will cover surveys on leases issued in the future. Existing lessees may voluntarily request modification of their leases to substitute the BMPs set forth in this BA.

2 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is data collection and associated activities conducted in support of OCS renewable energy. Data collection will occur at different times throughout the life of a lease, although the installation of metocean buoys will occur early in lease development to obtain data prior to construction. A commercial lease gives the lessee the exclusive right to seek BOEM approval for the development of the leasehold. The exclusive right makes it foreseeable that a lessee will conduct the surveys needed to develop and submit plans, and that the lessee will install site assessment devices to collect wind resource data needed to design wind energy facilities and plan a COP. The regulations also require that a lessee provide the results of HRG and geotechnical surveys with its COP, including a shallow hazards survey (30 C.F.R. 585.626 (a)(1)), geological survey (30 C.F.R. 585.626(a)(2)), geotechnical survey (30 C.F.R. 585.626(a)(4)), and an archaeological resource survey (30 C.F.R. 585.626(a)(5)) that are included in the proposed action.

BOEM reviews individual survey plans submitted under a lease, for compliance with lease stipulations and other regulatory requirements such as the ESA, to determine if the survey will meet BOEM's data needs. However, BOEM does not approve and disapprove individual HRG or geotechnical survey plans. BOEM approval of a COP is a precondition to the construction of any wind energy facility on the OCS (30 C.F.R. 585.620(c)). BOEM may approve, approve with modification, or disapprove a lessee's COP (30 C.F.R. 585.628). The proposed action does not include approval of COPs. Project-specific Section 7 consultation will be initiated when a complete COP is received by BOEM.

The data collection activities covered in this BA are categorized into four main categories: 1) HRG surveys, 2) geotechnical surveys, 3) biological surveys, and 4) metocean buoy(s) installation. The activities expected to occur during each main stage of lease development are shown in **Figure 3**.

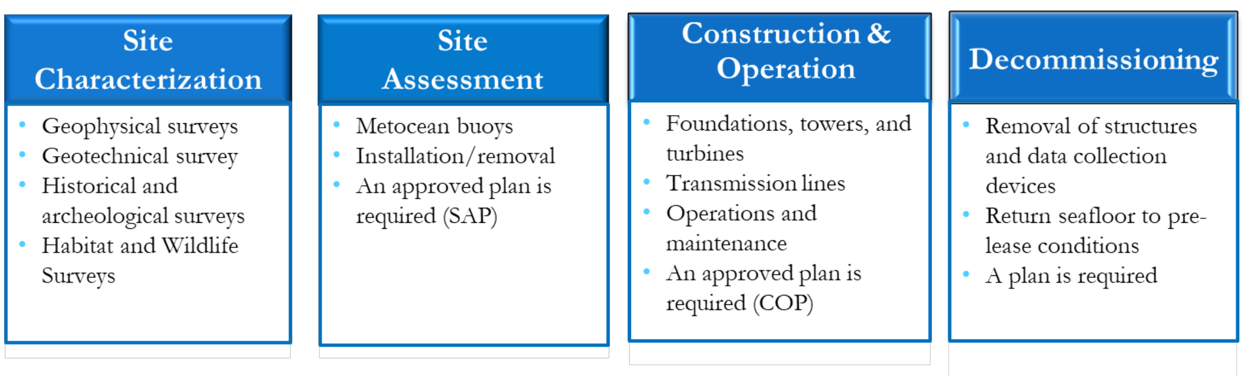

Figure 3. The data collection activities and stages of lease development at which they may occur.

Since creation of the program in 2005, there has been an average of about one lease per year issued by BOEM. There are currently 15 commercial leases, 1 research lease, and 1 ROW Grant along the U.S. Atlantic coast. These leases are at different stages of development, and the projected number of remaining surveys varies for each lease (Table 2). Therefore, we have conservatively calculated the maximum number of surveys that may occur on existing leases. The number of future leases will be driven by a number of factors, including the wind energy potential of the area, developer interest, state interest, and the economics of the industry. In addition to the current leases, BOEM estimates that it will conduct approximately one lease sale per year over the next

10 years, each involving one or more lease areas resulting in approximately 15-20 commercial wind energy leases.

The use of metocean buoys is the preferred method of collecting meteorological and oceanic data on OCS leases due to the improvement in light detection and ranging (LiDAR) technology, flexibility for installation at a variety of water depths, and much lower costs associated with buoy installation, maintenance, and decommissioning. As of January 2021, BOEM has approved ten SAPs that have, or will be installing buoys. For any given lease, a lessee would install 1-3 buoys to collect meteorological and oceanic data during the site assessment phase of development (Table 2). For some BOEM leases issued thus far, a single buoy is deployed and once retrieved, deployed to a second location such that the buoys are not necessarily deployed at the same time. Other leases may deploy buoys simultaneously. Future research and/or deployments are dependent upon Congressional guidance, but it is projected the number of devices that EERE would potentially provide funding in support of over the next 10 years is approximately 12 devices across the 3 BOEM planning areas. However, DOE funding and thus research priorities beyond 2021, have not yet been set by Congress.

Table 2. The total number of active competitive and non-competitive leases, ROWs, and data collection devices under the proposed action.

Actions	Renewable Energy Region: North Atlantic		Mid-Atlantic		South Atlantic	
	Existing	Proposed Action	Existing	Proposed Action	Existing	Proposed Action
Leases	11	7-9	5[a]	5-7	0	3-4
ROWs	1[b]	7-18[c]	0	5-14	0	3-8
Metocean Buoys	11-33	7-27	0	5-21	0	3-12
DOE Devices	12					

[a] Projected numbers of existing buoys includes those approved, deployed, or deployed and retrieved. Project buoys include existing leases that have no data collection approved yet, as well and projected leases to occur over 10 years.
[b] Block Island Wind Farm ROW OCS lease.
[c] It is projected there will be 1-2 ROWs per lease.

The number of lease blocks under the proposed action is based upon estimates of future renewable energy leases issued over the next 10 years (see https://www.boem.gov/Renewable-Energy-Path-Forward). Projected leases were identified in current Call Areas or unsold lease areas and from areas of the OCS that BOEM has identified as having moderate to high levels of leasing potential (83 FR 14882).[9] These areas of moderate to high leasing potential are located greater than 10 nm from the nearest coastline and are in depths of less than 60 meters. The new areas of leasing potential include 977 blocks in the North Atlantic, 26 blocks in the Mid-Atlantic, and 460 blocks in the South Atlantic. However, only 20.5-27.3 % (300-400) of these lease blocks are estimated to be available for leasing over the next 10 years. The amount of the OCS that BOEM leases in the next 10 years will be subject to factors such as industry interest, state offtake, and potential removal of areas from leasing consideration due to ocean user conflict and environmental

[9] https://www.boem.gov/Renewable-Energy-Path-Forward/

considerations. In 2020, BOEM completed a Supplement to the Draft Environmental Impact Statement for the Vineyard Wind 1 Offshore Wind Project (https://www.boem.gov/sites/default/files/documents/renewable-energy/Vineyard-Wind-1-Supplement-to-EIS.pdf). This supplement analysis of the cumulative potential offshore wind development based on planned and submitted projects on existing leases, offtake awarded, solicitations announced, and State capacity announced. However, the amount of leasing and associated survey activity will likely exceed the anticipated future development since greater survey effort is required to identify the appropriate areas meet geophysical, environmental, and engineering requirements. Therefore, the proposed action is not solely based on the projected wind farm development in the supplemental analysis but is based upon anticipated data collection on current and future leases over 10 years. Based on projected areas of interest, we estimate 7-9 leases in the North Atlantic, 5-7 leases in the Mid-Atlantic, and 3-4 leases in the South Atlantic (a total of 15-20 new leases) over the next 10 years.

The average lease size from leases issued to date is 23.5 lease blocks in the North Atlantic Region and 11.5 blocks in the Mid-Atlantic Region. A standard lease block is 4,800 m x 4,800 m (2,304 hectares or 23.04 km^2); although some exceptions exist along some boundaries where triangular, lease blocks may be present. Based on current lease sizes, BOEM estimates an average lease size of 20 blocks from lease sales in the next 10 years. Based on an estimated average lease size of 20 blocks and the maximum number of leases expected in each Renewable Energy Region, we have calculated the total number of leased blocks that may be expected to occur over the next 10 years (Table 3), with approximately 57% of leases in the North Atlantic, 31% in the Mid-Atlantic, and 12% in the South Atlantic.

Table 3. The estimated number of lease blocks used to calculate activity levels under the proposed action.

Renewable Energy Region	Blocks Currently Leased	New Blocks Leased 2021-2031	Total Blocks Leased 2021-2031 (Current Leases + New Leases)
North Atlantic	288	140-180	428-468
Mid-Atlantic	87	100-140	187-227
South Atlantic	0	60-80	60-80
Total	375	300-400	675-775

The area of transmission line easements surveyed can be variable depending on the number of cables and distance from shore for individual leases. There have been no ROWs for offshore infrastructure projects linking transmission cables from which survey estimates can be made, but the area surveyed is expected to be similar to areas surveyed associated with a lease as discussed below. The actual width of ROWs affected by installation is quite small, but the actual area that needs to be surveyed maybe much wider to identify the best possible routes. BOEM conservatively estimates a 1 km wide survey corridor associated with each OCS lease. A recently submitted construction plan by Vineyard Wind offshore Massachusetts, the longest proposed cable route is approximately 70 km long. Based on these estimates, a typical easement area surveyed will be 70 km^2 (1 km wide x 70 km long).

2.1 High-Resolution Geophysical Surveys

The HRG surveys can occur at any time during the lifespan of a lease. HRG surveys may be conducted in order to: 1) acquire geophysical shallow hazards information including information to determine whether shallow hazards will affect seabed support of the turbines; 2) obtain information pertaining to the presence or absence of archaeological resources; 3) characterize benthic resources; 4) conduct bathymetric charting; and identify areas to be avoided during lease development. Survey data are used to identify sensitive habitats, anchoring and foundation locations, pipeline routes, and geophysical properties to inform engineering decisions. Once a lease is granted, Lessees are required to submit the results of their HRG survey results with the submission of a SAP to install data collection devices (e.g., metocean buoys and wave riders), a GAP for construction activities on ROWs or limited leases (e.g., transmission cables or research leases), or a COP for construction and operations of a wind facility. HRG surveys will be required post-construction to monitor cable burial and foundation scour, and may be used to verify site clearance following decommissioning and removal of data collection devices from the seabed.

HRG surveys are typically conducted using equipment deployed from or attached to a single vessel. Lessees have recently proposed the use of one or more survey vessels using a manned vessel and an unmanned autonomous vessel within 1 km and controlled from the mother vessel. For both types of vessels, the same type of HRG equipment is used. Based on the offshore renewable energy surveys conducted so far, as well as BOEM's guidelines to meet the regulatory geophysical data requirements,[10] HRG surveys would be undertaken using the equipment described in Table 4 and Table 5. BOEM may allow the use of equivalent technologies to those shown in these tables so long as the lessee can demonstrate that their potential impacts are similar to those analyzed for the representative equipment and methods described below.

The line spacing for HRG surveys is dependent upon the intended purpose of the data, and is typically conducted in accordance with BOEM guidance as follows:

- For the collection of geophysical data for shallow hazards assessments, (including magnetometer, side-scan sonar and sub-bottom profiler systems) BOEM requires surveys lines will be conducted at 492-foot (ft) (150 m) over the proposed lease area;
- For the collection of geophysical data for archaeological resources assessments (including magnetometers, side-scan sonar, and all sub-bottom profiler systems) BOEM requires survey lines be conducted at 98 ft (30 m) line spacing over the proposed lease area; and
- For bathymetric charting and benthic surveys, the lessee would likely use a multi-beam echosounder at line spacing appropriate to the range of depths expected in the survey area.

Table 4. High-Resolution Geophysical Survey Equipment and Methods

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment
Bathymetry/ multi-beam echosounder	Bathymetric charting	A depth sounder is a microprocessor-controlled, high-resolution survey-grade system that measures precise water depths in both digital and graphic formats. The system would be used in such a manner as to record with a sweep

[10] https://www.boem.gov/survey-guidelines/

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment
		appropriate to the range of water depths expected in the survey area.
Magnetometer	Collection of geophysical data for shallow hazards and archaeological resources assessments	Surveys would be used to detect and aid in the identification of ferrous or other objects having a distinct magnetic signature. A sensor is typically towed as near as possible to the seafloor and anticipated to be no more than approximately 20 ft (6 m) above the seafloor.
Side-Scan Sonar	Collection of geophysical data for shallow hazards and archaeological resources assessments	This survey evaluates surface and near-surface sediments, seafloor morphology, and potential surface obstructions (MMS, 2007a). A typical side-scan sonar system consists of a top-side processor, tow cable, and towfish with transducers (or “pingers”) located on the sides. Typically, a lessee would use a digital dual-frequency side-scan sonar system with 300 to 500 kHz frequency ranges or greater to record continuous planimetric images of the seafloor.
Shallow and Medium (Seismic) Penetration Profilers	Collection of geophysical data for shallow hazards and archaeological resources assessments and to characterize subsurface sediments	High-resolution CHIRP System sub-bottom profiler or boomers are used to generate a profile view below the bottom of the seabed, which is interpreted to develop a geologic cross-section of subsurface sediment conditions under the track line surveyed. Another type of sub-bottom profiler that may be employed is a medium penetration system such as a boomer, bubble pulser or impulse-type system. Sub-bottom profilers are capable of penetrating sediment depth ranges of 10 ft (3 m) to greater than 328 ft (100 m), depending on frequency and bottom composition.
Acoustic Corer™ (https://www.pangeosubsea.com/acoustic-corer/)	Stationary acoustic source deployed on the seafloor with low and mid frequency chirp sonars to detect shallow (15 m to 40 m) subsea hazards such as boulders, cavities, and abandoned infrastructure by generating a 3D, 12-m diameter “acoustic core” to full penetration depth (inset above).	A seabed deployed unit with dual subsurface scanning sonar heads attached to a 12-m boom. The system is set on a tripod on the seafloor. Each arm rotates 180 degrees to cover a full 360 degrees. Chirp sonars of different frequencies can be attached to each arm providing for multi-aspect depth resolution. Acoustic cores supplement geophysical surveys such as bore holes and CPTs.

Table 5 provides a list of representative equipment specifications used in HRG surveys and their sound intensity (Crocker and Fratantonio 2016). Crocker and Fratantonio (2016) tested equipment for the available power settings and frequency settings available for the equipment. For purposes of the analysis in this BA, the representative equipment in Table 5 is conservatively listed using the highest power settings and source levels. Actual use could have source levels below those indicated.

Table 5. Acoustic Characteristics of Representative HRG Survey Equipment

	Highest Measured Source Level (Highest Power Setting)						
HRG Source	**Source Setting**	**PK**	**RMS**	**SEL**	**Pulse Width (s)**	**Main Pulse Frequency (kHz)**	**Inter-Pulse interval (1/PPS)**
AA200 Boomer Plate	250 J (low)	209	200	169	0.0008	4.3	1.0 (1 pps)
AA251 Boomer Plate	300 J (high)	216	207	176	0.0007	4.3	1.0 (1 pps)
Applied Acoustics S-Boom (3 AA252 boomer plates)	700 J	211	205	172	0.0006	6.2	1.0 (1 pps)
Applied Acoustics S-Boom (CSP-N Source)	1000 J	209	203	172	0.0009	3.8	.33333 (3 pps)
FSI HMS-620D Bubble Gun	Dual Channel 86 cm	204	198	173	0.0033	1.1	8.0 (1 per 8 s)
ELC820 Sparker	750 J (high) 1m depth	214	206	182	0.0039	1.2	1.0 (1 pps)
Applied Acoustic Dura-Spark	2400 J (high), 400 tips	225	214	188	0.0022	2.7	.33333 (1-3 pps)
Applied Acoustic Delta Sparker	2400 J at 1 m depth, 0.5 kHz	221	205	185	0.0095	0.5	.33333 (1-3 pps)
EdgeTech 424 with 3200-XS topside processor	100% power, 4-20 kHz	187	180	156	0.0046	7.2-11	.12500 (8 pps)
[1]**EdgeTech 512i Sub-bottom Profiler, 8.9 kHz**	100% power, 2-12 kHz	186	180	159	0.0087	6.3-8.9	.12500 (8 pps)
Knudsen 3202 Sub-bottom Profiler (2 transducers), 5.7 kHz	Power 4	214	209	193	0.0217	3.3-5.7	0.25000 (4 pps)
Reson Seabat 7111 Multibeam Echosounder	230 dB, 100 kHz	228	224	185	0.00015	100 kHz	0.0500 (20 pps)
Reson Seabat T20P Multibeam Echosounder	220 dB, 200, 300, or 400 kHz	221	218	182	0.00025	≥200 kHz	0.0200 (50 pps)

	Highest Measured Source Level (Highest Power Setting)						
HRG Source	**Source Setting**	**PK**	**RMS**	**SEL**	**Pulse Width (s)**	**Main Pulse Frequency (kHz)**	**Inter-Pulse interval (1/PPS)**
Bathyswath SWATHplus-M	100%, 234 kHz	223	218	180	0.00032	≥200 kHz	0.2000 pps
Echotrac CV100 Single-Beam Echosounder	Power 12, 80 cycles, 200 kHz	196	193	159	0.00036	≥200 kHz	0.0500 (20 pps)
Klein 3000 Side-Scan	132 kHz (also capable of 445 kHz)	224	219	184	0.000343	132 kHz	.03333 (30 pps)
Klein 3900 Side-Scan	445 kHz	226	220	179	0.000084	≥200 kHz	unreported
EdgeTech 4200 Side-Scan	100%, 100 kHz (also a 400 kHz setting)	206	201	179	0.0072	100 kHz	.03333 (30 pps)

Source: Highest reported source levels reported in Crocker and Fratantonio (2016).

Autonomous Surface Vehicles

Some HRG survey vessels utilize autonomous surface vehicles (ASVs) that have geophysical equipment survey equipment attached. ASVs in very shallow water can be operated remotely from a vessel or line of sight from shore by an operator and in an unmanned mode. Typically, one or two additional small ASVs are remotely operated from the mother vessel, including shallow-water surveys where mother vessels can operate in line of sight of ASVs where listed sea turtles and marine mammals may occur. ASVs may range in size from 5.5 ft (l.68 m) for very shallow-water surveys (such as the 1.68 m Geoswath USV[11] or the 1.83 m SR-Surveyor M1.8[12]) up to about 41 ft (12.5 m).[13] ASVs are beneficial to increase survey coverage, extend the reach of larger survey vessels into shallow water, and result in less time spent on the water surveying by completing required surveys more efficiently.

Although most ASVs can operate in a “mannned” or “unmanned” mode, all ASVs operating HRG equipment that may adversely affect listed sea turtle and marine mammal species will be required to have a mother vessel that will acquire survey data in tandem with ASVs, and/or the ASVs will be kept within sight of the mother vessel at all times. ASVs will operate in control of an operator from the mother vessel or autonomously along a parallel track to the mother vessel at a distance set to prevent crossed signaling of survey equipment. Even though the vessel may operate autonomously, it will be in control of an operator at all times. In a previous ASV survey to obtain survey data on an offshore wind lease, the ASV needed to operate within 2,625 ft (800 m) of the mother vessel. During data acquisition surveyors have full control of the data being acquired and have the ability to make changes to settings such as power, gain, range scale etc. in real time. If required, the instrumentation can be shut-down by the operator. At least one ASV technician will be assigned to manage each vessel to ensure the vehicle is operating properly and to take over control of the vehicle should the need arise, such as the implementation of mitigation measures. ASVs can be outfitted with an array of cameras, radars, thermal equipment and AIS, all of which can be monitored in real time. Additional mitigation proposed for surveys with ASVs includes a forward-facing dual thermal/HD camera installed on the mother vessel to provide a field of view ahead of the vessels, forward-facing thermal camera on the ASV itself with a real-time monitor display installed on the mother vessel bridge and use of night-vision goggles with thermal clip-ons for monitoring around the mother vessel and ASVs.

HRG Survey Activity Levels

HRG and geotechnical surveys are expected to occur in existing and future lease areas. Future survey effort is based on the total number of existing and potential future lease blocks for each renewable energy region, over the next 10 years. BOEM recommends that the HRG survey grid(s) for project structures and surrounding area for bathymetric charting, shallow hazards assessments, and archaeological resources assessments be oriented with respect to bathymetry, shallow geologic structure, and renewable energy structure locations whenever possible. The grid pattern for each survey should cover the maximum area of potential effect for all anticipated physical disturbances, as follows:

[11] https://www.kongsberg.com/maritime/products/marine-robotics/autonomous-surface-vehicles/geoswath-4r-USV/
[12] https://www.searobotics.com/products/autonomous-surface-vehicles/sr-surveyor-class
[13] https://media.fisheries.noaa.gov/dam-migration/bay_state_wind_2018_iha_application.pdf

- line spacing for all geophysical data for shallow hazards assessments (on side-scan sonar/all subbottom profilers) should not exceed 150 m (492 ft) with tie line spacing of 500 m throughout an area.
- line spacing for all geophysical data for archaeological resources assessments (on magnetometer, side-scan sonar, chirp subbottom profiler) should not exceed 30 m (98 ft) throughout the area. BOEM may require higher resolution surveys where necessary to ensure that the data collected is of sufficient detail to inform BOEM consultations and decisions under the National Historic Preservation Act.
- line spacing for bathymetric charting using multibeam technique or side-scan sonar should be suitable for the water depths encountered and provide both full coverage of the seabed plus suitable overlap and resolution of small discrete targets of 0.5-1.0 m (1.5-3 ft) in diameter.
- all track lines generally run parallel to each other. Tie-lines running perpendicular to the track lines should not exceed a line spacing of 150 m (492 ft) throughout the survey area.

During site characterization, a lessee would survey a potential transmission cable route (for connecting future wind turbines to an onshore power substation) from the lease area to shore using HRG survey methods. A lessee would submit detailed information on the proposed cable route(s) and wind turbine locations within their COP (see BOEM's COP guidelines available at http://www.boem.gov/COP-Guidelines/). BOEM would then analyze the proposed route(s) and location(s) in a project-/site-specific environmental document. BOEM assumes that lessees would survey 1-2 export cable routes per lease. HRG survey grids for a proposed transmission cable route to shore would likely occur with a survey grid for proposed transmission cable route(s) with a minimum 300 m (984 ft) wide corridor centered on the transmission cable location(s). Line spacing should be identical to that noted above (line spacing of 98 ft (30 m) for longitudinal lines and 500 m (1,640 ft) for perpendicular tie lines).

To estimate HRG activity levels (Table 6), BOEM assumes that HRG surveys for shallow hazards and archaeological resources would be conducted at the same time using the finer line spacing required for archaeological resource assessment (30 m [98 ft]). Tie-lines would be run perpendicular to the track lines at a line spacing of 150 m (492 ft), which would result in 925 km (575 mi [500 nm]) of HRG surveys per OCS block. It would take approximately 150 hr to survey one OCS block. In addition, a 75 km (46.6 mi) cable route to shore was assumed for each state, with a 300 m (984-ft) wide survey corridor requiring about 8 km (5 mi) or 1 hr of surveys per mile of cable. BOEM makes the following assumptions for HRG survey activity level:

- All the proposed lease blocks (675-775) will be completely surveyed;
- All ROWs with a length of 75 km (46.6 mi) by 8 km (5 mi) wide will be surveyed (15-40 ROWs) that is equivalent to approximately the total area of 52-138 lease blocks;
- A vessel speed of 4.5 knots;
- Survey line miles per OCS block is 926 km (575 mi, 500 nm);
- Survey time for one OCS block is 150 hr; and
- Surveys will occur 24 hr/d.

Table 6. Total HRG Survey Line Miles and Survey Days over the 30-Year Life of Leases in Each Renewable Energy Region.

Renewable Energy Region	Total HRG Statute Line Miles on Leases	ROW Survey Statute Line Miles
North Atlantic	246,100-269,100	4,025-10,350
Mid-Atlantic	107,525-130,525	2,875-8,050
South Atlantic	34,500-46,000	150-400

Most HRG surveys on leases will be pre-construction surveys occurring over a 5-year period for any given project phase. Multiple project phases may result in smaller areas within a lease being surveyed at different times over the 30-year lease term. Targeted, periodic surveys are expected to make up a small percentage of overall survey effort, and may occur anytime during operations for monitoring purposes (e.g., to monitor cables burial or foundation scour), or following decommissioning to ensure the site is clear of debris.

2.2 Geotechnical Surveys

Site characterization activities include geotechnical surveys such as cone penetrometer testing, boring, vibracoring, and other geotechnical exploration methods such as grab samples and benthic videography with ROVs. Geotechnical surveys generally do use active acoustic sources, but may have some low-level ancillary sounds associated with them. The G&G Final Programmatic EIS (BOEM, 2014a), which is hereby incorporated by reference, provides an overview of the geotechnical sampling techniques and devices such as bottom-sampling devices, vibracores, deep borings, and cone penetration tests (CPTs). Geotechnical surveys are used to determine whether the seabed can support wind turbine generators and transmission cables, as well as to document the sediment characteristics necessary for design and installation techniques for all structures and cables. The information obtained from these samplings is used to inform future phases of lease development. The information from the G&G Final PEIS is summarized below.

Samples for geotechnical evaluation are collected using shallow-bottom coring and surface sediment sampling devices taken from a small marine drilling vessel. The methods to obtain samples to analyze physical and chemical properties of surface sediments are described in Table 7. CPTs and bore sampling are often used together because they provide different data on sediment characteristics. A CPT provides a fairly precise stratigraphy of the sampled interval, plus other geotechnical data, but does not allow for capture of an undisturbed soil sample. Bore holes can provide undisturbed samples but are most effectively used in conjunction with CPT-based stratigraphy so that sample depths can be pre-determined. A CPT is suitable for use in clay, silt, sand, and granule-sized sediments as well as some consolidated sediment and colluvium. Bore sampling methods can be used in any sediment type and in bedrock. Vibracores are suitable for extracting continuous sediment samples from unconsolidated sand, silt, and clay-sized sediment up to 33 ft (10 m) below the seafloor.

Table 7. Geotechnical/Sub-bottom Sampling Survey Methods and Equipment

Survey Method	Use	Description of the Equipment and Methods
Bottom-sampling devices	Penetrating depths from a few centimeters (cm) to several meters (m)	Grab samplers, piston cores, and gravity cores are often used to obtain samples of soft surficial sediments. Unlike a gravity core, which is essentially a weighted core barrel that is allowed to free-fall into the water, piston cores have a "piston" mechanism that triggers when the corer hits the seafloor. The main advantage of a piston core over a gravity core is that the piston allows the best possible sediment sample to be obtained by avoiding disturbance of the sample (MMS 2007). Shallow-bottom coring employs a rotary drill that penetrates through several feet of consolidated rock. The above sampling methods do not use high-energy sound sources (Minerals Management Service 2004; MMS 2007).
Vibracores	Obtaining samples of unconsolidated sediment; may, in some cases, also be used to gather information to inform the archaeological interpretation of features identified through the HRG survey	Vibracore samplers typically consist of a core barrel and an oscillating driving mechanism that propels the core barrel into the sub-bottom. Once the core barrel is driven to its full length, the core barrel is retracted from the sediment and returned to the deck of the vessel. Typically, cores up to 20 ft (6 m) long with 3 inch (in.) (8 cm) diameters are obtained, although some devices have been modified to obtain samples up to 40 ft (12 m) long (MMS 2007; U.S. Army Corps of Engineers 1987).
Deep borings	Sampling and characterizing the geological properties of sediments at the maximum expected depths of the structure foundations (MMS, 2007a)	A drill rig is used to obtain deep borings. The drill rig is mounted on a jack-up barge supported by four "spuds" that are lowered to the seafloor. Geologic borings can generally reach depths of 100 to 200 ft (30 to 61 m) within a few days (based on weather conditions). The acoustic levels from deep borings can be expected to be in the range of 118 to 145 decibels (dB) at a frequency of 120 hertz (Hz), which would be below the 160 dB threshold established by NMFS to protect marine mammals.
Cone penetration test (CPT)	Supplement or use in place of deep borings	A CPT rig would be mounted on a jack-up barge similar to that used for the deep borings. The top of a CPT drill probe is typically up to 3 in. (8 cm) in diameter, with connecting rods less than 6 in. (15 cm) in diameter.

Sub-bottom sampling of a lease could require a sub-bottom sample at every potential wind turbine location (which would only occur in the portion of the lease where structural placement is allowed) and one sample per nautical mile of transmission cable corridor. The amount of effort and vessel trips required to collect the geotechnical samples varies by type of technology used to retrieve the sample.

- Vibracore samples would most likely be advanced from a single small vessel (approximately 45 ft [14 m]).
- CPT sampling would depend on the size of the CPT; it could be advanced from a medium vessel (approximately 65 ft [20 m]), a jack-up barge, a barge with a four-point anchoring system, or a vessel with a dynamic positioning system. Each barge scenario would include a support vessel.

- Geologic borings would be advanced from a jack-up barge, a barge with a four-point anchoring system, or a vessel with a dynamic positioning system. Each barge scenario would include a support vessel.

Geotechnical Survey Levels

Geotechnical surveys for renewable energy sites will be conducted from a small barge or boat in shallow water and larger vessels greater than 20 m (65 ft) in length in deeper waters. The spatial scale of sampling and testing activities would range from a minimum of 1/16 of a lease block (approximately 260 hectares [ha] or 640 acres [ac]) to multiple lease blocks and is assumed to include cable route(s) to shore. The area of seabed disturbed by individual sampling events (e.g., collection of a core or grab sample) is estimated to range from 1-10 m^2 (11-108 ft^2).

The number of bottom sampling/testing locations for geotechnical surveys is estimated as one sample collected at every potential turbine location. Spacing between wind turbines is typically determined on a case-by-case basis but is generally the distances of 3-6 times the rotor diameter. A review of offshore wind projects in Europe and anticipated development of offshore wind projects in the U.S. suggests a typical separation distance of 675-1,600 m for 6 megawatt (MW) to 12 MW turbine foundations (Rowe et al. 2017), turbine foundations would occupy 455,626 m^2 and 2,560,000 m^2, respectively. Based on this range in spacing, it would be possible to place 9-51 turbines in one OCS block. The sampling numbers in Table 8 and Table 9 are based on the assumption that a bottom sample would be collected at every potential turbine location on a lease, at a density of 9-51 turbines per block (Rowe et al. 2017). With recent trends toward greater 1 NM spacing between foundations, the number of possible turbine locations on an OCS block is very likely toward the lower end of this estimated range.

Assumptions for geotechnical survey activity level calculations:

- one sample (vibracore, CPT, and/or deep boring each) taken at each potential turbine location and one sample conducted per workday.
- Up to a 75 km (46.6 mi) cable route to shore for each lease, with one sub-bottom sample every nautical mile of transmission cable corridor and three buoy sites. The inter-array cables and transmission cables on a lease are already accounted for surveys occurring on a lease that assumes the whole lease is surveyed. The 75 km survey accounts for multiple cables that may be installed, and cable routes that may need to route around sensitive features or may not make landfall at the nearest distance to shore from a lease. However, not every point along a cable route would be sampled.

Table 8. Projected Levels of Geotechnical Surveys for Foundation sites in Renewable Energy Areas, 2021-2031

Renewable Energy Region	Total Number of Sampling Locations			Total Survey Days
	CPT	Coring	Grab Samples	
North Atlantic	3,852-23,868	3,852-23,868	3,852-23,868	3,852-23,868
Mid-Atlantic	1,683-11,577	1,683-11,577	1,683-11,577	1,683-11,577
South Atlantic	540-4,080	540-4,080	540-4,080	540-4,080

Most geotechnical survey effort on leases will be pre-construction surveys occurring over a 5-year period for any given project phase. Multiple project phases may result in smaller areas within a lease being surveyed at different times over the 30-year lease term.

Table 9. Projected Levels of Geotechnical Surveys for Cable Routes and Buoy location in Renewable Energy Areas, 2021-2031

Renewable Energy Region	Total Number of Sampling Locations			Total Survey Days
	CPT	Coring	Grab Samples	
North Atlantic	43-64	43-64	43-64	43-64
Mid-Atlantic	32-48	32-48	32-48	32-48
South Atlantic	10-16	10-16	10-16	10-16

Most geotechnical survey effort on leases will be pre-construction surveys occurring over a 5-year period for any given project phase. Multiple project phases may result in smaller areas within a lease being surveyed at different times over the 30-year lease term.

The noise from geotechnical surveys will be at discountable levels. Most noise generated would be from surface activity associated with lowering and raising equipment in the water and from benthic collection through equipment operated from machinery above the water, hydraulics, and seafloor noise associated with the collection of samples. The largest potential concern identified has been from drilling associated with the collection of sediment cores. Small-scale drilling noise associated with bore samples taken in shallow water has been measured to produce broadband sounds centered at 10 Hz with source levels at 71-89 dB re 1 µPa rms and 75-97 dB re 1 µPa peak depending on the water depth of the work site (Willis et al. 2010). Another study reported measured drilling noise from a small jack-up rig at 147 – 151 db re 1 µPa rms in the 1 Hz to 22 kHz range at 10 m from source (Erbe and McPherson 2017). These sound levels may be audible to listed species but will only be potentially disturbing over very short ranges while they occur at a bore site. Drilling noise is not likely to adversely affect listed species due to the low sound levels, small area affected, and short duration of occurrence under the proposed action.

Biological samples collected from the geotechnical sampling of shallow sediments and information from HRG surveys would help identify sensitive benthic habitats. These surveys will acquire information to identify the presence or absence of exposed hardbottoms of high, moderate, or low relief; hardbottoms covered by thin, ephemeral sand layers; and submerged aquatic vegetation or macro-algae, all of which are key characteristics of sensitive benthic habitat. There are two protocol surveys emphasized within the BOEM Benthic Habitat Survey Guidelines (BOEM 2013): a Sediment Scour and/or Deposition Survey and a Benthic Community Composition Survey. The first involves particle size analysis or sediment-profile imaging and multibeam/interferometric bathymetry (with the collection of backscatter data). The second requires benthic imagery (i.e., underwater video or still imagery of sediment bottom type) as well as physical sampling using Hamon grab (hardbottom), Van Veen grab (soft sediment), and/or Benthic sled. These surveys may be conducted concurrently with other HRG sampling and/or biological surveys and that the lessee would not need to conduct separate biological surveys to delineate benthic habitats. However, if the benthic surveys, G&G surveys, or other information identify the presence of sensitive benthic habitats on the leasehold, then additional site-specific surveys may be necessary.

2.3 Biological Surveys

Under BOEM's regulations, the SAP, COP, and GAP must describe biological resources that could be affected by the activities proposed in the plans, or that could affect the activities proposed in the plans (see 30 C.F.R. 585.611(a)(3); 30 C.F.R. 585.626(a)(3); and 30 C.F.R. 585.645(a)(5)). To support development of these plans, three primary categories of biological resources would need to be characterized using appropriate vessel and/or aerial surveys of the proposed lease area: (1) benthic habitats, (2) avian and bat resources, and (3) marine fauna (Table 10). No fishery-related biological surveys (e.g., trawl surveys, gillnet surveys, or fish/crustacean trap surveys) are included in this proposed action.

Table 10. Biological Survey Types and Methods

Biological Survey Type	Survey Method	Timing
Benthic Habitat	Bottom sediment/fauna sampling and underwater imagery/sediment profile imaging (sampling methods described above under geotechnical surveys)	Concurrent with geotechnical/sub-bottom sampling
Avian	Visual surveys from a boat	10 OCS blocks per day; monthly for 2 to 3 years
	Plane-based aerial surveys	2 days per month for 2 to 3 years
Bats	Ultrasonic detectors installed on survey vessels being used for other biological surveys	Monthly for 3 months per year between March and November
Marine Fauna (marine mammals, fish, and sea turtles)	Plane-based and/or vessel survey, passive acoustic detection – may be concurrent with other biological surveys, but will not be concurrent with any HRG or geotechnical survey work	2 years of survey to cover spatial, temporal, and inter-annual variance in the area of potential effect

For biological surveys completed under site characterization purposes, BOEM requires all vessels associated with the proposed action would be required to abide by PDCs in Appendix A, and individual surveys would implement any additional measures through any other state or federal permits that may be needed. Due to the slow vessel speeds, PSOs on duty, and implementation of vessel strike avoidance measures, no adverse effects will result from routine biological survey activities.

Benthic Habitat Surveys

BOEM requires the results of site characterization surveys of benthic habitat to support site assessment plans and construction and operations plans. These surveys are conducted through physical sampling with a grab sample device (e.g., Hamon grab, Van Veen grab), benthic video and still imagery (e.g., sediment profile imaging, towed video), and geophysical surveys (e.g., side scan sonar and multibeam echosounders). Often benthic habitat surveys are done concurrent with the geophysical and geotechnical surveys and do not constitute additional effort. However, there may be occasions where directed benthic surveys are needed to supplement what was collected during the geophysical survey campaign. It is not anticipated that vessel traffic beyond what is already accounted for under geophysical survey activities would result in additional measurable effects to ESA-listed species.

Avian and Bat Surveys

BOEM has funded avian digital aerial surveys across a number of planning areas. In areas where additional avian surveys are required, 2 to 3 years of surveys would be necessary to document the distribution and abundance of bird species within a leased area. This survey timeframe is based on the *Guidelines for Providing Avian Survey Information for Renewable Energy Development on the Atlantic Outer Continental Shelf Pursuant to 30 C.F.R. Part 585 (Bureau of Ocean Energy Management 2013b)*, which indicate that the lessee must document the spatial distribution of avian resources in the areas proposed for development, incorporating both seasonal and inter-annual variation. Although both boat-based and aerial surveys using visual observers have been used in the past, including for offshore wind baseline studies in the United States, these methodologies have been largely replaced by aerial digital imaging surveys in Europe because of reduced observer effects, higher statistical and scientific validity of the data, and the ability to conduct surveys at altitudes above the rotor swept zone of commercial marine wind turbine rotors (Rexstad and Buckland 2009; Thaxter and Burton 2009) and are less likely to flush birds than in traditional low flying aerial surveys. No additional vessel traffic would be expected from bat survey activities and no adverse effects will occur.

Marine Fauna Surveys

BOEM requires a lessee to characterize the marine fauna (i.e., marine mammals, sea turtles, and fish species) occurring within its lease area and include this information in its plan submissions (30 C.F.R. 585.610(b)(5)). The lessee may use existing information if the information meets plan requirements. Additional surveys may be required if data gaps, special circumstances, or the biological information available does not meet assessment requirements for the lease area. A period of 2-3 years of pre-construction surveys and post-construction surveys will be needed depending on the resource and available information in a lease area. BOEM, DOE, and state governments are in the process of collecting biological information in the Atlantic, including the National Oceanic and Atmospheric Administration (NOAA)/BOEM Atlantic Marine Assessment Program for Protected Species, and State-funded survey efforts will provide data to support site characterization. The results of these studies will be used to determine whether additional surveys would be necessary to document marine mammal, fish, or sea turtle resources in a leased area prior to submitting a plan. Vessel or aerial traffic associated with marine fauna surveys would not markedly add to current levels of traffic in these areas or the potential for adverse impacts to listed species.

2.4 Data Collection Devices

No site assessment activities can take place on a lease until BOEM has approved a lessee's SAP, which would most likely include the installation of a metocean buoys (see 30 C.F.R. 585.600(a)). Through lease stipulations, BOEM would require the lessee to submit a SAP survey plan that includes contacting the First Coast Guard District regarding issuance of a local notice to mariners and obtaining a private aids to navigation (PATON) permit for any metocean buoy installed, which will trigger a notification to NOAA to update nautical charts with these new offshore objects. Once approved, site assessment activities could occur over a 5-year period from the date of the lease.

2.4.1 Met Buoys

BOEM assumes a Lessee would install a maximum of two buoys on a lease area at any given time. These meteorological buoys would be anchored at fixed locations and regularly collect observations from many different atmospheric and oceanographic sensors. Buoys may be equipped with generators holding approximately 250 gallons of fuel. The *Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore Massachusetts Revised Environmental Assessment* (Bureau of Ocean Energy Management 2014) evaluated various meteorological buoy and anchor systems, including hull type, height, and anchoring methods. NOAA has successfully used boat-shaped hull buoys (known as Naval Oceanographic and Meteorological Automated Devices, or "NOMADs") and the newer, the Coastal Buoy and the Coastal Oceanographic Line-of-Sight (COLOS) buoys, for weather data collection for many years.

The choice of hull type used usually depends on its intended installation location and measurement requirements. To ensure optimum performance, a specific mooring design is produced based on hull type, location, and water depth (NOAA 2012). For example, a smaller buoy in shallow coastal waters may be moored using an all-chain mooring. On the OCS, a larger discus-type or boat-shaped hull buoy may require a combination of a chain, nylon, and buoyant polypropylene materials designed for many years of ocean service (NOAA 2012).

Discus-shaped, boat-shaped, and spar buoys (Figure 4, Figure 5) are the buoy types that would most likely be adapted for offshore wind data collection. A large discus-shaped hull buoy has a circular hull ranging between 33 and 40 ft (10 and 12 m) in diameter and is designed for many years of service (NOAA 2012). The boat-shaped hull buoy is an aluminum-hulled buoy that provides long-term survivability in severe seas (NOAA 2012).

Some deep ocean moorings have operated without failure for more than 10 years (NOAA 2012). The spar-type buoy can be stabilized through an on-board ballasting mechanism approximately 60 ft (18 m) below the sea surface. Approximately 30 to 40 ft (9 to 12 m) of the spar-type buoy would be above the ocean surface, where meteorological and other equipment would be located. Tension legs attached to a mooring by cables have been used for one spar-type buoy in federal waters offshore New Jersey.

In addition to the meteorological buoys described above, a small tethered buoy (typically 10 ft [3 m] in diameter or less) and/or other instrumentation may also be used to collect baseline information on the presence of certain marine life including passive acoustic monitoring. If a proposed buoy is found to have no individually or cumulatively significant effect on the human environment, and BOEM determines that no extraordinary circumstances exist under which the buoy may have a significant environmental impact, BOEM reserves the right to comply with its NEPA obligations through a categorical exclusion applicable to the action being evaluated.

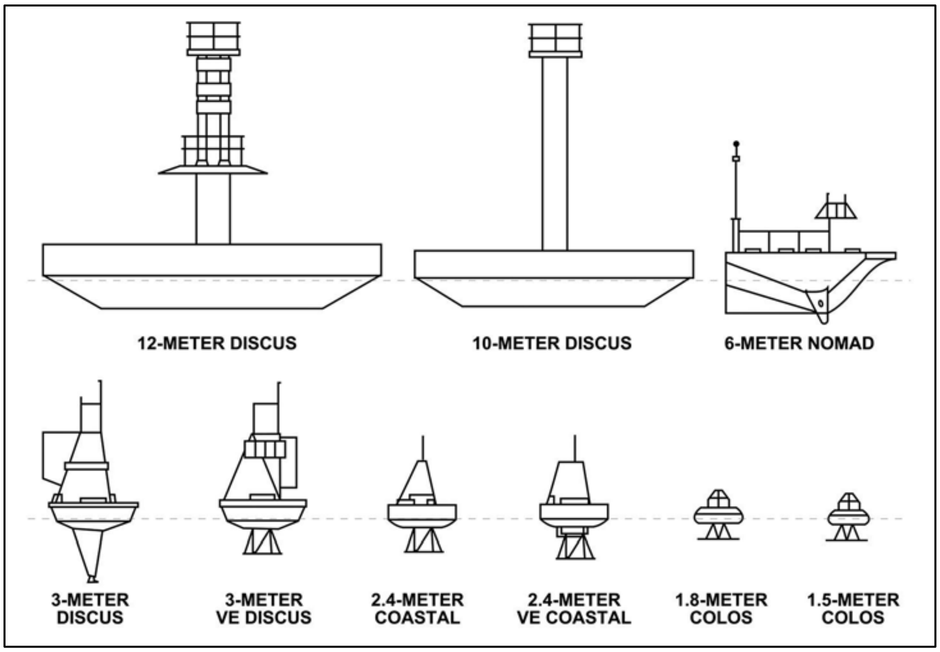

Figure 4. Buoy Schematic

Source: National Data Buoy Center, 2008

10-Meter Discus-Shaped Hull Buoy, ***Source: National Data Buoy Center, 2012***

6-Meter Boat-Shaped Hull Buoy ***Source: National Data Buoy Center, 2012***

Spar Buoy
Source: Australian Maritime Systems, 2016

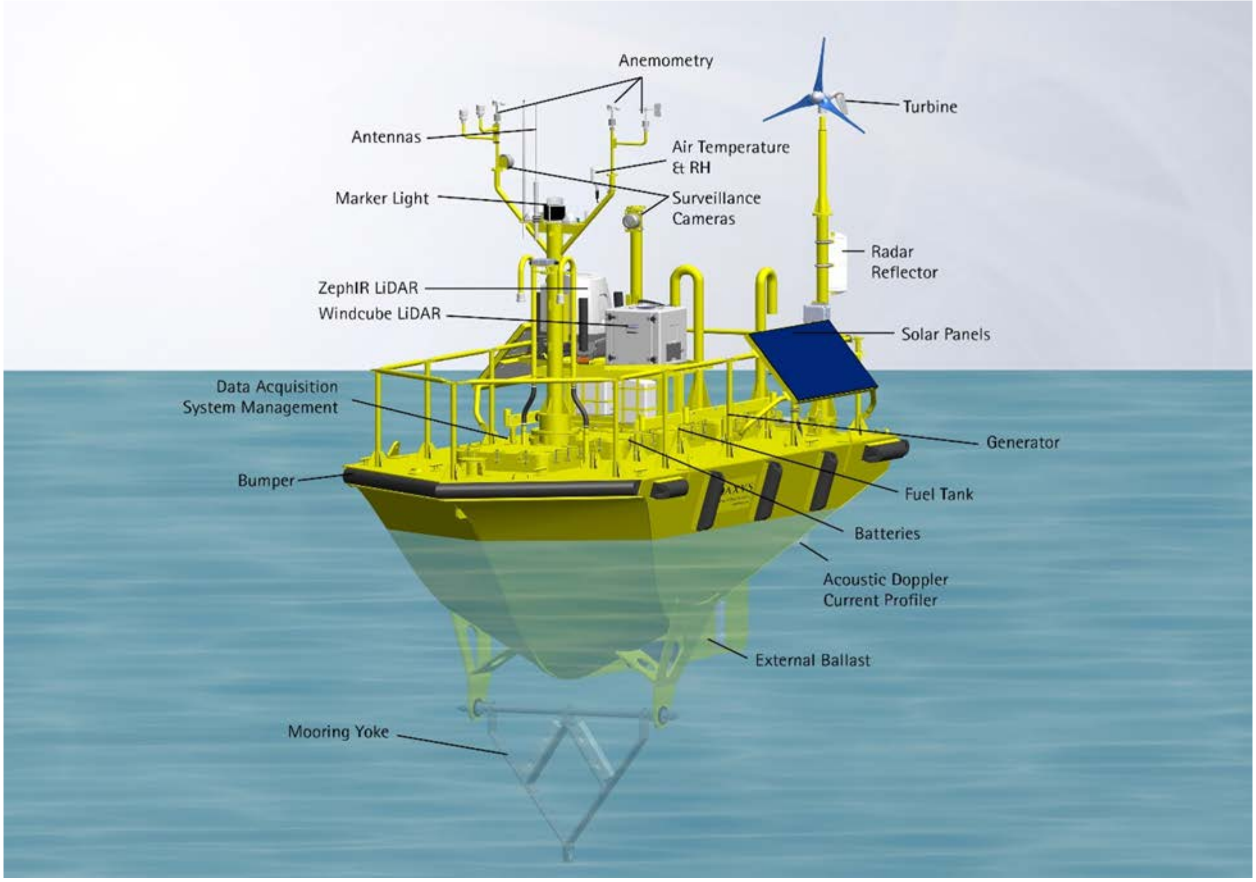

Figure 5. Typical type of buoys with attached equipment

Met Buoy FLiDAR and Wave Buoys Installation

Buoys would typically take approximately 1 day to install (Table 11).

Table 11. Spar-Type Buoy Installation Process

Installation Phases	Maximum Area of Disturbance	Transport Method	Total Time of Installation
Phase 1 – Deployment of clump anchor	484 ft^2	barge	1 day
Phase 2 – Deployment of the spar buoy and connection to the clump anchor with mooring chain	784 ft^2	barge	2 days

Source: Tetra Tech EC, Inc., 2010

Installation – Onshore Activity

Onshore activity (fabrication, staging, or launching of crew/cargo vessels) related to the installation of buoys is expected to use existing ports that are capable of supporting this activity. Refer to Section 2.7 for information pertaining to existing ports and industrial areas that would likely be used for meteorological buoys. No expansion of existing facilities would be necessary.

Installation – Offshore Activity

Boat-shaped and discus-shaped buoys are typically towed or carried aboard a vessel to the installation location. Once at the location site, the buoy would be either lowered to the surface from the deck of the transport vessel or placed over the final location, and then the mooring anchor dropped. Buoys may be moored using various mooring designs including all-chain, cables, nylon, polypropylene (NOAA 2012), and other new materials on the market such as line made from Dyneema fiber. BOEM continues to work with lessees and require the use of the best available mooring systems using shortest practicable line lengths, anchors, chain, cable, or coated rope systems that prevent or reduce to discountable levels any potential entanglement or entrainment of marine mammals and sea turtles. BOEM reviews each buoy design to ensure that low-risk mooring designs are used whenever possible for any given purpose. Based on previous proposals, anchors for boat-shaped or discus-shaped buoys would weigh about 6,000 to 8,000 lb (2721 to 3628 kg) with a footprint of about 6 ft^2 (0.5 m^2) and an anchor sweep of about 370,260 ft^2 (34398 m^2). After installation, the transport vessel would likely remain in the area for several hours while technicians configure proper operation of all systems. Transport and installation vessel anchoring for 1 day is anticipated for these types of buoys.

Typically, a buoy equipped with LiDAR is towed to the installation location by a transport vessel after assembly at a land-based facility. A barge-based crane lifted the buoy into the water where divers secured it to a 230-ton clump anchor by four tethers made of steel cables. Approximately 40 ft (12 m) of the buoy will visible above the water line. The maximum area of disturbance to benthic sediments occurs during anchor deployment and removal (e.g., sediment resettlement or sediment extrusion) for this type of buoy.

Operation and Maintenance

Monitoring information transmitted to shore would include systems performance information, such as battery levels and charging systems output, the operational status of navigation lighting, and buoy positions. Additionally, all data gathered via sensors would be fed to an on-board radio system that transmits the data string to a receiver onshore (TetraTech EC Inc 2010). On-site inspections and preventative maintenance (i.e., marine fouling, wear, or lens cleaning) are expected to occur on a monthly or quarterly basis. Periodic inspections for specialized components (i.e., buoy, hull, anchor chain, or anchor scour) would occur at different intervals, but would likely coincide with the monthly or quarterly inspection to minimize the need for additional boat trips to the site. Because limited space on the buoy would restrict the amount of equipment requiring a power source, this equipment may be powered by small solar panels or wind turbines; however, diesel generators may be used, which would require periodic vessel trips for refueling.

2.4.2 Meteorological Buoy Equipment

To obtain meteorological data, scientific measurement devices consisting of anemometers, vanes, barometers, and temperature transmitters would be mounted either directly on the buoy or on instrument support arms. In addition to conventional anemometers, LiDAR, sonic detection and ranging (SODAR), and coastal ocean dynamic applications radar (CODAR) devices may be used to obtain meteorological data. LiDAR is a ground-based remote sensing technology that operates via the transmission and detection of light, and recently, floating LiDAR (FLiDAR) is being used to collect meteorological data offshore of Europe. SODAR is also a ground-based remote sensing technology; however, it operates via the transmission and detection of sound. CODAR devices use high-frequency surface wave propagation to remotely measure ocean surface waves and currents.

Ocean Monitoring Equipment

To measure the speed and direction of ocean currents, Acoustic Doppler Current Profilers (ADCPs) would most likely be installed on each meteorological buoy. An ADCP is a remote sensing technology that transmits sound waves at a constant frequency and measures the ricochet of the sound wave off fine particles or zooplankton suspended in the water column. The ADCPs may be mounted independently on the seafloor but is typically attached to a buoy. A typical ADCP has three to four acoustic transducers that emit and receive acoustical pulses from different directions, with frequencies ranging from 300 to 600 kHz, with a sampling rate of 1 to 60 minutes. A typical ADCP is about 1 to 2 ft (0.3 to 0.6 m) tall and 1 to 2 ft (0.3 to 0.6 m) wide. Its mooring, base, or cage (surrounding frame) would be several feet wider.

Other Equipment

A meteorological buoy could also accommodate environmental monitoring equipment, such as bird and bat monitoring equipment (e.g., radar units, thermal imaging cameras, VHS receiving antennas), passive acoustic monitoring equipment for marine mammals, data logging computers, power supplies, visibility sensors, water measurement equipment (e.g., temperature, salinity), communications equipment, material hoist, and storage containers.

2.5 Operation and Maintenance

A moored data collection device would be present for approximately 5 years before BOEM decides whether to allow the device to remain in place for some or all of the operations term of a lease (25 years) or require that it be decommissioned immediately after the 5-year site assessment term. Buoys could also remain in place during the time period that BOEM reviews the COP (i.e., the buoys may remain for a number of years following the 5-year site assessment period).

Meteorological buoys could be powered by solar panels, small wind turbines, and/or diesel generators. No additional or expansion of onshore facilities would be required to conduct these tasks. BOEM projects that crew, or supply boats would be used for routine maintenance and generator refueling, if diesel generators are used. The use of helicopters to transport personnel or supplies during operation and maintenance is not anticipated.

Lighting and Marking

The U.S. Coast Guard (USCG) administers the permits for PATONs, which are buoys, lights, or day beacons owned and maintained by any individual or organization other than USCG. PATONS are intended to mark buoys and other structures as marine hazards. However, before certifying a navigational aid and obtaining a PATON permit, a structure must have approval from USACE, which regulates these structures pursuant to the Rivers and Harbors Act (33 U.S.C. § 403) and OCSLA (43 U.S.C. § 1333(e)). BOEM will require the lessee to apply to USCG to have its meteorological buoys in the proposed lease area classified as PATON, and if so determined, will trigger USCG's lighting and marking requirements (33 C.F.R. Part 66). USCG has informed BOEM it will require meteorological buoys to be displayed on NOAA nautical charts.

2.6 Decommissioning

Decommissioning is the process of removing BOEM-approved facilities from a lease or ROW. Equipment recovery would be performed with the support of a vessel(s) equivalent in size and capability to that used for installation (see installation section above). For small buoys, a crane-lifting hook would be secured to the buoy. A water/air pump system would de-ballast the buoy 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 by a barge. Buoy decommissioning is expected to be completed within 1 day. Buoys would be returned to shore and disassembled or reused in other applications. Mooring devices and hardware would be re-used or recycled (processed on land at a recycling facility. As late as 2 years after the cancellation, expiration, relinquishment, or other termination of the lease, the lessee would be required to remove all devices, works, and structures from the site and restore the leased area to its original condition before issuance of the lease (30 C.F.R. 585, Subpart I). Lessees are required to submit a decommissioning application to BOEM for approval prior to starting decommissioning activities (30 C.F.R. 585.902(b)).

2.7 Vessel Operations

The types of vessels that may be associated with the proposed action appear in Figure 6. In general, surveys occur at relatively slow speeds; however, transits between survey areas or to and from ports occur at higher speeds. The maximum speed of the vessel depends on the vessel type, meteorological conditions, and presence/absence of seasonal management areas for North Atlantic right whales.

The different types of surveys require data to be collected at varying line spacing. However, the same vessel (or group of vessels) following the smallest line spacing could conduct many of the surveys necessary to acquire relevant data at the same time. Therefore, BOEM assumes that the lessee would use the smallest line spacing, which is 98 ft (30 m) for the archaeological resource survey and acquire relevant data for most surveys at once. Assumptions specific to the different survey types are listed below.

Vessel Traffic Associated with Met Towers and Met Buoys

Specific ports that would be used by the lessee would be determined in the future and primarily by proximity to the lease blocks, capacity to handle the proposed activities (Figure 7) (ESS Group Inc 2016), and/or established business relationships between port facilities and the lessee. Installation of a metocean buoys would not require any special requirements other than likely require staging port facilities with the following requirements: Deep-water vessel access (greater than 15 ft [4.6 m]) to accommodate large vessels; landing and unloading facilities in close proximity to fabrication yards for staging, assembly, and temporary materials storage; and located within a reasonable travel distance to a leased area, which BOEM assumes to be less than 50 nm from the center of the proposed lease area to the port.

	Vessel Type	Length	Beam Width	Draft	Speed
	**HRG Surveyor**	**58.8 m**	**12.5 m**	**–**	**4-5 kt (survey) 10-12 kt (transit)**
	**Geotechnical Surveyor**	**61.7 m**	**11.4 m**	**3.6**	**DP thrusters (survey) 10-12.5 kt (transit)**
	**Jack up**	**60.0 m**	**38.0 m**	**3.9 m**	**Stationary (work) 7.5 kt (transit)**
 	**Service Vessel**	**24.7 m**	**8.0 m**	**1.2 m**	**23-26 kt (transit)**
	**Tug**	**26.0 m**	**7.9 m**	**2.7 m**	**10 kt**

Figure 6. Representative vessels specifications associated with survey, buoy installation, and service vessels.

Vessel trips would be required during installation, decommissioning, and routine maintenance of buoys. The number of vessel trips could be spread over one or more construction seasons due to weather and sea state conditions, the time to assess suitable site(s), the time to acquire the necessary permits, and the availability of vessels, and workers. Metocean buoy installation would likely occur in the second year after lease execution, would likely remain in place during the 5-year site assessment term (Years 2 through 6 after lease execution), and would likely be decommissioned the year after the end of the 5-year site assessment term (Year 7 after lease execution). For any given lease, BOEM estimates a median number of 675 vessel trips (350-1,000) for data collection activities.

Based on previous site assessment proposals submitted to BOEM, 3-6 round trips will occur during installation of metocean buoys, and 40-120 round trips for monthly maintenance trips (Table 12). Metocean buoys would typically take 1 to 2 days for one vessel to install and 1 to 2 days for one vessel to decommission.

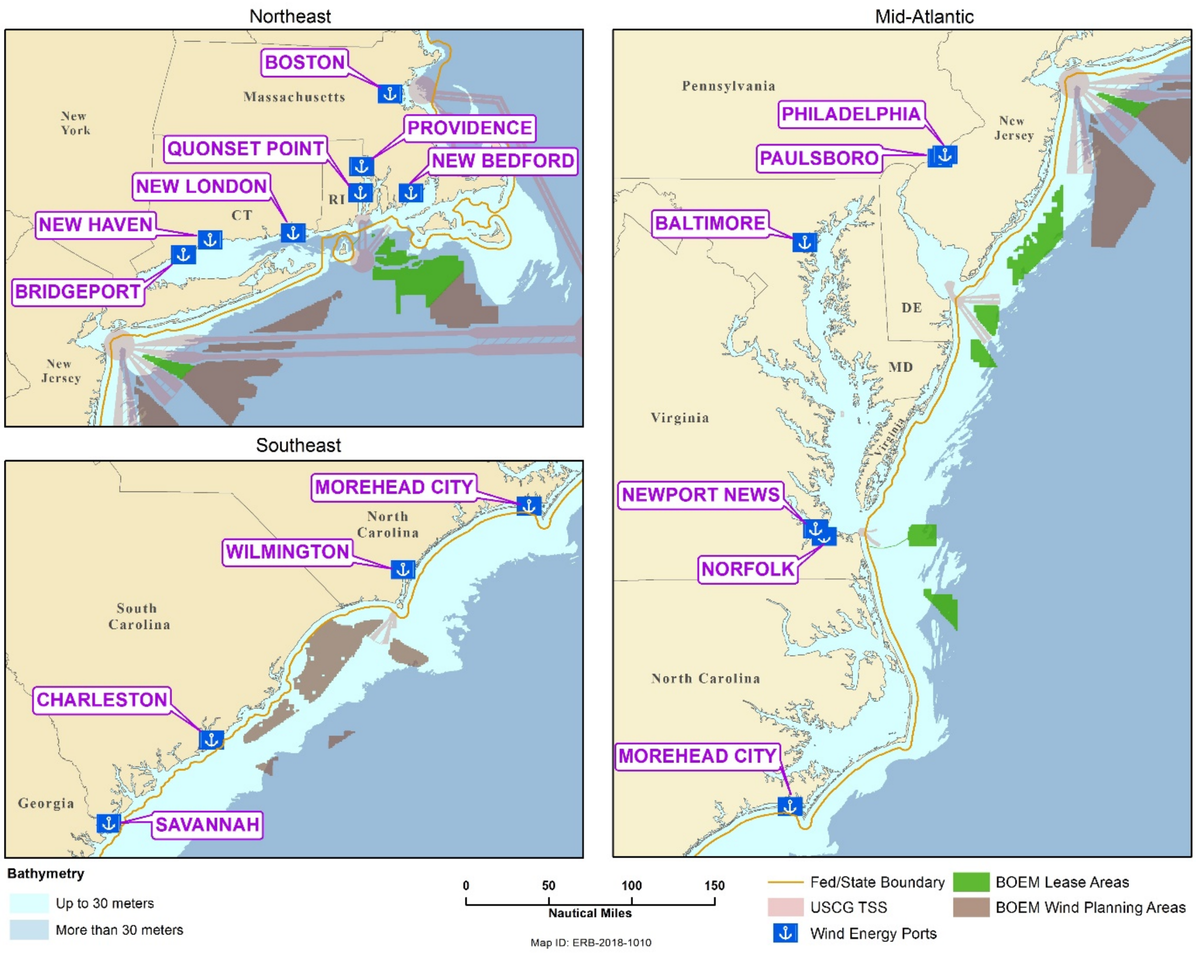

Figure 7. Ports identified as having the infrastructure capable of servicing offshore wind projects.

Table 12. Projected Maximum Vessel Trips for Each Lease Under the Proposed Action for Metocean Buoys

Site Assessment Activity	Round Trips	Formula
Meteorological Buoy Installation	3–6	1–2 round trips x 3 buoys
Metocean Buoy Quarterly–Monthly Maintenance Trips	40–120	4 quarters x 2 buoys x 5 years – 12 months x 2 buoys x 5 years
Metocean Buoy Decommission	2 –4	1–2 round trips x 2 buoys
Total Buoy Trips Over 5-Year Period	44–128	N/A

BOEM's maintenance vessel trip calculations are conservatively based on the number of trips for buoys over the entire 5-year site assessment period (Year 2 after lease execution and going through Year 6 after lease execution (Table 13). Crew boats used for operations and maintenance activities will be approximately 51 to 57 ft (16 to 17 m) long with 400- to 1,000-horsepower engines and 1,800-gallon fuel capacity. Installation, routine operations and maintenance, and decommissioning of data collection devices per project site are expected to be between 44 and 128 round trips. BOEM estimates an average round trip distance from a port will be approximately 92 nm. Surveying, buoy installation, and operations and maintenance activities could also be supported by smaller ports. Vessels used for these activities are anticipated to be approximately 65 to 100 ft (20 to 30 m) in length. These smaller ports would serve as staging areas and crew/cargo launch sites for the survey and operations and maintenance vessels.

Vessel Traffic Summary

BOEM estimates the number of round trips based on both 24-hour surveying and a 10-hour survey day (and thus one vessel round trip per day). BOEM assumes that the actual number of vessel trips would fall within the range of the fewest estimated trips associated with 24-hour surveying and the maximum estimated trips associated with 10-hour survey days. BOEM estimates that the amount of vessel round trips associated with the installation of buoys would range from approximately 350 to 1,000 trips (Table 13). The vessel round trips would occur from various ports to a leased area spread over approximately 7 years.[14]

Table 13. Range of Estimated Vessel Round Trips for Each Lease Assuming Installation of Two Buoys

Type of Activity	Number of Round Trips based on 24-hour surveying	Number of Round Trips based on a 10-hour-long Survey Day
Site Characterization	188–274	566–598
Site Assessment (Two Buoys)	44-128	44-128
Total	232–402	610–726

2.8 Discharges and Emissions

Operational wastes would be generated from all vessels associated with the proposed action. Requirements for management and disposal of bilge and ballast waters, solid waste (trash and debris), and sanitary/domestic wastes are described in the 2012 Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia Final Environmental Assessment (BOEM 2012). BOEM assumes that these requirements would be followed and hereby incorporates them by reference. The EPA regulates discharges incidental to the normal operation of all non-recreational, non-military vessels greater than 79 ft (24 m) in length into U.S. waters under Section 402 of the CWA. EPA requires that eligible vessels obtain coverage under the National Pollutant Discharge Elimination System Vessel General Permit (VPG).

A separate, streamlined permit is available for vessels less than 79 ft (24 m) (Small Vessel General Permit for Discharges Incidental to the Normal Operation of Vessels Less than 79 Feet). Typical

[14] For trip calculations, BOEM assumes that site characterization would occur in Years 1 to 5 after lease execution, and site assessment would be spread across Years 2 to 7 after lease execution as follows: Year 2 for construction and operation, Years 3 to 6 for operation, and decommissioning to occur in Year 7 (although buoys may remain in place for a number of years following the 5-year site assessment period).

discharges eligible for coverage under the VPG include deck runoff, graywater (from showers, sinks, laundry facilities, etc.), bilgewater, and ballast water. The discharge of any oil or oily mixtures within bilgewater is prohibited under 33 C.F.R. 151.10; however, discharges may occur in waters greater than 12 nm (22 km) from shore if the oil concentration is less than 100 parts per million and bilge/oily water separator effluent is covered for discharge under the final 2013 EPA VPG. Although ballast water is less likely to contain oil, it is subject to the same discharge limits as bilgewater (33 C.F.R. 151.10).

Ballast water, which is used to maintain stability of the vessel, may be pumped from coastal or marine waters when necessary and is usually stored in separate compartments not contaminated with oil. Ballast water is subject to USCG Ballast Water Management Program to prevent the spread of aquatic nuisance species. State regulations for bilge and ballast water are often more stringent than EPA VPG regulations. The discharge or disposal of solid debris into offshore waters from OCS structures and vessels is prohibited by BSEE (30 C.F.R. 250.300) and USCG (International Convention for the Prevention of Pollution from Ships [MARPOL], Annex V, Public Law 100–220 [101 Stat. 1458]). The Act to Prevent Pollution from Ships (APPS) is a U.S. federal law that allows USCG to implement the provisions of MARPOL (33 U.S.C. §§ 1901 – 1915). The APPS applies to all U.S. flagged ships in international waters and to all foreign flagged vessels operating in navigable waters of the United States, or while at port under U.S. jurisdiction. The USACE has regulatory responsibilities under the CWA to prevent water pollution, obtain water discharge permits and water quality certifications, develop risk management plans, and maintain such records. Prospective permittees of an NWP, if required, will be expected to contact the appropriate USACE district office to determine if regional conditions have been imposed on an NWP.

2.9 Best Management Practices

BOEM's primary strategy for minimizing adverse impacts is avoidance of the IPF. For impacts that cannot be entirely avoided, BOEM has developed PDCs to avoid and minimize the potential environmental risks to or conflicts with protected resources (Table 14). The PDCs summarized below, and the associated BMPs that further describe how the PDCs will be implemented (Appendix A) are part of the proposed action to minimize or avoid impacts on threatened and endangered marine mammals, sea turtles, and fish. These BMPs were developed by BOEM through consultation with NMFS and through coordination and feedback from stakeholders.

BOEM proposes to implement these BMPs through a combination of procedures including lease stipulations, individual plan reviews, and incidental take permit requirements for listed species under the Marine Mammal Protection Act. Recommended BMPs may be updated in the future through coordination with the NMFS. The following BMPs are proposed to be implemented until any future updates may occur. The current BMPs (Table 14) are fully described in Appendix B and are discussed in the relevant sections of this BA. BOEM's project-specific reviews may result in additional BMPs to clarify these conditions or to further minimize and avoid impacts to threatened or endangered species or their habitats.

Table 14. BOEM's proposed Project design Criteria for protected species.

PDC	Applicable to	Purpose
Avoid Live Bottom Features to Protect Corals	Employees and all at-sea contract personnel and vessels	To provide protection to corals and areas where undocumented threatened or endangered coral may occur and reduce the risk of adverse effects to discountable levels.
Marine Debris Awareness and Elimination	All at-sea and dockside operations	To provide informational training to all employees and contract personnel on the proper storage and disposal practices at-sea to reduce the likelihood of accidental discharge of marine debris that can impact protected species through entanglement or incidental ingestion.
Minimize Interactions with Listed Species during Site Characterization Survey Operations	Any survey vessel operating high-resolution geophysical survey equipment to obtain data associated with a lease and operating such equipment at or below 35 kHz for baleen whales, and at or below 160 kHz for sperm whales.	This PDC will avoid injury of ESA-listed species and minimize the likelihood of adverse effects associated with potential disturbance to discountable levels through the establishment of pre-clearance, exclusion zones, shut-downs, PSO monitoring, and other BMPs to avoid and reduce exposure of ESA-listed species to underwater survey noise. In addition to general BMPs, geographic-specific conditions also apply to Cape Cod Bay and Southern Critical Habitat for NARWs.
Minimize Vessel Interactions with Listed Species	All vessels	To avoid injuring or disturbing ESA-listed species by establishing minimum separation distances between vessels and marine protected species; operational protocols for vessels when animals are sighted; to establish sightings awareness for NARWs; and require vessel speed limits in Seasonal Management Areas and Dynamic Management Areas to avoid serious injury to NARWs.
Entanglement Avoidance	Mooring and anchoring systems for buoys and metocean data collection devices.	To use the best available mooring systems using anchors, chain, cable, or coated rope systems that prevent or reduce to discountable levels any potential entanglement or entrainment of marine mammals and sea turtles.
Protected Species Observers	Geophysical Surveys	To require PSO training; to require PSO approval requirements by NMFS prior to deployment on a project.
Reporting Requirements	PSOs and any project-related personnel who observe a dead and/or injured protected species.	To document and record monitoring requirements for geophysical surveys, project-related incidents involving listed species, and to report any impacts to protected species in a project area whether or not the impact is related to the project.

These PDCs are additional to, and do not substitute for, existing statutory and regulatory requirements, review procedures, and other best management practices that may apply.

OREP's Project-Specific Review Process

The data collection activities conducted under the proposed action and the process by which BOEM will regulate such activities will be similar throughout the action area. In addition, the nature of the effects in this BA are conservatively analyzed and we do not expect those effects to meaningfully vary from location to location that are not already otherwise specified by a seasonal-specific or geographic-specific condition (e.g., geophysical surveys in Cape Cod Bay or Southern Critical Habitat for NARWs) . All activities that fall within the scope of this proposed action will be covered under this programmatic BA and associated ESA consultation. Thus, there is not a need for project specific consultations on every site-specific agency action BOEM and BSEE will take under the umbrella of this proposed action unless certain criteria are met. BOEM will meet its ESA Section 7 responsibilities through second-tier consultation procedures for any activities for which BMPs cannot be implemented or that fall outside the scope of this proposed action. In this section, we describe our proposed coordination procedures.

For each plan that is submitted to BOEM that requires approval, BOEM will initiate a project-specific review to determine sufficiency and adequacy with existing statute, regulations, and consistency with any applicable biological opinion. BOEM will evaluate the plan to ensure it is found to be within the scope of existing biological opinions and poses no new effects. BOEM will identify the BMPs that apply and ensure their implementation is included in the plan. If for any reason an activity under the proposed action is not be within the scope of the biological opinion, BOEM will request second-tier or a project specific consultation with NMFS. Through additional consultation, it will be determined if additional conditions are required or if further consultative actions will be needed. If an action is outside the scope of this Programmatic Opinion, BOEM will request a separate consultation with NMFS. BOEM has identified the following potential conditions when second-tier consultation with NMFS may be needed:

- New or unusual technologies are proposed that may result in new effects that adversely affect protected species,
- BOEM substantially revises its BMPs, removes BMPs, or changes the effectiveness of the BMPs that are required to minimize or avoid adverse effects identified in the Opinion,
- New species are listed or critical habitat is designated that may be adversely affected by the proposed action,
- New information suggests effects may result in take that was not previously considered, and
- Any authorized take levels are exceeded.

Individual Plan Review Procedures

1. BOEM Plan Reviews: BOEM reviews each plan that is submitted to the Renewable Energy Program. Any proposed actions described in this BA will be reviewed to ensure they are within the scope of activities covered in the opinion. Upon completion of such reviews, BOEM/BSEE will coordinate with NMFS, as necessary.
2. Project-Specific Review for Out-of-Scope Plans: Any plans determined to be out-of-scope will be submitted by BOEM to NMFS for project-specific review. The plan will be accompanied by an analysis detailing the consistency issues identified for the project being out of scope. BOEM will implement any additional BMPs resulting from streamlined consultation. If the plan cannot be brought into scope, BOEM will return the plan to the lessee with a request for additional information and/or initiate formal project specific consultation as may be appropriate.
3. Project-Specific Review for BMP Revisions: BOEM will submit substantial BMP revisions or project-specific modifications to NMFS for the opportunity to review. BOEM will review any substantial modifications to ensure the changes will allow future activities to continue to be implemented in accordance with the intended purpose and effectiveness of BMPs and/or reasonable and prudent measures of any biological opinions.

4. Review and Response: BOEM will transmit project-specific reviews to NMFS via email, identifying the issues requiring project-specific review. NMFS will provide its comments or concurrence with any proposed changes, including no changes, via an email response within 15 calendar days of receipt of the request. Plans determined to have consistency issues that may be out of scope of ESA requirements will be reviewed by NMFS for any additional actions that may be required including additional conditions or consultation. If this review results in questions or concerns by NMFS, an in-person meeting or conference call will be scheduled with BOEM/BSEE to resolve any protected species or critical habitat issues or engage in additional consultation under Section 7 of the ESA.

3 ACTION AREA

Under ESA Section 7 consultation regulations, the *action area* under the ESA refers to the area affected by the Proposed Action (50 CFR 402.02) and also includes all consequences to listed species or critical habitat that are caused by the Proposed Action, including actions that would occur outside the immediate area involved in the action (see 50 CFR 402.17). The Atlantic OCS is approximately 50 to 250 kilometers (km) wide and is demarcated by the 200-meter water depth contour at the shelf break. The seaward limit for siting a wind energy facility on the OCS is approximately 25 nm (46.3 km) from shore or 100 m (328 ft) water depth due to economic viability limitations. The current fixed foundation technologies are limited to depths of about 60 m. Although the majority of site assessment and site characterization activities will occur in water <60 m to accommodate the depth limitations in support of fixed-leg foundations for wind turbine generators, floating foundations may be used in water depths >60 m in the future. Therefore, the action area conservatively includes Atlantic Renewable Energy Regions in OCS waters out to the 100-m depth contour in the North Atlantic, extending from waters offshore Maine to New Jersey; Mid-Atlantic, extending from waters offshore Delaware to North Carolina; and the South Atlantic extending from waters offshore South Carolina to east-central Florida (Table 15, Figure 10).

Table 15. The size of each Renewable Energy Region under consideration in this BA from the state/federal boundary seaward to the 100 m depth contour.

Renewable Energy Region	Area Size	
	Acres	km^2
North Atlantic	26,587,514	106,400
Mid-Atlantic	14,615,745	59,150
South Atlantic	15,795,630	63,620
Total Area	56,998,889	229,170

The OCS Renewable Energy Regions do not include any waters under State jurisdiction. On the Atlantic coast, State jurisdiction extends 3 nm (5.6 km) from shore. However, there may be interdependent and interrelated activities associated with the proposed action that are not under the jurisdiction of BOEM, such as surveys associated with cable routes and vessel traffic in State waters. Therefore, the main effects of the proposed action are expected offshore beyond 3 nm, but State waters are considered part of the Action Area for purposes of evaluating potential effects to listed species. Although the total area for the Atlantic wind energy planning areas encompasses the OCS out to 100 m along the U.S. Atlantic coast, most development is expected in the North and Mid-Atlantic Renewable Energy Regions.

There are currently 15 commercial leases, 1 research lease and 1 ROW lease active along the U.S. Atlantic coast upon which data collection activities are proposed to occur (Figure 8, Figure 9).

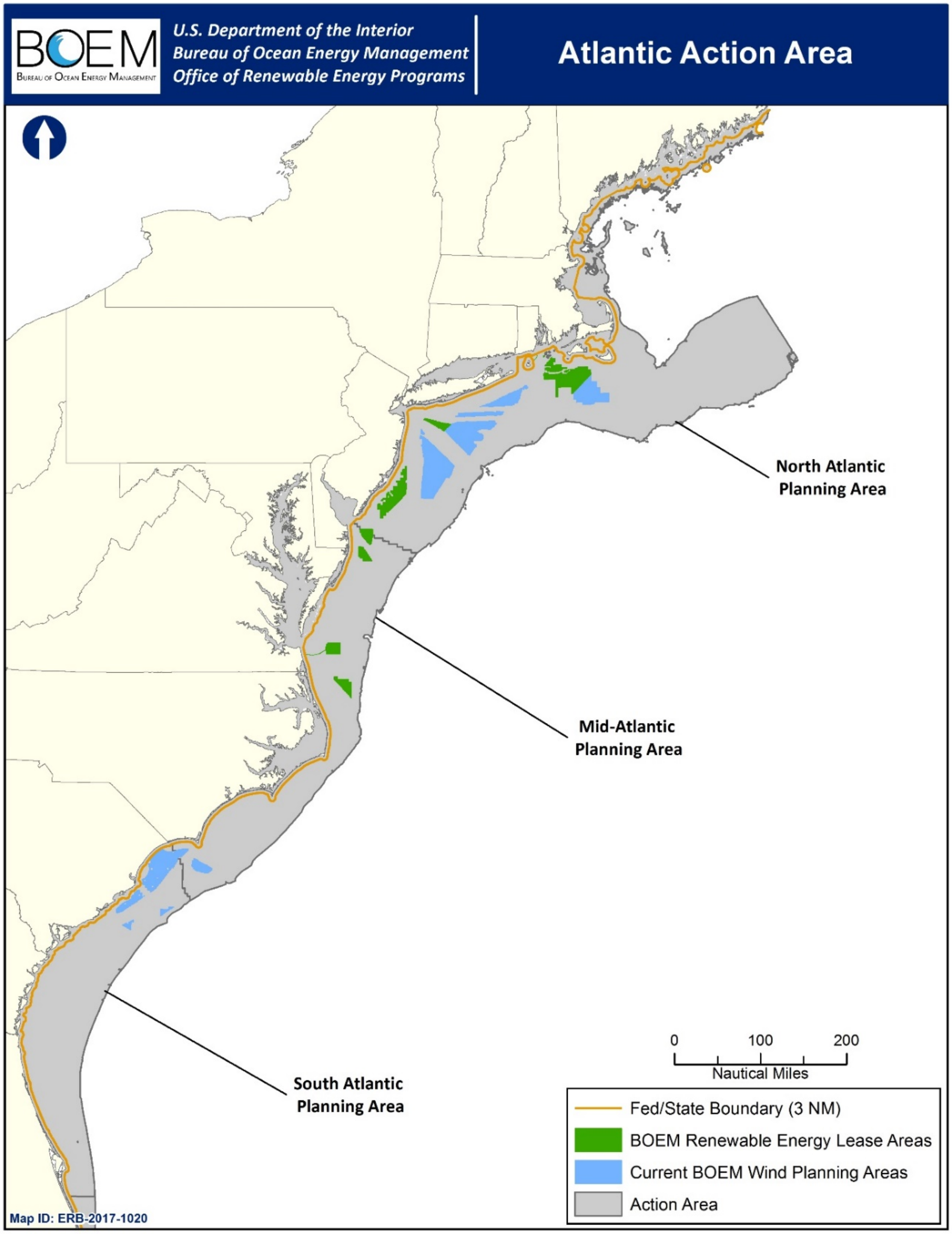

Figure 8. The action area includes current lease areas (green), current planning areas that may be leased (blue), and potential planning areas in the future (gray) from the state/federal boundary out to the 100-m contour.

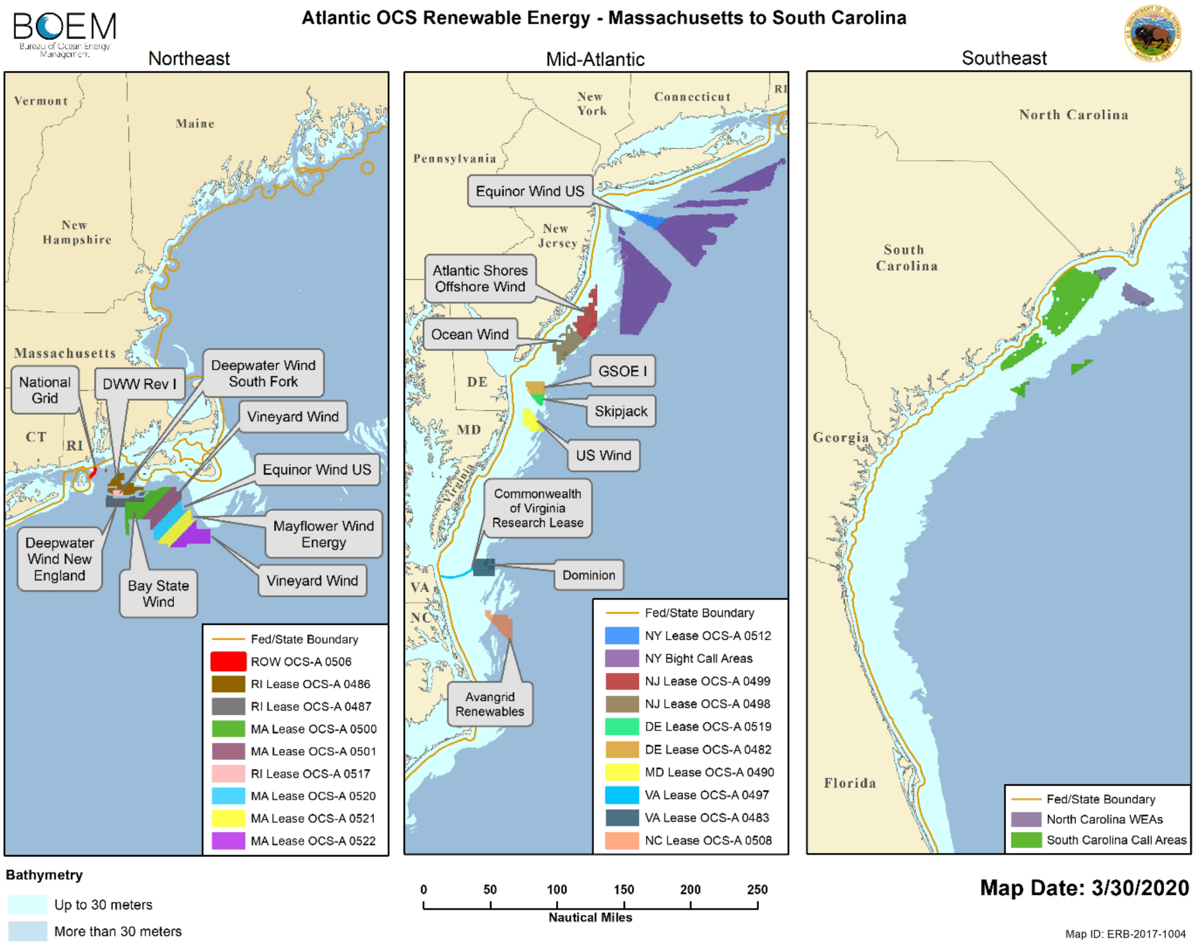

Figure 9. The locations of the existing leases in the North Atlantic, Mid-Atlantic, and South Atlantic Renewable Energy Regions.

Although surveys have already occurred on several of the leases, additional surveys are likely to occur in the future. Data collection activities may also occur over the lifetime on any new OCS leases awarded over the next 10 years in the action area. Offshore renewable energy leases are located in federal waters; however, the action area also includes riverine segments that currently have servicing ports used for vessel operations associated with the proposed action and/or electrical grid infrastructure that may inter-connection points for future offshore wind energy projects that may need to be surveyed. Additional data collection and survey activities in the action area that are consistent with the proposed action could be associated with BOEM's Environmental Studies Program in support of the Office of Renewable Energy Programs. Maps of each of the currently active lease areas including the lease number, lease blocks, lease type, and acreage are found in BOEM's Renewable Energy Lease Map Book at https://www.boem.gov/Renewable-Energy-Lease-Map-Book. BOEM will update the map book when new lease information is available.

Offshore renewable energy leases are located in federal waters; however, the action area also includes servicing ports used for vessel operations associated with the proposed action. Sixteen representative ports were identified by the BOEM funded study: *The Identification of Port Modifications and the Environmental and Socioeconomic Consequences* (ESS Group Inc 2016) as being capable of potentially servicing offshore wind projects and are included in the action area for their potential for vessel operation effects between the ports and offshore lease areas (Figure 10). These ports possess much of the required infrastructure deemed necessary for offshore wind development but are not necessarily the only ports that may be used in association with the proposed action.

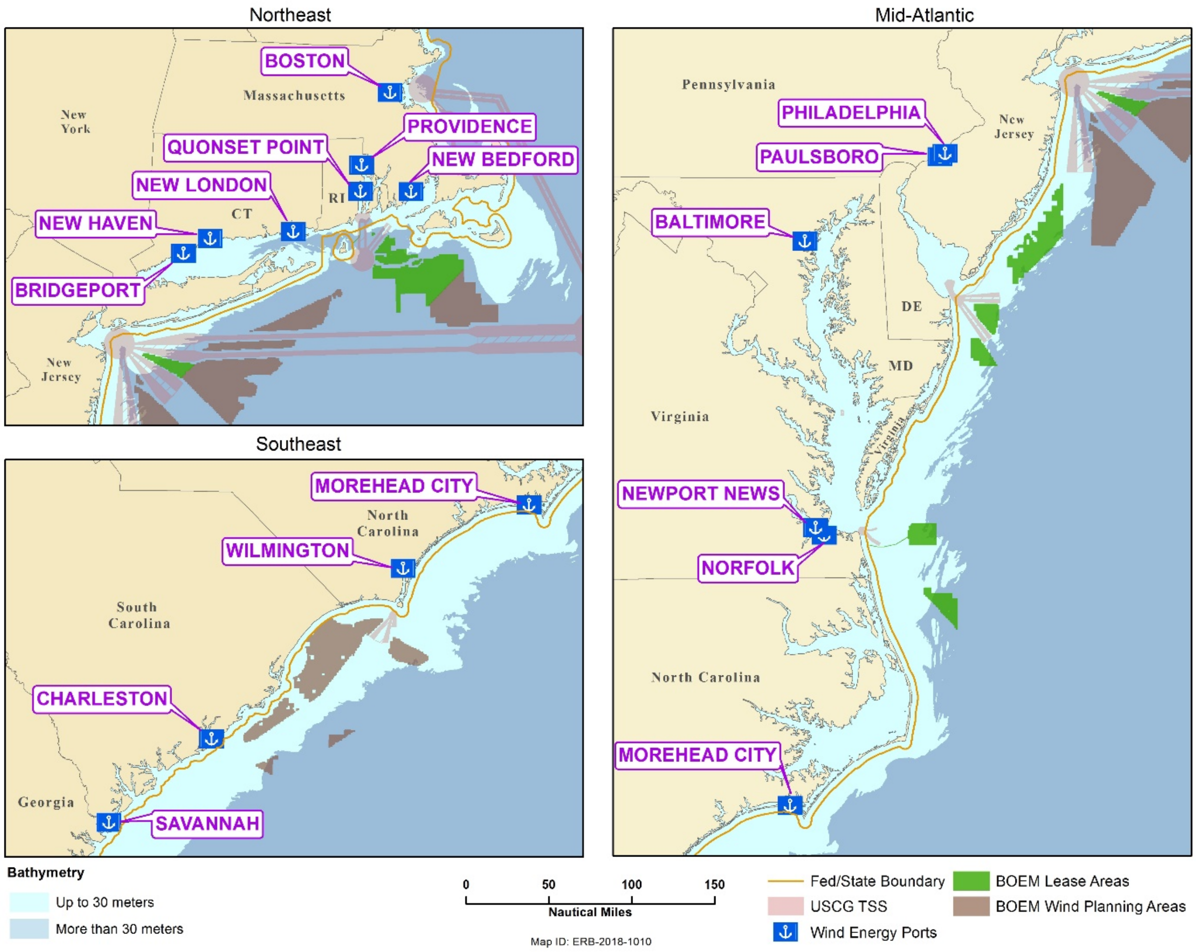

Figure 10. Representative ports that may be used in support of offshore renewable energy development (Figure adapted from *The Identification of Port Modifications and the Environmental and Socioeconomic Consequences* (BOEM 2016-034)).

4 LISTED SPECIES AND CRITICAL HABITAT

4.1 Species and Critical Habitat Considered but Discounted from Further Analysis

The following listed species were considered for their potential to occur in the action area, but were excluded from further analysis: blue whales (*Balaenoptera musculus*), critical habitat for Atlantic salmon (*Salmo salar*), giant manta ray (*Manta birostris*), oceanic whitetip shark (*Carcharhinus longimanus*), and ESA-listed staghorn coral (*Acropora cervicornis*), elkhorn coral (*Acropora palmata*), pillar coral (*Dendrogyra cylindrus*), rough cactus coral (*Mycetophyllia ferox*), lobed star coral (*Orbicella annularis*), mountainous star coral (*Orbicella faveolata*), and boulder star coral (*Orbicella franksi*).

Blue whales are primarily found in deeper waters seaward of the continental shelf edge (Hayes et al. 2018). The presence of blue whales in the action area is not expected due to the species' association with deep water habitat. There will be no effects expected to blue whales and this species is not discussed further.

Critical habitat for the Gulf of Maine DPS of Atlantic salmon was listed in 2009 (74 FR 29299 and 39903) and is comprised of 45 specific areas in perennial river, stream, estuary and lake habitat within the range of the Gulf of Maine DPS and in which are found the physical and biological features essential to the conservation of the species. This habitat is protected for the essential qualities it offers Atlantic salmon for completing their life cycles. Critical habitat has not been designated in marine waters due to the difficulty in determining the essential features of marine habitat for salmon. Stream and lake habitat are outside of the action area and it is unlikely that the perennial rivers and estuaries in the region would be surveyed.

The giant manta ray was listed as threatened in 2018 (83 FR 2916). The giant manta ray inhabits temperate, tropical, and subtropical waters worldwide, between 35°N and 35°S latitudes. In the western Atlantic Ocean, this includes South Carolina south to Brazil and Bermuda. Sighting records of giant manta rays in the Mid-Atlantic and New England are rare, but individuals have been observed as far north as New Jersey (Miller and Klimovich 2017) and Block Island (Gudger 1922). Giant manta rays travel long distances during seasonal migrations and may be found associated with productive upwelling features where they are feed on plankton. These areas include the shelf break, Atlantic canyons, and shelf valleys leading to canyons on the shelf edge. Giant manta rays occur most frequently along the shelf break but have been documented infrequently in the Hudson Shelf Valley through aerial surveys conducted by the State of New York. There is a small chance that vessels associated with the proposed action could traverse some upwelling areas. However, based on the low potential for occurrence and the probable low encounter rate by vessels in the action area, effects of the Proposed Action on the giant manta ray are not anticipated. Therefore, giant manta rays are not discussed further.

The oceanic whitetip shark, listed as threatened in 2018 (83 FR 4153), is usually found offshore in the open ocean, on the outer continental shelf, or around oceanic islands in deep water greater than 184 m. As noted in the status review for whitetip shark (Young et al. 2017), the species has a clear preference for open ocean waters between 10°N and 10°S, but can be found in decreasing numbers out to latitudes of 30°N and 35°S, with abundance decreasing with greater proximity to continental shelves. In the Western Atlantic, oceanic whitetips occur from Maine to Argentina, including the Caribbean and Gulf of Mexico. Oceanic whitetip sharks are not known to occur in waters less than 100 m in the action area. We have no information to suggest that the data collection activities associated with the Proposed Action will have any effect on this species. Therefore, oceanic whitetip sharks are not considered further. Threatened and endangered species of staghorn, elkhorn, pillar, rough cactus coral, lobed star coral, mountainous star coral, and boulder star corals are not known to occur on any of the existing leases, ROW, or wind energy areas thus far identified for potential future leasing. However, undocumented corals may occur in portions of the Action Area of the Mid-Atlantic and South Atlantic Planning Areas that could undergo site characterization and site assessment activities in the future. Although no specific areas of concern have been identified and no effects are anticipated at this time, the PDC to avoid live bottom features will avoid any potential future impacts. All vessel anchoring and any seafloor-sampling activities (i.e., drilling or boring for geotechnical surveys) will be limited to unconsolidated and uncolonized areas (i.e., sand areas lacking coral hardbottom and uncolonized by corals) and must occur at least 150 m from any threatened or endangered coral species. All sensitive live bottom habitats (eelgrass, cold-water corals, etc.) should be avoided whenever practicable.

Listed Species Included in the Analysis

Two species of whales (fin and North Atlantic right whale), five species of sea turtles (North Atlantic DPS of loggerheads, green, Kemp's ridley, leatherback, and hawksbill), Atlantic salmon, five DPSs of Atlantic sturgeon, shortnose sturgeon, smalltooth sawfish, and Nassau grouper may occur in the action area (Table 16). The occurrence and abundance of each species depends on several factors including the season, water depth, and the geographic location of any particular renewable energy region.

Table 16. Species Occurring in the Action Area That May Be Affected by the Proposed Action.

Common Name	Scientific Name	ESA Status
Marine Mammals		
North Atlantic Right Whale	***Eubalaena glacialis***	**Endangered**
Fin Whale	***Balaenoptera physalus***	**Endangered**
Sei Whale	***Balaenoptera borealis***	**Endangered**
Sperm Whale	***Physeter macrocephalus***	**Endangered**
Sea Turtles		
Loggerhead turtle North Atlantic DPS	***Caretta caretta***	**Threatened**
Green turtle North Atlantic DPS	***Chelonia mydas***	**Threatened**
Kemp's ridley turtle	***Lepidochelys kempii***	**Endangered**
Leatherback turtle	***Dermochelys coriacea***	**Endangered**
Hawksbill sea turtle	***Eretmochelys imbricata***	**Endangered**

Fish		
Atlantic salmon	***Salmo salar***	**Endangered**
Atlantic sturgeon	***Acipenser oxyrinchus oxyrinchus***	**Endangered**
New York Bight DPS		**Endangered**
Chesapeake Bay DPS		**Endangered**
Carolina DPS		**Endangered**
South Atlantic DPS		**Endangered**
Gulf of Maine DPS		**Threatened**
Shortnose sturgeon	*Acipenser brevirostrum*	**Endangered**
Smalltooth sawfish	*Pristis pectinata*	**Endangered**
Nassau grouper	*Epinephelus striatus*	**Threatened**

4.2 North Atlantic Right Whales

In 1970, right whales were listed as endangered under the Endangered Species Conservation Act (35 FR 8495, June 2, 1970). Subsequently, when the Endangered Species Act (ESA) became law in 1973, right whales were included on the list of endangered species under that statute. In 2008, NMFS listed right whales in the North Atlantic and North Pacific as separate endangered species under the ESA (73 FR 12024, March 6, 2008).

An estimate of pre-whaling population size is not available. A review of right whales (Reeves et al. 2007) calculated that a minimum of 5,500 right whales were taken in the western North Atlantic between 1634 and 1950, and concluded, “there were at least a few thousand whales present in the mid-1600s.” The authors cautioned, however, that the record of removals is incomplete, the results were preliminary, and refinements are required. The most recent minimum count for the Western North Atlantic population of right whales was 455-458 individuals (Hayes et al. 2018). The population growth rate for North Atlantic right whales (NARWs) is believed to be low compared to those for populations of other large whales that are recovering. For example, South Atlantic right whales and western Arctic bowhead whales have had growth rates of 4–7 % or more per year for decades. Because of the low reproductive output and small population size of NARWs, even low levels of human-caused mortality can pose a significant challenge for the species’ recovery. Recent data analysis indicates a decrease in calf productivity in the past 5 years, an increase in the number of severe injuries from entanglements in fishing gear and a significant decrease in the number of individuals sighted in all habitats in recent years (Pettis and Hamilton 2013; Robbins et al. 2015).

NARWs are large baleen whales with a stocky body; are generally black (some individuals have white patches on their undersides); don’t have a dorsal fin; have a large head (about 1/4 of the body length) with a strongly bowed margin of the lower lip; long, narrow rostrum; and roughened patches of skin called callosities on the head region (Rosenbaum et al. 2000). Whale lice colonize callosities giving them a white appearance. Two rows of long (up to eight feet in length), dark, closely-spaced baleen plates hang from the upper jaw used to filter feed copepods that float or drift in dense patches (i.e. zooplankton) (Kenney 2002). The all-black tail is broad and deeply notched with a smooth trailing edge. NARWs are associated with high latitude offshore areas as well as shallow water coastal areas along the Atlantic coast of North America (National Marine Fisheries Service 1991) dive as deep as 306 m (1,003 ft) (Mate et al. 1992). In the Great South Channel, average diving time is close to 2 minutes; average dive depth is 7.3 m (23.95 ft) with a maximum of 85.3 m (279.85 ft) (Winn et al. 1995). On the U.S. OCS the average diving time is about 7 min although maximum dive durations in deeper depths of 80-175 m (262 to 574 ft) have lasted between 5-14 min (Baumgartner and Mate 2003).

The mean age at first calving for female right whales has been estimated to be 9.53 (+/- 2.32) yr. (Kraus 1991). Females as young as 5 yr. and as old as 21 yr. have been observed with first calves. Three years is considered a “healthy,” successful calving interval for right whales (Best et al. 2001; Burnell 2001; Elwen and Best 2004; Knowlton et al. 1994). North Atlantic right whale calves are about 13 ft (4 m) long and weigh about 1 ton (1,000 kg) when born (Fortune et al. 2012; Moore et al. 2004a). Right whales give birth to a single calf after a gestation period of about one year (Lockyer 1984). Calves grow rapidly and achieve a length of about 11.3 yd (10.3 m) and 13.5 t (13,500 kg) in the first year (Fortune et al. 2012). Adults are generally between 14.2 yd (13 m) and 17.5 yd (16 m) long and can weigh up to 71 t (71,000 kg). NARW life expectancy is unknown, but one individual is known to have reached 65+ years of age (Hamilton et al. 1998; Kenney 2002).

The general pattern of occurrence of NARWs is greatest occurrences at high latitudes in summer and at lower latitudes in winter (Cummings 1985; Perry et al. 1999b; Rice 1998). Research results suggest the existence of six major habitats or aggregation areas for western North Atlantic right whales: the coastal waters of the southeastern United States; the Great South Channel; Georges Bank/Gulf of Maine; Cape Cod and Massachusetts Bays; the Bay of Fundy; and the Scotian Shelf. North Atlantic right whales follow a general annual pattern of migration between low latitude winter calving grounds and high latitude summer foraging grounds (Kenney 2002, Perry et al. 1999). However, movements within and between habitats are extensive. In addition, sightings of previously identified individuals have been made off Iceland, in the old Cape Farewell whaling ground east of Greenland (Hamilton et al. 2007), northern Norway (Jacobsen et al. 2004), and the Azores (Silva et al. 2012). Together, these long-range matches indicate an extended range for at least some individuals and perhaps the existence of important habitat areas not presently well described. Climate change may result in changes to currents and water temperatures that may affect the distribution copepod crustaceans. Future shifts in occurrence and reproduction may occur if changes in prey distribution occur. Changes in calving intervals with sea surface temperature have already been documented for southern right whales (Leaper et al. 2006).

NARWs may potentially occur in any renewable energy region; however, the greatest likelihood of occurrence depends on the latitude and time of year. Right whales have been observed from the Mid-Atlantic Bight northward through the Gulf of Maine during all months of the year. Foraging right whales (and their habitat) appear to be concentrated in New England waters. Variation in the abundance and development of suitable food patches appears to modify the general patterns of movement by reducing peak numbers, stay durations and specific locales (Brown et al. 2001; Kenney et al. 2001). In particular, large changes in the typical pattern of food abundance will dramatically change the general pattern of right whale habitat use (Kenney et al. 2001, (Nichols et al. 2008). Typically, peak abundance of North Atlantic right whales in feeding areas occurs in Cape Cod Bay beginning in late winter. In early spring (late February to April), peak North Atlantic right whale abundance occurs in Jordan and Wilkinson Basins to the Great South Channel (Kenney et al. 1995, (Nichols et al. 2008). In late June and July, North Atlantic right whale distribution gradually shifts to the northern edge of Georges Bank. In late summer (August) and fall, much of the population is found in waters in the Bay of Fundy, the western Gulf of Maine and around Roseway Basin (Benoit-Bird et al. 2004; Kenney et al. 1995; Kenney et al. 2001; Pace III and Merrick 2008; Winn et al. 1986).

The coastal waters of the southeastern United States are a wintering and sole known calving area for right whales. Sighting records of right whales spotted in the core calving area off Georgia and Florida consist of mostly mother-calf pairs and juveniles but also some adult males and females without calves (Kraus and Rolland 2007). As many as 243 right whales have been documented in the southeastern U.S. during one calving season. Right whale concentrations are highest in the core calving area from November 15 through April 15 (71 FR 36299, June 26, 2006); on rare occasions, right whales have been spotted as early as September and as late as July (Taylor et al. 2010). Most calves are likely born early in the calving season. Right whales generally occur off South and North Carolina from November 1 through April 30 and have been sighted as far as about 30 nautical miles offshore (Knowlton et al. 2002; Pabst et al. 2009).

North Atlantic right whales produce a variety of sounds, including moans, screams, gunshots, blows, upcalls, downcalls, and warbles that are often linked to specific behaviors (Laurinolli et al. 2003; Matthews et al. 2001; Parks et al. 2005; Parks and Tyack 2005; Vanderlaan et al. 2003). Sounds can be divided into three main categories: (1) blow sounds; (2) broadband impulsive sounds; and (3) tonal call types (Parks and Clark 2007). Broadband sounds include non-vocal slaps (when the whale strikes the surface of the water with parts of its body) and the “gunshot” sound; data suggests that the latter serves a communicative purpose ((Parks and Clark 2007). Tonal calls can be divided into simple, low-frequency, stereo-typed calls and more complex, frequency-modulated, higher-frequency calls (Parks and Clark 2007). Most of these sounds range in frequency from 0.02 to 15 kHz (dominant frequency range from 0.02 to less than 2 kHz; durations typically range from 0.01 to multiple seconds) with some sounds having multiple harmonics (Parks and Tyack 2005)). Source levels for some of these sounds have been measured as ranging from 137 to 192 dB re 1 µPa (rms) (Parks et al. 2005, Parks and Tyack 2005). Parks and Clark (2007) suggested that the frequency of right whale vocalizations increases significantly during the period from dusk until dawn. Recent morphometric analyses of North Atlantic right whale inner ears estimates a hearing range of approximately 0.01 to 22 kHz based on established marine mammal models (Parks et al. 2007; Parks and Tyack 2005). In addition, Parks et al. (2007) estimated the functional hearing range for right whales to be 15 Hz to 18 kHz.

Seasonal Management Areas (SMAs) for right whales have been designated to reduce ship strikes. All vessels greater than 19.8 m (65 ft) in overall length must operate at speeds of 10 kt or less within these areas during specific time periods (Table 17).

Table 17. Seasonal Management Areas for North Atlantic Right Whales in the Action Area.

Regional Area	Individual Areas	Concerns	Period of Activity
Northeast U.S. Seasonal Management Areas	Cape Cod Bay	Feeding Area	January 1–May 15
	Off Race Point	Feeding Area	March 1–April 30
	Great South Channel	Feeding Area	April 1–July 31
Mid-Atlantic U.S. Seasonal Management Areas	Block Island Sound	Migratory Route and Calving Grounds	November 1–April 30
	Ports of New York/ New Jersey		
	Entrance to Delaware Bay		
	Entrance to Chesapeake Bay		
	Ports of Morehead City and Beaufort, NC		
	Wilmington, NC to Brunswick, GA		
Southeast U.S. Seasonal Management Area	Central GA to northeast FL	Calving and Nursery Grounds	November 15–April 15

4.2.1 Right Whale Critical Habitat

Critical habitat was designated for the North Atlantic right whale in 1994 (59 FR 28805) and expanded in January 2016 (81 FR 4838). There are two critical habitat areas in the North Atlantic: Unit 1 in the Northeast U.S. (Figure 11) and Unit 2 in the Southeast U.S. (Figure 12).

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

The physical and biological features of right whale calving habitat that are essential to the conservation of the North Atlantic right whale are: (1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7 °C, and never more than 17 °C; and (3) water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 nm^2 of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves.

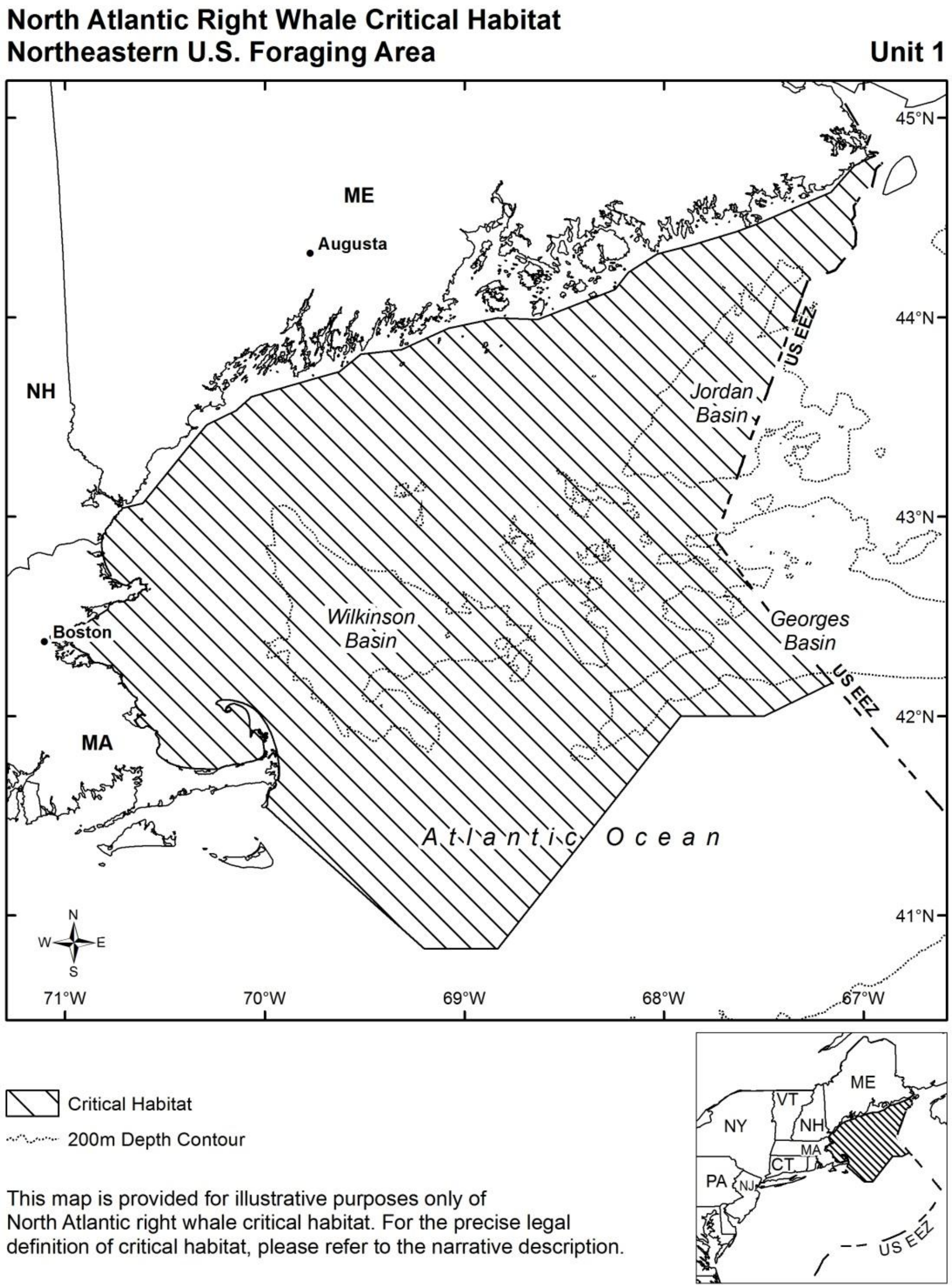

Figure 11. Unit 1 Northeast U.S. critical habitat for right whales

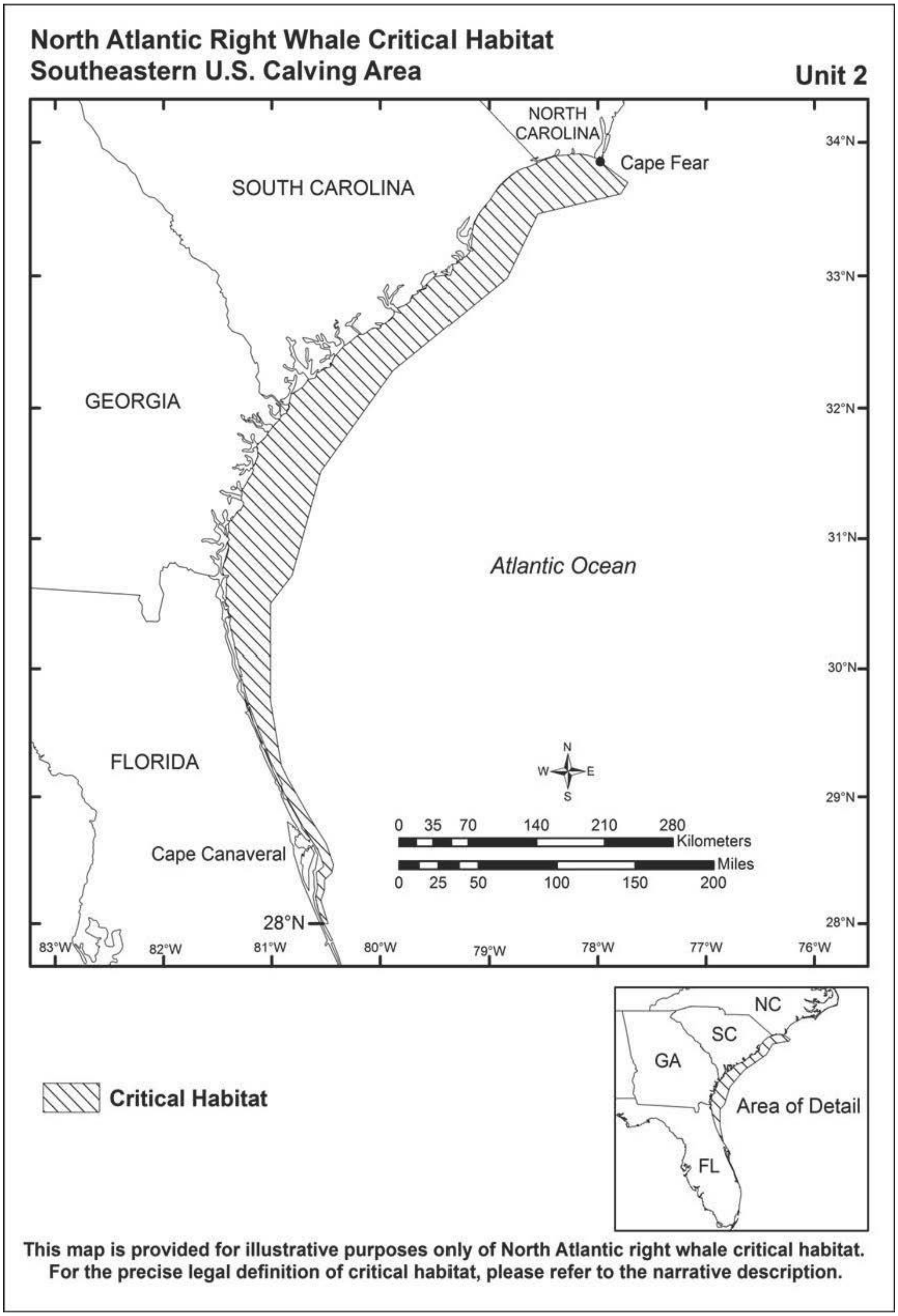

Figure 12. Unit 2 Southeast U.S. critical habitat for right whales

4.3 Fin Whales

Fin whales were originally listed as endangered in 1970 (35 FR 18319), and this status continues since the inception of the ESA in 1973. Although fin whale population structure remains unclear, various abundance estimates are available. Consideration of the status of populations outside of the action area is important under the present analysis to determine how the risk to the affected population(s) bears on the status of the species as a whole. Historically, worldwide populations were severely depleted by commercial whaling, with more than 700,000 whales harvested in the twentieth century (Cherfas 1989). Fin whales accounted for 46% of the large whales and 24% of all cetaceans sighted over the continental shelf during aerial surveys (CETAP 1982) between Cape Hatteras and Nova Scotia during 1978–1982. The best estimate of abundance for fin whales is 1,234-1,618 (CV=0.33) (Hayes et al. 2018).

The subspecies of fin whale in the North Atlantic, *Balaenoptera physalus physalus*, is the most common whale off the Atlantic coast of the U.S. in waters immediately off the coast seaward to the continental shelf edge. Fin whales occur during the summer from Baffin Bay to near Spitsbergen and the Barents Sea, south to Cape Hatteras in North Carolina (Rice 1998). Little is known about the winter habitat of fin whales, but in the western North Atlantic, the species has been found from Newfoundland south to the Gulf of Mexico and Greater Antilles. Fin whales in the North Atlantic eat pelagic crustaceans, mainly krill and schooling fish such as capelin, herring, and sand lance (Borobia et al. 1995; Christensen et al. 1992; Hjort and Ruud 1929; Ingebrigtsen 1929; Jonsgard 1966; Mitchell 1974; Overholtz and Nicolas 1979; Sergeant 1977) (Shirihai 2002; Watkins et al. 1984). Fin whales frequently forage along cold eastern current boundaries (Perry et al. 1999a). Feeding may occur in waters as shallow as 10 m when prey are at the surface, but most foraging is observed in high-productivity, upwelling, or thermal front marine waters (Panigada et al. 2008; Sergeant 1977).

Fin whales live 70-80 years (Kjeld et al. 2006). Fin whales reach sexual maturity between 5-15 years of age (COSEWIC 2005; Gambell 1985; Lockyer 1972). Mating and calving occurs primarily from October-January, gestation lasts ~11 months, and nursing occurs for 6-11 months (Boyd et al. 1999; Hain et al. 1992). The average calving interval in the North Atlantic is approximately 2-3 years (Agler et al. 1993; Christensen et al. 1992).

Fin whales produce a variety of low-frequency sounds in the 10-200 Hz range (Thompson et al. 1992; Watkins 1981; Watkins et al. 1987). Typical vocalizations are long, patterned pulses of short duration (0.5-2 s) in the 18-35 Hz range, but only males are known to produce these (Charif et al. 2002; Croll et al. 2002; Patterson and Hamilton 1964). Richardson et al. (1995) reported the most common sound as a 1 sec vocalization of about 20 Hz, occurring in short series during spring, summer, and fall, and in repeated stereotyped patterns during winter. Vocalization have been reported moans of 14-118 Hz with a dominant frequency of 20 Hz , tonal vocalizations of 34-150 Hz, and songs of 17-25 Hz (Cummings and Thompson 1994; Edds 1988; Watkins 1981). Source levels for fin whale vocalizations are 140-200 dB re 1μPa·m (Clark and Ellison 2004; Erbe 2002). The depth of calling fin whales has been reported to be about 50 m (Watkins et al. 1987b). In temperate waters, intense bouts of long patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clarke and Charif 1998). Short sequences of rapid pulses in the 20-70 Hz band are associated with animals in social groups (McDonald et al. 1995).

Although their function is still debated, low-frequency fin whale vocalizations travel over long distances and may aid in long-distance communication (Edds-Walton 1997; Payne and Webb 1971). During the breeding season, fin whales produce pulses in a regular repeating pattern that are believed to be mating displays similar to those of humpbacks (Croll et al. 2002). These vocal bouts last for a day or longer (Tyack 1999). The seasonality and stereotype of the bouts of patterned sounds suggest that these sounds are male reproductive displays (Watkins et al. 1987) while individual counter-calling data (McDonald et al. 1995) suggest that the more variable calls are contact calls. Some authors feel there are geographic differences in the frequency, duration and repetition of the pulses (Thompson et al. 1992). Direct studies of fin whale hearing have not been conducted, but it is assumed that fin whales can hear the same frequencies that they produce (low) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995).

4.4 Sei Whales

The sei whale has been listed as endangered under the Endangered Species Act (ESA) since its passage in 1973. The species is also listed as depleted by the MMPA. International protection for sei whales began in the 1970s, but the taking of sei whales has continued at relatively low levels by Icelandic and Japanese operations. Stocks in the North Atlantic and North Pacific have been legally protected from whaling since the International Whaling Commission (IWC) moratorium was passed in 1986. Of the commercially exploited large whales, the sei whale is one of the least studied, and the current status of most sei whale stocks is poorly known.

Throughout their range, sei whales occur predominantly in deep water. They are most common over the continental slope (CETAP 1982; Martin et al. 1984; Mitchell 1975c; Olsen et al. 2009), shelf breaks (COSEWIC 2003), and deep ocean basins situated between banks. The range of the Nova Scotia stock of sei whales includes the continental shelf waters of the northeastern U.S. and extends northeastward to south of Newfoundland. The total number of the Nova Scotia Stock of sei whales which occur in the in the Northeast U.S. Atlantic EEZ is estimated to be 263-357, but this is likely a conservatively low estimate (Hayes et al. 2018). There are insufficient data to determine trends of the sei whale population.

A major portion of the Nova Scotia sei whale stock is centered in northerly waters, perhaps on the Scotian Shelf during the feeding season (Mitchell and Chapman 1977). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ)—the Gulf of Maine and Georges Bank. Spring is the period of greatest abundance in U.S. waters, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP 1982). NMFS aerial surveys since 1999 have found concentrations of sei and right whales along the northern edge of Georges Bank in the spring. The sei whale is often found in the deeper waters characteristic of the continental shelf edge region (Hain et al. 1985), and NMFS aerial surveys found substantial numbers of sei whales in this region, in particular south of Nantucket, in the spring of 2001. Similarly, sei whales were reported off Nova Scotia to have a distribution closer to the 2,000-m depth contour than were fin whales (Mitchell 1975b).

Adults range from 40 to 60 ft (12 to 18 m) and weigh up to 99,000 lb (45,000 kg), with animals in the Southern Ocean occupying the larger end of size distribution. Females are considerably larger than males. They are long-bodied and slender, with an erect falcate dorsal fin set about two-thirds of the way back on the body. Sei whales are generally gray in color, with skin often marked by pits or wounds, which become oval-shaped white scars after healing. These are probably caused mainly by ectoparasitic copepods (*Penella* spp.) (Andrews 1916; Ivashin and Golubovsky 1978), lampreys (Pike 1951; Rice 1977), and "cookie-cutter" sharks (*Isistius brasiliensis*) (Shevchenko 1977). The most reliable feature for distinguishing sei whales from other baleen whales is their very fine baleen bristles (about 0.1 mm in diameter at the base) (Mead 1977). Mead also noted that the sei whale can be distinguished from all other species, except the smaller minke whale, by the relative shortness of its ventral grooves, which extend back only to a point about midway between the flippers and umbilicus.

Sei whales in the North Atlantic reportedly feed primarily on calanoid copepods, with a secondary preference for euphausiids (Christensen et al. 1992; Hjort and Ruud 1929; Mitchell 1975a; Mitchell 1986). Their preference for zooplankton and micronekton has been shown not only by stomach content analyses, but also by direct observations of feeding behavior (Watkins and Schevill 1979), by inference (sei whale occurrence and prey (copepod) densities (Olsen et al. 2009); and examination of feces collected near sei whales in the southern Gulf of Maine (Schilling et al. 1992; Weinrich et al. 1986). Sei whales reach sexual maturity at 8 to 10 years in both sexes (Lockyer and Martin 1983). In the North Atlantic, most births take place in November/December and conceptions in December/January (Lockyer and Martin 1983). Sei whale calves are probably nursed for six to nine months (Lockyer and Martin 1983). The average calving interval is probably at least two years (Jonsgard and Darling 1977; Lockyer and Martin 1983).

Although sei whale vocalizations have been recorded since at least the 1970s, these sounds have only recently been linked to the species. A number of researchers described characteristics of sei whale vocalizations from various locations and populations. Generally, calls are 1 to 1.5 seconds in duration and tend to down-sweep from 100 to 40 Hz. Reported calls that ranged from 200 to 600 Hz with an average frequency around 430 Hz (McDonald et al. 2005). There is no direct information about the hearing abilities of baleen whales. It is generally assumed that most animals hear well in the frequency ranges similar to those used for their vocalizations. The anatomy of the baleen whale inner ear seems to be well adapted for detection of low-frequency sounds (Ketten 1991; Ketten 1992; Ketten 1994).

4.5 Sperm Whales

Sperm whales were first listed under the precursor to the ESA, the Endangered Species Conservation Act of 1969, and remained on the list of threatened and endangered species after the passage of the ESA in 1973 (35 FR 18319, December 2, 1970). The primary cause of the population decline that precipitated ESA listing was commercial whaling for ambergris and spermaceti in the eighteenth, nineteenth, and twentieth centuries. The IWC estimates that nearly 250,000 sperm whales were killed worldwide in whaling activities between 1800 and 1900. From 1910 to 1982, nearly 700,000 sperm whales were killed worldwide by whaling activities (IWC Statistics 1959-1983). A compilation of all whaling catches in the North Atlantic north of 20ºN from 1905 onward gave totals of 28,728 males and 9,507 females.

The sperm whale occurs in all oceans of the world and perhaps the most widely distributed mammal on earth. For management purposes under the MMPA, sperm whales inhabiting U.S. waters have been divided into 5 stocks: (1) the California-Oregon-Washington Stock, (2) the North Pacific (Alaska) Stock, (3) the Hawaii Stock, 4) the Northern Gulf of Mexico Stock, (5) and the North Atlantic Stock. Females and juveniles form groups that are generally within tropical and temperate latitudes between 50°N and 50°S, while the solitary adult males can be found at higher latitudes between 75ºN and 75ºS (Ballance and Pitman 1998). The home ranges of individual females seem to span distances of approximately 1,000 km (Best 1979), (Dufault and Whitehead 1995). The best estimate for the current worldwide abundance of sperm whale is estimated between 300,000-450,000 individuals (Abend and Smith 1995; Whitehead 2002). The abundance of sperm whales in the North Atlantic stock is estimated to be 1,815-2,288 individuals and 560-763 whales in the northern Gulf of Mexico (Hayes et al. 2018). Occurrences of sperm whales from the North Atlantic stock may potentially occur in the action area but would be infrequent due to their preference for marine habitats occurring beyond the edge of continental shelf (>200 m).

Sperm whales are the largest of the toothed whales, reaching a length of 60 ft (18.3 m) in males and 40 ft (12.2 m) in females (Odell 1992). The age distribution of the sperm whale population is unknown, but they are believed to live at least 60 years (Rice 1989). Sperm whales are distributed throughout most oceanic areas but are found in deeper waters seaward of the continental shelf. Deep water is required so they can make prolonged, deep dives to locate prey, breed, and nurse their young. In general, females and immature sperm whales appear to be restricted in range, whereas males are found over a wider range and do make occasional movements across and between ocean basins (Dufault et al. 1999). Sperm whales undergo deep foraging dives to cephalopods (i.e., squid, octopi, cuttlefishes, and nautili), the main component of sperm whale diets. Sperm whales consume about 3.0-3.5% of their body weight per day (Lockyer 1981). Typical foraging dives last 40 minutes to depths of about 1,300 ft (400 m), followed by approximately 8 minutes of resting at the surface (Gordon 1987; Irvine et al. 1981; Papastavrou et al. 1989). Nonetheless, dives of over 2 hours and deeper than 2 miles (3.3 km) have been recorded (Clarke 1976); individuals may spend extended periods of time at the surface to recover.

The social organization of sperm whales, and with most other mammals, is characterized by females remaining in the geographic area in which they were born and males dispersing more broadly. Females group together and raise young. For female sperm whales, remaining in the region of birth can include very large oceanic ranges over which the whales need to successfully forage and nurse young whales. Male sperm whales are mostly solitary and disperse more widely and can mate with multiple female populations throughout a lifetime. Female sperm whales attain sexual maturity at the mean age of 8 or 9 years. Maturation in males usually begins in this same age interval as females, but males have a prolonged puberty and attain sexual maturity at between age 12 and 20. Males may require another 10 years to become large enough to successfully compete for breeding rights (Kasuya 1991). In the North Atlantic Ocean, the peak breeding season for sperm whales occurs during the spring (March/April to June), although some mating activity continues throughout the summer.

Gestation lasts well over a year, with credible estimates of the normal duration ranging from 15 months to more than a year and a half. A single calf is born at a length of about 13 ft (4 m), after a 15-16 month gestation period. Female sperm whales rarely become pregnant after the age of 40

(Whitehead 2003). Females assist each other in the care of offspring, guarding of young at the surface while mothers dive (Whitehead 1996). Females even have been observed nursing valves other than their own (Reeves and Whitehead 1997). Calves are nursed for 2-3 years (in some cases, up to 13 years), and the calving interval is estimated to be about 4-7 years (Kasuya 1991).

The disproportionately large head of the sperm whale is an adaptation to produce acoustic signals (Cranford 1992; Norris and Harvey 1972) Sperm whales locate prey by echolocation clicks while in a deep dive pattern, and also produce vocalizations while resting at the surface. The function of vocalizations is relatively well-studied (Goold and Jones 1995; Weilgart and Whitehead 1997) Long series of monotonous, regularly spaced clicks and closely spaced clicks are produced for echolocation and are associated with feeding and prey capture. Clicks produced by sperm whales (and presumably heard by them) are in the range of about 0.1-20 kHz (Goold and Jones 1995; Weilgart and Whitehead 1997; Weilgart et al. 1993) up to 30 kHz, often with most of the energy in the 2-4 kHz range (Watkins and Schevill 1980) Clicks have source levels estimated at 171 dB re: 1 μPa (Levenson 1974) Sperm whales also utilize unique stereotyped click sequences called "codas" (Adler-Fenchel 1980; Mullins et al. 1988; Watkins et al. 1985; Watkins and Schevill 1977) Codas may convey information about the age, sex, and reproductive status of the sender (Weilgart and Whitehead 1988) and may maintain social cohesion with the group (Weilgart et al. 1993). Sperm whales have been categorized as a cetacean in the mid-frequency functional hearing group in the range of 150-160 kHz and can hear wide variety of sounds in the ocean environment.

4.6 Loggerhead Sea Turtle North Atlantic DPS

The loggerhead sea turtle was listed as a threatened species throughout its global range on July 28, 1978. NMFS and USFWS published a final rule designating 9 DPSs for loggerhead sea turtles (76 FR 58868, September 22, 2011, and effective October 24, 2011). This rule listed the following DPSs: (1) Northwest Atlantic Ocean (threatened), (2) Northeast Atlantic Ocean (endangered), (3) South Atlantic Ocean (threatened), (4) Mediterranean Sea (endangered), (5) North Pacific Ocean (endangered), (6) South Pacific Ocean (endangered), (7) North Indian Ocean (endangered), (8) Southeast Indo-Pacific Ocean (endangered), and (9) Southwest Indian Ocean (threatened). The Northwest Atlantic (NWA) DPS is the only one that occurs within the action area and therefore is the only one considered in this Opinion.

Loggerhead turtles are likely to be the most common sea turtle species in the action area. Non-nesting, adult female loggerheads are reported throughout the U.S. Atlantic. Aerial surveys suggest that loggerheads as a whole are distributed throughout U.S. waters with most turtles occurring in the south and mid-Atlantic regions (Turtle Expert Working Group 2009). Within the Northwest Atlantic Ocean DPS, most loggerhead sea turtles nest from North Carolina to Florida and along the Gulf Coast of Florida. NMFS has estimated the adult female population size for the western North Atlantic (from the 2004-2008 time frame) is approximately 20,000 to 40,000 individuals (NMFS-SEFSC 2009). A less robust estimate for total benthic females in the western North Atlantic was also obtained, yielding approximately 30,000-300,000 individuals, up to less than 1 million (NMFS-SEFSC 2009). A preliminary regional abundance survey of loggerheads within the northwestern Atlantic continental shelf for positively identified loggerhead in all strata estimated about 588,000 loggerheads (interquartile range of 382,000-817,000). When correcting for unidentified turtles in proportion to the ratio of identified turtles, the estimate increased to about 801,000 loggerheads (interquartile range of 521,000-1,111,000) (NMFS-NEFSC 2011).

Loggerheads are large sea turtles. Adults in the southeast United States average about 3 ft (92 cm) long, measured as a straight carapace length (SCL), and weigh approximately 255 lb (116 kg) (Ehrhart and Yoder 1978). Adult and subadult loggerhead sea turtles typically have a light yellow plastron and a reddish brown carapace covered by non-overlapping scutes that meet along seam lines. They typically have 11 or 12 pairs of marginal scutes, 5 pairs of costals, 5 vertebrals, and a nuchal (precentral) scute that is in contact with the first pair of costal scutes (Dodd Jr. 1988). The loggerhead sea turtle inhabits continental shelf and estuarine environments throughout the temperate and tropical regions of the Atlantic and other ocean basins. Juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd Jr. 1988). Subadult and adult loggerheads are primarily found in coastal waters and eat benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats.

There are 8 life stages for the loggerhead life cycle, which include the ecosystems those stages generally use: (1) egg (terrestrial zone), (2) hatchling stage (terrestrial zone), (3) hatchling swim frenzy and transitional stage (neritic zone[15]), (4) juvenile stage (oceanic zone), (5) juvenile stage (neritic zone), (6) adult stage (oceanic zone), (7) adult stage (neritic zone), and (8) nesting female (terrestrial zone) (NMFS and USFWS 2008). Loggerheads are long-lived animals. They reach sexual maturity between 20-38 years of age, although age of maturity varies widely among populations. The annual mating season occurs from late March to early June, and female turtles lay eggs throughout the summer months. Females deposit an average of 4.1 nests within a nesting season (Murphy and Hopkins 1984), but an individual female only nests every 3.7 years on average (Tucker 2010). Each nest contains an average of 100-126 eggs (Dodd Jr. 1988) which incubate for 42-75 days before hatching (NMFS and USFWS 2008). Loggerhead hatchlings are 1.5-2 inches long and weigh about 0.7 ounces (20 grams).

As post-hatchlings, loggerheads hatched on U.S. beaches enter the “oceanic juvenile” life stage, migrating offshore and becoming associated with *Sargassum* habitats, driftlines, and other convergence zones (Carr 1986; Conant et al. 2009; Witherington 2002). Oceanic juveniles grow at rates of 1-2 inches (2.9-5.4 cm) per year (Bjorndal et al. 2003; Snover 2002) over a period as long as 7-12 years (Bolten et al. 1998) before moving to more coastal habitats. After departing the oceanic zone, neritic juvenile loggerheads in the Northwest Atlantic inhabit continental shelf waters from Cape Cod Bay, Massachusetts, south through Florida, the Bahamas, Cuba, and the Gulf of Mexico. Estuarine waters of the United States, including areas such as Long Island Sound, Chesapeake Bay, Pamlico and Core Sounds, Mosquito and Indian River Lagoons, Biscayne Bay, Florida Bay, and numerous embayments fringing the Gulf of Mexico, comprise important inshore habitat. Essentially all shelf waters of the Atlantic are inhabited by loggerheads (Conant et al. 2009).

Offshore, adults primarily inhabit continental shelf waters, from New York south through Florida, the Bahamas, Cuba, and the Gulf of Mexico. Seasonal use of mid-Atlantic shelf waters, especially offshore New Jersey, Delaware, and Virginia during summer months, and offshore shelf waters, such as Onslow Bay (off the North Carolina coast), during winter months has also been

[15] Neritic refers to the nearshore marine environment from the surface to the sea floor where water depths do not exceed 200 meters.

documented (Hawkes et al. 2007). Numbers of nests and nesting females can vary widely from year to year. Nesting beach surveys, though, can provide a reliable assessment of trends in the adult female population, due to the strong nest site fidelity of female loggerhead sea turtles, as long as such studies are sufficiently long and survey effort and methods are standardized (NMFS and USFWS 2008).

4.6.1 Critical Habitat for NWA DPS of Loggerhead Sea Turtle

NMFS and USFWS designated critical habitat for the threatened NWA DPS of loggerhead sea turtle on July 18, 2013, followed by the Final Rule on July 10, 2014 (79 FR 39855 2014). The designation includes 38 marine areas within portions of the northwestern Atlantic Ocean and the Gulf of Mexico (Figure 15). Each of these areas consists of one or a combination of the following habitat types: nearshore reproductive habitat (directly off high density nesting beaches out to 1 mi [1.6 km]), wintering habitat, breeding habitat, constricted migratory corridors, and *Sargassum* habitat. These habitat types support key life history phases of the loggerhead sea turtle and are essential to the conservation of the species. Loggerhead critical habitat is defined by physical and biological features (PBFs) of the habitat that are vital for the conservation of the species and the primary constituent elements (also referred to as "essential features") that support the PBFs (Table 18).

Table 18. Loggerhead Marine Critical Habitats and Primary Constituent Elements

Nearshore Reproductive Habitat (1) Nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 C.F.R. 17.95(c) to 1.6 km (1 mile) offshore; (2) Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; and (3) Waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.
Foraging Habitat (1) Sufficient prey availability and quality, such as benthic invertebrates, including crabs (spider, rock, lady, hermit, blue, horseshoe), mollusks, echinoderms and sea pens; and (2) Water temperatures to support loggerhead inhabitance, generally above 10° C.
Winter Habitat (1) Water temperatures above 10° C from November through April; (2) Continental shelf waters in proximity to the western boundary of the Gulf Stream; and (3) Water depths between 20 and 100 m
Breeding Habitat (1) High densities of reproductive male and female loggerheads; (2) Proximity to primary Florida migratory corridor; and (3) Proximity to Florida nesting grounds.
Migratory Habitat (1) Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory pathways; and (2) Passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas.

***Sargassum* Habitat**
(1) Convergence zones, surface-water down-welling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerheads;
(2) *Sargassum* in concentrations that support adequate prey abundance and cover;
(3) Available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods; and
(4) Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerheads, i.e., >10 m depth.

Winter, breeding, and migratory habitat occur primarily in the Mid-Atlantic and South Atlantic action areas; however, there is a small amount of overlap with *Sargassum* critical habitat on the outer edges of the action area near the 100-m isobath (Figure 13).

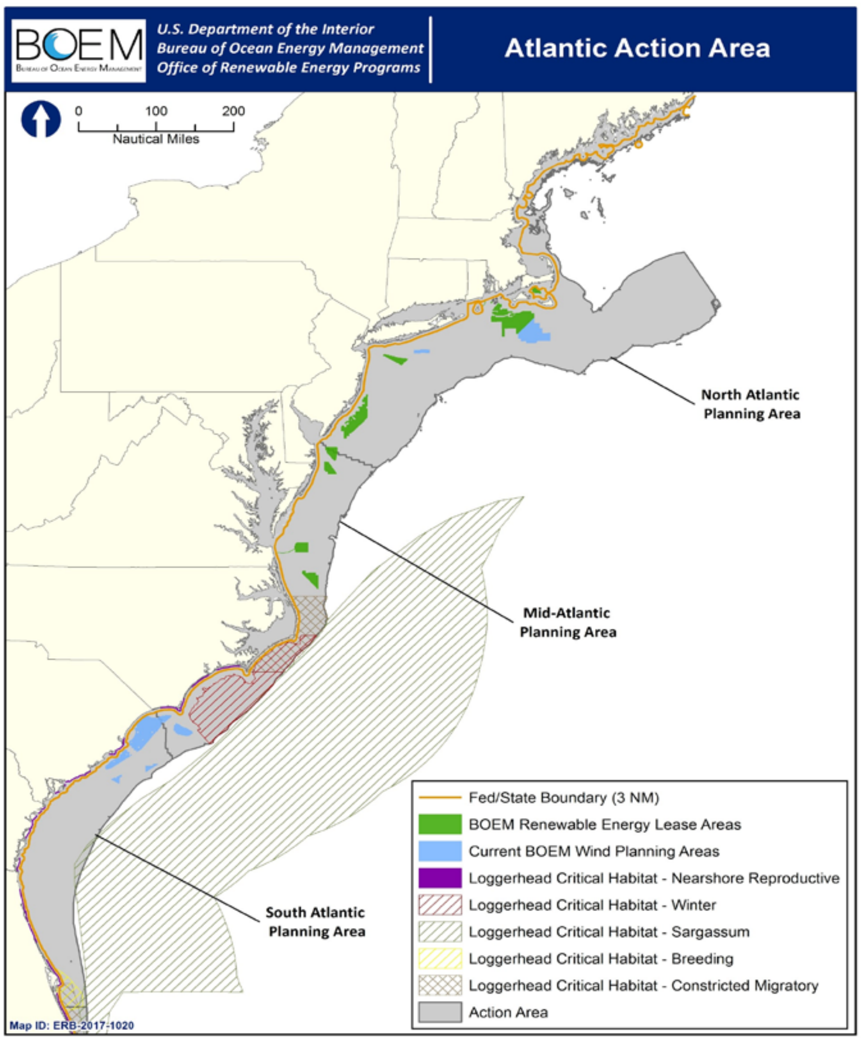

Figure 13. The location of loggerhead critical habitat in the Renewable Energy Areas

4.7 Green Sea Turtle North Atlantic DPS

The green sea turtle was listed as threatened under the ESA on July 28, 1978, except for the Florida and Pacific coast of Mexico breeding populations, which were listed as endangered.

In U.S. Atlantic and Gulf of Mexico waters, green sea turtles are distributed throughout inshore and nearshore waters from Texas to Massachusetts, including the action area. Principal benthic foraging areas in the southeastern United States include Aransas Bay, Matagorda Bay, Laguna Madre, and the Gulf inlets of Texas (Doughty 1984; Hildebrand 1982; Shaver 1994), the Gulf of Mexico off Florida from Yankeetown to Tarpon Springs (Caldwell and Carr 1957; Carr 1984), Florida Bay and the Florida Keys (Schroeder and Foley 1995), the Indian River Lagoon system in Florida (Ehrhart 1983), and the Atlantic Ocean off Florida from Brevard through Broward Counties (Guseman and Ehrhart 1992; Wershoven and Wershoven 1992). The summer developmental habitat for green sea turtles also encompasses estuarine and coastal waters from North Carolina to as far north as Long Island Sound (Musick and Limpus 1997). Additional important foraging areas in the western Atlantic include the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, the Caribbean coast of Panama, scattered areas along Colombia and Brazil (Hirth 1971), and the northwestern coast of the Yucatán Peninsula.

With the exception of post-hatchlings, green sea turtles live in nearshore tropical and subtropical waters where they generally feed on marine algae and seagrasses. They have specific foraging grounds and may make large migrations between these forage sites and natal beaches for nesting (Hays et al. 2001). The complete nesting range of green sea turtles within the southeastern United States includes sandy beaches between Texas and North Carolina, as well as the U.S. Virgin Islands and Puerto Rico (Dow et al. 2007; NMFS and USFWS 1991). Still, the vast majority of green sea turtle nesting within the southeastern United States occurs in Florida (Johnson and Ehrhart 1994; Meylan et al. 1995). Principal U.S. nesting areas for green sea turtles are in eastern Florida, predominantly Brevard south through Broward counties. For more information on green sea turtle nesting in other ocean basins, refer to the 1991 publication, *Recovery Plan for the Atlantic Green Turtle* (NMFS and USFWS 1991) or the 2007 publication, *Green Sea Turtle 5-Year Status Review*(NMFS and USFWS 2007).

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 lb (159 kg) with a straight carapace length of greater than 3.3 ft (1 m). Green sea turtles have a smooth carapace with 4 pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes. They typically have a black dorsal surface and a white ventral surface, although the carapace of green sea turtles in the Atlantic Ocean has been known to change in color from solid black to a variety of shades of grey, green, or brown and black in starburst or irregular patterns (Lagueux 2001).

In the continental United States, green sea turtle nesting occurs along the Atlantic coast, primarily along the central and southeast coast of Florida where an estimated 200-1,100 females nest each year (Meylan et al. 1994; Weishampel et al. 2003). Green sea turtle nesting is also annually documented on beaches of North Carolina, South Carolina, and Georgia, though in low quantities (nesting databases maintained on www.seaturtle.org). Green sea turtles reproduce sexually, and mating occurs in the waters off nesting beaches. Mature females return to their natal beaches (i.e., the same beaches where they were born) to lay eggs (Frazer and Ehrhart 1985) every 2-4 years while males are known to reproduce every year (Balazs 1983). In the southeastern United States, females generally nest between June and September, and peak nesting occurs in June and July (Witherington and Ehrhart 1989). During the nesting season, females nest at approximately 2-week intervals, laying an average of 3-4 clutches (Johnson and Ehrhart 1996). Clutch size often varies among subpopulations, but mean clutch size is approximately 110-115 eggs.

In Florida, green sea turtle nests contain an average of 136 eggs (Witherington and Ehrhart 1989). Eggs incubate for approximately 2 months before hatching. Hatchling green sea turtles are approximately 2 inches (5 cm) in length and weigh approximately 0.9 ounces (25 grams). Survivorship at any particular nesting site is greatly influenced by the level of anthropogenic stressors, with the more pristine and less disturbed nesting sites (e.g., along the Great Barrier Reef in Australia) showing higher survivorship values than nesting sites known to be highly disturbed (Campell and Lagueux 2005; Chaloupka and Limpus 2005). After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. Pelagic juvenile turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. This early oceanic phase remains one of the most poorly understood aspects of green sea turtle life history (NMFS and USFWS 2007). Green sea turtles mature slowly, requiring 20-50 years to reach sexual maturity (Chaloupka and Musick 1997; Hirth 1997).

4.8 Kemp's Ridley Sea Turtle

The Kemp's ridley sea turtle was listed as endangered on December 2, 1970, under the Endangered Species Conservation Act of 1969, a precursor to the ESA. Internationally, the Kemp's ridley is considered the most endangered sea turtle (Groombridge 1982; TEWG 2000; Zwinenberg 1977). Of the 7 species of sea turtles in the world, the Kemp's ridley has declined to the lowest population level. Most of the population of adult females nest on the beaches of Rancho Nuevo, Mexico (Pritchard 1969)(Pritchard 1969). When nesting aggregations at Rancho Nuevo were discovered in 1947, adult female populations were estimated to be in excess of 40,000 individuals (Hildebrand 1963). By the mid-1980s, however, nesting numbers from Rancho Nuevo and adjacent Mexican beaches were below 1,000, with a low of 702 nests in 1985. Yet, nesting steadily increased through the 1990s, and then accelerated during the first decade of the twenty-first century, which indicates the species is recovering.

Kemp's ridley habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 ft (37 m) deep, although they can also be found in deeper offshore waters. These areas support the primary prey species of the Kemp's ridley sea turtle, which consist of swimming crabs, but may also include fish, jellyfish, and an array of mollusks. The primary range of Kemp's ridley sea turtles is within the Gulf of Mexico basin, though they also occur in coastal and offshore waters of the U.S. Atlantic Ocean. Foraging areas along the Atlantic coast include various embayments and estuarine systems from Florida to New York. Coles (1999) reported that Kemp's ridleys were frequently sighted in Chesapeake Bay during the summer over a continuous 18-year sea turtle stranding survey. Coles (Coles 1999) also indicated that the Mid-Atlantic Bight is an important foraging area for juvenile Kemp's ridleys during spring through fall. Juvenile Kemp's ridley sea turtles, possibly carried by oceanic currents, have been recorded as far north as Nova Scotia. In 2012, the rare Kemp's ridley sea turtle nest was recorded in Virginia.

The Kemp's ridley sea turtle is the smallest of all sea turtles. Adults generally weigh less than 100 lb (45 kg) and have a carapace length of around 2.1 ft (65 cm). Adult Kemp's ridley shells are almost as wide as they are long. Coloration changes significantly during development from the grey-black dorsum and plastron of hatchlings, a grey-black dorsum with a yellowish-white plastron as post-pelagic juveniles, and then to the lighter grey-olive carapace and cream-white or yellowish plastron of adults. There are 2 pairs of prefrontal scales on the head, 5 vertebral scutes, usually 5 pairs of costal scutes, and generally 12 pairs of marginal scutes on the carapace.

Kemp's ridley sea turtles share a general life history pattern similar to other sea turtles. Females lay their eggs on coastal beaches where the eggs incubate in sandy nests. After 45-58 days of embryonic development, the hatchlings emerge and swim offshore into deeper, ocean water where they feed and grow until returning at a larger size. Hatchlings generally range from 1.65-1.89 in (42-48 mm) SCL, 1.26-1.73 in (32-44 mm) in width, and 0.3-0.4 lb (15-20 g) in weight. Their return to nearshore coastal habitats typically occurs around 2 years of age (Ogren 1989), although the time spent in the oceanic zone may vary from 1-4 years or perhaps more (TEWG 2000). Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops.

The average rates of growth may vary by location, but generally fall within 2.2-2.9 ± 2.4 in per year (5.5-7.5 ± 6.2 cm/year) (Schmid and Witzell 2006; Schmid and Woodhead 2000) . Age to sexual maturity ranges greatly from 5-16 years. It is unlikely that most adults grow very much after maturity. While some sea turtles nest annually, the weighted mean remigration rate for Kemp's ridley sea turtles is approximately 2 years. Nesting generally occurs from April to July and females lay approximately 2.5 nests per season with each nest containing approximately 100 eggs (Márquez M. 1994).

The increases in Kemp's ridley sea turtle nesting over the last 2 decades is likely due to a combination of management measures including elimination of direct harvest, nest protection, the use of turtle excluder devices, reduced trawling effort in Mexico and the United States, and possibly other changes in vital rates (TEWG 2000). However, the species limited range as well as low global abundance makes it particularly vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty.

4.9 Hawksbill Sea Turtle

The hawksbill sea turtle was listed as endangered throughout its entire range on June 2, 1970 (35 FR 8491) under the Endangered Species Conservation Act of 1969, a precursor to the ESA. Critical habitat was designated on June 2, 1998, in coastal waters surrounding Mona and Monito Islands in Puerto Rico (63 FR 46693), but none is found in the action area. Hawksbills are currently subjected to the same suite of threats on both nesting beaches and in the marine environment that affect other sea turtles (e.g., interaction with federal and state fisheries, coastal construction, oil spills, and climate change affecting sex ratios).

Hawksbill sea turtles have a circumtropical distribution and usually occur between latitudes 30°N and 30°S in the Atlantic, Pacific, and Indian Oceans. In the western Atlantic, hawksbills are widely distributed throughout the Caribbean Sea, off the coasts of Florida and Texas in the continental United States, in the Greater and Lesser Antilles, and along the mainland of Central America south to Brazil (Amos 1989; Groombridge and Luxmoore 1989; Lund 1985; Meylan 1999; Plotkin and Amos 1988; 1990). Hawksbills are considered extralimital in areas north of Florida. The hawksbill turtle has a restricted distribution and range given that its habitat (foraging) preference is coral reefs and mangrove estuaries. There are currently no reliable estimates of population abundance and trends for non-nesting hawksbills.

Hawksbill sea turtles are small- to medium-sized (99 to 150 lb on average [45 to 68 kg]) although females nesting in the Caribbean are known to weigh up to 176 lb (80 kg) (Pritchard et al. 1983; Pritchard and Frazer 1983). The carapace is usually serrated and has a "tortoise-shell" coloring, ranging from dark to golden brown, with streaks of orange, red, and/or black. The plastron of a hawksbill turtle is typically yellow. The head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find sponges, their primary adult food source, and other invertebrates. The shells of hatchlings are 1.7 in (42 mm) long, are mostly brown, and somewhat heart-shaped (Eckert 1995; Hillis and Mackay 1989; van Dam and Sarti 1989).

Hawksbill sea turtles nest on sandy beaches throughout the tropics and subtropics. The most significant nesting within the United States occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and St. Croix, Virgin Islands. Although nesting within the continental United States is typically rare, it can occur along the southeast coast of Florida and the Florida Keys. The largest hawksbill nesting population in the western Atlantic occurs in the Yucatán Peninsula of Mexico, where several thousand nests are recorded annually in the states of Campeche, Yucatán, and Quintana Roo (Spotila 2004). In the U.S. Pacific, hawksbills nest on main island beaches in Hawaii, primarily along the east coast of the island. Hawksbill nesting has also been documented in American Samoa and Guam.

Female hawksbills return to the beaches where they were born (natal beaches) every 2-3 years to nest (Van Dam et al. 1991; Witzell 1983) and generally lay 3-5 nests per season (Richardson et al. 1999). Compared with other sea turtles, the number of eggs per nest (clutch) for hawksbills can be quite high. The largest clutches recorded for any sea turtle belong to hawksbills (approximately 250 eggs per nest) (Hirth and Latif 1980), though nests in the U.S. Caribbean and Florida more typically contain approximately 140 eggs (USFWS hawksbill fact sheet, http://www.fws.gov/northflorida/SeaTurtles/Turtle%20Factsheets/hawksbill-sea-turtle.htm). Eggs incubate for approximately 60 days before hatching (USFWS hawksbill fact sheet). Hatchling hawksbill sea turtles typically measure 1-2 in (2.5-5 cm) in length and weigh approximately 0.5 oz (15 g). Hawksbill sea turtles exhibit slow growth rates. Although they are known to vary within and among populations, they can reach a high of 2 in (5 cm) or more per year, measured at some sites in the (Diez and Van Dam 2002; León and Diez 1999).

4.10 Leatherback Sea Turtle

The leatherback sea turtle was listed as endangered throughout its entire range on June 2, 1970, (35 FR 8491) under the Endangered Species Conservation Act of 1969. The status of the Atlantic leatherback population is not clear due to inconsistent beach and aerial surveys, cycles of erosion, and reformation of nesting beaches in the Guianas (representing the largest nesting area). Leatherbacks also show a lesser degree of nest-site fidelity than occurs with the hardshell sea turtle species.

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (Turtle Expert Working Group 2007). This area includes the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela, with most of the nesting occurring in the Guianas and Trinidad. The Southern Caribbean/Guianas stock of leatherbacks was designated after genetics studies indicated that animals from the Guianas (and possibly Trinidad) should be viewed as a single population. Using nesting females as a proxy for population, the TEWG (2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate. TEWG observed positive growth within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (Turtle Expert Working Group 2007). More specifically, Wallace et al. (2014) report an estimated three-generation abundance change of +3%, +20,800%, +1,778%, and +6% in Trinidad, Guyana, Suriname, and French Guiana, respectively.

The leatherback is the largest sea turtle in the world, with a curved carapace length (CCL) often exceeding 5 ft (150 cm) and front flippers that can span almost 9 ft (270 cm) (NMFS and USFWS 1998). Mature males and females can reach lengths of over 6 ft (2 m) and weigh close to 2,000 lb (900 kg). The leatherback does not have a bony shell. Instead, its shell is approximately 1.5 inches (4 cm) thick and consists of a leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. The ridged shell and large flippers help the leatherback during its long-distance trips in search of food.

Unlike other sea turtles, leatherbacks have several unique traits that enable them to live in cold water. For example, leatherbacks have a countercurrent circulatory system (Greer et al. 1973), a thick layer of insulating fat (Davenport et al. 1990; Goff and Lien 1988), gigantothermy (Paladino et al. 1990), and they can increase their body temperature through increased metabolic activity (Bostrom and Jones 2007; Southwood et al. 2005). These adaptations allow leatherbacks to be comfortable in a wide range of temperatures, which helps them to travel further than any other sea turtle species. They search for food between latitudes 71°N and 47°S, in all oceans, and travel extensively to and from their tropical nesting beaches. In the North Atlantic Ocean, leatherbacks have been recorded as far north as Newfoundland, Canada, and Norway.

While leatherbacks will look for food in coastal waters, they appear to prefer the open ocean at all life stages (Heppell et al. 2003). Leatherbacks have pointed tooth-like cusps and sharp-edged jaws that are adapted for a diet of soft-bodied prey such as jellyfish and salps. A leatherback's mouth and throat also have backward-pointing spines that help retain jelly-like prey. Leatherbacks' favorite prey (e.g., medusae, siphonophores, and salps) occur commonly in temperate and northern or sub-arctic latitudes and likely has a strong influence on leatherback distribution in these areas

(Plotkin 2003). Leatherbacks are known to be deep divers, with recorded depths in excess of a half-mile (Eckert 1989), but they may also come into shallow waters to locate prey items.

The leatherback life cycle is broken into several stages: (1) egg/hatchling, (2) post-hatchling, (3) juvenile, (4) subadult, and (5) adult. Leatherbacks are a long-lived species that delay age of maturity, have low and variable survival in the egg and juvenile stages, and have relatively high and constant annual survival in the subadult and adult life stages (Crouse 1999; Heppell et al. 1999; Heppell et al. 2003; Spotila et al. 1996; Spotila et al. 2000). While a robust estimate of the leatherback sea turtle's life span does not exist, the current best estimate for the maximum age is 43 (Avens et al. 2009). The average size of reproductively active females in the Atlantic is generally 5-5.5 ft (150-162 cm) CCL (Benson et al. 2007; Hirth et al. 1993; Starbird and Suarez 1994). Still, females as small as 3.5-4 ft (105-125 cm) CCL have been observed nesting at various sites (Stewart et al. 2007).

Female leatherbacks typically nest on sandy, tropical beaches at intervals of 2-4 years (Garcia M. and Sarti 2000; McDonald and Dutton 1996; Spotila et al. 2000). Unlike other sea turtle species, female leatherbacks do not always nest at the same beach year after year; some females may even nest at different beaches during the same year (Dutton et al. 2005; Eckert 1989; Keinath and Musick 1993; Steyermark et al. 1996). Individual female leatherbacks have been observed with fertility spans as long as 25 years (Hughes 1996). Females usually lay up to 10 nests during the 3-6 month nesting season (March through July in the United States), typically 8-12 days apart, with 100 eggs or more per nest (Eckert et al. 2012; Maharaj 2004; Matos 1986; Stewart and Johnson 2006; Tucker 1988). Yet, up to approximately 30% of the eggs may be infertile (Matos 1986, Stewart and Johnson 2006, Tucker 1988). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50% worldwide (Eckert et al. 2012), which is lower than the greater than 80% reported for other sea turtle species (Miller 1997).

In and near the action area, the Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with recent total nests between 900-1,600 per year between 2011-2015 compared to nesting totals fewer than 100 nests per year in the 1980s (Florida Fish and Wildlife Conservation Commission, unpublished data). Eggs hatch after 60-65 days, and the hatchlings have white striping along the ridges of their backs and on the edges of the flippers. In the Atlantic, the sex ratio appears to be skewed toward females. Leatherback hatchlings weigh approximately 1.5-2 ounces (40-50 g) and are approximately 2-3 inches (51-76 mm) in length, with fore flippers as long as their bodies. Rapid growth rates have been reported for leatherbacks hatchlings at an estimated at 12.6 inches (32 cm) per year (Jones et al. 2011).

4.11 Atlantic Salmon

The Atlantic salmon Gulf of Maine DPS was listed as federally endangered in 2000 (65 FR 69459); the DPS was revised in 2009 (74 FR 29344). Hatchery-reared Atlantic salmon that are stocked to help restore the Gulf of Maine DPS are considered protected, but their numbers are not considered toward reclassifying the protected status of the Gulf of Maine DPS Atlantic salmon. The Gulf of Maine DPS of Atlantic salmon was listed as endangered primarily due to declines resulting from anthropocentric land and water use practices that have hindered the completion of their life cycle (Baum 1997).

Atlantic salmon spend 2 to 3 years in suitable freshwater tributaries where they begin their life cycle as parr (juvenile stage). Smoltification begins after about 2 years of growing in their natal tributaries, which prepares them for traveling to sea. It takes between 2 to 3 weeks for smolts to travel to sea as they face increased predation and the physiological osmoregulation adaptation that allows them to survive in saline conditions (McCormick et al. 1998). As smolts migrate to sea they utilize the ebbing tides, are associated with the upper water column, and congregate in schools in the open ocean (LaBar et al. 1978; Shelton et al. 1997). A 2005 telemetry study by NMFS found that smolts travel within the upper 1.5 meters of the water column on average in Penobscot Bay. Smolt migration timing is variable depending on differences in annual environmental factors like increasing water levels and temperatures in spring (Danie et al. 1984). Migration consistently occurs as temperatures and flows increase in April, May, and into early June in the Denny's River ((Hasler and Wisby 1951; Lacroix et al. 2005; McCormick et al. 1998). Post-smolts become adults in the northern Atlantic Ocean where they spend another 2 to 3 years feeding along the southeastern coast of Greenland and Labrador (Baum 1997). Very few studies examine adult activity and habitat utilization while living in the open ocean (Fay et al. 2006b).

Adults migrate back to their original tributaries in the Gulf of Maine in early fall to spawn. Salmon homing mechanisms for returning to their natal rivers has been attributed to their olfactory senses that detect water chemical signatures (amino acids) from natal rivers that are established when juveniles, which are used to guide them back to these rivers (Hasler and Wisby 1951). Regardless of genetic origin, hatchery reared smolts will return to the rivers they were released in (Hansen et al. 1993). Peak adult upstream migration occurs in Maine during June and into the fall (Fay et al. 2006a). After spawning, adults are referred to as kelts, and migrate back to sea in late fall to continue feeding and prepare to migrate and spawn again in following years, however, some males overwinter in the rivers before migrating downstream in the spring (Baum 1997; Scott and Crossman 1973a). The total return to US rivers in 2016 was 626 through documented returns to traps and returns estimated by redd counts on selected Maine rivers; 2016 ranked 24 out of 26 years for the 1991-2016 time series, but represents a 164% increase over 2014 (the lowest in the time series) and only 15% of the recent high return number in 2011 (USASAC 2017).

4.12 Atlantic Sturgeon

Five separate DPSs of Atlantic sturgeon were listed under the ESA by NMFS effective April 6, 2012 (77 FR 5880 and 5914, February 6, 2012). The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered. The Gulf of Maine DPS was listed as threatened. Historically, Atlantic sturgeon were present in approximately 38 rivers in the United States from the St. Croix River, Maine to the St. Johns River, Florida, of which 35 rivers have been confirmed to have had a historical spawning population. Atlantic sturgeon are currently present in approximately 32 of these rivers, and spawning occurs in at least 20 of them. The marine range of Atlantic sturgeon extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. Because adult Atlantic sturgeon from all DPSs mix extensively in marine waters, we expect fish from all DPSs to be found in the action area.

Atlantic sturgeon are long-lived, late-maturing, estuarine-dependent, anadromous fish distributed along the eastern coast of North America (Waldman and Wirgin 1998). Historically, sightings have been reported from Hamilton Inlet, Labrador, south to the St. Johns River, Florida (Smith and

Clugston 1997). Atlantic sturgeon may live up to 60 years, reach lengths up to 14 ft, and weigh over 800 lb (ASSRT 2007; Branstetter 2002). Atlantic sturgeon spend the majority of their lives in nearshore marine waters, returning to their natal rivers to spawn (Wirgin et al. 2002). Sturgeon are omnivorous benthic (bottom) feeders and filter quantities of mud along with their food. Adult sturgeon diets include mollusks, gastropods, amphipods, isopods, and small fishes, especially sand lances (*Ammodytes sp*.) (Scott and Crossman 1973b). Juvenile sturgeon feed on aquatic insects and other invertebrates (Smith 1985a).

Atlantic sturgeon populations show clinal variation, with a general trend of faster growth and earlier age at maturity in more southern systems. Atlantic sturgeon mature between the ages of 5-19 years in South Carolina (Smith and Dingley 1984), between 11-21 years in the Hudson River, and between 22-34 years in the St. Lawrence River (Scott and Crossman 1973a). Multiple studies have shown that spawning intervals range from 1-5 years for males (Caron et al. 2002; Collins et al. 2000; Smith 1985a) and 2-5 years for females (Stevenson and Secor 1999; Van Eenennaam et al. 1996; Vladykov and Greely 1963). Spawning adult Atlantic sturgeon generally migrate upriver in spring/early summer, which occurs in February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Bain 1997; Caron et al. 2002; Smith and Clugston 1997; Smith et al. 1985). In some southern rivers, a fall spawning migration may also occur (Moser et al. 1998; Rogers and Weber 1995).

Atlantic sturgeon spawning occurs in fast-flowing water between the salt front and fall line of large rivers (Bain et al. 2000; Crance 1987; Leland 1968; Scott and Crossman 1973a) over hard substrate, such as cobble, gravel, or boulders, to which the highly adhesive sturgeon eggs adhere (Smith and Clugston 1997).. Hatching occurs approximately 94-140 hours after egg deposition and larvae assume a demersal existence. The yolk sac larval stage is completed in about 8-12 days, during which time the larvae move downstream to rearing grounds (Kynard and Horgan 2002).. Juvenile and adult Atlantic sturgeon occupy upper estuarine habitat where they frequently congregate around the saltwater/freshwater interface. Estuarine habitats are important for juveniles, serving as nursery areas by providing abundant foraging opportunities, as well as thermal and salinity refuges, for facilitating rapid growth. Some juveniles will take up residency in non-natal rivers that lack active spawning sites (Bain 1997). Residency time of young Atlantic sturgeon in estuarine areas varies between 1-6 years (Schueller and Peterson 2010; Smith 1985b) after which Atlantic sturgeon start out-migration to the marine environment.

At the time Atlantic sturgeon was listed, the best available abundance information for each of the 5 DPSs (Figure 14) was the estimated number of adult Atlantic sturgeon spawning in each of the rivers on an annual basis.

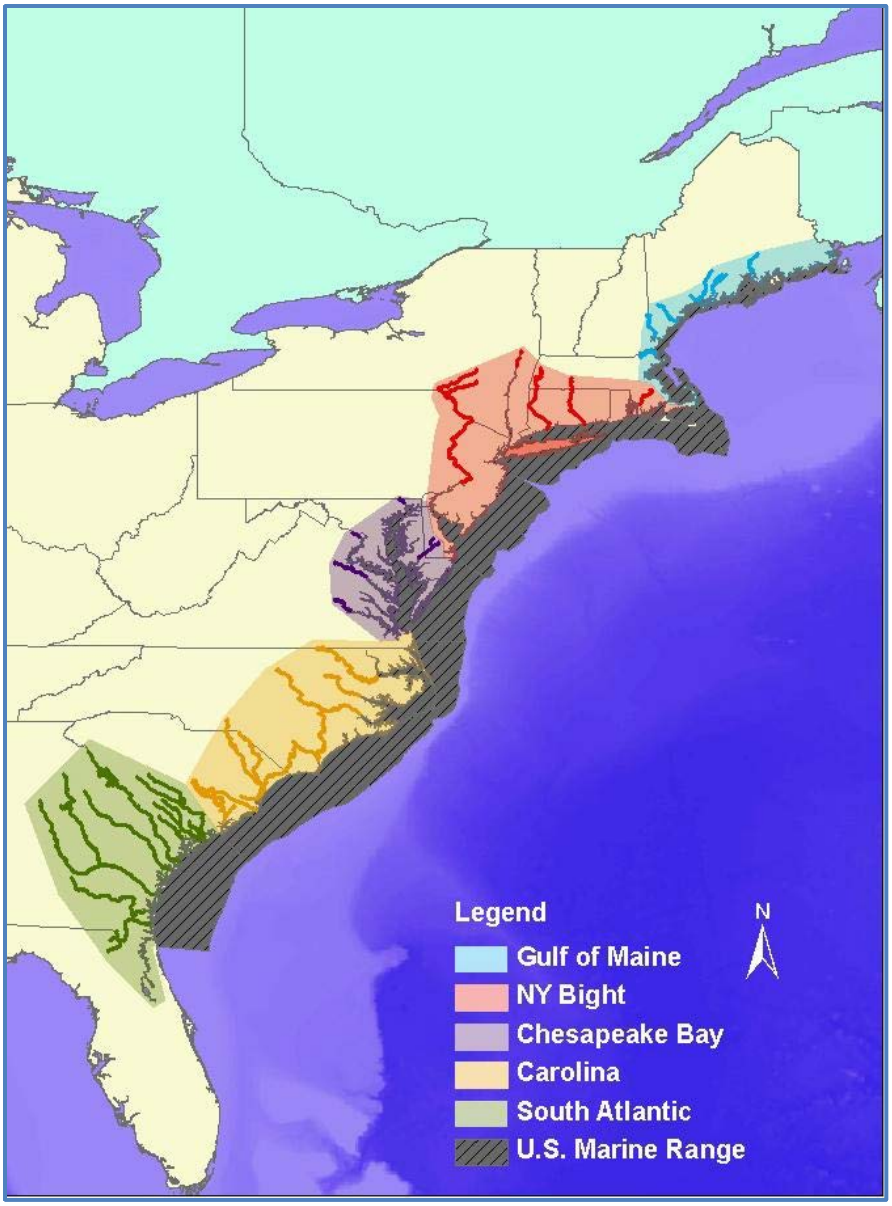

Figure 14. The five Distinct Population Segments of Atlantic sturgeon

The Atlantic States Marine Fisheries Commission recently completed a benchmark stock assessment for Atlantic sturgeon (Atlantic States Marine Fisheries Commission 2017) indicating that the coastwide population and each DPS remains depleted but is slowly recovering. However the stock status report determined it could only qualitatively assess the stock abundance relative historical abundance based on the data available. The total ocean population abundance estimates listed in Table 19 currently represent the best available population abundance estimates for the five U.S. Atlantic sturgeon DPSs.

Table 19. Summary of Calculated Population Estimates based upon the NEAMAP Survey Swept Area, Assuming 50% Efficiency (NMFS 2013)

DPS	Estimated Ocean Population Abundance
Gulf of Maine	7,455
New York Bight	34,566
Chesapeake Bay	8,811
Carolina	1,356
South Atlantic	14,911

Gulf of Maine DPS

The Gulf of Maine DPS includes all anadromous Atlantic sturgeons that are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, Massachusetts. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT 2007). Spawning still occurs in the Kennebec and Androscoggin Rivers, and may still occur in the Penobscot River. Atlantic sturgeon continue to be present in the Kennebec River; in addition, they are captured in directed research projects in the Penobscot River. They are also observed in the Saco, Presumpscot, and Charles rivers where they were unknown to occur before or had not been observed to occur for many years. These observations suggest that the abundance of the Gulf of Maine DPS of Atlantic sturgeon is large enough that recolonization to rivers historically suitable for spawning may be occurring. The NEAMAP model estimates a minimum ocean population of 7,455 Atlantic sturgeon, of which 1,864 are adults.

New York Bight DPS

The New York Bight DPS includes all anadromous Atlantic sturgeon that spawn in the watersheds that drain into coastal waters from Chatham, Massachusetts, to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (ASSRT 2007; Murawski and Pacheco 1977; Secor and Niklitschek 2002). Spawning still occurs in the Connecticut, Delaware and Hudson Rivers (Atlantic States Marine Fisheries Commission 2017). The NEAMAP model estimates a minimum ocean population of 34,566 Atlantic sturgeon, of which 8,642 are adults with a generally upward population trend.

Chesapeake Bay DPS

The Chesapeake Bay DPS includes all anadromous Atlantic sturgeons that are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). It is now known that spawning definitely occurs in the James and York (Pamunkey sub-tributary) Rivers, and likely occurs in the Nanticoke River (Marshyhope sub-tributary). Spawning is suspected to occur in several other tributaries (Rappahannock and other sub-estuaries of the York and Nanticoke Rivers) (Atlantic States Marine Fisheries Commission

2017). Atlantic sturgeon that are spawned elsewhere are known to use waters of the Chesapeake Bay for other life functions, such as foraging and as juvenile nursery habitat, before entering the marine system as subadults (ASSRT 2007; Grunwald et al. 2008; Vladykov and Greely 1963; Wirgin et al. 2007). The NEAMAP model estimates a minimum ocean population of 8,811 Chesapeake Bay DPS Atlantic sturgeon, of which 2,319 are adults.

Carolina DPS

The Carolina DPS includes all Atlantic sturgeon that are spawned in the watersheds (including all rivers and tributaries) from the Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. Atlantic sturgeon have been verified to spawn in the Roanoke River, and are suspected to spawn in the Tar-Pamlico, Neuse, and Cape Fear Rivers in North Carolina as well as, the Pee Dee and Cooper Rivers in South Carolina based on recent tagging studies and collections of river-resident age-0 and age-1 fish. Many of the spawning populations in the Carolina DPS have not been verified through egg or larval collections, and there are few long term data on relative sturgeon abundance(Atlantic States Marine Fisheries Commission 2017). In some rivers, though, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee, and Cooper Rivers, though it is uncertain. The NEAMAP model estimates a minimum ocean population of 1,356 Carolina DPS Atlantic sturgeon, of which 339 are adults.

South Atlantic DPS

The South Atlantic DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto River Basins southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. The Northeast Area Monitoring and Assessment Program (NEAMAP) model estimates a minimum ocean population of 14,911 South Atlantic DPS Atlantic sturgeon, of which 3,728 are adults. The 2017 benchmark stock assessment concludes that South Atlantic DPS rivers appear to be stable, if not increasing (Atlantic States Marine Fisheries Commission 2017).

4.12.1 Critical Habitat for Atlantic sturgeon

Five separate DPSs of Atlantic sturgeon were listed under the ESA in 2012 (77 Federal Register 5880, 77 Federal Register 5914): Chesapeake Bay (endangered), Carolina (endangered), New York Bight (endangered), South Atlantic (endangered), and Gulf of Maine (threatened). The final rule for Atlantic sturgeon critical habitat (all listed DPSs) was issued in 2017 (82 Federal Register 39160). Included in this rule are 31 units, all rivers, occurring from Maine to Florida. No marine habitats were identified as critical habitat because the physical and biological features in these habitats essential for the conservation of Atlantic sturgeon could not be identified. Because effects of the Proposed Action would not extend into critical habitat for Atlantic sturgeon, BOEM concludes that the Proposed Action would not affect any critical habitat for Atlantic sturgeon that has been designated under the ESA.

The critical habitat designation (82 Federal Register 39160) for all DPSs is for habitats that support successful Atlantic sturgeon reproduction and recruitment. The physical features essential for Atlantic sturgeon reproduction and recruitment and therefore to the conservation of the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (National Marine Fisheries Service 2017a; 2017b) are:

1. Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0-0.5 parts per thousand range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;
2. Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 parts per thousand and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;
3. Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (1) unimpeded movements of adults to and from spawning sites; (2) seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and; (3) staging, resting, or holding of subadults or spawning condition adults. Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river, and;
4. Water quality conditions between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support spawning; (2) annual and interannual adult, subadult, larval, and juvenile survival; and (3) larval, juvenile, and subadult growth, development, and recruitment (e.g., 13° C to 26° C for spawning habitat and no more than 30° C for juvenile rearing habitat, and 6 mg/L or greater dissolved oxygen for juvenile rearing habitat).

4.13 Shortnose Sturgeon

The shortnose sturgeon was originally listed as endangered in 1967 under the Endangered Species Preservation Act (32 FR 4001) and was subsequently listed under the ESA in 1973 (39 FR 41370). A status review was conducted in 2007 (Shortnose Sturgeon Status Review Team 2010). Shortnose sturgeon currently remains listed as an endangered species throughout its range along the U.S. East Coast; this includes 18 DPSs from Maine to Florida and one DPS in Canada. Currently, shortnose sturgeon are found in 41 rivers and bays along the East Coast, spawning in 19 of those rivers and comprising three “metapopulations,” or reproductively isolated groups. These three metapopulations include the Carolinian Province (southern metapopulation), Virginian Province (mid-Atlantic metapopulation), and Acadian Province (northern metapopulation).

The species is amphidromous, spawning and growing in freshwater habitat and foraging in estuarine environments in most major riverine systems along the Atlantic coast, with limited forays into nearshore coastal marine waters for short feeding or migratory trips (Bain 1997; Dial Cordy and Associates Inc. 2010)(Fernandes et al. 2010). Spawning adults migrate upriver in spring; spawning occurs between February and May depending on latitude. Spawning takes place from January to April in the South, April to May in the Mid-Atlantic, and May in New England and Canada (Dadswell et al. 1984). In riverine habitat, shortnose sturgeon and Atlantic sturgeon foraging habitat and food resources overlap, but shortnose sturgeon spawning habitat occurs generally farther upriver, and the species spawns earlier than Atlantic sturgeon (Bain 1997).

Shortnose sturgeon are slow-growing and late-maturing and may reach up to 4.5 feet in length and live 30 years or more. As observed in Atlantic sturgeon, shortnose sturgeon populations exhibit clinal variation in growth and maturity, with a general trend of faster growth and earlier age at maturity in more southern systems. Maximum ages range from 67 years in Canada to 10 years in Georgia (Dadswell et al. 1984).

Shortnose sturgeon have barbels ventral to their mouths that are tactile receptors used to locate prey on the benthos. Sturgeon possess a highly protrusible mouth that extends downward to vacuum up sediments containing their prey (i.e., infaunal macroinvertebrates). Shortnose sturgeon are benthic invertivores and feed throughout their lifecycle on infaunal macroinvertebrates, including crustaceans, mollusks, and polychaetes (Dadswell et al. 1984). Because substrate type strongly affects composition of benthic prey, both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates. Foraging in the colder rivers in the northern part of their range appears to cease (or nearly cease) during winter months when shortnose sturgeon become inactive. In mid-Atlantic areas, including the Chesapeake Bay, and the Delaware River, foraging is believed to occur year-round, though shortnose sturgeon are believed to feed less in the winter (Shortnose Sturgeon Status Review Team 2010). In the southern part of their range, shortnose sturgeon are known to forage widely throughout the estuary during the winter, fall, and spring. During the hotter months of summer, foraging may taper off or cease as shortnose sturgeon take refuge from high water temperatures by congregating in cool, deep areas of rivers (Shortnose Sturgeon Status Review Team 2010).

Although shortnose sturgeon are no longer fished, threats remain that continue to affect recovery efforts. Throughout their range, the species are exposed to a variety of habitat stressors from anthropogenic activities including: obstructed or restricted access to riverine habitat; perturbations of habitat from dredging and construction and degraded habitat and water quality which may result in water quality standards that are below fish health standards and tissue contamination (Shortnose Sturgeon Status Review Team 2010).

4.14 Smalltooth Sawfish

The U.S. DPS of smalltooth sawfish was listed as endangered under the ESA in 2003 (68 FR 15674 2003). A status review was conducted in 2018 (NMFS 2018) for the only U.S. DPS, located along the coast of Florida. There is one DPS in non-US waters.

Within the United States, smalltooth sawfish were historically captured in estuarine and coastal waters from New York southward through Texas, although the distribution of the species is now concentrated around peninsular Florida, which has the largest number of recorded captures (NMFS 2010). Recent records indicate that there is a resident reproducing population of smalltooth sawfish in south and southwest Florida from Charlotte Harbor through the Dry Tortugas, which is the last U.S. stronghold for the species (Poulakis and Seitz 2004; Seitz and Poulakis 2006). Individuals in the population exhibit occasional northward excursions into Georgia, possibly associated with seasonal migrations (Brame et al. 2019). Water temperatures (no lower than 16-18°C) and the availability of appropriate coastal habitat, such as shallow, euryhaline waters and red mangroves, are the major environmental constraints limiting the northern movements of smalltooth sawfish in the western North Atlantic.

Smalltooth sawfish reach maturity at 7 – 11 years and live for an estimated 30 years. Maximum size is approximately 5 m (16.4 ft) (Brame et al. 2019). Smalltooth sawfish are piscivorous and exhibit an ontogenetic habitat shift from shallow estuarine and riverine waters as small juveniles to a broader array of coastal habitats and deeper water (up to 100 m) as large juveniles and adults (Brame et al. 2019). The species is most often encountered over mud or sand bottoms (Poulakis and Seitz 2004), with river mouths identified as areas where all life stages have been observed (Seitz and Poulakis 2002). Smaller juveniles tend to be more closely associated with certain habitats in nearshore areas, especially shallow estuarine habitats fringed with vegetation, such as red mangroves. The species is physiologically resilient to anthropogenic stressors but preserving habitat and reducing fishing effects remain priorities.

Smalltooth sawfish are yolk-sac viviparous, emerging into estuarine waters after a 1-year gestation period as fully developed pups. Individual females have a biennial reproductive cycle (Brame et al. 2019). Births peak at the southern tip of Florida between March and July, and between April and May on the west side of Florida (Brame et al. 2019).

There is currently no estimate of smalltooth sawfish abundance throughout its range and there are few long-term abundance data sets that include smalltooth sawfish. However, based on limited data and anecdotal reports, the abundance of smalltooth sawfish in U.S. waters has decreased over the past century. More recent analyses of smalltooth sawfish data indicate the population decline may be diminishing as the core population stabilizes (SSSRT 2018). Critical habitat for smalltooth sawfish was designated in 2009 (74 CFR 45353). It occurs in two units along the southwestern coast of Florida between Charlotte Harbor and Florida Bay, and is therefore not within the action area considered in this BA.

4.15 Nassau Grouper

Nassau grouper were designated as threatened under the ESA in 2016 (81 FR 42268, June 29, 2016). In the U.S. the Nassau grouper is found in southern coastal Florida and the Florida Keys.
It is considered a reef fish, but it transitions as it grows through a series of shifts in both habitat and diet. As larvae they are planktonic. As juveniles they are found in nearshore shallow waters in macroalgal and seagrass habitats. They shift deeper (up to 426 ft) as they grow, to predominantly reef habitat (forereef and reef crest). Adult Nassau grouper tend to be relatively sedentary and are found most abundantly on high relief coral reefs or rocky substrate in clear waters although they can be found from the shoreline to about 100-130m. Larger adults tend to occupy deeper, more rugose, reef areas. Both adults and juveniles will use either natural or artificial reefs (National Marine Fisheries Service 2013b). There is currently no critical habitat designated for Nassau grouper. The primary threat to Nassau grouper is fishing on spawning aggregations (81 FR 42268, June 29, 2016).

5 EFFECTS OF THE PROPOSED ACTION

The effects of the proposed action include routine activities associated with data collection surveys and installation, operation, and decommissioning of data collection devices. The main routes of effects from these activities that have the potential to adversely affect listed species include underwater noise and vessel operations. These main effects are discussed in the analysis below. Other potential routes of effects such as emissions (that may require a permit by the EPA) and habitat impacts associated with anchoring and benthic sampling are anticipated to have insignificant effects on listed species. As discussed at the end of the analysis, these impacts to the benthic habitat, water quality, and air quality will be minor and have no detectable impact on listed species resulting from the proposed action.

Background on the Effects of Underwater Noise

Depending on the type and location of a noise, potential effects from noise sources can range from increases in background noise (ambient noise) to disturbance and in some cases injury from very loud sounds. Disturbance of normal behaviors may result in potentially adverse effects on feeding success, resting periods, migration, diving patterns, or breeding behaviors. Exposure to very loud, high pressure, or persistent noises, may impair animals through temporary and permanent hearing loss (Figure 15).

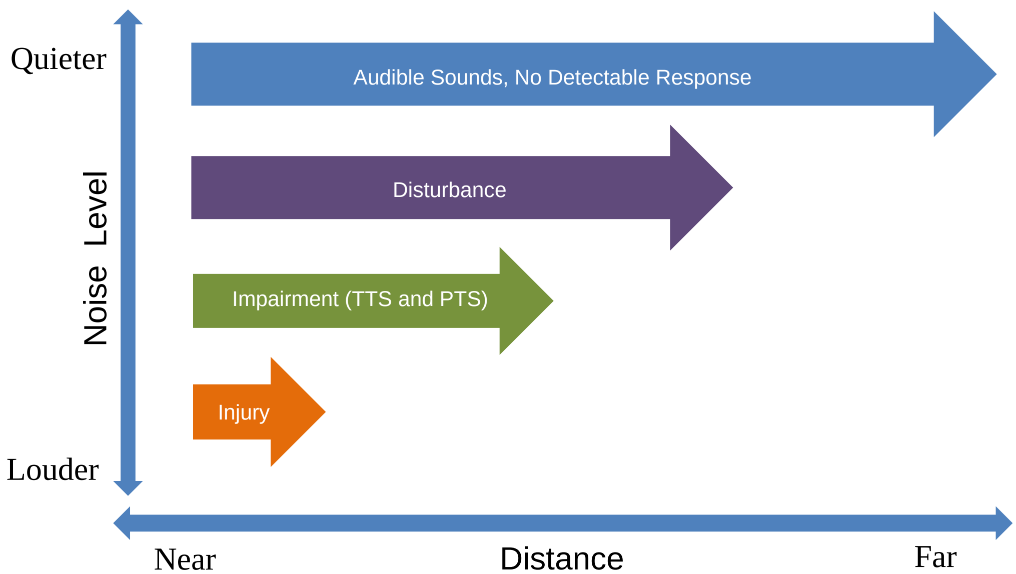

Figure 15. Diagram of the relative magnitude of effects of noise with decreasing loudness level

In general, while many anthropogenic sounds above ambient levels have the potential to be audible, animals have different hearing abilities which directly affect their sensitivities to certain types of sound. Effects on hearing ability or disturbance can result in disturbance of important biological behaviors such as migration, feeding, resting, communication, and breeding. In order for a sound to be potentially disturbing, it must be able to be heard by the animal. Sea turtles generally hear sounds 50 Hz to 2 kHz, baleen whales 7 Hz to 35 kHz, and sperm whales 275 Hz to 160 kHz. Atlantic salmon, Atlantic sturgeon, shortnose sturgeon and Nassau grouper are low frequency generalists with best hearing below 2,000 Hz. Elasmobranchs such as the smalltooth sawfish have highest sensitivity at lower frequencies (40 Hz to 800 Hz). Therefore, listed sea turtles and fish will not be affected by mid and high frequency noise sources and are indicted with "NA" in the tables below. Although their hearing abilities are much greater than fish or turtles, baleen whales have best hearing in lower frequencies up to 35 kHz. Sperm whales have mid-frequency hearing abilities and have a broad ability to hear many underwater sounds from 150 Hz to 160 kHz (Table 20), but cannot hear higher frequency sound sources associated with high frequencies sonars above 160 kHz. Some sonar types can be excluded from potential effects to different species, yet our review shows that multiple sound sources are often used simultaneously for any given HRG survey (3-6 different sonars) such that a wide spectrum of frequencies are usually produced that are potentially audible in varying degrees to all listed species in the project area.

Table 20. Hearing Ranges of Listed Species in the Action Area

Species or Group	Hearing Range	References
Sea turtles	50 Hz to 2 kHz	(Dow Piniak et al. 2012; Ketten and Bartol 2006; Lenhardt et al. 1996; Lenhardt 1994; McCauley et al. 2000a; McCauley et al. 2000b; Moein 1994; O'Hara and Wilcox 1990)
Atlantic Sturgeon	100 Hz to 800 Hz	(Lovell et al. 2005; Meyer et al. 2010; Meyer and Popper 2002).
Atlantic Salmon	< 380 Hz	(Hawkins and Johnstone 1978)
Shortnose Sturgeon	100 Hz to 800 Hz	(Lovell et al. 2005; Meyer et al. 2010; Meyer and Popper 2002).
Smalltooth Sawfish	40 Hz to 800 Hz	(Casper et al. 2003; Myrberg 2001)
Nassau Grouper	100 Hz to 1000 Hz	(Croll et al. 1999)
Baleen Whales	7 Hz to 35 kHz	See synthesis (National Marine Fisheries Service 2016) for low-frequency functional hearing groups
Sperm Whales	150 Hz to 160 kHz	See synthesis (National Marine Fisheries Service 2016) for mid-frequency functional hearing groups

Marine mammals use sound for vital biological functions, including socialization, foraging, responding to predators, and orientation. It has been documented that some anthropogenic noise can negatively impact the biological activities of marine mammals in some instances (Southall et al. 2007). The response of marine mammals to sound depends on a range of factors including: (1) the SPL(frequency, duration, and novelty of the sound); (2) the physical and behavioral state of the animal at the time of perception; and (3) the ambient acoustic features of the environment (Hildebrand 2004; Nowacek et al. 2004; Southall et al. 2011). Although the traditional criteria for behavioral disturbance will be used, in all likelihood there will be a spectrum of behavioral responses with some animals or species showing tolerance of some noise while others may elicit stronger responses based on the signal characteristics (Nowacek et al. 2004).

Although the potential for adverse reactions to sound may vary considerably between individuals and species, sound exposure thresholds are useful to estimate when adverse reactions may be likely to occur in some measurable way that has potential significance to an animal. Sound exposure levels above certain thresholds would therefore have the greatest potential to disturb or cause injury. Marine mammal exposure thresholds have been published for assessing the effect of sound exposure on marine mammal hearing (National Marine Fisheries Service 2016). Studies indicate that the onset of TTS and permanent threshold shift (PTS) are correlated with the type of sound, peak pressure, and sound exposure level depending on the frequency, duration, and intensity of exposure to a sound source. The assessment of potential hearing effects in marine mammals in this BA is based on NMFS technical guidance for assessing acoustic impacts (National Marine Fisheries Service 2016).

There is also some evidence of TTS in sea turtles from loud impulsive sources. Although airgun arrays will not be used for renewable energy program surveys, most information on sea turtles is available for airguns. Therefore, impulsive sources such as boomers and the potential effects on sea turtles are inferred from the available information from airguns. In a study of juvenile loggerheads sponsored by the U.S. Army Corps of Engineers (Moein et al. 1994), sea turtles were contained in a pen in shallow water as they were exposed to pulses from a single airgun. Physiological and behavioral responses were observed. The turtles avoided airgun pulses, at received levels of 175-180 dB re 1 μPa, but either habituated or suffered TTS by the third presentation of the sounds. In some cases, these animals remained close to the airgun as it was operating. In 10-15% of the sea turtles exposed to airgun pulses, a temporary shift in auditory responses was measured. The threshold criteria used in this assessment (Table 21) are provided for both impulsive and non-impulsive based on the hearing abilities of each hearing group.

Table 21. Threshold Criteria for the Onset of Hearing Loss and Potential Injury in ESA-Listed Species

Hearing Group	Sound Type	
	Impulsive	Non-impulsive
Listed Baleen Whales (Low-Frequency Cetaceans)	219 dB Peak	NA
	183 dB cSEL	199 dB cSEL
Sperm Whales (Mid-Frequency Cetaceans	230 dB Peak	NA
	185 dB cSEL	198 dB SEL
Sea Turtles	232 dB Peak	NA
	or 203 dB cSEL	220 dB SEL
Fish[b]	206 dB peak	NA
	187 dB cSEL	NA

[a] Department of the Navy (2017)
[b] NMFS-recommended criteria adopted from the Fisheries Hydroacoustic Working Group (2008) for cSEL (for fish ≥ 2g) and peak (for all sizes of fish)

Behavioral reactions are expected to occur over a wide spectrum of responses, some which may be negligible, while others can possibly result in disturbance. To assess the potential for disturbance, BOEM currently follows NMFS traditional threshold criteria for marine mammals and commonly used thresholds for sea turtles and fish. Exposures to sound levels above these thresholds are considered to have a potential to adversely affect listed species. Unlike impacts to hearing abilities, the likelihood of an exposure being adverse depends on a number of factors including the context of the exposure, time of year, and habitat.

- 160 re 1 μPa root mean square (RMS) for the potential onset of behavioral disturbance (Level B) from a *non-continuous* source (e.g., impulsive HRG survey equipment)
- 175 dB re 1 μPa (RMS) for sea turtles, and
- 150 dB re 1 μPa (RMS) for Atlantic salmon, Atlantic sturgeon, shortnose sturgeon, smalltooth sawfish, and Nassau grouper.

Animals exposed to levels above the threshold will be further considered for their potential to be injured or disturbed. An alternative model for marine mammals applies a probabilistic approach that predicts the percentage of animals exposed that may be disturbed by sound (Wood et al. 2012). The model proposes that marine mammals will generally show a gradually increasing behavioral response to mammal hearing weighted (M-weighted) sound levels (L_{rms}). The application of this approach is not used in this BA. In general, the application of the traditional criteria is more conservative and assumes 100 percent of animals will have the potential to be disturbed from impulsive noise at 160 dB (RMS). NMFS has provided guidance to use the traditional threshold criteria at this time.

The assessment of potential hearing impairment is relatively straightforward in the analysis where it is assumed an animal exposed may be potentially impaired. However, whether or not changes in behavior can harm a species depends on the context of the noise exposure: the species, life history stage, or what behavior the animals were engaged in at the time of exposure (Ellison et al. 2012). For example, migrating baleen whales may be more sensitive to disturbance and change their course to avoid the sound source, while foraging animals may be tolerant and continue feeding.

5.1 Effects of HRG Surveys

A compilation of sound source characteristics of HRG survey equipment was recently completed. Source levels and frequencies of HRG equipment were measured under controlled conditions and represent the best available information for HRG sources (Crocker and Fratantonio 2016). This analysis applies this information on source levels with NOAA's sound exposure spreadsheet tool to estimate PTS ranges. We also used a geometric spreading model to estimate disturbance distances for listed marine mammals, sea turtles, and Atlantic sturgeon.

BOEM completed a desktop analysis of nineteen HRG sources in Crocker and Fratantonio (2016) to evaluate PTS and disturbance distances for listed species. Equipment types or frequency settings that would not be used for the survey purposes by the offshore wind industry are not included in this analysis. Equipment excluded from this analysis includes side-scan sonars operating at frequencies greater than 180 kHz and other equipment described in (Crocker and Fratantonio 2016) that is unlikely to be used for data collection surveys associated with offshore renewable energy. To provide the maximum impact scenario for spreadsheet calculations, the highest power levels and most sensitive frequency setting for each hearing group were used when the equipment had the option for multiple user settings. All sources were analyzed at a tow speed of 2.315 m/s (4.5 knots). PTS cumulative exposure distances were calculated for the low-frequency hearing group (sei, fin, and North Atlantic right whales), the mid-frequency group (sperm whales), and for a worst-case exposure scenario of 60 continuous minutes for sea turtles and fish. Once all the HRG sources were analyzed, we compared the results and combined similar equipment types into categories that had similar frequency ranges and isopleth distances (Appendix B)

The greatest PTS distance for the equipment calculated for assessment for renewable energy surveys is found in (Table 22) and represent the loudest power levels we could identify. In most cases, any potential impact of PTS is near the equipment and would not extend laterally beyond the hull width of the survey vessel and animals would be a greater risk of interaction with the vessel itself rather than the sound source (vessel interactions are discussed in more detail in the analysis below).

Table 22. Summary of PTS Exposure Distances from mobile HRG Sources at Speeds of 4.5 knots

HRG SOURCE	Highest Source Level (dB re 1 μPa)	PTS DISTANCE (m)			
		Sea Turtles[a]	Fish[b]	Mysticetes[c]	Sperm Whales[c]
Mobile, Impulsive, Intermittent Sources					
Boomers, Bubble Guns	176 dB SEL 207 dB RMS 216 PEAK	0	3.2	0.3	0
Sparkers	188 dB SEL 214 dB RMS 225 PEAK	0	9.0	12.7	0.2
Chirp Sub-Bottom Profilers	193 dB SEL 209 dB RMS 214 PEAK	NA	NA	1.2	0.3
Mobile, Non-impulsive, Intermittent Sources					
Multi-beam echosounder (100 kHz)	185 dB SEL 224 dB RMS 228 PEAK	NA	NA	0	2
Multi-beam echosounder (>200 kHz) (mobile, non-impulsive, intermittent)	182 dB SEL 218 dB RMS 223 PEAK	NA	NA	NA	NA
Side-scan sonar (>200 kHz) (mobile, non-impulsive, intermittent)	184 dB SEL 220 dB RMS 226 PEAK	NA	NA	NA	NA

[a]Sea turtle PTS distances were calculated for 203 cSEL and 230 dB peak criteria from Navy (2017).
[b] Fisheries Hydroacoustic Working Group (2008).
[c]PTS injury distances for listed marine mammals were calculated with NOAA's sound exposure spreadsheet tool using sound source characteristics for HRG sources in Crocker and Fratantonio (2016)
NA = not applicable due to the sound source being out of the hearing range for the group.

The PTS distances represent exposures of animals to mobile HRG sound sources from vessel moving at 4.5 knots. Field measurements indicate that PTS distances are smaller or effectively do not risk any exposure to listed species. Worst case predicted distances using NOAA's spreadsheet are larger for several reasons including the power settings of the equipment result in lower source levels than the highest power settings used in this analysis, the spreadsheet does not account for the tow depth or directional beam width of the HRG sources, and do not account for local propagation characteristics. Exposure thresholds are higher for fish and turtles than for marine mammals, and based on the source characteristics, are not likely to result in PTS. The predicted distances from these mobile sound sources indicate the sound sources are transitory and have no risk of exposure to levels of noise that could result in PTS for sea turtles and fish.

For marine mammals, the PTS distances are small and have a discountable chance of exposing listed species to levels of sound causing ear injury. The largest possible PTS distance is 26 m for mysticetes. In a scenario where an HRG vessel is approaching a mysticetes at 26 m, it will reach the whale in approximately 12 seconds at a speed of 4.5 knots (2.315 m/sec). Subsequently, a vessel would pass a whale and be beyond the 26 m disturbance distance in another 12 sec. Therefore, the largest potential disturbance time is likely to be no longer than 24 seconds. With the PDCs for vessels to maintain much greater distances from marine mammals and sea turtles and the shutdown requirements (Appendix A), BOEM believes that the risk of PTS occurring in any listed species from HRG surveys is discountable.

Potential for Disturbance

Using the same sound sources for the PTS analysis, the disturbance distances to 175 dB re 1 µPa rms for sea turtles, 160 dB re 1 µPa rms for marine mammals, and 150 dB re 1 µPa rms for fish were calculated using a spherical spreading model (20 LogR) (Table 23). BOEM has conservatively used the highest power levels for each sound source reported in Crocker and Fratantonio (2016). Additionally, the spreadsheet and geometric spreading models don't consider the tow depth and directionality of the sources; therefore, these are likely overestimates of actual disturbance distances. Although these are likely conservative estimates, these results can confidently be used as a maximum impact scenario to analyze the exposure of listed species to each sound source.

Table 23. Summary of worst case disturbance distances

HRG SOURCE	DISTURBANCE DISTANCE (m)			
	Mysticetes	Sperm Whales	Sea Turtles	Fish
Boomers, Bubble Guns	224	224	40	708
Sparkers	502	502	90	1,996
Chirp Sub-Bottom Profilers	10	10	2	32
Multi-beam Echosounder (100 kHz)	NA	1,585	NA	NA
Multi-beam Echosounder (>200 kHz)	NA	NA	NA	NA
Side-scan Sonar (>200 kHz)	NA	NA	NA	NA

NA = not applicable due to the sound source being out of the hearing range for the group.

The disturbance distances range from 6 to 1,996 m depending on the equipment and species present. The visual monitoring measures are most influenced by the potential disturbance to whales caused by equipment in the boomer/bubble gun and sparker categories. When we remove Atlantic sturgeon from consideration for the visual monitoring measures, the result is a disturbance distance of approximately 10-502 m for baleen whales and 10-1,585 m for sperm whales depending on the suite of equipment used during any particular survey. The upper estimated range of behavioral disturbance of 1,585 m corresponds only to sperm whales and potential behavioral disturbance from multi-beam echosounders operating at or below 150 kHz. Although echosounders with setting options to use frequencies both above and below 200 kHz have been proposed, lessees have asserted that only the frequencies above 200 kHz are used to collect the desired data to support lease development. However, BOEM cannot completely rule out the potential use of multi-beam echosounders during future surveys and have included them in the envelope for this analysis. Despite their possible use in the future, the potential for adverse effects to sperm whales is expected to be low for the following reasons. Sperm whales may occasionally be found over the OCS waters following prey into relatively shallower depths; however, the species' habitat is typically found out in deeper, offshore waters outside of the action area. Because of the offshore habitat preferences of sperm whales and the uncommon use of echosounders, the co-occurrence of this species and disturbance from HRG surveys will be low.

Equipment other than sparkers and boomers/bubble guns operate at sound levels resulting in no resulting effect or produced very short isopleth distances to thresholds of disturbance for listed species. Although some isopleths modeled from equipment other than boomer/bubble guns and sparkers may reach threshold levels, the likelihood and consequence of this potential exposure would have discountable effects due to the very short distances of the potential effect. These sources that are considered unlikely to result in adverse effects and have no mitigation for the sound sources required include:

- Multibeam echosounders (hull-mounted or portable)
- Side-scan sonars
- Hull-mounted sub-bottom profilers (e.g., Knudsens)
- Fathometers for navigation
- Towed sub-bottom profilers/Chirp systems (e.g., Edgetech 424, Edgetech 512i)
- EK60/EK80 split-beam echosounders
- Ultra-short baseline (USBL) positioning equipment, e.g., for navigation of submersibles, ROVs, etc.
- All acoustic Doppler current profiling (ADCP) equipment
- All instrumentation on HOV/AUV/ROVs
- All instruments operated at 180 kHz or greater, including Non-Airgun High-Resolution Geophysical (HRG)

Other PDCs pertaining to operation vessels and minimization and avoidance or potentially adverse effects still apply to all vessels regardless of any sound source that may be deployed.

Exposure Analysis for Potential Disturbance

In evaluating the number of listed whale species that may be potentially harassed in a given lease area, we considered:

- The average annual density (D) and upper 95% CI of each species areas (individuals/100 km^2) in the three geographic regions of the action area (individuals/100 km^2) (Table Table 24);
- An estimated area of a single cable ROW (75 km^2 or equivalent to the area of 3.45 lease blocks);
- The area of a single lease block (23.04 km^2 adjusted to the 100 km^2 scale to match density data);
- The predicted number of lease blocks in each area (see Table 2 and Table 3); and
- The predicted maximum number of ROWs in each area (see Table 2 and Table 3).

Table 24. The densities of listed species used in the exposure calculations

Species	Number of Individuals/100 km^2					
	North Atlantic		Mid Atlantic		South Atlantic	
	High D	+95% CI	High D	+95% CI	High D	+95% CI
North Atlantic right whale	0.347 (APR)	0.549	0.111 (MAR)	0.175	1.102 (JAN)	1.442
Fin whale	0.818 (JUN)	1.476	0.492 (APR)	0.872 (APR)	0.064 (MAR)	0.106
Sei whale	0.153 (MAY)	0.323	0.038 (APR)	0.084	0.010 (JAN-FEB)	0.025
Sperm whale	0.042 (MAY)	0.117	0.025 (APR)	0.067	< 0.001	< 0.001

Highest monthly densities were used in the exposure calculations as shown in parentheses.

Although BOEM calculated the isopleth distances for the different types of HRG equipment to develop BMPs, the exposure of animals was not calculated by isopleth distances. Since HRG surveys are conducted by moving vessels throughout the lease area, exposure to HRG survey noise was calculated by multiplying the density of each species by the total area predicted to be leased over the next 10 years. This approach conservatively assumes that over the lifetime of a lease, every individual occurring in the lease area has a potential to be harassed. Therefore, the lease area is considered the survey area for the exposure analysis. The total number of exposures for each species was calculated as follows:

species density x (lease block area x total blocks leased) x (ROW area x total ROWs)

Because we cannot predict the exact time of year of future surveys will occur within the action area, we used average annual densities, but also calculated the upper density (+95% CI) to better represent seasonal differences when species may be found in higher numbers (Table 25).

Table 25. The number of listed whales potentially occurring in the exposure area > 160 dB rms as a result of the proposed action without implementation of PDCs.

Species	Number of Animals in All Survey Areas over 10 years					
	North Atlantic		Mid Atlantic		South Atlantic	
	High. D	+95% CI	Avg. D	+95% CI	Avg. D	+95% CI
North Atlantic right whale	29.7	46.9	5.15	8.11	21.08	27.59
Fin whale	69.90	126.14	22.77	40.40	1.23	2.03
Sei whale	13.07	27.63	1.74	3.90	0.20	0.49
Sperm whale	3.62	10.01	1.14	3.09	< 0.001	< 0.001

The calculated numbers of animals for each species represent potential for exposure to HRG surveys conducted all existing and future renewable energy leases issued over the next 10 years (28-47 leases). A lease life is expected to be 30 years. These exposures are likely overestimates since they do not account for avoidance behaviors by animals to the vessels, the conservative assumptions made that all sound sources are omnidirectional, and assumptions that every animal within a lease area has the potential to be exposed. Actual field measurements of HRG equipment has shown that the worst reasonable case propagation distances are typically not achieved due to tow depth, beam width, beam direction focused toward the seafloor. The proposed PDCs include the use of PSOs to monitor for protected species, a pre-survey clearance of a 500-m exclusion zone for North Atlantic right whales, 100 m exclusion for other listed whales and sea turtles and other BMPs as described in Appendix A. Additionally, PAM and night vision equipment is required when surveying at night. Any time a listed species is sighted within their respective exclusion zone, HRG sources will be powered to off.

The purpose of the watch zone is to monitor for behavioral disturbance when listed species are within the survey area and to watch for any animals heading toward the exclusion zone. For any animals sighted within the watch zone, a shut-down would not be required unless adverse responses are observed or animals are in distress (e.g., an injured or entangled animal). An exception to this non-shut-down general requirement is proposed for North Atlantic right whales; potential disturbance is to be avoided any time a North Atlantic right whale is sighted in the watch zone, because the watch zone is the same as the exclusion zone for right whales. The purpose of the exclusion zones for all listed species is to avoid or minimize the number of exposures by means of monitoring and HRG equipment shut-down provisions when listed marine mammals are sighted within the exclusion distance. A description of the PDCs and associated BMPs for PSOs, including watch zones, exclusion zones, shut-downs, and ramp-up requirements can be found in Appendix A. Harm from periodic behavioral reactions to HRG survey noise is not expected to occur for any listed species with the implementation of the proposed PDCs.

There are not reliable density estimates yet available for sea turtles or fish in the areas to complete an exposure analysis. However, the effects of potential disturbances to these species are expected to be temporary and minor as a vessel passes by an average speed of 4.5 knots.

Sea Turtles and Fish

The largest possible disturbance distance for sea turtles is 90 m from an HRG vessel. In a scenario where a vessel is approaching a turtle at 90 m, it will reach the turtle in 39 seconds at a speed of

4.5 knots (2.315 m/sec). Subsequently, a vessel could pass a turtle and be beyond the 90 m disturbance distance in another 39 sec. Therefore, the largest potential disturbance time is likely to be no longer than 78 seconds along any given survey line. BOEM believes that these brief, periodic disturbances will have discountable effects on sea turtles. NMFS has previously concluded that HRG surveys may affect, but are not likely to adversely affect the ESA-listed Atlantic sturgeon since effects are expected to be extremely unlikely or insignificant (National Marine Fisheries Service 2013a). Some renewable development activities may potentially occur in areas where Atlantic salmon, shortnose sturgeon, smalltooth sawfish, and Nassau grouper occur. However, any noise exposure from surveys is expected to be short-term and minor. Under the same scenario for sea turtles above, Atlantic salmon, sturgeon, shortnose sturgeon, smalltooth sawfish, and Nassau grouper could be exposed for periods of up to approximately 28-30 minutes at a distance of 1,996 m to the 150 dB rms isopleth. Any temporary avoidance of the survey area that may occur for such short periods is expected to have discountable effects on all five fish species.

5.2 Effects of Geotechnical Surveys

Geotechnical surveys (drilling, CPTs and vibracores) related to offshore renewable energy activities are typically numerous, but very brief sampling activities that introduce relatively low levels of sound into the environment. General vessel noise produced from vessel engines and dynamic positioning (DP) to keep the vessel stationary while equipment is deployed and sampling conducted. Following review and discussion between BOEM and NMFS regarding the low sound source levels and marine mammal habitats found in lease areas in the northeast, it is not believed that these activities will have any detectable effect on any biologically important behaviors that will result in take. The separation distances and vessel strike avoidance requirements to avoid harassment or the risk of collision still apply to all vessels including those conducting geotechnical survey activities. The effects of geotechnical surveys on listed species will be discountable.

5.3 Vessel Interactions

A number of ports may be used in support of data collection activities. A BOEM-funded study identified a number of ports along the east coast that may be used to service offshore energy development (ESS Group Inc 2016). Some representative ports and distances to offshore areas show that actual distances might be quite variable depending on the location of offshore areas surveyed and nearby ports (Table 26).

Table 26. Representative ports along the Atlantic coast.

Port Name	Offshore Area	Distance (nm)
Boston	MASS	127
New Haven	MASS/RI SOUTH	75
New York	NY	30
Paulsboro	DE	88
Norfolk	NC	50
Wilmington	NC/SC	30

BOEM and BSEE monitor for any takes that have occurred as a result of vessel strikes by requiring any operator of a vessel immediately report the striking of any ESA-listed marine animal. BOEM's proposed BMP for Vessel Strike Avoidance and Injured/Dead Protected Species Reporting requires operators to implement measures to minimize the risk of vessel strikes to protected species and report observations of injured or dead protected species. This BMP will be required for every applicable permit and plan that has associated vessel traffic that is approved by BOEM or BSEE. Vessel operators and crews must maintain a vigilant watch for marine protected species and slow down or stop their vessel to avoid striking protected species. Crews must report sightings of any injured or dead protected species (marine mammals and sea turtles) immediately, regardless of whether the injury or death is caused by their vessel, to the Marine Mammal and Sea Turtle Stranding Hotline or the Marine Mammal Stranding Network. In addition, if it was the operator's vessel that collided with a protected species, BSEE must be notified within 24 hours of the strike. Additionally, a separation of 500 m (1,640 ft) from a sighted North Atlantic right whale and 100 m (328 ft) from all other listed whales is required of all vessels. Additional vessel speed requirements for North Atlantic right whales apply to vessels ≥ 65 ft operating between November 1 and July 31 (Appendix A). The potential for effects to all listed species from vessel traffic associated with data collection activities are expected to be reduced to discountable levels with the implementation of the PDCs for vessel operations.

5.4 Marine Debris

Records of interactions between anthropogenic marine debris and wildlife have been increasing rapidly in recent decades and is a cumulative source if impacts on listed species and other marine life. In the marine environment alone, the number of species reported to be affected by debris increased by more than 159% during 1995–2015 (Fossi et al. 2018). Sea turtles are reported to be ingesting large amounts of debris worldwide (Schuyler et al. 2013). Lessees are prohibited from deliberately discharging containers and other similar materials (i.e., trash and debris) into the marine environment (30 C.F.R. 250.300(a) and (b)(6)) and are required to make durable identification markings on equipment, tools, containers (especially drums), and other material (30 C.F.R. 250.300(c)). The intentional jettisoning of trash has been the subject of strict laws such as MARPOL, Annex V and the Marine Plastic Pollution Research and Control Act, and regulations imposed by various agencies including USCG and EPA. As a BMP to reduce the anthropogenic impact of marine debris, BSEE NTL 2015-G03 "Marine Trash and Debris Awareness and Elimination" provides guidance to prevent intentional and/or accidental introduction of debris into the marine environment. BOEM also requires that operators ensure that all offshore employees and those contractors actively engaged in their offshore operations complete awareness training that includes viewing a training video or slide show (specific options are outlined in the NTL. With continued training and awareness, marine debris is not expected to be a significant concern from renewable energy activities and the effects will be discountable.

5.5 Discountable Effects of Sampling, Installation, and Decommissioning of Structures

Benthic soft-bottom communities that are affected by benthic sampling, anchoring of vessels and buoys, and installation of a buoy could take some time to recover. Generally, benthic impacts are not expected to impact marine mammals or Atlantic salmon but could affect prey items of sea turtles, Atlantic sturgeon, shortnose sturgeon, smalltooth sawfish, and Nassau grouper.

Sandy substrates are less stable than silt/clay substrates, and the benthic macrofauna consists mainly of opportunistic species that have rapid dispersal and high reproductive rates that allow them to colonize disturbed sediments rapidly (Grassle and Sanders 1973). The macrobenthos in the Middle Atlantic continental shelf region is dominated by opportunistic species (Boesch et al. 1975). The recolonization of disturbed areas by opportunistic species has been reported many times (Grassle and Sanders 1973; Kaiser et al. 1998; Ray 2001; Thistle 1981; Thrush and Dayton 2002). Mobile sand habitats that experience natural movement are able to recover in a relatively short timeframe of less than 1 year (Lindholm et al. 2004). In a sandy substrate, epibenthic surveys pre- and post-dredge were very similar because of the dynamic nature of sand and the low species diversity (Blake et al. 1996). Soft-bottom habitats generally recover more rapidly than other substrates, but should not be overlooked from the perspective of biological productivity (Kritzer et al. 2016).

The area affected by physical site characterization activities (e.g., grabs, cores) is very small, on the order of 1 ft^2 (0.1 m^2) per sample. Thus, organisms from adjacent, unaffected sediments would simply migrate to the location where a grab or core had been taken, resulting in rapid recovery. For instance, sandy areas in water depths up to 197 ft (60 m) were characterized as mobile sand, influenced by tide and storm-driven currents, which regularly alter the microtopography of the bottom (Lindholm et al. 2004). No adverse effects to listed species are expected from sampling activities.

While none of the benthic invertebrates discussed in this section are listed under the ESA, some of these invertebrates are prey items for listed species (e.g., sturgeon, sea turtles). Thus, impacts to benthic resources may alter the diet composition of these ESA-listed species. However, because the amount of benthic habitat affected by routine activities would be temporary and extremely small relative to the available foraging habitat in the renewable energy regions, any effects to listed species resulting from benthic disturbance would be insignificant.

5.6 Entanglement

A potential impact on marine mammals and sea turtles is entanglement with mooring lines in the water column. Entanglement is a growing problem in terms of conservation, welfare and human safety for responders who respond to, and disentangle marine animals. Entanglement can lead to drowning as trapped animals cannot reach the surface to breathe, to laceration and infection as heavy ropes bite through skin, and to starvation if animals cannot feed effectively (Cassof et al. 2011) (also see summary at https://iwc.int/entanglement). For animals that survive entanglements, increased energy costs and decreased health can lead to a decrease in reproductive success (Van der Hoop et al. 2017; Van Der Hoop et al. 2014). There is considerable understanding of how entanglement occurs in fisheries, but much less is known of the potential risks for incidental mortality associated with other offshore industries (Benjamins et al. 2014).

Most entanglements are never observed, but there are many cases of entangled whales with unidentified gear (IWC 2016). There are reports of large whales (including humpback, right and fin whales) interacting with anchor moorings of yachts and other vessels, towing small yachts from their moorings or becoming entangled in anchor chains, sometimes with lethal consequences (Anonymous 2012; Kerr 2013; Richards 2012; Trekking the Sea 2013). Animals may swim into moorings accidentally or actively seek out anchor chains or boats as a surface to scratch against

(Benjamins et al. 2014). In July 2015, a humpback whale near Nuuk, Greenland was observed entangled in heavy line from a ship. In October 2014, a humpback whale was entangled around the caudal peduncle with a waverider buoy; caught in bungee cord between a 10 ft chain and line that ran to a 300 lb anchor (IWC 2016). The whale was discovered after about 3 weeks and successfully disentangled (California Whale Rescue 2014). When all entanglement interactions were evaluated for NARWs by Knowlton between 1980 and 1999 (IWC 2015; Knowlton et al. 2016), moderate and severe injuries have been increasing and gear configurations have become of higher risk (constricting wraps or multiple anchoring points or trailing gear greater than one body length) over the past three decades. One of the reasons for this increased risk is changes in rope manufacturing in the mid 1990's that resulted in stronger ropes at the same diameter (Knowlton et al. 2016).

Sea turtles have been documented to be entangled in a large variety of man-made items (Duncan et al. 2017; NMFS and USFWS 2008). Sea turtle entanglements are an underestimate as not all entanglements are reported. In waters off the Northeast United States, the primary species entangled is the leatherback sea turtle, but loggerhead and green sea turtles entanglements also occur. Since the Sea Turtle Disentanglement Network was formed in 2002 and through 2014, there have been 275 entanglements in vertical lines (NMFS 2015). Turtles are usually entangled around the neck and/or front flippers. Although entanglement may occur anywhere in the Atlantic, the majority of entanglements in the northeast occur offshore Massachusetts, where leatherbacks are the most commonly entangled species. Chesapeake Bay also has a large number of interactions. Entanglements with hard-shelled turtles occur more frequently in the Mid- and South-Atlantic. Approximately one-third of sea turtles stranded in Virginia are documented with gear or have injuries consistent with gear interactions (NMFS 2008)

A review of mooring systems associated with marine renewable energy devices suggested that for systems under tension, there is not nearly as large a risk of entanglement compared to fisheries entanglements. However, slack or float lines may occur on some buoys designs. Even for lines under tension, moored devices pose an increasing risk of entanglement for animals with longer body length, rigidity of the animal, and mode of feeding with mouths open (Benjamins et al. 2014), which are all characteristics of large whales. In bowhead whales (a species similar to right whales), line entanglement scars are usually about 0.5 m linear or curvilinear cuts or scars into the skin around the mouth, flippers, flukes, or peduncle region (George et al. 2017). These injuries are consistent with the kind of damage a high-tension line would make wrapped around the whale's body (Moore et al. 2004b). Because vessel anchoring and lines in the water associated with installation work are expected to be temporary, there is a discountable risk of entanglement to listed species. The potential for marine mammals and sea turtles to interact with the buoy and to become entangled in the buoy or mooring system is low compared to fisheries entanglement given the lower probability of encountering the relatively fewer mooring structures associated with the proposed action. However, the best available information summarized above suggests the risk is not discountable.

Reviews of entanglements of large whales and sea turtles have resulted in a number of recommendations to reduce the risk of entangling animals (IWC 2016; NMFS 2008; 2015), some of which are practicable for marine industries in general. General recommendations to reduce entanglement risks include reduced number of buoy lines, no floating line at the surface which have a high risk of interacting with turtles and whales that spend a good deal of time at the surface of the water. Other recommendations include reducing the amount of slack in line. Use sinking lines, rubber-coated lines, sheaths, chains, acoustic releases, weak links, and other potential solutions to lower entanglement risk. Weak links may not be feasible if there is a risk of the data buoy being lost, but they may be feasible on ancillary lines that will not affect the integrity of the buoy mooring. However, there are several best practices available that can reduce risks on all mooring types. BOEM's BMPs to use the best available technologies to reduce entanglement risks greatly reduce the risk of entanglement.

BOEM continues to work lessees and require the use of the best available mooring systems using shortest practicable line lengths, anchors, chain, cable, or coated rope systems that prevent or reduce to discountable levels any potential entanglement or entrainment of marine mammals and sea turtles. BOEM reviews each buoy design to ensure that reasonable low-risk mooring designs are used. Potential impacts on listed species from entanglement related to buoy operations are thus expected to be discountable.

5.7 Emissions and discharges

Routine activities associated with data collection activities are considered for the sources below.

1) Emissions from vessels used for site characterization surveys and site assessment activities (i.e., surveys, construction, operations and maintenance, and decommissioning of metocean buoys),
2) Emissions from onshore vehicles and equipment, such as heavy duty trucks, personal vehicles from commuting workers, construction equipment used in construction of a metocean buoy, and diesel engines used to operate the metocean buoys.

The impacts of miscellaneous onshore activities will be insignificant because of the temporary nature and nearly undetectable impact of the activities when compared to the existing industrial activities/production operations already occurring at the fabrication yards. There is no detectable route of effects between onshore emissions and potential effects to listed species or critical habitat. No drilling equipment would be required to install meteorological buoys. Installation and decommissioning of a meteorological buoy can likely be completed in two days (and thus a maximum of two vessel round trips/buoy). Impacts from air pollutant emissions associated with offshore vessel operations will be localized within the vicinity of the vessel before dissipating to undetectable levels. There are not expected to be any detectable effects to listed species.

Routine activities that have the potential to adversely affect water quality include discharges from survey vessels and vessels servicing the buoys (i.e., bilge water, ballast water, sanitary waste, and debris). Bilge and ballast water discharges may contain small amounts of petroleum-based products and metals, and as such are prohibited within 12 nm (24 km) of the shore. Any vessels conducting surveys or servicing buoys are likely to be equipped with holding tanks for sanitary waste and would not discharge untreated sanitary waste within state or federal waters. The instrumentation used for site characterization is self-contained, so there should be no discharges from instruments aboard the survey vessels that would impact water quality.

Non-routine events include fuel spills, collisions, and allisions. Although spills are unlikely, vapors from fuel spills resulting either from vessel collisions/allisions or from servicing or refueling generators on the metocean buoys may result in impacts on air and water quality. The estimated spill size is assumed to be approximately 88 gallons (333 liters). If such a spill were to occur, it would be expected to dissipate rapidly and then evaporate and biodegrade within a few days. Due to the expected rarity of spills and their small size, potential accidental discharges will not have any adverse effects on listed species.

6 Effects to Critical Habitat

BOEM conducted an analysis of the potential effects from the proposed action on the essential features (or primary constituent elements) to North Atlantic right whale critical habitat, the North Atlantic DPS of loggerhead sea turtles, and Atlantic sturgeon critical habitat. A description of these features is found in the species descriptions in Section 3.

6.1 North Atlantic Right Whale Northern Critical Habitat

BOEM did not identify any potential effects of the proposed action that would affect the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *C. finmarchicus* for right whale foraging. Particularly, prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes would not be affected.

BOEM did not identify any potential effects of the proposed action that would increase low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins.

BOEM did not identify any potential effects of the proposed action that would affect dense aggregations of late stage *C. finmarchicus* in the Gulf of Maine and Georges Bank region, not any affects to diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region.

North Atlantic Right Whale Southern Critical Habitat

BOEM did not identify any potential effects of the proposed action that would affect calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale, nor affect sea surface temperatures.

BOEM did not identify any potential effects of the proposed action that would affect water depths in any significant way that would increase or decrease water depths between 6 to 28 meters. The footprints of the activities under the proposed action are so small that no essential features are affected. Since these features are not affected, the proposed action will not affect the simultaneous co-occurrence of these features over contiguous areas of at least 231 nm^2 of ocean waters during the months of November through April.

BOEM did not identify any potential effects of the proposed action that would affect the ability of right whale cows and calves to select an area with these features, when they co-occur, within the ranges specified. The presence of survey boats and small acoustic footprint of surveys are not expected to affect the selection of these critically important features by right whales. As a precaution, and required by federal regulations, all vessels must maintain a distance of 500 m or greater from any sighted right whale. Adherence to this requirement will further ensure no adverse effects on the ability of whales to select an area where these features co-occur.

Following the analysis of the potential effects to North Atlantic right whale northern and southern critical habitat, BOEM concludes that the proposed action will not affect any of the essential features. *The proposed action will not affect any critical habitat for North Atlantic right whales* that has been designated under the ESA.

6.2 North Atlantic Ocean DPS of Loggerhead Sea Turtles

BOEM analyzed the primary constituent elements of loggerhead nearshore reproductive habitat, foraging habitat, winter habitat, breeding habitat, migratory habitat, and *Sargassum* habitat. There is no critical habitat designated in the North Atlantic Renewable Energy Region. Primarily, winter, breeding and migratory habitat occur Mid-Atlantic and South Atlantic regions of the action areas; however, there is a small amount of overlap with *Sargassum* critical habitat on the outer edges of the action area near the 100-m isobath (see Figure 13 in Section 4). BOEM. BOEM did not identify any potential effects on *Sargassum*; thus, the analysis focused on the winter, breeding, and migratory habitat.

Nearshore Reproductive Habitat

BOEM did not identify any potential effects of the proposed action that would affect nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 C.F.R. 17.95(c) to 1.6 km (1 mile) offshore. Although some vessel activities and surveying may occur there, waters would remain free of obstructions or artificial lighting that would affect the transit of turtles through the surf zone and outward toward open water. Installation of buoys would occur in federal waters outside the designated area and would not promote predators or disrupt wave patterns necessary for orientation or create excessive longshore currents.

Foraging Habitat

BOEM did not identify any potential effects of the proposed action that would affect the elements of foraging habitat. Although benthic sampling activities could impact small areas of seafloor and possible kill or injury small numbers of prey items, the impacts would not rise to any level that would impact sufficient prey availability and quality, such as benthic invertebrates, including crabs, mollusks, echinoderms and sea pens. No proposed action would impact water temperatures that support loggerhead inhabitance, generally above 10° C.

Winter Habitat

BOEM did not identify any potential effects of the proposed action that would affect or change water temperatures above 10° C from November through April; affect habitat in continental shelf waters in proximity to the western boundary of the Gulf Stream; or change water depths between 20 and 100 m. Although the proposed activities may occur in these areas where these features occur, the elements temperature and depth features of the habitat will not be affected in any manner that adversely impacts critical habitat.

Breeding Habitat

BOEM did not identify any potential effects of the proposed action that would affect high densities of reproductive male and female loggerheads in proximity to the primary Florida migratory corridor and Florida nesting grounds.

Migratory Habitat

BOEM did not identify any potential effects of the proposed action that would constrict or concentrate migratory pathways. BOEM did not identify any effects of the action that would impede, change, or otherwise alter passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas.

Following the above analysis of potential impacts of the proposed action on loggerhead critical habitat, BOEM has determined that *the proposed action may affect, but is not likely to adversely affect any loggerhead critical habitat* designated under the ESA.

6.3 Atlantic Sturgeon Critical Habitat

BOEM analyzed the primary constituent elements of Atlantic sturgeon critical habitat (see Section 4.12.1). While there is no Atlantic sturgeon critical habitat designated in BOEM leased areas, there remains a potential for vessels transiting through Atlantic sturgeon critical habitat from up-river ports and geophysical surveys of potential cable routes in critical habitat. The essential features of these critical habitat as described in Section 4.12.

The primary activity that would overlap with the Hudson River and Delaware River (NY DPS) and James River (Chesapeake Bay DPS), critical habitat units of Atlantic sturgeon is the transit of vessels from ports berthing survey vessels (see Table 26). While the primary activity is transiting vessels, there is an indication that cable landfall locations may be located further inshore in the future. Thus, geophysical surveys of potential cable routes into rivers designated as critical habitat is reasonably foreseeable.

Feature One: Hard bottom habitat with salinity less than 0.5 ppt

Vessels transit would have no effect on this feature as they would not interact with the bottom in this area and therefore would not impact hard bottom habitat. The vessel would use existing port facilities by tying up at an existing berth and would not be expected to set anchor where there is adequate water depth to prevent bottoming out or otherwise scouring the riverbed. The vessel's operations would not preclude or significantly delay the development of hard bottom habitat in the part of the river with salinity less than 0.5 ppt because it would not impact the river bottom in any way or change the salinity of portions of the river where hard bottom is found. Similarly, geophysical surveys use acoustics to accurately map the seafloor which would not impact any hard bottom that is present. Grab samples and geotechnical surveys may impact hard bottom habitat, but these surveys are very limited in scope and scale and are meant to better delineate the very features that this CH designation is meant to protect.

Feature Two: Transitional salinity zone with soft substrate

In evaluating effects to feature two, we consider whether the proposed action would have any effect on areas of soft substrate within transitional salinity zones; therefore, we consider effects to soft substrate and salinity. The area potentially transited by project vessels also overlaps with the portions of the designated rivers that contain this feature. Project vessels would have no effect on this feature. The project vessels would not have any effect on salinity. The vessels would not interact with the river bottom in this reach and therefore, there would be no impact to soft substrate. The vessels' operations would not preclude or significantly delay the development of soft bottom habitat in the transitional salinity zone because they would not impact salinity or the river bottom in any way. Similarly, geophysical surveys use acoustics to accurately map the seafloor which would not impact any soft substrate that is present. Grab samples and geotechnical surveys may impact soft substrate, but these surveys are very limited in scope and scale and are meant to better delineate the very features that this CH designation is meant to protect

Feature Three: Water of appropriate depth and absent physical barriers to passage between the river mouth and spawning sites

As Project activities in the designated rivers only include vessel transit, there would be no activities that would occur or structures that would be placed that could impede passage of Atlantic sturgeon. The river systems that would experience traffic and noise from geophysical surveys are heavily traveled with vessels so sound produced by project vessels would not be anticipated to be significantly above background noise and would not impede fish passage. Regarding geophysical surveys specifically, while multibeam echosounders are often mounted on the hull of ships, lower frequency sub-bottom profilers and “flown” a few meters above the seafloor and are thus not directing low frequency sound through the entire water column. Furthermore, while sound may elicit behavioral responses in fish, there is no evidence to suggest that sound from geophysical surveys would create any sort of barrier to fish movement, even temporarily. Therefore, Project activities would have no effect on this feature.

Feature Four: Water with the temperature, salinity, and oxygen values that, combined, provide for dissolved oxygen values that support successful reproduction and recruitment and are within the temperature range that supports the habitat function

Feature four addresses the temperature, salinity and dissolved oxygen needs for Atlantic sturgeon spawning and recruitment. These water quality conditions are interactive and both temperature and salinity influence the dissolved oxygen saturation for a particular area.

Project activities in river systems only include vessel transit and surveys. Vessel operations and surveys would have no effects on water temperature, salinity, or dissolved oxygen; therefore, Project activities would have no effect on this feature.

Conclusion

Vessel activities and geophysical and geotechnical surveys may overlap with critical habitat for river units of all Atlantic sturgeon DPS. The portion of the critical habitat that overlaps with vessel activities contains essential features 1, 2, 3 and 4 (NMFS 2017), as defined in Section 4.12 above. The operation of the project vessels described above would have no effect on any of these features. That is because: (1) the vessels interaction with hard bottom would be limited to geotechnical and grab sample surveys, that would not significantly impact the availability hard substrate, (2) interaction with soft bottom would be limited to geotechnical and grab sample surveys, that would not significantly impact the availability soft substrate; (3) the vessels would not act as a barrier to passage; and (4) the vessels would not impact salinity, temperature or dissolved oxygen. Therefore, the action would have no effect on critical habitat, and is not likely to adversely affect critical habitat for Atlantic sturgeon.

7 Cumulative Effects

ESA-listed marine mammals experience a variety of anthropogenic impacts, including collisions with vessels (ship strikes), entanglement with fishing gear, noise from human activities, pollution, disturbance of marine and coastal environments, climate change, effects on benthic habitat, waste discharge, and accidental fuel leaks or spills. Many marine mammals migrate long distances and are affected by these factors over very broad geographical scales. Potential effects associated with the proposed action are expected to be relatively minor. Vessel trips associated with the proposed action will not significantly increase vessel traffic in the action area. Vessels generally move slowly while surveying or remain stationary. Vessel may transit at higher speeds between surveys and departing/returning from ports and offshore areas. The proposed action would result in a minor incremental contribution to cumulative impacts. Adherence to BOEM's BMPs (Appendix A) regarding vessel strike avoidance measures and exclusion zones to minimize acoustic impacts would reduce the potential for cumulative impacts on listed marine mammals. Based on the analysis in this BA, BOEM has determined that the incremental contribution to cumulative impacts on marine mammals from the proposed action will be minor.

Loggerhead, leatherback, green, Kemp's ridley, and hawksbill sea turtles are ESA-listed as threatened or endangered and are all highly migratory species that could occur within the action area. Human impacts on sea turtles include collisions with vessels (ship strikes), entanglement with fishing gear, noise, pollution, disturbance of marine and coastal environments, disturbance of nesting habitat, and climate change. The most likely impacts on sea turtles because of the proposed action are minor disturbance or hearing impairment through noise exposure, effects of vessel impacts, and the physical placement of buoys. Adherence to BOEM's BMPs regarding vessel strike avoidance measures, marine debris training, mooring BMPs, and measures to reduce exposure to sound would greatly reduce the potential for impacts on sea turtles from the proposed action.

For BOEM-regulated projects and activities (wind energy development, Block Island Wind Farm undersea transmission line, and OCS minerals use), adherence to BOEM's SOCs would reduce the potential cumulative impacts on sea turtles. In general, most impacts to sea turtles from wind farm projects would be relatively low. Compliance with state and federal regulations and coordination with appropriate federal wildlife protection agencies would ensure that project activities will be conducted in a manner that would greatly minimize or avoid affecting these species or their habitats. The proposed action would result in a minor incremental contribution to overall cumulative impacts.

Five federally endangered fish, Atlantic sturgeon, Atlantic salmon, shortnose sturgeon, smalltooth sawfish, and Nassau grouper may occur in the action area. Impacts from data collection activities would be minor and are not anticipated to contribute to cumulative effect on fish species. Cumulative noise sources include sonars from fishing vessels, merchant vessels, and military vessels, as well as vessel traffic noise (engine noise and propeller cavitation). The cumulative impact to fish from underwater noise may include no effect, habituation to noise, diminishment of communication space, and physiological stress. Noise from HRG surveys could result in temporary and minor behavioral effects to fish and critical habitat for Atlantic sturgeon; However, because the potential acoustic effects will be limited to small areas compared to the species' ranges, and the duration will occur for short periods over which very few animals could be exposed, no significant cumulative impacts to any listed species populations or critical habitat will occur.

Small accidental spills and trash could have a direct effect on fish. However, a large-scale spill response involving multiple vessels is not expected. Therefore, the incremental impacts from a fuel spill from vessels would have a negligible contribution to cumulative impacts. The proposed action would result in a minor incremental contribution when combined with the past, present, and reasonably foreseeable future activities, and overall cumulative activities considered in this analysis are anticipated to cause negligible to minor impacts on listed fish and their habitat.

8 Conclusion

Based on the analysis in this BA regarding the effects of the activities analyzed for their potential to affect listed species and critical habitat occurring in the Atlantic OCS Renewable Energy Regions, BOEM has concluded that the proposed action is not likely to adversely affect listed species of whales, sea turtles, or fish with implementation of the proposed PDCs and BMPs. The potential effects will be minor and non-lethal in nature. The proposed action will not have any measurable effect the fitness of individuals or populations of listed species. All effects associated with geotechnical surveys, metocean buoys, vessel traffic, and routine operation and maintenance of data collection devices and structures may affect but are not likely to adversely affect listed species. Some of these activities may have minor effects that are reduced to discountable levels with implementation of BOEM's proposed BMPs (Table 27). The proposed action will have no adverse effects on critical habitat for North Atlantic right whales or the North Atlantic Ocean DPS of loggerhead sea turtles.

Table 27. Summary analysis of effects from OCS renewable energy data collection activities on ESA-listed species covered in this BA.

Activity	Route of Effect	Potential Effect	BMP	Effect Determination		
				Whales	Sea Turtles	Fish
Metocean Buoy Installation						
Installation of metocean buoys, wave gliders, and other data collection devices	Turbidity/seafloor disturbance	Foraging/prey availability	N	NE	NLAA	NLAA
	physical presence of moorings/buoys	Entanglement	Y	NLAA	NLAA	NE
Emissions and discharges	Onboard generators and fuel storage	Air and Water Quality	N	NLAA	NLAA	NLAA
HRG and Geotechnical Surveys						
HRG surveys	Noise	Disturbance	Y	LAA	NLAA	NLAA
Piston/gravity/vibra/box cores, cone penetrometer	Turbidity/water quality	No effect	N	NLAA	NLAA	NLAA
	Noise	Disturbance	Y	NLAA	NLAA	NLAA
Core sampling	Turbidity/water quality	No effect	N	NE	NE	NE
	Drill noise	Disturbance	Y	NLAA	NLAA	NLAA
	Vessel operation	Disturbance	Y	NLAA	NLAA	NE
Site clearance verification surveys	foundation removal, seafloor disturbance, turbidity	Foraging/prey availability	N	NE	NE	NLAA
	Side-scan sonar (≥200 kHz)	No effect	N	NE	NE	NE
Vessel Operations						
	Strikes	Injury	Y	NLAA	NLAA	NE

Activity	Route of Effect	Potential Effect	BMP	Effect Determination		
				Whales	Sea Turtles	Fish
Vessel transits and operations	Noise	Disturbance	N	NLAA	NLAA	NLAA
Vessel Engines and Thrusters	Noise	Disturbance	Y	NLAA	NLAA	NE
	Impingement	No Effect	N	NE	NE	NE
Vessel Anchoring	Seafloor disturbance, turbidity	Foraging/prey availability	N	NLAA	NLAA	NE
Marine Debris						
Accidental release of marine debris	Ingestion, entanglement	Injury	Y	NLAA	NLAA	NLAA

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Appendix A. Best Management Practices for Offshore Wind Data Collection Activities. (Revised June 10, 2021)

BOEM will ensure the following project design criteria (PDCs) and best management practices (BMPs) are implemented and enforced through a combination of procedures including lease stipulations and conditions of plan approval. It is possible that BOEM will make future updates and/or revisions to the BMPs and/or amendments as new information becomes available or provide clarity to these conditions. Any substantial BMP updates will be developed in coordination with the National Marine Fisheries Service (NMFS). These PDCs and BMPs are intended to be flexible to allow for project-specific implementation (e.g., certain types of equipment or methods used) to accommodate site- and project-specific conditions and circumstances, while still providing as much or more protection to listed species.

Summary of BOEM Project Design Criteria for actions covered under this Biological Assessment

PDC	Applicable to	Purpose
Avoid Live Bottom Features	Employees and all at-sea contract personnel and vessels	To provide protection to corals, live-bottom habitats, and areas important to threatened or endangered species to reduce the risk of adverse effects to discountable levels.
Avoid Spawning and Developmental Habitat of Sturgeon	Vessel operations and benthic survey activities	To protect spawning and rearing areas within freshwater reaches of shortnose and Atlantic sturgeon habitats.
Marine Debris Awareness and Elimination	All at-sea and dockside operations	To provide informational training to all employees and contract personnel on the proper storage and disposal practices at-sea to reduce the likelihood of accidental discharge of marine debris that can impact protected species through entanglement or incidental ingestion.
Minimize Interactions with Listed Species during Site Characterization Survey Operations	Any survey vessel operating high-resolution geophysical survey equipment to obtain data associated with a lease and operating such equipment at or below 35 kHz for baleen whales, and at or below 160 kHz for sperm whales.	This PDC will avoid injury of ESA-listed species and minimize the likelihood of adverse effects associated with potential disturbance to discountable levels through the establishment of pre-clearance, exclusion zones, shut-downs, PSO monitoring, and other BMPs to avoid and reduce exposure of ESA-listed species to underwater survey noise. In addition to general BMPs, geographic-specific conditions also apply to Cape Cod Bay and Southern Critical Habitat for NARWs.
Minimize Vessel Interactions with Listed Species	All vessels	To avoid injuring or disturbing ESA-listed species by establishing minimum separation distances between vessels and marine protected species; operational protocols for vessels when animals are sighted; to establish sightings awareness for NARWs; and require vessel speed limits in Seasonal Management Areas and Dynamic Management Areas to avoid serious injury to NARWs.
Entanglement Avoidance	Mooring and anchoring systems for buoys and metocean data collection devices.	To use the best available mooring systems using anchors, chain, cable, or coated rope systems that prevent or reduce to discountable levels any potential entanglement or entrainment of marine mammals and sea turtles.
Protected Species Observers	Geophysical Surveys	To require PSO training; to require PSO approval requirements by NMFS prior to deployment on a project.
Reporting Requirements	PSOs and any projected-related personnel who	To document and record monitoring requirements for geophysical surveys, project-related incidents involving listed species, and to

	observe a dead and/or injured protected species.	report any impacts to protected species in a project area whether or not the impact is related to the project.

Project Design Criteria and Best Management Practices for Threatened and Endangered Species for Site Characterization and Site Assessment Activities to Support Offshore Wind Projects

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

PDC: Avoid Live Bottom Features
BMP:

All vessel anchoring and any seafloor-sampling activities (i.e., drilling or boring for geotechnical surveys) are restricted from seafloor areas with consolidated seabed features .[16] All vessel anchoring and seafloor sampling must also occur at least 150 m from any known locations of threatened or endangered coral species. All sensitive live bottom habitats (eelgrass, cold-water corals, etc.) should be avoided as practicable. All vessels in coastal waters will operate in a manner to minimize propeller wash and seafloor disturbance and transiting vessels should follow deep-water routes (e.g., marked channels), as practicable, to reduce disturbance to sturgeon and sawfish habitat.

PDC: Avoid Spawning and Developmental Habitat of Sturgeon
BMP:

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

River	**No Work Window**	**Area Affected**
Hudson	April – July	Upstream of the Delaware Memorial Bridge
Delaware	April – July	Upstream of Newburgh, NY - Beacon Bridge/Rt 84

This table will be supplemented with additional rivers as may be necessary.

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

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

BMPs:

1. Training: All vessel operators, employees, and contractors performing OCS survey activities on behalf of the Lessee (collectively, "Lessee Representatives") must complete marine trash and debris awareness training annually. The training consists of two parts: (1) viewing a marine trash and debris training video or slide show (described below); and (2) receiving an explanation from management personnel that emphasizes their commitment to the requirements. The marine trash and debris training videos, training slide packs, and other marine debris related educational material may be obtained at https://www.bsee.gov/debris. The training videos, slides, and related material may be downloaded directly from the website. Lessee Representatives engaged in OCS survey activities must continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures that they, as well as their respective employees, contractors, and subcontractors, are in fact trained. The training process must include the following elements:

    a. viewing of either a video or slide show by the personnel specified above;

    b. an explanation from management personnel that emphasizes their commitment to the requirements;

    c. attendance measures (initial and annual); and

    d. recordkeeping and availability of records for inspection by DOI.

    By January 31 of each year, the Lessee must submit to DOI an annual report signed by the Lessee that describes its marine trash and debris awareness training process and certifies that the training process has been followed for the previous calendar year. You must send the reports via email to renewable_reporting@boem.gov and to marinedebris@bsee.gov.

2. Marking: Materials, equipment, tools, containers, and other items used in OCS activities which are of such shape or configuration that they are likely to snag or damage fishing devices, and could be lost or discarded overboard, must be clearly

marked with the vessel or facility identification and properly secured to prevent loss overboard. All markings must clearly identify the owner and must be durable enough to resist the effects of the environmental conditions to which they may be exposed.

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

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

4. Reporting: The Lessee must report all marine trash and debris lost or discarded to DOI (using the email address listed on DOI's most recent incident reporting guidance).

   This report applies to all marine trash and debris lost or discarded, and must be made monthly, no later than the fifth day of the following month. The report must include the following:

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

   b. the date and time of the incident;

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

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

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

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

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

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

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

PDC: Minimize Interactions with Listed Species during Geophysical Survey Operations
To avoid injury of ESA-listed species and minimize any potential disturbance, the following measures will be implemented for all vessels operating boomer, sparker, or bubble gun equipment.
BMPs:

1. For situational awareness a Monitoring Zone (500 m in all directions) for ESA-listed species must be monitored around all vessels operating boomer, sparkers, or bubble gun equipment.
    a. The Monitoring Zone must be monitored by approved third-party PSOs at all times and any observed listed species must be recorded (see reporting requirements below).

   b. For monitoring around the autonomous surface vessel (ASV) where remote PSO monitoring must occur from the mother vessel, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. PSOs must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft. In addition, night-vision goggles with thermal clip-ons and a handheld spotlight must be provided and used such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.

2. To minimize exposure to noise that could be disturbing, a 500 m Exclusion Zone for North Atlantic right whales and a 100 m Exclusion Zone for other ESA-listed whales visible at the surface must be established around each vessel operating boomer, sparker, or bubble gun equipment.
   a. The Exclusion Zone(s) must be monitored by third-party PSOs at all times when noise-producing equipment is being operated and all observed listed species must be recorded (see reporting requirements below).
   b. If an ESA-listed whale is detected within or entering the respective Exclusion Zone, any noise-producing equipment operating below 180 kHz must be shut off until the minimum separation distance is re-established and the measures in (5) are carried out (500 m for North Atlantic right whales and 100 m for other ESA-listed whales).
      i. A PSO must notify the survey crew that a shutdown of all active boomer, sparker, and bubble gun acoustic sources below 180 kHz is immediately required. The vessel operator and crew must comply immediately with any call for a shutdown by the PSO. Any disagreement or discussion must occur only after shutdown.
   c. If the Exclusion Zone(s) cannot be adequately monitored for whale presence (i.e. a PSO determines conditions, including at night or other low-visibility conditions, are such that listed whales cannot be reliably sighted within the Exclusion Zone(s), the survey must be stopped until such time that the Exclusion Zone(s) can be reliably monitored.
3. Before any noise-producing survey equipment is deployed, the Monitoring Zone (500 m for all listed species) must be monitored for 30 minutes of pre-clearance observation.
   a. If any ESA-listed species is observed within the Monitoring Zone during the 30-minute pre-clearance period, the 30-minute clock must be paused.

If the PSO confirms the animal has exited the zone and headed away from the survey vessel, the 30-minute clock that was paused may resume. The pre-clearance clock will reset to 30 minutes if the animal dives or visual contact is otherwise lost.

4. When technically feasible, a "ramp up" of the electromechanical survey equipment occurs at the start or re-start of geophysical survey activities. A ramp up must begin with the power of the smallest acoustic equipment for the geophysical survey at its lowest power output. When technically feasible the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.
5. Following a shutdown for any reason, ramp up of the equipment may begin immediately only if: (a) the shutdown is less than 30 minutes, (b) visual monitoring of the Exclusion Zone(s) continued throughout the shutdown, (c) the animal(s) causing the shutdown was visually followed and confirmed by PSOs to be outside of the Exclusion Zone(s) and heading away from the vessel, and (d) the Exclusion Zone(s) remains clear of all listed species. If all (a, b, c, and d) the conditions are not met, the Monitoring Zone (500 m for all listed species) must be monitored for 30 minutes of pre-clearance observation before noise-producing equipment can be turned back on.
6. In order for geophysical surveys to be conducted at night or during low-visibility conditions, PSOs must be able to effectively monitor the Exclusion Zone(s). No surveys may occur if the Exclusion Zone(s) cannot be reliably monitored for the presence of ESA-listed whales to ensure avoidance of injury to those species.
    a. An Alternative Monitoring Plan (AMP) must be submitted to BOEM (or the federal agency authorizing, funding, or permitting the survey) detailing the monitoring methodology that will be used during nighttime and low-visibility conditions and an explanation of how it will be effective at ensuring that the Exclusion Zone(s) can be maintained during nighttime and low-visibility survey operations. The plan must be submitted 60 days before survey operations are set to begin.
    b. The plan must include technologies that have the technical feasibility to detect all ESA-listed whales out to 500 m and sea turtles to 100 m.
    c. PSOs should be trained and experienced with the proposed night vision technology.
    d. The AMP must describe how calibration will be performed, for example, by including observations of known objects at set distances and under various lighting conditions. This calibration could be performed during mobilization and periodically throughout the survey operation.
    e. PSOs shall make nighttime observations from a platform with no visual barriers, due to the potential for the reflectivity from bridge windows or other structures to interfere with the use of the night vision optics.

7. To minimize risk to North Atlantic right whales, no surveys may occur in Cape Cod Bay from January 1 - May 15 of any year (in an area beginning at 42°04′56.5″ N-070°12′00.0″ W; thence north to 42°12′00.0″ N-070°12′00.0″ W; thence due west to charted mean high water line; thence along charted mean high water within Cape Cod Bay back to beginning point).
8. Boomer, sparker, or bubble gun sound sources used within the Southeast Right Whale Critical Habitat during the calving and nursing season (December-March) shall operate at frequencies above 30 kHz or above 180 kHz at night and sound sources at and below 30 kHz and within the audibility range of North Atlantic right whales during daylight hours.
9. At times when multiple survey vessels are operating within a lease, adjacent lease areas, or exploratory cable routes, a minimum separation distance (to be determined on a survey specific basis, dependent on equipment being used) must be maintained between survey vessels to ensure that sound sources do not overlap.
10. To minimize disturbance the Northwest Atlantic Ocean Distinct Population Segment of loggerhead sea turtles, a voluntary pause in sparker operation should be implemented for all vessels operating in nearshore critical habitat for loggerhead sea turtles. These conditions apply critical habitat boundaries for nearshore reproductive habitats LOGG N-3 through LOGG N-16 (79 FR 39855) from April 1 to September 30. Following pre-clearance procedures, if any loggerhead or other unidentified sea turtles is observed within a 100-meter monitoring zone during a survey, sparker operation should be paused by turning off the sparker until the sea turtle is beyond 100-meters of the survey vessel. If the animal dives or visual contact is otherwise lost, sparker operation may resume after a minimum 2-minute pause following the last sighting of the animal.
11. Any visual observations of listed species by crew or project personnel must be communicated to PSOs on-duty.
12. During good conditions (e.g., daylight hours; Beaufort scale 3 or less) when survey equipment is not operating, to the maximum extent practicable, PSOs must conduct observations for listed species for comparison of sighting rates and behavior with and without use of active geophysical survey equipment. Any observed listed species must be recorded regardless of any mitigation actions required.

PDC: Minimize Vessel Interactions with Listed Species
All vessels associated with survey activities (transiting or actively surveying) must comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. If any such incidents occur, they must be reported as outlined below.
BMPs:

1. Vessel captains and crew must maintain a vigilant watch for all ESA-listed species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any listed species. The presence of a single individual at the surface may

indicate the presence of submerged animals in the vicinity; therefore, precautionary measures should always be exercised.

2. Anytime a survey vessel is underway (transiting or surveying), a PSO must monitor a Vessel Strike Avoidance Zone (500 m or greater from any sighted ESA-listed whales or other unidentified large marine mammal and 100 m or greater from any other ESA-listed species visible at the surface) to ensure detection of that animal in time to take necessary measures to avoid striking the animal. If the survey vessel does not require a PSO for the type of survey equipment used, a trained crew lookout or PSO may be used. For monitoring around the autonomous surface vessels, regardless of the equipment it may be operating, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. A dedicated operator must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft.

    a. Survey plans must include identification of vessel strike avoidance measures, including procedures for equipment shut down and retrieval, communication between PSOs/crew lookouts, equipment operators, and the captain, and other measures necessary to avoid vessel strike while maintaining vessel and crew safety. If any circumstances are anticipated that may preclude the implementation of this PDC, they must be clearly identified in the survey plan and alternative procedures outlined in the plan to ensure minimum distances are maintained and vessel strikes can be avoided.
    b. All vessel crew members must be briefed in the identification of listed species that may occur in the survey area and in regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all project vessels for identification of listed species. The expectation and process for reporting of protected species sighted during surveys must be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so.
    c. A minimum separation distance of 500 m from all ESA-listed whales (including unidentified large whales) must be maintained around all surface vessels at all times.
    d. If an ESA-listed whale or large unidentified whale is identified within 500 m of the forward path of any vessel, the vessel operator must steer a course away from the whale at 10 knots (18.5 km/hr) or less until the 500 m minimum separation distance has been established. Vessels may also shift to idle if feasible.
    e. If an ESA-listed large whale is sighted within 200 m of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral.

Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If stationary, the vessel must not engage engines until the ESA-listed large whale has moved beyond 500 m.

f. If a sea turtle or manta ray is sighted within 100 m of the operating vessel's forward path, the vessel operator must slow down to 4 knots (unless unsafe to do so) and may resume normal vessel operations once the vessel has passed the individual. If a sea turtle or manta ray is sighted within 50 m of the forward path of the operating vessel, the vessel operator must shift to neutral when safe to do so and then proceed away from the individual at a speed of 4 knots or less until there is a separation distance of at least 100 m at which time normal vessel operations may be resumed.
g. During times of year when sea turtles are known to occur in the survey area, vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats). In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.
h. Vessels operating in water depths with less than four feet of clearance between the vessel and the bottom should maintain speeds no greater than 4 kts to minimize risk of vessel strikes on sturgeon and sawfish.

3. To monitor the Vessel Strike Avoidance Zone, a PSO (or crew lookout if PSOs are not required) must be posted during all times a vessel is underway (transiting or surveying) to monitor for listed species within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard).
   a. Visual observers monitoring the vessel strike avoidance zone can be either PSOs or crew members (if PSOs are not required). If the trained lookout is a vessel crew member, this must be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. All observations must be recorded per reporting requirements.
   b. Regardless of monitoring duties, all crew members responsible for navigation duties must receive site-specific training on ESA-listed species sighting/reporting and vessel strike avoidance measures.
4. Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (18.5 mph) or less while operating in any Seasonal Management Area (SMA) and Dynamic Management Area (DMA) (or Slow Zone otherwise designated as a DMA).
   a. In the event that a DMA or Slow Zone spans multiple bodies of water due to coastal geography, BOEM will consult with NMFS on the need to adhere to the DMA or Slow Zone restriction based on the actual location of right whales that

triggered the DMA or Slow Zone in relation to the planned area where transits or surveys will occur.

5. Vessels underway must not divert their course to approach any listed species.
6. The Lessee must ensure all vessel operators check for information regarding mandatory or voluntary ship strike avoidance (SMAs and DMAs (or Slow Zones that re also designated as DMAs) and daily information regarding North Atlantic right whale sighting locations. These media may include, but are not limited to: NOAA weather radio, U.S. Coast Guard NAVTEX and channel 16 broadcasts, Notices to Mariners, the Whale Alert app, or WhaleMap website.
    a. North Atlantic right whale Sighting Advisory System info can be accessed at: WhaleMap.

PDC: Entanglement Avoidance
Any mooring systems used during survey activities prevent any potential entanglement or entrainment of listed species, and in the unlikely event that entanglement does occur, ensure proper reporting of entanglement events according to the measures specified below.
BMPs:

1. The Lessee must ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device.
2. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables, or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species.
3. Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose.
4. During all buoy deployment and retrieval operations, buoys should be lowered and raised slowly to minimize risk to listed species and benthic habitat. Additionally, PSOs or trained project personnel (if PSOs are not required) should monitor for listed species in the area prior to and during deployment and retrieval and work should be stopped if listed species are observed in the area to minimize entanglement risk.
5. If a live or dead marine protected species becomes entangled, operators must immediately contact the applicable stranding network coordinator using the reporting contact details (see Reporting Requirements section) and provide any on-water assistance requested.
6. All buoys must be properly labeled with owner and contact information.

PDC: Protected Species Observers
The Lessee must use qualified third-party PSOs to observe Monitoring and Exclusion Zones as outlined in the conditions above.
BMPs:

1. All PSOs must have completed a BOEM-approved PSO training program and have received NMFS approval to act as a PSO for geophysical surveys. The Lessee must provide to BOEM upon request, documentation of NMFS approval as PSOs for geophysical activities in the Atlantic and copies of the most recent training certificates of individual PSOs' successful completion of a commercial PSO training course with an overall examination score of 80% or greater. Instructions and application requirements to become a NMFS- approved PSO can be found at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/careers-and-opportunities/protected-species-observers.
2. Crew members serving as lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.
3. PSOs deployed for geophysical survey activities must be employed by a third-party observer provider. While the vessel is underway, they must have no other tasks than to conduct observational effort, record data, and communicate with and instruct relevant vessel crew to the presence of listed species and associated mitigation requirements. PSOs on duty must be clearly listed on daily data logs for each shift.
    a. Non-third-party observers may be approved by NMFS on a case-by-case basis for limited, specific duties in support of approved, third-party PSOs.
4. A minimum of one PSO (assuming condition 5 is met) must be observing for listed species at all times that noise-producing equipment is operating, or the survey vessel is actively transiting. The Lessee must include a PSO schedule showing that the number of PSOs used is sufficient to effectively monitor the affected area for the project (e.g., surveys) and record the required data. PSOs must not be on watch for more than 4 consecutive hours, with at least a 2-hour break after a 4-hour watch. PSOs must not work for more than 12 hours in any 24-hour period.
5. Visual monitoring must occur from the most appropriate vantage point on the associated operational platform that allows for 360-degree visual coverage around the vessel. If 360-degree visual coverage is not possible from a single vantage point, multiple PSOs must be on watch to ensure such coverage.
6. The Lessee must ensure that suitable equipment is available to each PSO to adequately observe the full extent of the Monitoring and Exclusion Zones during all vessel operations and meet all reporting requirements.
    a. Visual observations must be conducted using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.
    b. Rangefinders (at least one per PSO, plus backups) or reticle binoculars (e.g., 7 x 50) of appropriate quality (at least one per PSO, plus backups) to estimate distances to listed species located in proximity to the vessel and Monitoring and Exclusion Zone(s).
    c. Digital cameras with a telephoto lens that is at least 300 mm or equivalent on a full-frame single lens reflex (SLR). The camera or lens should also have an image

stabilization system. Used to record sightings and verify species identification whenever possible.

d. An laptop or tablet to collect and record data electronically.
e. Global Positioning Units (GPS) if data collection/reporting software does not have built-in positioning functionality.
f. PSO data must be collected in accordance with standard data reporting, software tools, and electronic data submission standards approved by BOEM and NMFS for the particular activity.
g. Any other tools deemed necessary to adequately perform PSO tasks.

PDCs: Reporting Requirements

To ensure compliance and evaluate effectiveness of mitigation measures, regular reporting of survey activities and information on listed species will be required as follows.

BMPs:

1. Data from all PSO observations must be recorded based on standard PSO collection and reporting requirements. PSOs must use standardized electronic data forms to record data. The following information must be reported electronically in a format approved by BOEM and NMFS:

   Visual Effort:

   a. Vessel name;
   b. Dates of departures and returns to port with port name;
   c. Lease number;
   d. PSO names and affiliations;
   e. PSO ID (if applicable);
   f. PSO location on vessel;
   g. Height of observation deck above water surface;
   h. Visual monitoring equipment used;
   i. Dates and times (Greenwich Mean Time) of survey on/off effort and times corresponding with PSO on/off effort;
   j. Vessel location (latitude/longitude, decimal degrees) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts; recorded at :30 intervals if obtainable from data collection software;
   k. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any change;
   l. Water depth (if obtainable from data collection software);
   m. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort scale, Beaufort wind force, swell height, swell angle, precipitation, cloud cover, temperature, sun glare, and overall visibility to the horizon;

n. Factors that may be contributing to impaired observations during each PSO shift change or as needed as environmental conditions change (e.g., vessel traffic, equipment malfunctions);
o. Survey activity information, such as type of survey equipment in operation, acoustic source power output while in operation, and any other notes of significance (i.e., pre-clearance survey, ramp-up, shutdown, end of operations, etc.);

Visual Sighting (all Visual Effort fields plus:

a. Watch status (sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform);
b. Vessel/survey activity at time of sighting;
c. PSO/PSO ID who sighted the animal;
d. Time of sighting;
e. Initial detection method;
f. Sightings cue;
g. Vessel location at time of sighting (decimal degrees);
h. Direction of vessel's travel (compass direction);
i. Direction of animal's travel relative to the vessel;
j. Identification of the animal (e.g., genus/species, lowest possible taxonomic level, or unidentified); also note the composition of the group if there is a mix of species;
k. Species reliability;
l. Radial distance;
m. Distance method;
n. Group size; Estimated number of animals (high/low/best);
o. Estimated number of animals by cohort (adults, yearlings, juveniles, calves, group composition, etc.);
p. Description (as many distinguishing features as possible of each individual seen, including length, shape, color, pattern, scars or markings, shape and size of dorsal fin, shape of head, and blow characteristics);
q. Detailed behavior observations (e.g., number of blows, number of surfaces, breaching, spyhopping, diving, feeding, traveling; as explicit and detailed as possible; note any observed changes in behavior);
r. Mitigation Action; Description of any actions implemented in response to the sighting (e.g., delays, shutdown, ramp-up, speed or course alteration, etc.) and time and location of the action.
s. Behavioral Observation to Mitigation;
t. Equipment Operating During Sighting;
u. Source Depth;
v. Source Frequency;

   w. Animal's closest point of approach and/or closest distance from the center point of the acoustic source;
   x. Time Entered Exclusion Zone;
   y. Time Exited Exclusion Zone;
   z. Time in Exclusion Zone;
   aa. Photos/Video
2. The PSO Provider or Lessee must submit raw PSO sightings and trackline data by the 15th of each month for the previous calendar month of surveys to renewable_reporting@boem.gov and incidental.take@noaa.gov. Data must be submitted in Excel spreadsheet format or in another format approved by BOEM and NMFS.
3. The Lessee must submit a monitoring report to BOEM and NMFS within 90 days after completion of yearly survey activities. The report must fully document the methods and monitoring protocols, summarizes the data recorded during monitoring, estimates the number of listed species that may have been taken during survey activities, describes, assesses and compares the effectiveness of monitoring and mitigation measures. PSO raw sightings and trackline data must also be provided with the final monitoring report.
4. Reporting sightings of North Atlantic right whales:
   a. If a North Atlantic right whale is observed at any time by a PSO or project personnel during surveys or vessel transit, the Lessee or PSO must report sighting within two hours of occurrence when practicable and no later than 24 hours after occurrence. In the event of a sighting of a right whale that is dead, injured, or entangled, efforts must be made to make such reports as quickly as possible to the appropriate regional NOAA stranding hotline (from Maine-Virginia report sightings to 866-755-6622, and from North Carolina-Florida to 877-942-5343). Right whale sightings in any location may also be reported to the U.S. Coast Guard via channel 16 and through the WhaleAlert App (http://www.whalealert.org/).
   b. Further information on reporting a right whale sighting can be found at: https://apps-nefsc.fisheries.noaa.gov/psb/surveys/documents/20120919_Report_a_Right_Whale.pdf
5. In the event of a vessel strike of a protected species by any survey vessel, the Lessee must immediately report the incident to BOEM (renewable_reporting@boem.gov) and NMFS (incidental.take@noaa.gov) and the NOAA stranding hotline: From Maine-Virginia, report sightings to 866-755-6622, and from North Carolina-Florida to 877-942-5343. The report must include the following information:
   a. Name, telephone, and email or the person providing the report;
   b. The vessel name;
   c. The Lease Number;
   d. Time, date, and location (latitude/longitude) of the incident;

   e. Species identification (if known) or description of the animal(s) involved;
   f. Vessel's speed during and leading up to the incident;
   g. Vessel's course/heading and what operations were being conducted (if applicable);
   h. Status of all sound sources in use;
   i. Description of avoidance measures/requirements that were in place at the time of the strike and what additional measures were taken, if any, to avoid strike;
   j. Environmental conditions (wave height, wind speed, light, cloud cover, weather, water depth);
   k. Estimated size and length of animal that was struck;
   l. Description of the behavior of the species immediately preceding and following the strike;
   m. If available, description of the presence and behavior of any other protected species immediately preceding the strike;
   n. Disposition of the animal (e.g., dead, injured but alive, injured and moving, blood or tissue observed in the water, last sighted direction of travel, status unknown, disappeared); and
   o. To the extent practicable, photographs or video footage of the animal(s).
6. The Lessee must ensure that sightings of any injured or dead listed species are immediately reported, regardless of whether the injury or death is related to survey operations, to BOEM (renewable_reporting@boem.gov), NMFS (incidental.take@noaa.gov), and the appropriate regional NOAA stranding hotline (from Maine-Virginia report sightings to 866-755-6622, and from North Carolina-Florida to 877-942-5343). If the Lessee's activity is responsible for the injury or death, the Lessee must ensure that the vessel assist in any salvage effort as requested by NMFS. When reporting sightings of injured or dead listed species, the following information must be included:
   a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
   b. Species identification (if known) or description of the animal(s) involved;
   c. Condition of the animal(s) (including carcass condition if the animal is dead);
   d. Observed behaviors of the animal(s), if alive;
   e. If available, photographs or video footage of the animal(s); and
   f. General circumstances under which the animal was discovered.
7. Reporting and Contact Information:
   a. Dead and/or Injured Protected Species:
      1. NMFS Greater Atlantic Region's Stranding Hotline: 866-755-6622
      2. NMFS Southeast Region's Stranding Hotline: 877-942-5343
   ii. Injurious Takes of Endangered and Threatened Species:

1. NMFS Greater Atlantic Regional Office, Protected Resources Division (incidental.take@noaa.gov)

BOEM Environment Branch for Renewable Energy, Phone: 703-787-1340, Email: renewable_reporting@boem.gov

Appendix B. PTS and Disturbance Isopleth Distances for Offshore Wind HRG Survey Equipment

Table 28. Predicted isopleths for peak pressure (using 20 LogR) and cSEL using NOAA's general spreadsheet tool (December 2020 Revision) to predict cumulative exposure distances.

HRG SOURCE	PTS INJURY DISTANCE (m)							
	Low Frequency Cetaceans		Mid Frequency Cetaceans		High Frequency Cetaceans		Seals (Phocids)	
	PK	SEL	PK	SEL	PK	SEL	PK	SEL
AA200 Boomer Plate	0	0.1	0	0	2.2	0.9	0	0.0
AA251 Boomer Plate	0	0.3	0	0	5.0	4.7	0.0	0.2
Applied Acoustics S-Boom (3 AA252 boomer plates)	0	0.1	0	0.0	2.8	5.6	0	0.1
Applied Acoustics S-Boom (CSP-N Source)	0	0.3	0	0	2.2	3.7	0	0.2
FSI HMS-620D Bubble Gun (impulsive)	0	0	0	0	1.3	0	0	0
ELC820 Sparker (impulsive)	0	3.2	0	0	4.0	0.7	0.0	0.7
Applied Acoustics Dura-Spark (impulsive)	2.0	12.7	0	0.2	14.1	47.3	2.2	6.4
Applied Acoustics Delta Sparker (impulsive)	1.3	5.7	0	0	8.9	0.1	1.4	0.3
EdgeTech 424 Sub-bottom profiler 3200-XS, 7.2 kHz	—	0	—	0	—	0.0	—	0
EdgeTech 512i Sub-bottom Profiler, 6.39 kHz	—	0	—	0	—	0.0	—	0
Knudsen 3202 Chirp Sub-bottom profiler (2 transducers), 5.7 kHz	—	1.2	—	0.3	—	35.2	—	<1
Reson Seabat 7111 Multibeam Echosounder,100 kHz	—	0	—	0.5	—	251.4	—	0.0
Reson Seabat T20P Multibeam Echosounder	—	0	—	0	—	0	—	0
Bathyswath SWATHplus-M	—	0	—	0	—	0	—	0
Echotrac CV100 Single-Beam Echosounder	—	0	—	0	—	0	—	0
Klein 3000 Side-Scan, 132 kHz	—	0	—	0.4	—	193.6	—	0.0
Klein 3000 Side-Scan, 445 kHz	—	0	—	0	—	0	—	0

HRG SOURCE	PTS INJURY DISTANCE (m)							
	Low Frequency Cetaceans		Mid Frequency Cetaceans		High Frequency Cetaceans		Seals (Phocids)	
	PK	SEL	PK	SEL	PK	SEL	PK	SEL
Klein 3900 Side-Scan, 445 kHz	—	0	—	0	—	0	—	0

Table 29. PTS distance for sea turtles, sturgeon, and salmon exposed to impulsive HRG sound sources for up to 60 minutes

HRG SOURCE		Sea Turtles*, Sturgeon, and Salmon			
		PTS INJURY DISTANCE (m) for Impulsive HRG Sources			
	SEL Source level	Fish cSEL Distance to 187 dB (m)	Turtle cSEL Distance (m)	Peak Source Level	Fish Peak Distance to 206 dB (m)
AA200 Boomer Plate	169	0	0	209	1.4
AA251 Boomer Plate	176	0	0	216	3.2
Applied Acoustics S-Boom (3 AA252 boomer plates)	172	0	0	211	2.5
Applied Acoustics S-Boom (CSP-N Source)	172	0	0	209	1.4
FSI HMS-620D Bubble Gun (impulsive)	173	0	0	204	0
ELC820 Sparker (impulsive)	182	0	0	214	4.0
Applied Acoustics Dura-Spark (impulsive)	188	1.6	0	225	9.0
Applied Acoustics Delta Sparker (impulsive)	185	1.1	0	221	5.7
EdgeTech 424 Sub-bottom profiler 3200-XS, 7.2 kHz	156	NA	NA	187	NA
EdgeTech 512i Sub-bottom Profiler, 8.9 kHz	159	NA	NA	186	NA
Knudsen 3202 Chirp Sub-bottom profiler (2 transducers), 5.7 kHz	193	NA	NA	214	NA

HRG SOURCE		Sea Turtles*, Sturgeon, and Salmon			
		PTS INJURY DISTANCE (m) for Impulsive HRG Sources			
	SEL Source level	Fish cSEL Distance to 187 dB (m)	Turtle cSEL Distance (m)	Peak Source Level	Fish Peak Distance to 206 dB (m)
Reson Seabat 7111 Multibeam Echosounder,100 kHz	185	NA	NA	228	NA
Reson Seabat T20P Multibeam Echosounder	182	NA	NA	221	NA
Bathyswath SWATHplus-M	180	NA	NA	223	NA
Echotrac CV100 Single-Beam Echosounder	159	NA	NA	196	NA
Klein 3000 Side-Scan, 132 kHz	184	NA	NA	224	NA
Klein 3000 Side-Scan, 445 kHz	179	NA	NA	226	NA
EdgeTech 4200 Side-Scan, 100 kHz	169	NA	NA	206	NA
EdgeTech 4200 Side-Scan, 400 kHz	176	NA	NA	210	NA

cSEL distances were calculated by 20 log(Source Level + 10 log(1800 sec) – Threshold Level)

NA = Frequencies are out of the hearing range of the sea turtles, sturgeon, and salmon

*Sea Turtle peak pressure distances for all HRG sources are below the threshold level of 232dB.

Table 30. Summary of PTS Calculations from Exposure to HRG surveys based on source levels in Crocker and Fratantonio (2016)

HRG SOURCE	PTS INJURY DISTANCE (m)			
	Low Frequency Cetaceans	Mid Frequency Cetaceans	Sea Turtles	Fish
Boomers, Bubble Guns	<1	0	0	3.2
Sparkers	12.7	<1	0	9.0
Chirp Sub-Bottom Profilers	1.2	<1	0	NA

HRG SOURCE	PTS INJURY DISTANCE (m)			Fish
	Low Frequency Cetaceans	Mid Frequency Cetaceans	Sea Turtles	
Multi-beam Echosounder (100 kHz)	0	<1	0	NA
Multi-beam Echosounder (>200 kHz)	0	0	0	NA
Side-scan Sonar (100-132 kHz)	0	<1	0	NA
Side-scan Sonar (>200 kHz)	0	0	0	NA

Table 31. Summary of Worst Case Cumulative Sound Exposure Level Distances for ESA-Listed Species Supporting the Determination of Discountable Effects.

HRG SOURCE	Source Levels	PTS DISTANCE (m)		
		Fish[a]	Baleen Whales[b]	Sperm Whales[b]
Mobile, Impulsive, Intermittent Sources				
Boomers, Bubble Guns	176 dB SEL, 207 dB RMS 211 PEAK	3.2	<1	0
Sparkers	188 dB SEL, 214 dB RMS 225 PEAK	9.0	12.7	<1
Chirp Sub-Bottom Profilers	193 dB SEL, 209 dB RMS 214 PEAK	NA	1.2	1
Mobile, Non-impulsive, Intermittent Sources				
Multi-beam echosounder (100 kHz)	185 dB SEL, 224 dB RMS 233 PEAK	NA	0	<1
Multi-beam echosounder (>200 kHz)	182 dB SEL, 218 dB RMS 228 PEAK	NA	NA	NA
Side-scan sonar (>200 kHz)	184 dB SEL, 220 dB RMS 232 PEAK	NA	NA	NA

[a]Fish PTS distances were calculated using the NMFS recommended thresholds (Fisheries Hydroacoustic Working Group 2008).
[b]PTS injury distances for listed marine mammals were calculated with NOAA's sound exposure spreadsheet tool using sound source characteristics for HRG sources in Crocker and Fratantonio (2016)

NA = not applicable due to the sound source being out of the hearing range for the group.

Using the same sound sources for the PTS analysis, the disturbance distances to 175 dB re 1 µPa rms for sea turtles, 160 dB re 1 µPa rms for marine mammals, and 150 dB re 1 µPa rms for Atlantic sturgeon were calculated using a spherical spreading model (20 LogR). The results of the disturbance distances for each sound source category are shown in Tables 4 and 5 below. To account for the worst reasonable case, the highest power levels were used for each sound source reported in Crocker and Fratantonio (2016). Additionally, the spreadsheet and geometric spreading models don't consider the tow depth and directionality of the sources which conservatively estimate the worst-case propagation of sound.

Table 32. Disturbances distances for marine mammals (160 dB RMS), sea turtles (175 dB RMS), and fish (150 dB RMS) using 20LogR spherical spreading loss

HRG SOURCE	DISTANCE OF POTENTIAL DISTURBANCE (m)		
	Marine Mammals	Sea Turtles	Fish
AA200 Boomer Plate	100	18	317
AA251 Boomer Plate	224	40	708
Applied Acoustics S-Boom (3 AA252 boomer plates)	178	32	563
Applied Acoustics S-Boom (CSP-N Source)	142	26	447
FSI HMS-620D Bubble Gun	80	15	252
ELC820 Sparker	200	36	631
Applied Acoustics Dura-Spark	502	90	1,996
Applied Acoustics Delta Sparker	178	32	563
EdgeTech 424 Sub-bottom Profiler, 7.2 and 11 kHz	10	2	32
EdgeTech 512i Sub-bottom Profiler	10	2	32
Knudsen 3202 Echosounder (2 transducers)	892	NA	NA
[1]Reson Seabat 7111 Multibeam Echosounder	NA	NA	NA

Reson Seabat T20P Multibeam Echosounder	NA	NA	NA
Bathyswath SWATHplus-M	NA	NA	NA
Echotrac CV100 Single-Beam Echosounder	NA	NA	NA
Klein 3000 Side-Scan, 132 kHz	NA	NA	NA
Klein 3000 Side-Scan, 445 kHz	NA	NA	NA
Klein 3900 Side-scan, 445 kHz	NA	NA	NA
EdgeTech 4200 Side-Scan, 100 kHz	NA	NA	NA
EdgeTech 4200 Side-Scan, 400 kHz	NA	NA	NA

NA = Not Audible

[1] These multi-beam echosounder and side-scan sonars are only audible to mid- and high-frequency hearing groups of marine mammals.

* Disturbance distances have been round up to the next nearest whole number.

Table 33. Summary of worst case disturbance distances for sound sources grouped by equipment type and similarity of isopleth distances

HRG SOURCE	POTENTIAL DISTURBANCE EXPOSURE DISTANCE (m)		
	Marine Mammals	Sea Turtles	Fish
Boomers, Bubble Gun	224	40	708
Sparkers	502	90	1,996
Sub-Bottom Profilers	10	2	32
Multi-beam Echosounder (100 kHz)	0	NA	NA
Multi-beam Echosounder (>200 kHz)	NA	NA	NA
Side-scan Sonar (100-132 kHz)	NA	NA	NA
Side-scan Sonar (>200 kHz)	NA	NA	NA

*Gray-shaded cells have been Sources determined to have no effect or insignificant effects on listed species. Boomers, sparkers, and bubble guns will have discountable effects with implementation of the PDCs.