NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION

AGENCY: Bureau of Ocean Energy Management
Bureau of Safety and Environmental Enforcement
National Marine Fisheries Service, Office of Protected Resources
U.S. Army Corps of Engineers
U.S. Coast Guard

ACTIVITY CONSIDERED: Construction, Operation, Maintenance, and Decommissioning of the Maryland Wind Offshore Energy Project (Lease OCS-A 0490)

GARFO-2024-00070

CONDUCTED BY: National Marine Fisheries Service
Greater Atlantic Regional Fisheries Office

DATE ISSUED: June 18, 2024

APPROVED BY: ______________________

Michael Pentony
Regional Administrator

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1.0 INTRODUCTION

This constitutes NOAA's National Marine Fisheries Service's (NMFS) biological opinion (Opinion) issued to the Bureau of Ocean Energy Management (BOEM), as the lead federal agency, in accordance with section 7 of the Endangered Species Act of 1973 (ESA), as amended, on the effects of its proposed approval, with conditions, of the Construction and Operation Plan (COP) authorizing the construction, operation, maintenance, and decommissioning of the Maryland Wind Offshore Wind Project (Lease OCS-A 0490) under the Outer Continental Shelf Lands Act (OCSLA). The applicant, US Wind, Inc. (US Wind) is proposing to construct, operate, and eventually decommission a commercial-scale offshore wind energy facility within Lease Area OCS-A 0490 that would generate up to approximately 2.2 gigawatts of electricity and consist of 114 wind turbine generators, four offshore substations, one meteorological tower, and associated inter-array cabling as well as export cabling to bring electricity to land.

BOEM is the lead federal agency for purposes of section 7 consultation; the other action agencies include the Bureau of Safety and Environmental Enforcement (BSEE), the U.S. Army Corps of Engineers (USACE), the U.S. Coast Guard (USCG), and NMFS Office of Protected Resources[1] each of whom is taking action under their respective statutory and regulatory authorities related to approval of the COP and its conditions and therefore have corresponding ESA Section 7 consultation responsibilities. This Opinion considers effects of the proposed federal actions (collectively referred to in this opinion as the proposed action) on ESA-listed whales, sea turtles, fish, and designated critical habitat that occur in the action area (as defined in section 3.0 of this Opinion). A complete administrative record of this consultation will be kept on file at our Greater Atlantic Regional Fisheries Office.

1.1 Regulatory Authorities

The Energy Policy Act of 2005 (EPAct), Public Law 109-58, added section 8(p)(1)(c) to the Outer Continental Shelf Lands Act. This authorized the Secretary of Interior to issue leases, easements, and rights-of-way (ROW) in the Outer Continental Shelf (OCS) for renewable energy development, including wind energy. The Secretary delegated this authority to the former Minerals Management Service, and later to BOEM. Final regulations implementing this authority (30 CFR part 585) were promulgated on April 22, 2009 and amended in 2023. These regulations prescribe BOEM's responsibility for determining whether to approve, approve with modifications, or disapprove a lessee's Construction and Operations Plan (COP). US Wind, a lessee, filed their COP with BOEM on August 11, 2020, with subsequent updates in November 23, 2021, March 3, 2022, May 27, 2022, November 30, 2022, May 27, and July 28, 2023[2]. BOEM issued a Notice of Intent to prepare an Environmental Impact Statement (EIS) under the National Environmental Policy Act (NEPA) (42 USC § 4321 et seq.) on June 8, 2022, to assess the potential biological and physical environmental impacts of the Proposed Action and Alternatives (87 FR 34901) on the human environment. A draft EIS (DEIS) was published on

[1] The NMFS Office of Protected Resources (OPR), located in NMFS' Silver Spring, MD, Headquarters (HQ) Office, is proposing to issue an Incidental Take Authorization under the MMPA and is thus an action agency responsible for consulting under Section 7 of the ESA, whereas NMFS's Gloucester, MA, Greater Atlantic Regional Fisheries Office (GAR) is the consulting agency, under ESA regulations at 50 C.F.R. part 402.

[2] The July 2023 COP and appendices are available online at: https://www.boem.gov/renewable-energy/state-activities/maryland-offshore-wind-construction-and-operations-plan

September 29, 2023, with the official Notice of Availability of a Draft EIS in the Federal Register published on October 6, 2023.[3]

BSEE's mission is to enforce safety, environmental, and conservation compliance with any associated legal and regulatory requirements during project construction and future operations. BSEE will be in charge of the review of Facility Design and Fabrication and Installation Reports, oversee inspections/enforcement actions as appropriate, oversee closeout verification efforts, oversee facility removal inspections/monitoring, and oversee bottom clearance confirmation. BSEE's approvals and activities are included as elements of the proposed action in this Opinion.

OCS Air Regulations are generally implemented and enforced by the EPA Regional Offices, but this authority may be delegated to state or local air permitting agencies that meet specific criteria (62 FR 46409). The EPA has delegated authority to administer OCS Air Regulations to the State of Maryland. The Maryland Department of Environmental (MDE) is proposing to issue an OCS Air Permit to US Wind. US Wind submitted an application to MDE for the OCS Air Permit on November 30, 2023. This permit will be issued pursuant to the provisions of Section 328 of the Clean Air Act (CAA) and the Code of Federal Regulations (C.F.R.) Title 40, Part 55, and will be effective until surrendered. MDE anticipates including emission limits, operating requirements and work practices, and testing, recordkeeping, and reporting requirements. Anticipated air emission sources are the marine vessels to be used to support construction and operation/maintenance, and any generators or other emission sources at the WTGs and offshore substation. The effects of the emissions addressed through MDE's issuance of an OCS Air permit are addressed in the *Effects of the Actio*n section of this Opinion.

USACE issued a Public Notice (NAP-2020-60863-M34[4]) describing its consideration of US Wind's request for a permit authorization pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403) and Section 404 of the Clean Water Act (33 U.S.C. 1344) on October 6, 2023. As described in the Public Notice, the applicant proposes to develop the Maryland Offshore Wind Project to generate approximately 2 gigawatts of nameplate capacity by constructing up to 114 wind turbine generators, up to four offshore substations, one meteorological tower within the approved lease area; installation of submarine array cables between WTGs and OSSs; up to four offshore export cables with connection to the existing Indian River Substation in Millsboro, Delaware, and construct an operations and maintenance facility within West Ocean City, Maryland. USACE's permit authorization is included as an element of the proposed action in this Opinion.

The USCG administers the permits for private aids to navigation (PATON) located on structures positioned in or near navigable waters of the United States. PATONS and federal aids to navigation (ATONS), including radar transponders, lights, sound signals, buoys, and lighthouses are located throughout the Project area. It is anticipated that USCG approval of additional PATONs during construction of the WTGs, OSSs, Met Tower, and along the offshore export cable corridor may be required. These aids serve as a visual reference to support safe maritime

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[3] The DEIS is available online at: https://www.federalregister.gov/documents/2023/10/06/2023-21749/notice-of-availability-of-a-draft-environmental-impact-statement-for-us-wind-incs-proposed-wind.

[4] Public Notice is online at: https://www.nab.usace.army.mil/Missions/Regulatory/Public-Notices/Public-Notice-View/Article/3547512/pn-23-44-nab-2020-60863-m34-us-wind-inc-md-offshore-wind-energy/

navigation. Federal regulations governing PATON are found within 33 CFR part 66 and address the basic requirements and responsibilities. USCG's proposal to permit installation of additional aids to navigation are included as elements of the proposed action in this Opinion.

The Marine Mammal Protection Act of 1972 (MMPA) as amended, and its implementing regulations (50 CFR part 216) allow, upon request, the incidental take of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region assuming certain statutory and regulatory findings are made. To "take" is defined under the MMPA (50 CFR§ 216.3) as,

> to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following: The collection of dead animals, or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; and feeding or attempting to feed a marine mammal in the wild.

"Incidental taking" means "an accidental taking. This does not mean that the taking is unexpected, but rather it includes those takings that are infrequent, unavoidable, or accidental." (50 C.F.R. §216.103). NMFS Office of Protected Resources (OPR) has received a request for Incidental Take Regulations (ITR) and associated Letter of Authorization (LOA) from US Wind, Inc. for the incidental take of small numbers of marine mammals during the construction of the Maryland Offshore Wind project.[5] The requested ITR would govern the authorization of take, by both Level A and Level B harassment[6], of "small numbers" of marine mammals over a 5-year period incidental to construction-related pile driving activities (impact) and high-resolution geophysical (HRG) site characterization surveys. A final ITR, if published, would allow for the issuance of a LOA to US Wind for a 5-year period. NMFS OPR's proposed issuance of an ITR and LOA is included as an element of the proposed action in this Opinion.

US Wind may choose to obtain a Letter of Acknowledgment from NMFS for certain fisheries survey activities. A Letter of Acknowledgement acknowledges, but does not authorize, certain activities as scientific research conducted from a scientific research vessel. (See 50 CFR §600.745(a)). Scientific research activities are activities that would meet the definition of fishing under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act), but for the statutory exemption provided for scientific research. (16 USC § 1802(16)). Such activities are statutorily exempt from any and all regulations promulgated under the Magnuson-Stevens Act, provided they continue to meet the definition of scientific research activities conducted from a scientific research vessel. To meet the definition of a scientific research vessel, the vessel must be conducting a scientific research activity and be under the direction of one of the following: Foreign government agency; U.S. Government agency; U.S. state or territorial

[5] Application, Notice of Receipt of Application, Proposed Rule, and Supporting Materials are available online at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-wind-inc-construction-and-operation-maryland-offshore-wind

[6] Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. Level B harassment refers to acts that have the potential to disturb (but not injure) a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. 50 CFR §216.3

agency; University (or other educational institution accredited by a recognized national or international accreditation body); International treaty organization; or, Scientific institution. In order to meet this definition, vessel activity must be dedicated to the scientific research activity, and cannot include commercial fishing. Scientific research activity, for Magnuson-Stevens Act purposes, includes, but is not limited to, sampling, collecting, observing, or surveying the fish or fishery resources within the Exclusive Economic Zone. Research topics include taxonomy, biology, physiology, behavior, disease, aging, growth, mortality, migration, recruitment, distribution, abundance, ecology, stock structure, bycatch or other collateral effects of fishing, conservation engineering, and catch estimation of fish species considered to be a component of the fishery resources. The issuance of a Magnuson-Stevens Act related Letter of Acknowledgment by NMFS is not a federal action subject to section 7 consultation, and it is not an authorization or permit to carry out an activity and the issuance of any Letter of Acknowledgement(s), should they be requested, is not considered an element of the proposed action in this Opinion. However, BOEM's proposed action we are consulting on includes surveys that may be carried out with a Magnuson-Stevens Act Letter of Acknowledgement. These surveys and their effects would not occur but for the Maryland Offshore Wind project proposed in the Construction and Operation Plan upon which BOEM intends to act under OCSLA, and it is, thus appropriate to consider them in this Opinion as consequences of BOEM's proposed action and, to the extent the surveys may cause effects to listed species at a level resulting in the incidental take of ESA-listed species, address such take in this Opinion's Incidental Take Statement.

2.0 CONSULTATION HISTORY AND APPROACH TO ASSESSMENT

As explained above, BOEM is the lead federal agency for this section 7 consultation. BOEM submitted a draft Biological Assessment (BA) to NMFS GARFO on June 2, 2023. We requested additional information from BOEM in correspondence dated September 11, 2023. BOEM submitted a revised BA and request for consultation to NMFS GARFO on October 17, 2023. In correspondence dated November 2, 2023, we notified BOEM that we had completed our review of the updated draft BA but still had some significant questions and comments about the document. In a teleconference on November 3, 2023, BOEM and NMFS discussed our comments and suggestions. BOEM submitted a revised BA to NMFS GARFO on December 15, 2023. In correspondence dated December 20, 2023, we submitted clarifying questions to BOEM. Between December 2023 and January 2024, BOEM provided additional information and responses to our questions and a final, revised BA was submitted to us on January 3, 2024.

On December 28, 2023, we received a draft *Notice of Proposed Incidental Take Regulations for the Taking of Marine Mammals Incidental to the Maryland Wind Offshore Wind Project*, from our Office of Protected Resources (OPR) and an accompanying request for ESA section 7 consultation. On January 4, 2024, OPR submitted the published proposed rule (89 FR 504, referred to herein as the proposed MMPA ITA).

On January 3, 2024, we deemed the information submitted by BOEM and NMFS OPR sufficient to assess the effects of the proposed action on ESA-listed species and designated critical habitat and that the information constituted the best scientific and commercial data available (50 CFR §402.14(c)(-(d)); ESA formal section 7 consultation was initiated on that date. To harmonize various regulatory reviews, increase certainty among developers regarding anticipated regulatory timelines, and allow sufficient time for NMFS' production of a final biological opinion, BOEM and NMFS have agreed to a standardized ESA Section 7 consultation timeline under the offshore wind program that allocates 150 days for consultation and production of a biological opinion for each proposed offshore wind project, unless extended. In this case, the identified deadline for issuance of the Opinion is June 18, 2024.

Consideration of Activities Addressed in Other ESA Section 7 Consultations
As described in section 3 below, some Maryland Wind project vessels will utilize the Paulsboro Marine Terminal in Paulsboro, NJ, the New Jersey Wind Port in Lower Alloways, NJ, and the Nexans Cable Plant in Goose Creek, Charleston, SC. NMFS GARFO has completed ESA section 7 consultation with the USACE for the construction and operation of the Paulsboro Marine Terminal and the New Jersey Wind Port. The Biological Opinions prepared by NMFS for the Paulsboro Marine Terminal (November 7, 2023[7], "2023 Paulsboro Opinion") and New Jersey Wind Port (February 25, 2022, "2022 NJWP Opinion") considered effects of all vessels transiting Delaware Bay and the Delaware River to/from these ports on ESA listed species that occur in that area and critical habitat designated for the New York Bight distinct population segment (DPS) of Atlantic sturgeon. NMFS SERO has completed ESA section 7 consultation with the USACE for the construction and operation of the Nexans Cable Plant. The Biological Opinion prepared by NMFS SERO for the Nexans facility (May 4, 2020, "2020 Nexans Opinion") considered the effects of construction activities as well as effects of all vessels transiting the Cooper River in Charleston, SC to/from the Nexans facility on ESA listed species that occur in that area and critical habitat designated for the Carolina DPS of Atlantic sturgeon.

Each of these three Biological Opinions analyzed an overall amount of vessel transits of which US Wind would contribute a small part. The effects analyzed in the three completed port Opinions will be considered as part of the *Environmental Baseline* of this Opinion, given the definition of that term at 50 CFR §402.02. The effects specific to US Wind's vessel use of those ports will be discussed in the *Effects of the Action* section by referencing the analysis in the three port Opinions and determining whether the effects of US Wind's vessels transiting to and from those ports are consistent with those analyses or anticipated to cause additional or different effects. In the *Integration and Synthesis* section, if we determine any additional or different effects of US Wind's vessels will be caused by the proposed action, we will evaluate them in addition to the effects included in the *Environmental Baseline*, which already includes the effects of vessel transits analyzed in the three completed port Biological Opinions.

By using this methodology, this Opinion ensures that all of the effects of US Wind's vessel transits to and from the ports analyzed in other Biological Opinions will be considered in the *Integration and Synthesis* section and reflected in this Opinion's final determination under ESA 7(a)(2). This methodology also ensures this Opinion does not "double-count" effects of US Wind's vessel transits to and from the ports– once in the *Environmental Baseline* and then again in the *Effects of the Action* section. Any incidental take anticipated to result from US Wind's vessel transits, even if already specified and exempted in the port Biological Opinions' Incidental Take Statements, will also be specified in this Opinion's Incidental Take Statement and will be subject to relevant reasonable and prudent measures and terms and conditions from the port

[7] The November 2023 Opinion is the result of reinitiation of ESA section 7 consultation and replaces the July 19, 2022 Opinion issued to the USACE.

Opinions. This approach is being taken because BOEM was not a party to the three port Biological Opinions, yet US Wind's vessel transits would not occur but for BOEM's COP approval. Therefore, it is reasonable, necessary and appropriate to specify this incidental take, as well as any non-discretionary measures to minimize, monitor, and report such take, in this Opinion's Incidental Take Statement that will apply to the relevant action agencies identified in this Opinion and its ITS.

Consideration of the 2024 ESA Section 7 Regulations
On April 5, 2024, NMFS and the U.S. Fish and Wildlife Service (FWS) (the Services) published joint final revisions to the 2019 Section 7 regulations in the Federal Register (89 FR 24268). These updates to the regulations governing interagency consultation (50 CFR part 402) were effective on May 6, 2024. We are applying the updated regulations to this consultation. The 2024 regulatory changes, like those from 2019, were intended to improve and clarify the consultation process, and, with one exception from 2024 (offsetting reasonable and prudent measures), were not intended to result in changes to the Services' existing practice in implementing section 7(a)(2) of the Act (89 FR 24268; 84 FR 45015). We have considered the prior rules and affirm that the substantive analysis and conclusions articulated in this Biological Opinion and its Incidental Take Statement would not have been any different under the 2019 regulations or pre-2019 regulations.

3.0 DESCRIPTION OF THE PROPOSED ACTIONS ON WHICH CONSULTATION WAS REQUESTED

In this section and throughout the Opinion we use a number of different terms to describe geographic areas of interest. For clarity, we define those terms here. Wind Development Area (WDA) is the area consisting of the location of the wind turbine generators, offshore substations, Meteorological Tower (Met Tower), interarray cables, and the cable corridors between the substations and the landfall site in Delaware. The Wind Farm Area (WFA) is that portion of US Wind's lease (OCS-A 0490) where the wind turbine generators, OSSs, and a single Met Tower will be installed and operated (i.e., the offshore portion of the WDA minus cable routes to shore); the WFA is nearly co-extensive with the lease area and we may use the terms WFA and lease area interchangeably in the Opinion. The project area is the area consisting of the location of the wind turbine generators, offshore substations, Met Tower, interarray cables, the cable corridor to shore, and the inshore export cable route traversing Indian River Bay, as well as all vessel transit routes to ports in Maryland, Virginia, New Jersey, Delaware, South Carolina, Maine, and the Gulf of Mexico, (i.e., the WDA plus these transit routes). The action area is defined in section 3.9 below and includes the project area, WDA, and WFA as well as the portion of the U.S. EEZ used by project vessels transiting to/from foreign ports.

3.1 Overview of Proposed Federal Actions
BOEM is the lead federal agency for the project for purposes of this ESA consultation. The proposed action described in the BA consists of the proposed approvals, permits, and authorizations for Maryland Offshore Wind Project located in Lease Area OCS-A 0490. The Lease Area is located on the outer continental shelf (OCS) off the coast of Maryland. The proposed location of the project and the cable installation corridor are shown in Figure 3.1.

In addition to BOEM's proposed approval of US Wind's COP for the Maryland Wind Project, BOEM's January 2024, request for consultation also included: EPA's proposal to issue an Outer Continental Shelf Air Permit; EPA's proposal to issue an NPDES general permit; the USACE's proposal to issue a permit for in-water work, structures, and fill under Section 10 of the Rivers and Harbors Act of 1899 and Section 404 of the Clean Water Act; and the USCG proposal to issue a Private Aids to Navigation (PATON) Authorization. BOEM also identified the role of the Bureau of Safety and Environmental Enforcement (BSEE) in taking actions related to the project and NMFS OPR's proposal to issue a Marine Mammal Protection Act (MMPA) Incidental Take Authorization (ITA). NMFS OPR submitted a separate request for consultation on December 28, 2023.

The reorganization of the Renewable Energy rules [30 CFR Parts 285, 585, and 586], enacted on January 31, 2023, reassigned existing regulations governing safety and environmental oversight and enforcement of OCS renewable energy activities from BOEM to Bureau of Safety and Environmental Enforcement (BSEE). BSEE is responsible for enforcing safety, environmental, and conservation compliance with any associated legal and regulatory requirements during project construction and future operations. Additionally, BSEE will: oversee operations, inspections, and enforcement actions; oversee closeout verification efforts; decommissioning activities including facility removal and inspections/monitoring; bottom clearance confirmation and provide analysis of the Facilities Design Report and Fabrication and Installation Report (FDR/FIR) and other project-related plans for operations, safety, and environmental protection. 30 CFR 285.700(a)-(c).

BOEM indicated it will require, through COP approval, all Project construction vessels to adhere to existing state and federal regulations related to ballast and bilge water discharge, including USCG ballast discharge regulations (33 CFR §151.2025) and EPA National Pollutant Discharge Elimination System Vessel General Permit standards.

The information presented here reflects the proposed action and effects described by BOEM in their January 3, 2024, final Biological Assessment, and the proposed Marine Mammal Protection Act Incidental Take Authorization (89 *Federal Register* 504; January 4, 2024). As noted, all the foregoing Federal permits, authorizations, and approvals collectively constitute the proposed action for consultation in this opinion. Accordingly, for simplicity, we may refer to BOEM's authorization when that authorization may also include other Federal actions (e.g., construction, operation, and decommissioning of the wind turbines requires authorizations from BOEM, BSEE, USACE, USCG, and NMFS OPR).

The proposed action described in the BA and analyzed in this Opinion consists of three phases of development which together are the Maryland Offshore Wind Project. The project includes MarWin, an offshore wind development of approximately 300 MW for which US Wind was awarded offshore wind renewable energy credits (ORECs) in 2017 by the State of Maryland; Momentum Wind, consisting of approximately 808 MW for which the State of Maryland awarded additional ORECs in 2021; and future build out of the remainder of the Lease Area to fulfill ongoing, government-sponsored demands for offshore wind energy.

The project design envelope described in the COP includes up to 121 WTGs, however, the proposed action described by BOEM in the BA and assessed in the proposed rule for the MMPA ITA, includes a 1 nautical mile (1.9 kilometer) setback from the traffic separation scheme (TSS) from Delaware Bay which removes 7 of the 121 WTG positions. Therefore, the proposed action described in the BA and analyzed in this Opinion consists of up to 114 WTGs - ranging from 14 to 18 MW each, up to four OSSs, one Met Tower, interarray cables in strings of four to six linking the WTGs to the OSSs, and substation interconnector cables linking the OSSs to each other, all of which will be located in BOEM Renewable Energy Lease Area OCS-A-0490, located within the Maryland Wind Energy Area (WEA). All WTGs will be placed on 26.2- to 36.1-foot (8- to 11-meter) diameter monopile foundations. Each of the four OSS jacket foundations will include a lattice-type steel structure that includes four pin-piles (i.e., legs) each with a diameter of 9.8-feet (3-meters). Alternatively, OSSs may be placed on 26.2- to 36.1- feet (8- to 11-meters) diameter monopile foundations or 32.8- to 49.2-feet (10- to 15-meters) suction bucket jacket foundations. The one Met Tower braced Caisson foundation will include a main Caisson steel pile with two bracing piles. The main Caisson will be a 6-foot (1.8-meter) diameter pile that tapers to 5-feet (1.5-meters) in diameter above the mudline. The two bracing piles will each be 5-feet (1.5-meters) in diameter. The initial construction campaign, MarWin, would include installation of approximately 21 WTGs, 1 OSS, and cable landing infrastructure during the first year of activities in the most eastern part of the Lease Area. The second construction campaign, Momentum Wind, would take place during the second year of construction activities and include installation of approximately 55 WTGs, 2 OSSs, and a Met tower immediately to the west of MarWin. The third construction campaign, currently unnamed and referred to as Future Development, would occur during the third year of construction activities and include the installation of approximately 38 WTGs and 1 OSS in the most western portion of the Lease Area.

The project's export cables include offshore and inshore segments. Up to four alternating current (AC) cables installed within one Offshore Export Cable Route (i.e., combination of Offshore Export Cable Common Corridor and Offshore Export Corridor 1) would connect the Maryland WFA to the Inshore Export Cable Route which connects to the existing mainland electric grid in the town of Dagsboro, Delaware. Offshore, the export cables are located in federal waters and state waters off the coast of Delaware. A single offshore export cable will run from each OSS to the transition vault at the landing location. The offshore export cables will be buried to a target depth of 3.3 to 9.8 feet (1 to 3 meters) below the seafloor within a 1,968 foot (600 meter) wide corridor. The Inshore Cable Route originates at the landfall at 3R's Beach. From the transition vaults at 3R's Beach landfall, the export cables will continue on as inshore export cables and traverse the Indian River Bay to connect to an onshore substation adjacent to the point of interconnection (POI) at the Indian River substation owned by Delmarva Power and Light (DPL). Within the Inshore Export Cable Route, the cables will be buried to a target depth of approximately 3 to 7 feet (1 to 2 meters) below the seafloor. The inshore export cables will be laid parallel to each other and spaced 32 to 98 feet (10 to 30 meters) apart.

The Lease Area is located in federal waters on the OCS approximately 10.1 miles (16.2 kilometers) off the coast of Maryland. The proposed location of the Maryland WFA and the Offshore Export Cable Route are shown in Figure 3.1.

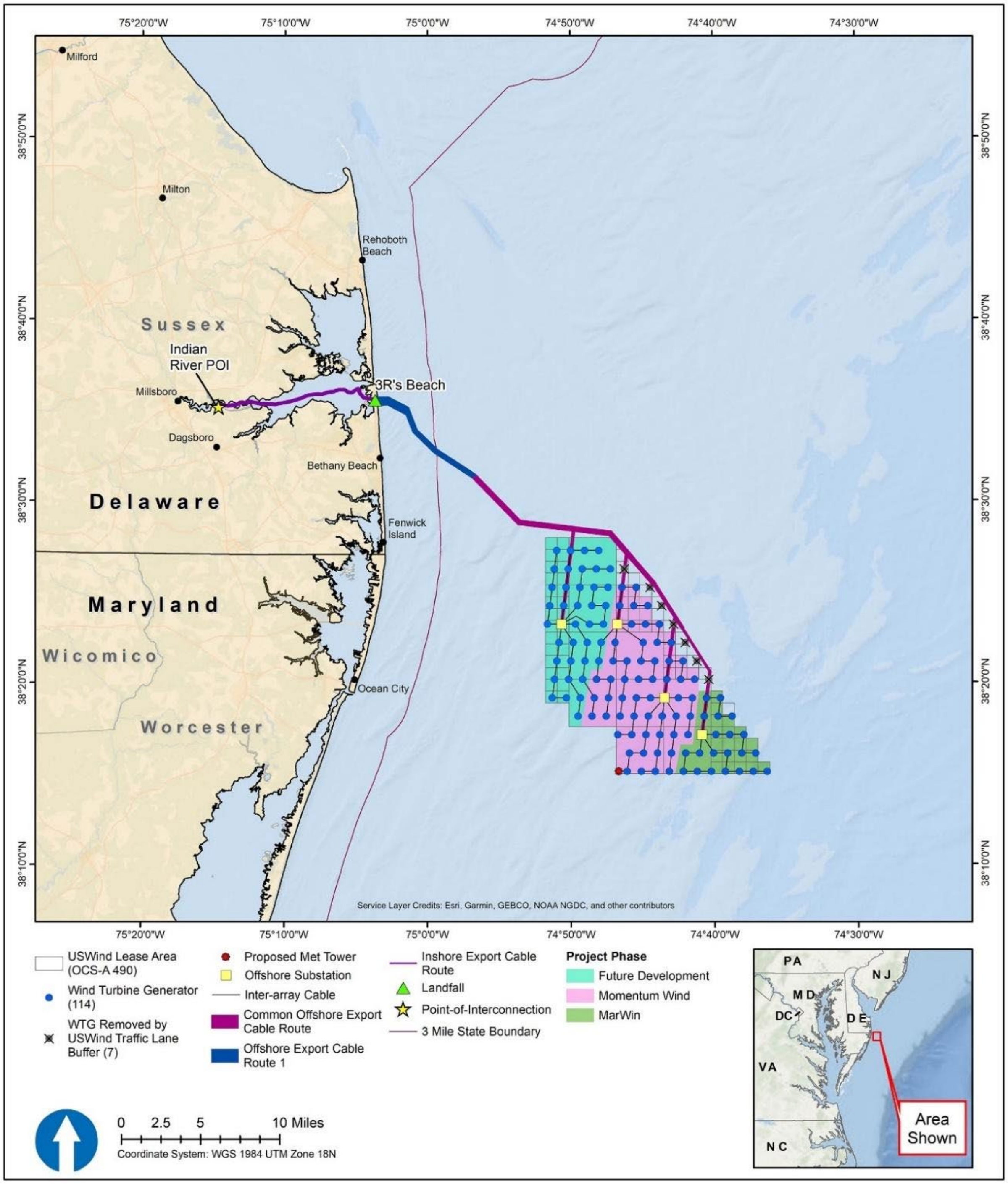


Figure 3.1. Maryland Offshore Wind Proposed Action footprint
Source: US Wind BA

The proposed action we are consulting on includes the above identified components of the Maryland Offshore Wind Project as well as shoreside improvements at the operations and maintenance facility (O&M Facility) located on the waterfront in West Ocean City, Maryland. Planned improvements include replacement of an existing fixed pier with an improved pier and associated timber fender system and wave screen. Bulkhead repairs including steel sheet pile and an attached timber fender system will occur along the existing concrete wharf 175 feet (53.3 meters).

The Maryland Offshore Wind Project also includes a number of survey components including high-resolution geophysical surveys (HRG), fisheries resource surveys and monitoring, and a Marine Mammal Monitoring Program that includes passive acoustic monitoring studies conducted in partnership with the University of Maryland Center for Environmental Science (UMCES) “Tailwinds”, or “Team for Assessing Impacts to Living resources from offshore WIND turbineS”. Deployment of Near Real-Time Whale Buoys (RTWB) to monitor for North Atlantic right whales and other baleen whales will also be deployed as part of the ongoing Tailwinds program. These data collection activities will occur at different times during the pre-construction, construction, and operation and maintenance phases of the project.

3.2 Construction

The proposed action described in the BA would consist of three construction campaigns, MarWin, Momentum Wind, and Future Development. US Wind anticipates construction starting with MarWin and moving to the northwest in approximately 300- to 400-megawatt sections. The subsequent campaigns would comprise Momentum Wind and any future build out of the remaining Lease Area. The offshore elements of the MarWin construction campaign are scheduled to be initiated in 2024 and completed in 2025; the offshore elements of Momentum Wind construction phase is scheduled to be initiated in 2025 and completed in 2026; and the offshore elements of the future development construction campaign is scheduled to be initiated in 2026 and completed in 2027. All work associated with the installation of the inshore export cable within Indian River Bay is anticipated to be completed in 2024 and 2026. HRG site characterization surveys would be conducted only during the Momentum Wind and future development campaigns. The total number of construction and installation days for each project component would depend on several factors, including environmental conditions, planning, construction, and installation logistics. The general construction schedule, assuming a late 2024 start, is described in the table 3.1. below.

Table 3.1. US Wind’s Anticipated Construction Milestones and Time Frames

Project Component	Activity Duration	Anticipated Time Frame
Mar Win Construction Campaign (Phase 1)		
Procurement and design of Project infrastructure	Varied	Q1 2022 to Q3 2025 (depending on component)
Foundation installation	22 pile driving days[1]	Q2 2025 to Q3 2025
Submarine cable installation[2]	N/A	Q2 2025 to Q3 2025
OSS installation	N/A	Q1 2025 to Q2 2025
WTG installation	N/A	Q2 2025 to Q4 2025
Landfall (HDD) cable installation	N/A	Q1 2025 to Q2 2025
Momentum Wind Construction Campaign (Phase 2)		
Procurement and design	Varied	Q1 2022 to Q3 2026
Foundation installation	58 pile driving days[1]	Q2 2026 to Q3 2026
Submarine cable installation[2]	N/A	Q3 2025 to Q3 2026

Project Component	Activity Duration	Anticipated Time Frame
OSS installation	N/A	Q1 2026 to Q2 2026
WTG installation	N/A	Q2 2026 to Q4 2026
Micro-siting HRG surveys	Maximum of 14 days	Q2 2026 to Q3 2026
Future Development Construction Campaign (Phase 3)		
Procurement and design	Varied	Q1 2022 to Q3 2026
Foundation Installation	39 pile driving days[1]	Q2 2027 to Q3 2027
Submarine cable installation[2]	N/A	Q2 2026 to Q3 2027
OSS installation	N/A	Q1 2027 to Q2 2027
WTG installation	N/A	Q2 2027 to Q4 2027
Micro-siting HRG surveys	Maximum of 14 days	Q2 2027 to Q3 2027

HDD = horizontal directional drilling; HRG = high-resolution geophysical; N/A = not applicable; OSS = Offshore substation; Q = quarter; WTG = wind turbine generator.
Source: US Wind (2023); TRC (2023)
[1]Includes all pile types (e.g., monopile, skirt pile, pin pile); however, installation of the piles for the Met Tower will only occur in phase 2.
[2] Includes the Offshore Export Cable, Inshore Export Cable, and inter-array cable installation.

3.2.1 Sea Floor Preparations

In the BA, BOEM describes that route clearance activities will be conducted along the Offshore Export Cable Route prior to offshore export cable installation including a pre-installation survey and grapnel run. The pre-installation survey and grapnel run would be performed to locate and clear obstructions such as abandoned fishing gear and other marine debris. BOEM and US Wind have determined that additional sea floor leveling, pre-trenching, UXO detonation, or boulder removal is not expected, and no sand wave leveling is included under the Proposed Action; therefore, these activities are not assessed in this Opinion.

Prior to commencing installation activities in the WFA, foundation locations would be cleared of any obstacles. As described in Section 3.3 of the COP, US Wind does not anticipate seabed preparation would be necessary to provide a level surface at any of the jacket foundation locations for the OSSs. However, in the event that seabed leveling is needed, US Wind anticipates using a trailing suction hopper dredge to level the seabed. US Wind estimates a maximum case scenario of approximately 5,000 cubic yards (3,823 cubic meters) would be relocated at each of the four OSS locations in the event that seabed leveling is required.
Prior to or following installation of a monopile foundation, the first layer of scour protection rocks will be deployed. Scour protection around WTGs will have an area of approximately three times the diameter of the foundation. Scour protection around the base of the OSS jacket foundations will also consist of rocks in an area approximately three times the diameter of the piles (COP Volume I, Section 2.3.1, US Wind 2023). US Wind estimates scour protection in an area of approximately 0.06 acres (0.02 hectares) at the jacketed OSS foundations.

3.2.2 Foundation Installation – WTGs, OSSs, and Met Tower

Foundations will be installed following completion of the seafloor preparation. The proposed project will include the installation of up to 114 WTG foundations, 4 OSSs, and 1 Met Tower installed over three construction seasons. Each WTG would extend a maximum of 938 feet (286 meters) above mean sea level. Approximate spacing between the WTGs would be 0.77 nautical miles (1.43 kilometers) in the east-west direction and 1.02 nautical miles (1.89 kilometers) in the north-south direction. No foundation pile driving would occur from December 1 through April 30 of any year.

As noted above, a variety of foundation types are proposed. For all three construction campaigns, all WTGs will be placed on monopile foundations. The single Met Tower for the Momentum Wind construction campaign will be installed on a braced Caisson foundation. Up to four OSSs will be placed on jacket foundations (pile supported or potentially suction bucket foundations).

The WTGs would consist of three components: a three-bladed rotor nacelle assembly, the tower, and the foundation. The rotor would drive a variable speed electric generator. The maximum rotor diameter for the Project would be 820 feet (250 meters). Integrated sensors on the WTG would detect wind direction, and the WTG would automatically turn into the wind with a yaw system, housed in the nacelle, along with the drivetrain, electric generator, control system, and power electronics. The rotor nacelle assembly would be located at the top of the tower, a steel tubular structure that supports the assembly and provides the height required to efficiently capture wind energy. The tower may house the power converter and transformer, though these pieces of equipment may also be housed within the nacelle. The tower may also contain the switchgear and inter-array cable terminations, though these pieces of equipment may also be located within the top of the foundation, which would be connected to the tower. Each WTG would contain oils, greases, and fuels used for lubrication, cooling, and hydraulic transmission. Each WTG would also include a Supervisory Control and Data Acquisition (SCADA) system, to allow for remote control and monitoring. Additionally, WTGs would include marking and lighting in accordance with USCG, Federal Aviation Administration (FAA), and BOEM guidelines and regulations.

Piled foundations (i.e., monopiles and piled jackets) would be driven into the seabed. Monopiles consist of a single vertical, hollow steel pile which may be connected to a transition piece that attaches the WTG tower to the monopile above the water line or may directly interface with the WTG tower. The maximum monopile diameter for the Project would be 36 feet (11 meters). Piled jacket foundations will be used for the OSSs. Piled jacket foundations are vertical steel lattice structures with three to four legs connected by cross bracing. Each leg is secured to the seabed using piles. Each OSS piled jacket foundation is expected to have four legs with one 9.8-foot (3-meter) diameter pile per leg. A Braced Caisson foundation design will be used for the Met Tower. This design consists of a main Caisson steel pile with two bracing piles. The main Caisson will be a 6-foot (1.8-meter) diameter pile that tapers to 5-feet (1.5-meters) in diameter above the mudline. The two bracing piles will each be 5-feet (1.5-meters) in diameter.

Piled foundations would be installed using a hydraulic impact hammer deployed on a jack-up or heavy lift vessel using dynamic positioning or anchoring. The impact hammer utilized for installation of monopile foundations would have a maximum rated capacity of 4,400 kilojoules and would drive the monopiles up to 164 feet (50 meters) into the seabed. No more than one monopile will be driven per day for a duration of approximately 2-hours. The impact hammer utilized for the installation of pin piles for the OSS piled jacket foundations would have a maximum rated capacity of 1,500 kilojoules and would drive the pin piles up to 262 feet (80 meters) into the seabed. The impact hammer for the piled jacket foundations will be operated at approximately 40 blows per minute for a total blow count of 19,200 per day and a duration of up to 8-hours per day to install all four pin piles for a jacket. The impact hammer utilized for installation of piles for the Met Tower foundation would have a maximum rated capacity of 500 kilojoules and would drive the piles up to 166 feet (51 meters) into the seabed. The impact hammer for the Met Tower Braced Caisson foundation piles will be operated at approximately 8 blows per minute for a total blow count of 3,000 per day and a duration of up to 6 hours to install the three Caisson piles.

In the event that a pile meets refusal prior to the embedment depth, US Wind would conduct "relief drilling" as needed. Relief drilling would be conducted using a trailing suction hopper dredge which would suction sediments from around the pile rather than from within the pile. Any soils removed during relief drilling will remain at the foundation location and will be placed in the general area where scour protection will be later installed. Upon completion of relief drilling to free up the pile, normal pile hammering would resume until the pile has reached target penetration. Based on current drivability assessments, US Wind anticipates a very low likelihood that the piles will not reach penetration depth and expects a small number, if any, foundations will require relief drilling throughout the construction phase of the project.

As noted above, pile driving will be limited to May 1 – November 30 in each construction year. While BOEM's BA notes that no time-of-day restrictions are proposed for pile driving and that piling may be initiated at any time, the proposed MMPA ITA indicates that initiation of pile driving after dark is not currently proposed. Both the BA and proposed MMPA ITA describe the conditions that US Wind would need to meet in order for pile driving to be initiated at night. Absent an approved night time monitoring plan, consistent with the description of the action in the proposed MMPA ITA, all pile driving will be initiated during day time (i.e., between one hour after civil sunrise to 1.5 hours before civil sunset), and nighttime pile driving could only occur if unforeseen circumstances (e.g., temporary shutdowns caused by marine mammal or sea turtle sightings, weather or metocean conditions, or equipment repair/maintenance or slower-than-anticipated pile driving speeds caused by geotechnical or other factors) prevent the completion of pile driving during daylight hours and it is necessary to continue piling during the night to protect the asset integrity or safety. BOEM indicates in the BA that no concurrent pile driving is proposed; therefore, concurrent pile driving (i.e., two piles being installed at the same time) is not considered as part of the proposed action. More information on the requirements for night time piling is included below.

In the event foundations for the OSSs are not piled jackets or monopiles with installations as described above, jackets on suction buckets may be used. For the jacket on suction bucket configuration, the buckets are integrated into the jacket legs and the structure is installed as one piece, with no piling. Suction buckets with scour protection mats incorporated into the buckets may be used if available and feasible. The installation process of suction bucket foundations would entail:

- Feeder or installation vessel transports foundation to site;.
- Jacket on suction buckets delivered to installation vessel, lifted from feeder vessel, and lowered in the target area on the seabed.

- Verify correct orientation of the jacket.
- Activate and test the suction bucket dewatering pumps. Dewatering process commenced, drawing suction buckets to design embedment depth.
- Jacket verticality monitored during lowering, and suction pressure adjusted per bucket, if needed.
- Once the buckets have reached their target penetration, the suction pumps will be disconnected from the buckets by ROV and recovered to the vessel.
- Deploy scour protection, if applicable.

3.2.3 Cable Installation- Offshore

As described in BOEM's BA, offshore submarine cabling for the Project includes up to 125.6 miles (202.2 kilometers) of inter-array cables and 142.5 miles (229.3 kilometers) of submarine export cables. As described in the BA, the inter-array cables would connect the WTGs into strings and then connect these strings to the OSSs. The inter-array cables will be a 66 kilovolt (kV) three-core, solid dielectric construction. The sizes of the cables will vary depending on the distance of the WTG from the OSS and the number of WTGs on a given string. Up to four submarine export cables, occupying up to two 1,968-foot (600-meter) corridors, would connect the OSSs to the planned landfall location near 3R's Beach. The submarine export cable for each OSS will be a 230 to 275 kV, three-core cable up to 12 inches (300 millimeters) in diameter. Prior to cable installation, US Wind would carry out pre-installation activities including a pre-installation survey and grapnel run. Collected debris will be recovered and disposed of in appropriate shore-side facilities. BOEM indicates in the BA that additional seafloor leveling, pre-trenching, or boulder removal is not expected, and no sand wave leveling is included under the Proposed Action; therefore, these activities are not assessed in this Opinion.

Once the pre-installation activities are completed, US Wind would lay and bury the export and inter-array cables. Cable lay and burial may be completed using three methods:

- Simultaneous lay and burial: Cable is directly guided from the installation vessel through the burial tool and laid into the seabed. US Wind expects to use this method for installation of inter-array and export cables
- Post-lay burial: Cable is temporarily laid on the seabed then buried in a subsequent, separate operation. This method leaves the cables unprotected between laying and burial operations, but burial can be completed more quickly, minimizing duration of cable installation impacts, and multiple passes with the burial tool can be completed to reach target burial depth, minimizing the need for cable protection. If needed, US Wind will use this method for installation in areas along the Offshore Export Cable Route.
- Pre-lay trenching: A trench is excavated prior to cable installation, cable is laid into the trench, and the trench is backfilled with spoils from trench excavation. This method would be limited to portions of cable alignments where deeper cable burial is required, or firmer sediments are encountered. If needed, US Wind will use this method for installation in areas along the Offshore Export Cable Route.

The BA describes a variety of tools to perform cable lay and burial operations. Final equipment selection will be based upon seabed conditions, cable properties, laying and burying combinations, burial tool systems, and anticipated performance.

- Jet trenching: Involves injecting pressurized water jets into the seabed, creating a trench. This equipment can be used in soft sediments for either simultaneous lay and burial or post-lay burial techniques
- Plowing/jet plowing: As the plow is dragged along the seabed, a trench to the required burial depth is created and held open. As the plow advances, the cable is placed in the trench and displaced sediment is either mechanically returned to the trench or backfills naturally. This equipment is typically used for simultaneous lay and burial
- Mechanical trenching: This tool cuts a narrow trench into the seabed using a jetting sword or excavation chain, and cable is buried in the trench either simultaneously or subsequently. This equipment is generally used in firmer sediments for simultaneous lay and burial, post-lay burial, and pre-lay trenching techniques.

US Wind anticipates the majority of offshore cable installation will utilize a towed or self-driving jet plow. A mechanical cutting/trenching tool or conventional cable plow is only expected in areas where soil conditions do not permit the use of a jet plow.

In areas where burial of the cables to target depth (3.3 to 6.6 feet [1 to 2 meters] for inter-array cables; 3.3 to 9.8 feet [1 to 3 meters] for offshore export cables) is not feasible, cable protection would be installed on the seabed above the cable as a secondary measure to protect the cables. Proposed types of cable protection described in the BA are:

- Rock placement: Up to three layers of rock, with rock size increasing in higher layers
- Concrete mattresses: High-strength concrete blocks cast around mesh that holds the blocks in a flexible covering
- Cable Protection Systems: Composite materials that are fixed around a cable.

At the WTG and OSSs, scour protection will be placed over the cable as required after the cable is pulled into the WTG to the hang-off platform, or into the OSS through a J-tube.
It is anticipated that the submarine cable installation (i.e., offshore export cable and inter-array cable installation) for the MarWin construction campaign would occur over the second and third quarters of 2025. The submarine cable installation for the Momentum Wind construction campaign would occur from the third quarter of 2025 through the third quarter of 2026. For the Future Development construction campaign, submarine cable installation would occur from the second quarter of 2026 through the third quarter of 2027.

3.2.3.1 Cable Landfall Activities at 3R's Beach
US Wind will connect the export cables at the 3R's Beach landfall location via Horizontal Directional Drilling (HDD). HDD would involve drilling underneath the seafloor using land-based and offshore HDD equipment. Land-based HDD equipment will consist of a drilling rig, mud pumps, drilling fluid cleaning systems, pipe-handling equipment, excavators, and support equipment (e.g., generators and trucks). Offshore HDD equipment will consist of a work platform (either a barge or a small jack-up) and associated support vessels (e.g., tugs, small work boats). The work platform will be equipped with a crane, an excavator, winches, and auxiliary equipment, including generator and lights.

Offshore export cables will be pulled into cable ducts that route the cables under the beach to subterranean transition vaults located in existing developed areas such as parking lots. As described in the BA and COP, US Wind evaluated cofferdams at the HDD locations and determined that the use of a gravity cell would be more appropriate for soil conditions as well as avoid the use of a vibratory hammer that would create additional underwater sound. The gravity cell is the proposed action considered in this Opinion. It will be lowered onto the seafloor and would not require the walls of the cell to be driven into the seabed. The HDD drill rig will be set up onshore in an excavated area and the drill would advance to the offshore exit point. During drilling operations, drilling mud will be injected to cool the drill bit, provide lubrication, and stabilize the borehole. The drilling fluid (mud) is an inert bentonite slurry and will carry the cuttings back to the shoreside excavation pit for collection/removal and reuse. HDD operations will include monitoring of the downhole water/bentonite slurry to minimize the potential of drilling fluid breakout. The offshore cable will be pulled in through the HDD ducts into the cable jointing/transition vault at the landfall location.

3.2.4 Cable Installation- Inshore

As described in the BA, the export cables would continue along the Inshore Export Cable Route into Indian River Bay (Old Basin Cove) after leaving the transition vaults at 3R's Beach. Up to four inshore export cables, occupying a corridor with a minimum width of 131 feet (40 meters) would traverse Indian River Bay and connect to onshore substations next to the POI at the Indian River substation in Dagsboro, Delaware. Inshore submarine cabling for the Project includes up to 97 miles (156 kilometers) of export cables. US Wind expects to direct the cables along a southern route through Indian River Bay.

Prior to inshore cable installation, US Wind would carry out dredging for barge access in locations along the Inshore Export Cable Routes. US Wind assumes the maximum of 73,676 cubic yards (56,329 cubic meters) of dredged material, assuming all four cables were installed within the southern Inshore Export Cable Routes. Dredging is expected to be completed using hydraulic means. Dredged material will be piped via temporary dredge pipeline to a dewatering staging area at the US Wind Substations. Dredged materials will be dewatered and placed in trucks for disposal/placement at an upland disposal site. Dewatering will be achieved by a passive method using large geobags which would allow dredged material to dewater over approximately 30-60 days prior to removal and placed into dump trucks. Alternatively, mechanical dewatering using a temporary system of separators (shakers), clarifiers, mixing tanks, and belt presses could be sized to meet target daily dredge production and continuously remove material to one or more upland disposal sites. A combination of passive and mechanical dewatering methods may be used, pending final project design.

Seabed preparation, specifically a pre-installation survey and grapnel run will also be performed prior to cable installation. Collected debris will be recovered and disposed of in appropriate shore-side facilities. BOEM indicates in the BA that pre-installation seafloor preparation, such as leveling, pre-trenching or boulder removal is not expected along the Inshore Export Cable Route; therefore, these activities are not assessed in this Opinion.

Once pre-installation activities are completed, US Wind would feed the inshore export cable to the HDD ducts at 3R's Beach using small boats and floatation. The cables will be subsequently pulled through the ducts into the transition vaults and the offshore and inshore cables will be spliced together. US Wind will pre-install a temporary cable roller highway to reduce cable tension if necessary. The cable barge will lay and bury the cable between the two HDD exit points at Old Basin Cove (Indian River Bay) and Deep Hole (Indian River). The cable barge will maneuver along the cable route using a six-point anchoring system, assisted by an anchor handling tug in combination with stud piles. Once the inshore cable reaches the HDD location at Deep Hole, the export cables would exit the HDD duct, enter underground transition vaults approximately the same size as the transition vaults at 3R's Beach landfall, and traverse underground to be terminated at the respective substation block.

US Wind expects to use a barge mounted vertical injector, which fluidizes the soil, to be the primary burial tool for the inshore export cable. If needed, US Wind will use a cable plough or barge mounted excavator in some areas along the Inshore Export Cable Route. US Wind will use a self-driving or towed post-lay cable burial tool in shallow water. As stated above, US Wind expects the inshore export cables to be buried to a depth of 3 to 7 feet (1 to 2 meters) based on the anticipated long-term bay morphology. With any of the cable burial methods along the Inshore Export Cable Route, US Wind expects the narrow trench in the bay bottom to collapse immediately after the cable has been depressed in the trench. Based on currently available information, US Wind does not expect cable or pipeline crossings to occur within the Inshore Export Cable Route. US Wind anticipates that the inshore cable will be installed in a continuous length. However, if operational needs warrant, US Wind will install the inshore cable in smaller sections that would be spliced together.

All construction, including any dredging, within Indian River Bay would occur over two construction seasons, anticipated from the third quarter of 2024 through the first quarter of 2026. The MarWin construction campaign would consist of one inshore cable installation. Up to three inshore cables would be installed in association with the Momentum and Future Development campaigns. US Wind anticipates all construction, including any dredging, would occur within a October-February window, observing the general time-of-year restrictions for summer flounder and other species. Any further time-of-year restrictions will be determined through consultations with the Delaware Department of Natural Resources and Environmental Control (DNREC).

3.2.5 Shoreside Improvements at the O&M Facility

As described in the BA, a new O&M facility will be developed within Ocean City Harbor, Maryland. The existing floating dock which is 75 feet (22.9 meters) long and the existing pier which is 550 feet (167.6 meters) long by 12-foot (3.7 meters) wide will be replaced by a fixed pier which will be 625 feet (190.5 meters) long and range from by 30 feet (9.1 meters) to 32 feet (9.7 meters) wide. The length of the proposed pier will not extend any further into Ocean City Harbor than the current dock and pier structures. To repair the existing bulkhead, US Wind plans to place up to 120 sheet piles a maximum of 18 inches beyond the existing wharf face and fill the void between the two before being capped. This bulkhead repair would include replacing the existing bulkhead/quay wall from the end of the pier to 175 feet (53 meters) to the west. The fixed pier would include installing up to 170 steel pipe pier piles with diameters of 12-to-18-inches (30.5 to 45.7 centimeters) and lengths of 100 to 125 feet (30.5 to 38.1 meters). Along the north side of the pier and along the steel sheet pile bulkhead, US Wind will install a 2-foot (0.6 meter) wide timber fender system. On the south side of the pier, US Wind will install a 2-foot (0.6 meter) wide timber fender system and wave screen. Up to 240 timber fender system piles with diameters of 12-to-18-inch (30.5 to 45.7 centimeters) and lengths of 40 to 45 feet (12.2 to

13.7 meters) will be installed. The footprint of the proposed bulkhead repairs and fixed pier would permanently impact approximately 19,700 square feet (1,830.2 square meters) of seafloor. All pile installation will be completed with an impact hammer. The piling duration for the steel pipe pier piles and timber fender system piles would occur over a period of up to 6-months and the sheet pile bulkhead repairs would occur over a period of up to 3-months. While no specific timeline for acquisition and retrofitting of the O&M facility is provided in the BA or COP, BOEM and US Wind anticipate that any inshore impact pile driving required to develop the O&M facility will be completed before the targeted commercial operations date for phase 1 in December 2025.

3.3 Operations and Maintenance

US Wind's Lease with BOEM (Lease OCS-A 0490) has an operations term of 25 years that would commence on the date of COP approval. US Wind would have to apply for an extension if it wished to operate the proposed Project for more than 25 years; in the DEIS and BA, BOEM considers an operational period of up to 30 years. As described in the BA and COP, once operational, the Project will be supported by a new O&M facility that US Wind is proposing to establish in West Ocean City, Maryland. The facility will be used for O&M operations including material storage, day-to-day management of inspection and maintenance activities, vehicle parking, marine coordination, vessel docking, and dispatching of technicians.

During operation, the WTGs would be remotely monitored through the SCADA system, which acts as an interface for a number of sensors and controls throughout the wind farm. The SCADA system allows status and performance to be monitored and for systems to be controlled remotely, where required. The WTGs will be regularly inspected and maintained. Generally, WTG O&M activities would include:

- Regularly scheduled inspections and routine maintenance of the WTG mechanical and electrical components
- Annual maintenance campaigns for general upkeep (e.g., bolt tensioning, crack and coating inspection, safety equipment inspection, cleaning, high-voltage component service, and blade inspection)
- Replacement of consumable items (e.g., lubrication, oil changes) and scour materials.

During O&M, the OSSs would be serviced at predefined intervals. Scheduled maintenance will include high-voltage protection functional testing, switchgear tests, and detailed transformer inspections. Routine maintenance and inspection of the OSS structures and support systems would also be conducted to assess structural integrity, corrosion protection, seafloor scouring and maintenance of safety systems.

US Wind and a third-party contractor will jointly monitor the Met Tower remotely via the high-speed remote data link and anticipated near real-time data transmissions. Scheduled maintenance activities would occur in-person annually and consist of instrumentation, data logging, power, safety, and communication systems maintenance, along with above-water structural checks. Unscheduled maintenance will be conducted as necessary based on the nature of the issue.
The topside portions of the foundations would be visually inspected, while the underwater portions of the foundations will be inspected utilizing a remotely operated vehicle (ROV). Foundations would be inspected above and below the water line at least once approximately 2

years following construction for each Project phase. US Wind anticipates inspections would occur every 4 to 5 years throughout the operational life of the Project.

The offshore export cables and inter-array cables would be monitored and surveyed in year 1, year 3, and then every 5 years thereafter during O&M for each Project phase. Cable surveys would be performed to identify potential issues with burial depth or scour. The frequency of cable surveys will be determined based on the results of the initial surveys. In the unlikely event of cable exposure, the cable would be reburied or cable protection would be applied. Should unplanned repairs be required, the damaged portion of the cable will be spliced and replaced with a new, working segment. This will require the use of various cable installation equipment, as described for construction activities.

To support operation and maintenance of WTGs and the OSSs, each WTG and OSS would require various oils, fuels, lubricants, and coolants. A spill containment strategy for each WTG and OSS would be comprised of preventive, detective, and containment measures. These measures include 100 percent leakage-free joints to prevent leaks at the connectors, high-pressure and oil level sensors that can detect both water and oil leakage, and appropriate integrated retention reservoirs capable of containing more than the volume of potential leakages at each WTG and OSS (Appendix A, Table 4, COP 2023). Table 3.2 provides a summary of chemical products to be used on the Project; the volume stored on location; their treatment, discharge, or disposal method and location; manner of delivery to site; and frequency of transfers.

Table 3.2. Chemical Products Used and Stored

Chemical Product Used	Use	Volume Stored on Location or Contained in Equipment	Treatment, discharge, or disposal method and location	Manner of delivery to site	Quantity per Transfer and Number of Transfers
Synthetic Ester	OSS Transformer Cooling Oil	159,482 liters (42,131 gallons) per OSS	Removed from transformer to service vessel during routine maintenance Material brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Every 2 years, based on conditions, if needed
Motor Oil	OSS Emergency Generator	44 liters (12 gallons) per OTM	Removed from engine and brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Annually, based on conditions, if needed
Hydraulic oil	OSS Heavy Lift Crane	1,267 liters (335 gallons) per OSS	Removed from hydraulic system and brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Annually, based on conditions, if needed

Chemical Product Used	Use	Volume Stored on Location or Contained in Equipment	Treatment, discharge, or disposal method and location	Manner of delivery to site	Quantity per Transfer and Number of Transfers
Diesel Oil	OSS Emergency Generator	160,856 liters (42,494 gallons) per OSS	Removed from fuel storage tank brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	As required
Water/glycol	OSS Emergency Generator	114 liters (30 gallons) per OSS	Removed from OSS components brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Every 2 years
Grease	WTG bearings and auxiliary equipment	355 liters (94 gallons) per WTG	Removed from WTG components brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Every 2 years

Chemical Product Used	Use	Volume Stored on Location or Contained in Equipment	Treatment, discharge, or disposal method and location	Manner of delivery to site	Quantity per Transfer and Number of Transfers
Synthetic Ester	WTG Transformer Cooling Fluid	4,500 liters (1,189 gallons) per WTG	Removed from transformer to service vessel during routine maintenance Material brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Every 2 years, based on conditions, if needed
Compressor oil	Rotor locking and rotor brake	83 liters (22 gallons) per WTG	Removed from WTG components brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Every 4 years, based on conditions, if needed
Lubricating oil	WTG Pitch and yaw gear and damper mass system lubricants	323 liters (85 gallons) per WTG	Removed from WTG components brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Every 4 years

Chemical Product Used	Use	Volume Stored on Location or Contained in Equipment	Treatment, discharge, or disposal method and location	Manner of delivery to site	Quantity per Transfer and Number of Transfers
Water Propylene Glycol mix	WTG Coolant	1,300 liters (343 gallons) per WTG	Removed from cooling system and brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	Every 2 years
Fire suppressant (foam)	WTG	75 liters (20 gallons) per WTG	Collected and brought to port for appropriate disposal as necessary	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	As needed
Fire suppressant IG541 inert gas bottles	WTG	9 * 5.91 kg	Removed from WTG components brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	As needed
Ion exchange resin	WTG	27.5 liters (7.3 gallons) per WTG	Removed from WTG components brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	As needed

Chemical Product Used	Use	Volume Stored on Location or Contained in Equipment	Treatment, discharge, or disposal method and location	Manner of delivery to site	Quantity per Transfer and Number of Transfers
SF6 gas	WTG and OSS Switchgear	n/a	Removed from WTG and OSS components and brought to port for disposal	Transferred via installation or service vessel at time of installation	As needed
Portable fire extinguishers	Foam and CO2 extinguishers	9L Foam and 6kg CO2 per extinguisher	Removed from WTG and OSS components and brought to port for disposal	Transferred via installation or service vessel at time of installation Transferred via service vessels during O&M phase	As needed

Source: Appendix I-H of the COP

3.4 Decommissioning

The Maryland Offshore Wind Project would be decommissioned and removed at the end of its approximately 25-30 year operating period. Consistent with the requirements of 30 CFR 585 and their lease, US Wind would be required to remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the sea floor of all obstructions created by the proposed Project. All facilities would need to be removed 15 feet (4.6 m) below the mudline (30 CFR 585.910(a)). Unless otherwise authorized by BSEE, pursuant to the applicable regulations in 30 CFR Part 285, US Wind would be required to "remove or decommission all facilities, projects, cables, pipelines, and obstructions and clear the seafloor of all obstructions created by activities on leased area, including any project easement(s) within two years following lease termination, whether by expiration, cancellation, contraction, or relinquishment, in accordance with any approved SAP, COP, or approved Decommissioning Application and applicable regulations in 30 CFR Part 285." As noted below, BOEM may authorize facilities to remain in place. When possible, decommissioning would recover valuable recyclable materials, including steel foundation components.

In accordance with BSEE requirements, US Wind would be required to remove and/or decommission all Project infrastructure and clear the seabed of all obstructions when the Project reaches the end of its 25-30 year designed service life. Before ceasing operation of individual WTGs or the entire Project and prior to decommissioning and removing Project components, US Wind would consult with BSEE and submit a decommissioning plan for review and approval. Upon receipt of the necessary BSEE approval and any other required permits, US Wind would implement the decommissioning plan to remove, and recycle, when possible, equipment and associated materials.

The decommissioning process for the WTGs, OSSs, and the Met Tower with their associated foundations, is anticipated to generally be the reverse of installation, with Project components transported to an appropriate disposal and/or recycling facility. All foundations and other Project components would need to be removed 15 feet (4.6 meters) below the mudline, unless other methods are deemed suitable through consultation with BSEE and other applicable regulatory authorities, including BOEM. Submarine export and inter-array cables would be retired in place or removed in accordance with the BSEE-approved decommissioning plan. US Wind would need to obtain separate and subsequent approval from BOEM to retire any portion of the Project in place. Project components will be decommissioned using a similar suite of vessels as Project construction.

3.5 Survey and Monitoring Activities

US Wind is proposing to carry out or BOEM is proposing to require that US Wind carry out as conditions of COP approval, high-resolution geophysical (HRG) surveys and a number of ecological surveys/monitoring activities. US Winds is proposing to partner with University of Maryland Center for Environmental Science (UMCES) "Tailwinds", or Team for Assessing Impacts to Living resources from offshore WIND turbineS to conduct fisheries and marine mammal monitoring (https://tailwinds.umces.edu/) for the Project. These activities are described in the BA and are part of the proposed action for this consultation and their effects on ESA-listed species are thus evaluated in this Opinion.

3.5.1 High-Resolution and Geological Surveys and Geophysical Surveys

Geophysical surveys would be conducted during the Momentum and Future Development construction campaigns (i.e., during Year 2 and Year 3 of the 5-year effective period of the LOA) to refine the locations of project elements such as construction footprints, WTG and OSS foundations, and cables, or to meet BOEM or other agency requirements for additional surveys. HRG surveys use a combination of sonar-based methods to map shallow geophysical features. The survey equipment is typically towed behind a moving survey vessel attached by an umbilical cable. HRG survey vessels move slowly, with typical operational speeds of less than approximately 4 knots.

These surveys are expected to utilize active acoustic equipment including multibeam echosounders, side scan sonars, shallow penetration sub-bottom profilers (SBPs) (*e.g.*, Compressed High-Intensity Radiated Pulses (CHIRPs) non-parametric SBP), medium penetration sub-bottom profilers (e.g., sparkers and boomers), ultra-short baseline positioning equipment, and marine magnetometers. No airguns are proposed for use and the use of airguns is not considered here. US Wind anticipates HRG surveys using sparkers and boomers to occur during 2026 and 2027. Up to 14 days of HRG survey activity are planned from April through June 2026 during the Momentum campaign. In addition, up to 14 days of HRG survey activity are planned from April through June 2027 during the Future Development campaign. As described in the MMPA ITA, US Wind's HRG surveys would be conducted using one vessel at a time. Up to 111.1 km of survey lines would be surveyed per vessel each survey day at approximately 7.4 km/hour (4 knots (kn)) during daylight hours.

BOEM has completed a programmatic ESA consultation with NMFS for HRG surveys and other types of survey and monitoring activities supporting offshore wind energy development (NMFS 2021a; Appendix C to this Opinion), inclusive of the equipment proposed for use by US Wind. As described in the US Wind BA, BOEM will require the Lessee to comply with all relevant programmatic survey and monitoring PDCs and BMPs included in the 2021 programmatic ESA consultation; these measures are detailed in Appendix B of the programmatic consultation (see Appendix C of this Biological Opinion for a copy of the programmatic consultation). HRG surveys and grab sampling related to the approval of the US Wind COP are considered part of the proposed action evaluated in this Opinion. The applicable survey and monitoring PDCs and BMPs included in the 2021 programmatic ESA and identified by BOEM in its BA are also elements of the proposed action evaluated in this Opinion.

3.5.2 Fishery Resource Monitoring

The fisheries resource monitoring program will be carried out to evaluate black sea bass (*Centropristis striata*) availability to commercial fishers and charter anglers based on the extent to which black sea bass change their aggregate behaviors in association with newly introduced WTG foundations. Fisheries monitoring surveys will be conducted over a 6-year survey period, divided into 2-year phases corresponding with before, during and after construction periods. The fisheries resource monitoring program considered under the proposed action will consist of two components: 1) a commercial ventless pot survey and 2) a recreational charter fisheries survey. Surveys will occur in the WFA and in adjacent control areas (Figure 3.2).

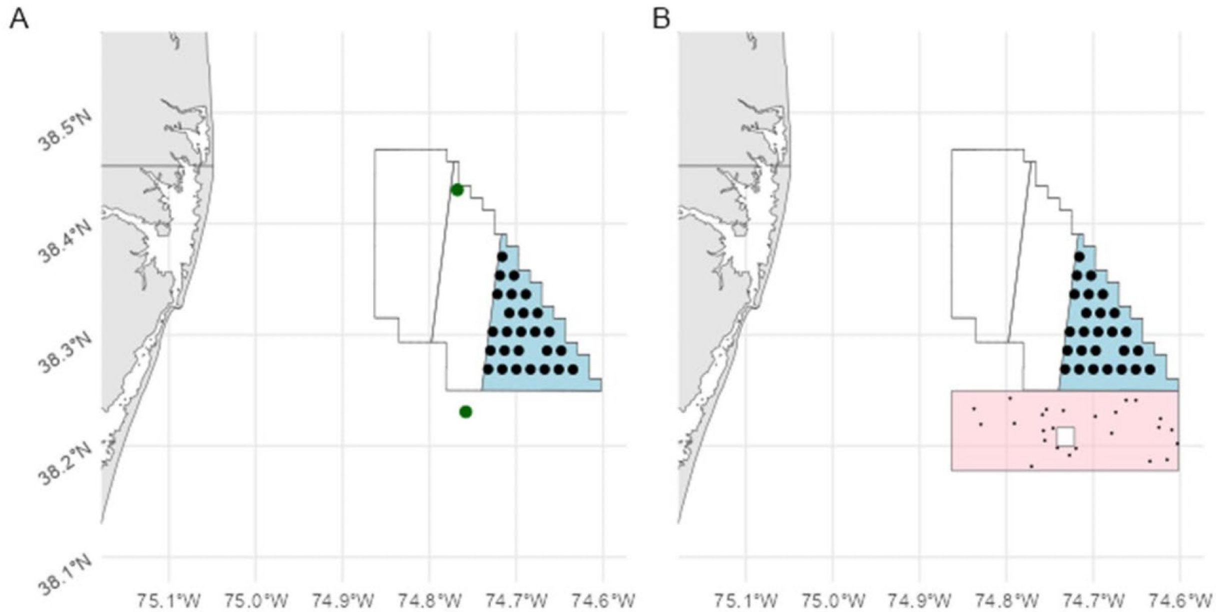


Figure 3.2. Study site for recreational[1] (A) and commercial[2] (B) surveys
[1]For the recreational survey, reference artificial reef sites (green points) and two turbine sites are selected per surveys.

<u>Commercial Ventless Pot Survey:</u> The commercial pot survey will consist of rigs of up to 15 commercial pots each, with pots spaced proximate and distant to turbine structures to capture both turbine- and project-scaled changes in black sea bass catch rates. At least two years of pre-construction data would be collected. Anticipated monthly pot surveys (March through November) of six rigs (four in the Project area and two in an adjacent control area) will be conducted. Prior to each monthly survey, a subset of four project and two control sites will be randomly selected from all possible turbine and control sites (Figure 3.2B). Transits to the survey locations will occur aboard the *F/V Integrity* or a similar vessel from its homeport in West Ocean City, Maryland. The anticipated total number of surveys and deployments is summarized in Tables 3.3. and 3.4.

Table 3.3. Anticipated pot survey periods, months, and vessel days

Period	**Years**	**Monthly Surveys**	**Total Surveys**	**Vessel Days/year**	**Total Vessel Days/Period**
Before	2023-2024	Mar-Nov	Up to 18	Up to 18	Up to 36
Construction	2025-2026	Mar-Nov	Up to 18	Up to 18	Up to 36
After	2027-2028	Mar-Nov	Up to 18	Up to 18	Up to 36
Total	2023-2028	Mar-Nov	Up to 54		Up to 108

Source: BA Appendix A

Table 3.4. Anticipated pot survey gear deployments

Sites	**Rigs**	**Pots/rig**	**Total Pots**	**Ropeless Devices**
Project	4	Up to 15	Up to 60	4
Control	2	Up to 15	Up to 30	2

Total	6	Up to 15	Up to 90	6

Source: BA Appendix A

Pots will be soaked for a single night (<24 hours) and retrieved. Upon pot retrieval, black sea bass would be counted and measured for total length and weight and, for a retained subsample of fish; all other species would be identified to the lowest taxon possible and enumerated. Ropeless/on-demand gear will be utilized to eliminate the use of vertical buoy lines. This consists of an EdgeTech device connected to a retrieval cage containing buoys and a coiled line; the lid of the cage would be released upon remote acoustic signaling from a deck box on the vessel, which would allow the buoys to be released and rise to the surface for recovery.

Recreational Charter Fisheries Survey: The recreational survey will compare two well-fished artificial reef sites (control) to two turbine sites. The two reference artificial reef sites are the southern Site 1: the sunken freighter, the *USS Saetia* (1918), a 98 meter vessel of mostly <2 meter hull relief; and the northern Site 2: the "Great Eastern Reef," a deposition area of opportunistic materials (primarily concrete units and cable mounds) with <2 meter relief (Figure 3.2A). At least two years of pre-construction data would be collected. In each year, six monthly surveys (May through October) will use standard angling techniques to obtain catch rates at the two reference artificial reef sites and at two sites where WTG foundations will be constructed. For each month, one control and one turbine site would be visited per day across two days, with the order of site visits randomized within a day and all sites visited within a 2-day window to limit bias owing to sea conditions and time of day. Transits to the survey locations will occur aboard the *F/V Fin Chaser* or a similar vessel from its homeport in West Ocean City, Maryland. At each site, drift and jigging methods commonly used for black sea bass angling will be conducted. Following a 15-minute jigging trial, three anglers will complete fifteen 3-minute timed fishing "drops" from the vessel. The total number of surveys and deployments is summarized in Table 3.5.

Table 3.5. Anticipated recreational survey periods, months, and related deployments

Period	Years	Monthly Surveys	Total Surveys	Vessel Days/year	Total Vessel Days	Fishing Sites
Before	2023-2024	May-Oct	Up to 6	Up to 12	Up to 24	4
Construction	2025-2026	May-Oct	Up to 6	Up to 12	Up to 24	4
After	2027-2028	May-Oct	Up to 6	Up to 12	Up to 24	4
Total	2023-2028	May-Oct	Up to 18		Up to 72	4

Source: BA Appendix A

3.5.3 Marine Mammal Monitoring Program

Passive acoustic monitoring (PAM) surveys in the Maryland Lease Area and nearby waters are planned to determine the response of marine mammals to the construction and operation of offshore wind farms, with comparison to pre-construction data. During the first two years of the Marine Mammal Monitoring program, data from the US Wind metocean buoy will also be analyzed. At least two years of pre-construction data would be collected. A 10-hydrophone array will be deployed within the Maryland Lease Area, and at three locations outside of the Lease Area to sample inshore (west) and offshore (east) within the area of potential effects (APE). Data from the 10-hydrophone array will be collected every 6 months (April/October of each year) for 6 years spanning the construction and operational phases of the Project. PAM recorders will be deployed from the University of Delaware vessel *R/V Daiber*, the UMCES vessel the *R/V Rachel Carson* or from a fishing vessel in West Ocean City, MD (e.g., *F/V Seaborn* and *F/V Integrity*).Vessel trips are expected twice per year since recorders will be deployed and recovered every 6 months.

3.5.4 Near Real-Time Whale Buoy Monitoring Program
Near Real-Time Whale Buoys (RTWB) relay whale detection information to shore via Iridium satellite communications every 2 hours where it is displayed in near real-time on a publicly accessible website, mobile applications, and direct messaging to subscribers via email and text. An RTWB unit has been continuously deployed within the MarWin project area since May 2021. US Wind, in collaboration with the UMES Tailwinds program, will use the data collected by these buoys to analyze the presence and occurrence of whales, their response to vessels, and will compare the RTWB data to visual whale sightings.

In-water activities related to the near real-time whale buoy monitoring program will involve maintenance and deployment of an RTWB unit. During the first 3 months of the proposed 4-year work plan, an RTWB would be refurbished and prepared for deployment. The RTWB would be annually recovered and a replacement deployed each year for 3 years. Final recovery of the RTWB and wrap-up analysis would occur in Year 4. Vessel transits would occur annually for the near-real time whale buoy monitoring program, totaling four vessel days over the four-year monitoring program.

3.6 Vessel Use
As described in the BA, various types of vessels will be used during construction and installation, O&M, and decommissioning. The construction and decommissioning phases would involve the most vessel based activity over relatively short-term periods, whereas O&M-related vessel traffic would occur intermittently over the life of the project. The information presented in the BA is summarized here.

US Wind has identified various vessels that would be used to support construction and operations and maintenance of the Project. Each vessel would have operational Automatic Identification Systems (AIS), which would be used to monitor the number of vessels and traffic patterns for analysis and compliance with vessel speed requirements. Construction and installation vessels will operate over a three year period (currently anticipated 2024-2027). In the BA, BOEM identifies that vessels would use existing port facilities located in the following locations: Baltimore (Sparrows Point), Maryland; Ocean City, Maryland; Gulf of Mexico (e.g., Ingleside, Texas; Houma/Harvey, Louisiana); Brewer, Maine; and Europe (port not yet identified). In addition, US Wind acknowledges that alternate ports for the project vessels could include Hampton Roads area, Virginia; Port Norris, New Jersey; Lewes, Delaware; Cape Charles, Virginia; Port of New York/New Jersey; Charleston, South Carolina; Delaware River and Bay (e.g., Paulsboro, New Jersey; Hope Creek, New Jersey; and Wilmington, Delaware).. Table 3.6 summarizes the various vessels associated with project-related offshore construction and installation.

Table 3.6. Estimated Proposed Action vessel use parameters for primary ports during construction

						Number of Round Trips per Year		
Primary Ports[1]	**Vessel Class**	**Vessel Role**	**Approximate Length**	**Number of Vessels**	**Vessel speed (Maximum / Average)**	**Year 1**	**Year 2**	**Year 3**
Europe	Heavy lift vessel	Foundation installation	394–735 feet (120–223 meters)	1	12 kts / 2kts	2	2	2
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Support	210–295 feet (65–90 meters)	1	15 kts / 4 kts	2	4	2
Baltimore (Sparrows Point), Maryland	Fallpipe vessel	Scour protection	400–550 feet (120–170 meters)	1	12 kts / 2kts	2	4	4
Baltimore (Sparrows Point), Maryland	Tug	Foundation transport/feeder	75–115 feet (16–35 meters)	4	8 kts / 4 kts	13	32	22
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Support	210–295 feet (65–90 meters)	1	15 kts / 4 kts	2	4	3
Baltimore (Sparrows Point), Maryland	Jack-up vessel	WTG installation	400–740 feet (120–225 meters)	1	10 kts / 1kt	2	2	2
Baltimore (Sparrows Point), Maryland	Tug	WTG transport/feeder	75–115 feet (16–35 meters)	3	8 kts / 4 kts	25	62	43
Baltimore (Sparrows Point), Maryland	CTV	Support	30–100 feet (10–30 meters)	3	25 kts / 8 kts	198	512	346

						Number of Round Trips per Year		
Primary Ports[1]	**Vessel Class**	**Vessel Role**	**Approximate Length**	**Number of Vessels**	**Vessel speed (Maximum / Average)**	**Year 1**	**Year 2**	**Year 3**
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Support	210–295 feet (65–90 meters)	1	15 kts / 4 kts	9	18	9
Baltimore (Sparrows Point), Maryland	Tug	Transport/feeder	75–115 feet (16–35 meters)	3	8 kts / 4 kts	3	6	3
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Support	210–295 feet (65–90 meters)	2	15 kts / 4 kts	2	4	2
Baltimore (Sparrows Point), Maryland	Jack-up vessel	Support	400–740 feet (120–225 meters)	1	10 kts / 1kt	2	2	2
Baltimore (Sparrows Point), Maryland	Cable lay vessel	Inter-array cable installation	262–492 feet (80–150 meters)	1	10 kts / 3 kts	2	6	4
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Support	210–295 feet (65–90 meters)	1	15 kts / 4 kts	1	1	1
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Inter-array cable installation	210–295 feet (65–90 meters)	1	15 kts / 4 kts	2	2	2
Baltimore (Sparrows Point), Maryland	Heavy transport carrier	Offshore export cable transport/feeder	394–735 feet (120–223 meters)	1	12 kts / 10 kts	1	1	1
Baltimore (Sparrows Point), Maryland	Jack-up vessel	Support	400–740 feet (120–225 meters)	1	10 kts / <1kt	1	2	1

						Number of Round Trips per Year		
Primary Ports[1]	**Vessel Class**	**Vessel Role**	**Approximate Length**	**Number of Vessels**	**Vessel speed (Maximum / Average)**	**Year 1**	**Year 2**	**Year 3**
Baltimore (Sparrows Point), Maryland	Cable lay vessel	Offshore export cable installation	262–492 feet (80–150 meters)	1	10 kts / 3 kts	1	2	1
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Support	210–295 feet (65–90 meters)	1	15 kts / 4 kts	2	2	2
Baltimore (Sparrows Point), Maryland	Multipurpose OSV	Offshore export cable installation	210–295 feet (65–90 meters)	1	15 kts / 4 kts	1	2	1
Ocean City, Maryland	CTV	Support	30–100 feet (10–30 meters)	1	25 kts / 8 kts	10	28	19
Ocean City, Maryland	Commercial fishing vessel	Support	45–80 feet (15–25 meters)	1	15 kts / 2 kts	21	55	38
Ocean City, Maryland	Sportfisher	Support	45–80 feet (15–25 meters)	1	25 kts / 2 kts	21	55	38
Ocean City, Maryland	CTV	Support	30–100 feet (10–30 meters)	2	25 kts / 8 kts	120	280	200
Ocean City, Maryland	Commercial fishing vessel	Support	45–80 feet (15–25 meters)	1	15 kts / 2 kts	0	6	4
Ocean City, Maryland	Dive support vessel	Support	N/A	1	15 kts / 1 kt	1	2	1

						Number of Round Trips per Year		
Primary Ports[1]	**Vessel Class**	**Vessel Role**	**Approximate Length**	**Number of Vessels**	**Vessel speed (Maximum / Average)**	**Year 1**	**Year 2**	**Year 3**
Ocean City, Maryland	Rigid inflatable boat	Support	N/A	1	20 kts / 2 kts	14	28	14
Brewer, Maine	Heavy lift vessel	OSS topside installation	394–735 feet (120–223 meters)	1	12 kts / 2 kts	1	2	1
Gulf of Mexico (e.g., Ingleside, Texas; Houma/Harvey, Louisiana)	Heavy lift vessel	Met Tower installation	394–735 feet (120–223 meters)	1	12 kts / 2kts	0	1	0

Source: COP, Volume II, Section 1.3 (US Wind 2023); Appendix A, TRC 2023
CTV = crew transfer vessel; N/A = not available; OSV = offshore support vessel
[1] US Wind anticipates WTG, foundation, and cable components will be shipped from European and other U.S. East Coast ports, including ports in the Gulf of Mexico, to a staging area in Baltimore (Sparrows Point), Maryland. The exact ports to be used will not be known until final contracts are in place.

US Wind expects to use a variety of vessels to support O&M, including crew transfer vessels (CTVs), jack-up vessels, sportfishers, and multipurpose offshore support vessels (Table 3.7). As described in BOEM's BA, one CTV departing from Lewes, Delaware would make approximately 58 roundtrips to the WFA each year to support routine maintenance. Four CTVs departing from West Ocean City, Maryland would make approximately 760 trips annually to the WFA to support routine maintenance. A sportfishing vessel departing from West Ocean City would also make approximately four annual round trips to the WFA to support routine maintenance. US Wind anticipates major maintenance activities requiring deep draft or jack-up vessels would operate from the Baltimore (Sparrows Point), Maryland and Hampton Roads area, Virginia. Non-routine maintenance activities requiring deep draft or jack-up vessels are expected to make less than one round trip annually.

Table 3.7. Estimated Proposed Action vessel use parameters during O&M Phase

Primary Port	Vessel Class	Vessel Role[1]	Approx. Length	Number of Vessels	Vessel Speed (Maximum / Average)	Number of Annual Round Trips
Lewes, Delaware	CTV	Support – routine maintenance	30–100 feet (10–30 meters)	1	25 kts / 8 kts	58
Ocean City, Maryland	CTV	Support – routine maintenance	30–100 feet (10–30 meters)	4	25 kts / 8 kts	760
Ocean City, Maryland	Sportfishing	Support – routine maintenance	45–80 feet (15–25 meters)	1	25 kts / 2 kts	4
Baltimore (Sparrows Point), Maryland; Hope Creek, New Jersey; Port of New York/ New Jersey	Multipurpose OSV	Support – non-routine maintenance	210–295 feet (65–90 meters)	1	15 kts / 4 kts	<1
Baltimore (Sparrows Point), Maryland; Hope Creek, New Jersey; Port of New York/New Jersey	Jack-up vessel	Support – non-routine maintenance	400–740 feet (120–225 meters)	1	10 kts / <1kt	<1

Source: US Wind 2023
CTV = crew transfer vehicle; OSV = offshore support vessel

Vessel classes and numbers for decommissioning are expected to be similar to the construction and installation phase. Therefore, the total estimated number of vessel round-trips to the Lease Area during decommissioning is 2,355 trips. In the BA, BOEM has indicated that it is difficult to predict the amount of vessel traffic and the ports to be used to support decommissioning but that they are expected to be substantially similar to vessel traffic during construction.

3.7 Minimization and Monitoring Measures that are part of the Proposed Action
There are a number of measures that US Wind, through its COP, is proposing to take and/or BOEM and/or USACE is proposing to require as conditions of COP approval or other project permits or authorizations that are designed to avoid, minimize, or monitor effects of the action on ESA listed species. For the purpose of this consultation, the avoidance, minimization, and monitoring measures proposed by BOEM and/or USACE and identified in the BA as part of the action that BOEM is requesting consultation on. They are considered as part of the proposed action evaluated in this Opinion. Additionally, NMFS OPR includes a number of measures to avoid, minimize, or monitor effects in the proposed MMPA ITA (see below and Appendix B); these measures are also considered as part of the proposed action for this consultation and are evaluated in this Opinion. The proposed ITA only proposes mitigation and monitoring measures for marine mammals including the threatened and endangered whales considered in this Opinion. Although some measures for marine mammals also apply to and provide minimization of potential impacts to listed sea turtle and fish species (e.g., pile driving soft start minimize potential effects to all listed species), they do not completely cover all threatened and endangered species avoidance, minimization, mitigation, monitoring, and reporting needs. The measures proposed by US Wind and/or BOEM are considered part of the proposed action, and thus mandatory for implementation through enforceable conditions in applicable approvals, authorizations and permits, are described in Table 3-20 in BOEM's BA. For ease of reference, these are copied into Appendix A of this Opinion. These are in addition to the conditions of the proposed ITA, which are also part of the proposed action (see Appendix B). We note that the final MMPA ITA may contain measures that include requirements that may differ from the proposed rule; as explained in this Opinion's ITS, compliance with the conditions of the final MMPA ITA is necessary for the ESA take exemption to be effective for the otherwise unlawful take of ESA-listed marine mammals. BOEM and NMFS OPR are proposing to require monitoring of clearance and shutdown zones before and during pile driving. More information is provided in the *Effects of the Action* section of this Opinion. These zones are summarized in table 3.8. In addition to the clearance and shutdown zones, the MMPA ITA identifies a minimum visibility zone for foundation pile driving. Before pile driving activity may commence, this is the distance from the pile that the visual observers must be able to effectively monitor for marine mammals; that is, lighting, weather (e.g., rain, fog, etc.), and sea state must be sufficient for the observer to be able to detect a marine mammal within that distance from the pile.

The clearance zone is the area around the pile that must be declared "clear" of marine mammals and sea turtles prior to the activity commencing. The size of the zone is measured as the radius with the impact activity (e.g., pile) at the center. For sea turtles, the area is "cleared" by visual observers determining that there have been no sightings of sea turtles in the identified area for a prescribed amount of time. For marine mammals, both visual observers and passive acoustic monitoring (PAM, which detects the sound of vocalizing marine mammals) will be used; the area is determined to be "cleared" when visual observers have determined there have been no sightings of marine mammals in the identified area for a prescribed amount of time and, for North Atlantic right whales in particular, if no right whales have been visually observed in any area beyond the minimum clearance zone that the visual observers can see. Further, the PAM operator will declare an area "clear" if they do not detect the sound of vocalizing whales within the identified PAM clearance zone for the identified amount of time. Pile driving cannot commence until all of the required clearances (i.e., visual and PAM) are made. Once pile driving begins, the shutdown zone applies. If a marine mammal, including ESA-listed species, or sea turtle is observed by a visual PSO entering or within the respective shutdown zones after pile driving has commenced, an immediate shutdown of pile driving will be implemented unless US Wind and/or its contractor determines shutdown is not feasible due to an imminent risk of injury or loss of life to an individual; or risk of damage to a vessel that creates risk of injury or loss of life for individuals. For right whales, shutdown is also triggered by: the visual PSO observing a right whale at any distance (i.e., even if it is outside the shutdown zone identified for other whale species), and a detection by the PAM operator of a vocalizing right whale at a distance determined to be within the identified PAM shutdown zone. If shutdown is called for but US Wind and/or its contractor determines shutdown is not feasible due to imminent risk of injury or loss of life, reduced hammer energy must be implemented when the lead engineer determines it is practicable. As described by BOEM and US Wind there are two scenarios, approaching pile refusal and pile instability, where this imminent risk could be a factor; however, US Wind describes a low likelihood of occurrence for the pile refusal/stuck pile or pile instability scenario as explained below. US Wind notes that other unpredictable scenarios may occur that would present an imminent risk of injury or loss of life such that shutdown would not be feasible; any such incidences are expected to be rare.

Stuck Pile
If the pile driving sensors indicate the pile has reached more than half of its target penetration, and a shut-down could lead to a stuck pile, shut down may be determined to be infeasible if the stuck pile is determined to pose an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals. US Wind also notes that the risk comes from the pile settling prior to reaching target depth which may damage it beyond repair or present concerns regarding stability. The pile could then fall and damage the vessel and/or personnel on board the vessel. The lessee describes their mitigation of this risk as follows, each pile is specifically engineered to manage the sediment conditions at the location at which it is to be driven, and therefore designed to avoid and minimize the potential for piling refusal. They will use pre-installation engineering assessments with real-time hammer log information during installation to track progress and continuously judge whether a stoppage would cause a risk of injury or loss of life. Due to this advanced engineering and on-site construction, BOEM and the lessee expect that circumstances under which piling could not stop if a shutdown is requested are very limited.

Pile Instability
A pile may be deemed unstable and unable to stay standing if the piling vessel were to "let go." During these periods of instability, the lead engineer may determine a shut-down is not feasible because the shutdown combined with impending weather conditions may require the piling vessel to "let go" which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals from a falling pile. As described by BOEM, weather conditions criteria will be established that determine when a piling vessel would have to "let go" of a pile being installed for safety reasons. To reduce the risk that a requested shutdown would not be possible due to weather, project personnel will actively assess weather, using two independent forecasting systems. Initiation of piling also requires a Certificate of Approval by the Marine Warranty Supervisor. In addition to ensuring that current weather conditions are suitable for piling, this Certificate of Approval process considers forecasted

weather for 6 hours out and will evaluate if conditions would limit the ability to shut down and "let go" of the pile. If a shutdown is not feasible due to pile instability and weather, piling would continue only until a penetration depth sufficient to secure the pile is achieved. As piling instability is most likely to occur due to letting go of the pile during the soft start period, and soft start cannot commence till the Marine Warranty Supervisor has issued a Certificate of Approval that signals there is a current weather window of at least 6 hours, the likelihood is low for the pile to not achieve stability within the 6-hour window inclusive of stops and starts.

Table 3.8. Proposed clearance and exclusion zones.
These are the PAM detection, minimal visibility, clearance and shutdown zones incorporated into the proposed action; the zones for marine mammals reflect the proposed conditions of the MMPA ITA, and the zones for sea turtles reflect the zone sizes proposed by BOEM (as updated by BOEM during the consultation period). Pile driving will not proceed unless the visual PSOs can effectively monitor the full extent of the minimum visibility and clearance zones. Detection of an animal within the clearance zone triggers a delay of initiation of pile driving; detection of an animal in the shutdown zone triggers the identified shutdown requirements.

Species	Clearance Zone (m)	Shutdown Zone (m)
Impact Pile Driving		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessel): Monopiles - 2,900 m; 3-m pin piles - 1,400 m; 1.8-m pin piles - 200 m PAM monitoring out to 10,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (2,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM	At any distance (Minimum visibility zone (2,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM
Other large whales (visual and PAM monitoring)	Monopiles - 5,250 m 3-m pin piles - 1,400 m 1.8-m pin piles - 200 m (visual or PAM detection)	Monopiles - 2,900 m 3-m pin piles - 1,400 m 1.8-m pin piles - 100 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)
HRG Surveys – visual PSOs		
North Atlantic right whales	500 m	500 m
Other Large Whales	500 m	100 m
Sea Turtles	100 m	100 m

3.8 MMPA Incidental Take Authorization (ITA) Proposed for Issuance by NMFS

In response to their application, the NMFS Office of Protected Resources (OPR) has proposed to issue US Wind an ITA for the take of small numbers of marine mammals incidental to construction of the project with a proposed duration of five years, it is anticipated that the proposed regulation would be effective from January 1, 2025 to December 31, 2029. More information on the proposed Incidental Take Regulation (ITR) and associated Letter(s) of Authorization (LOA), including US Wind's application is available online (*https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-wind-inc-construction-and-operation-maryland-offshore-wind*). As described in the Notice of Proposed Rule (89 FR 504; January 4, 2024), take of marine mammals may occur incidental to the construction of the project due to in-water noise exposure resulting from Project activities likely to result in incidental take include pile driving (impact) and vessel-based site assessment surveys using high-resolution geophysical (HRG) equipment.

3.8.1 Amount of Take Proposed for Authorization

The proposed ITA would be effective for a period of five years, and, if issued as proposed, would authorize Level A and Level B harassment as the only type of take of ESA listed marine mammal species expected to result from activities during the construction phase of the project, with Level A take limited to only fin and sei whales. Section 3(18) of the Marine Mammal Protection Act defines ''harassment'' as any act of pursuit, torment, or annoyance, which (i) has the potential to injure a marine mammal or marine mammal stock in the wild (Level A harassment); or (ii) has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B harassment). It is important to note that the MMPA definition of harassment is not the same as the ESA definition. This issue is discussed in further detail in the *Effects of the Action* section of this Opinion.

Take Proposed for Authorization under the MMPA

The methodology for estimating marine mammal exposure and incidental take is described fully in the Notice of Proposed ITA and discussed further in the *Effects of the Action*. For the purposes of the proposed ITA, NMFS OPR estimated the amount of take by considering: (1) acoustic thresholds above which NMFS OPR determined the best available scientific information indicates marine mammals will be behaviorally harassed (Level B) or incur some degree of permanent hearing impairment (Level A); (2) the area or volume of water that will be ensonified above these levels in a day; (3) the density or occurrence of marine mammals within these ensonified areas; and, (4) the number of days of activities. NMFS OPR is proposing to authorize MMPA take of ESA listed marine mammals resulting from noise exposure from impact pile driving for foundation installation and HRG surveys.

Installation of Foundation Piles with Impact Hammer

As described in the Notice of Proposed ITA, modeling has been completed to estimate the sound fields associated with a number of noise producing activities and to estimate the number of individuals likely to be exposed to noise above identified thresholds. Table 3.9 contains the amount of Level A and Level B take proposed to be authorized resulting from impact pile driving assuming 10 dB attenuation (as required by conditions of the proposed ITA).

Table 3.9. MMPA Take of ESA Listed Species by Level A and B Harassment Proposed for Authorization through the MMPA ITA Resulting from Impact Pile Driving (Over 3 Years)

Species	Level A Harassment	Level B Harassment
North Atlantic right whale	0	6
Fin whale	6	31
Sei whale	3	3

Source: Information in 89 FR 504 (table 20)

HRG Surveys
The Notice of Proposed ITA includes a description of the modeling used to predict the amount of incidental take proposed for authorization under the MMPA. The amount of Level B harassment take proposed for authorization by NMFS OPR is illustrated in Table 3.10.

Table 3.10. MMPA Take of ESA Listed Species by Level B Harassment Proposed for Authorization through the MMPA ITA Resulting from High-Resolution Geophysical Surveys (Over 2 Years)

Species	Level B Harassment
North Atlantic right whale	4
Fin whale	4
Sei whale	0

Source: Information in 89 FR 504 (table 22)

3.8.2 Mitigation Measures Included in the Proposed ITA

The proposed ITA includes a number of minimization and monitoring methods that are designed to ensure that the proposed project has the least practicable adverse impact upon the affected species or stocks and their habitat and would be required to be implemented by US Wind. The proposed ITA, inclusive of the proposed mitigation requirements, has been published in the FR (89 FR 504). The proposed mitigation measures include seasonal restrictions on timing for pile driving, establishment of minimum visibility and clearance zones for pile driving and some HRG surveys, shutdown measures, soft start of pile driving, ramp up of HRG sources, noise mitigation for impact pile driving, and vessel strike avoidance measures. For the purposes of this section 7 consultation, as noted, all minimization and monitoring measures included in the ITA proposed by NMFS OPR are considered as part of the proposed action for this consultation. We note that some of the measures identified here overlap or are duplicative with the measures described by BOEM in the BA as part of the proposed action (Appendix A as referenced above). The mitigation measures included in the January 2024 Proposed ITA are listed in Appendix B.

3.9 Action Area

The action area is defined in 50 CFR 402.02 as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action.” Effects of the action are defined in 50 CFR 402.02 as“ all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action.”

The action area includes the WDA where construction, operations and maintenance, and decommissioning activities will occur and the surrounding areas ensonified by noise from project activities; the cable corridors; and the areas where HRG and biological resource surveys will take place. Additionally, the action area includes the U.S. EEZ along the Atlantic and Gulf coasts between Ingleside, Texas and Brewer, Maine; this includes the vessel transit routes between the WDA and ports in Texas, Louisiana, South Carolina, Delaware, New York, New Jersey, Maryland, and Virginia. As explained below, it does not include the portion of the vessel transit routes between the WDA and ports in Europe outside the U.S. EEZ as we have determined that the effects of vessel transit from those ports are not effects of the proposed action as defined in 50 CFR 402.17.

In the BA (table 3-11), BOEM identifies the potential for up to six round trip vessel transits associated with the proposed project to originate from unidentified ports in Europe. These trips will occur in all three years of construction. The ports that these vessels will originate from and the vessel routes from those port facilities to the project site are unknown and will be variable and depend, on a trip-by-trip basis, on weather and sea-state conditions, other vessel traffic, and any maritime hazards. These vessels are expected to enter the U.S. EEZ along the Atlantic Coast and then travel along established traffic lanes and fairways until they approach the lease area. Because the ports of origin and vessel transit routes are unknown, we are not able to identify what areas outside the U.S. EEZ will be affected directly or indirectly by the Federal action; that is, while we recognize that there will be vessel trips outside of the US EEZ that would not occur but for the approval of US Wind's COP, we cannot identify what areas vessel transits will occur as a result of BOEM's proposed approval of US Wind's COP. Though these vessel transits may be caused by the proposed action, without specific information including vessel types and size, the ports of origin, and, the location, timing and routes of vessel transit, we cannot predict that specific consequences of these activities on listed species[8] are reasonably certain to occur, and they are therefore not considered effects of the proposed action. 50 CFR 402.17(a)-(b). Therefore, the action area is limited to the US EEZ off the Atlantic and Gulf coasts of the United States between Ingleside, Texas and Brewer, Maine.

4.0 SPECIES AND CRITICAL HABITAT NOT CONSIDERED FURTHER IN THIS OPINION

In the BA, BOEM concludes that the proposed action may affect but is not likely to adversely affect the blue whale, Cape Verde/Northwest Africa DPS of humpback whales, Rice's whale, hawksbill sea turtles, the Gulf of Maine DPS of Atlantic salmon, Gulf sturgeon, Nassau grouper, smalltooth sawfish, scalloped hammerhead sharks (Central and Southwest Atlantic DPSs), and oceanic whitetip sharks and critical habitat designated for North Atlantic right whale, North Atlantic Ocean DPS of loggerhead sea turtles, or any of the five DPSs of Atlantic sturgeon. BOEM concludes that the proposed action will have no effect on any species of ESA listed

[8] In an abundance of caution, we have considered the risk that these vessel trips may pose to ESA listed species that may occur outside the US EEZ. We have determined that these species fall into two categories: (1) species that are not known to be vulnerable to vessel strike and therefore, we would not expect a project vessel to strike an individual regardless of the location of the vessel; or (2) species that may generally be vulnerable to vessel strike but outside the US EEZ, co-occurrence of project vessels and individuals of those ESA listed species are expected to be extremely unlikely due to the seasonal distribution and dispersed nature of individuals in the open ocean, and intermittent presence of project vessels. These factors make it extremely unlikely that there would be any effects to ESA listed species from the operation of project vessels outside the EEZ.

corals or critical habitat designated for Gulf sturgeon or smalltooth sawfish. The Cape Verde/Northwest Africa DPS of humpback whales does not occur in the action area; therefore, the proposed action will have no effect on this DPS. There are no ESA listed DPSs of humpback whales that occur in the action area. Similarly, the Eastern Atlantic DPS of scalloped hammerhead sharks does not occur in the area and there are no ESA listed hammerhead sharks in the action area; therefore, the proposed action will have no effect on any ESA listed hammerhead sharks. As explained below, we have determined that the project will have no effect on the Gulf of Maine DPS of Atlantic salmon, critical habitat designated for the Gulf of Maine DPS of Atlantic salmon, critical habitat designated for the Gulf of Maine DPS and Carolina DPS of Atlantic sturgeon, or critical habitat designated for the North Atlantic right whale. We concur with BOEM's determination that the proposed action is not likely to adversely affect hawksbill sea turtles or oceanic whitetip sharks; we conclude consultation informally for these species and critical habitat designations. Effects to critical habitat designated for the New York Bight DPS of Atlantic sturgeon are addressed in section 6 and 7 of this Opinion.

4.1 ESA Listed Species

Blue whales (Balaenoptera musculus) – Endangered

In the North Atlantic Ocean, the range of blue whales extends from the subtropics to the Greenland Sea. As described in Hayes et al. (2020; the most recent stock assessment report), blue whales have been detected and tracked acoustically in much of the North Atlantic with most of the acoustic detections around the Grand Banks area of Newfoundland and west of the British Isles. Photo-identification in eastern Canadian waters indicates that blue whales from the St. Lawrence, Newfoundland, Nova Scotia, New England, and Greenland all belong to the same stock, while blue whales photographed off Iceland and the Azores appear to be part of a separate population (CETAP 1982; Wenzel et al. 1988; Sears and Calambokidis 2002; Sears and Larsen 2002). The largest concentrations of blue whales are found in the lower St. Lawrence Estuary (LeSage et al. 2017, Comtois et al. 2010) which is outside of the action area. Blue whales do not regularly occur within the U.S. EEZ and typically occur further offshore in areas with depths of 100 m or more (Waring et al. 2010).

Migration patterns for blue whales in the eastern North Atlantic Ocean are poorly understood. However, blue whales have been documented in winter months off Mauritania in northwest Africa (Baines & Reichelt 2014); in the Azores, where their arrival is linked to secondary production generated by the North Atlantic spring phytoplankton bloom (Visser et al. 2011); and traveling through deep-water areas near the shelf break west of the British Isles (Charif & Clark 2009). Blue whale calls have been detected in winter on hydrophones along the mid-Atlantic ridge south of the Azores (Nieukirk et al. 2004).

Blue whales have not been documented in the WDA[9] and are not expected to occur in the WDA and are not expected to occur along any of the vessel transit routes described in BOEM's BA. A single blue whale was acoustically tracked by Muirhead et al. (2018) in the New York Bight, and shown to be on the edge of the continental shelf, well offshore and north of the WDA. During aerial line-transect surveys in the New York Bight from 2017 to 2020, Zoidis et al. (2021) observed blue whales 3 times: 2 groups totaling 4 individuals sighted in the plain zone in winter

[9] Available sightings data at: http://seamap.env.duke.edu/species/180528. Last accessed March 1, 2024.

(in January and February) of Year 1, and a single individual in the fall (September) seen on the slope in Year 3. Estabrook et al (2021) reported results from three years of acoustic surveys of large whales in the New York Bight; blue whales were rarely detected and only on the furthest offshore acoustic receivers. The authors concluded that at least some of the detections were likely from whales located outside the New York Bight beyond the shelf edge. These results were consistent with a similar 2008-2009 survey (Muirhead et al. 2018, Davis et al. 2020). The small number of days with detections suggests blue whales do not spend much time in the offshore waters of the NY Bight, and instead are likely migrating through the area (Estabrook et al. 2021). All of these detections were north and offshore of the Maryland Wind lease area and outside of the action area.

The rarity of observations in this area is consistent with the conclusion in Waring et al. (2010) that the blue whale is best considered as an occasional visitor in U.S. Atlantic EEZ waters and would be rare in the vicinity of the WDA. Therefore, based on the best available information cited herein, which supports a conclusion that blue whales are extremely unlikely to occur in the action area, we conclude that blue whales are extremely unlikely to be exposed to any effects of project activities in the action area; therefore, effects of those activities, including construction, operations, and decommissioning, inclusive of associated vessel activities and surveys, are discountable. No take is anticipated.

Rice's whale (Balaenoptera ricei) – Endangered

On August 23, 2021, NMFS issued a direct final rule to revise the common and scientific name of the Gulf of Mexico Bryde's whale to Rice's whale, *Balaneoptera ricei*, and classification to species to reflect the scientifically accepted taxonomy and nomenclature of the whales (86 FR 47022). The distribution of Rice's whale is limited to the northeastern Gulf of Mexico, along the continental shelf break between 100 m and 400 m depths (Rosel et al. 2016). The only project-related activity that has the potential to overlap with the species distribution are vessel transits between the WDA and ports in the Gulf of Mexico (i.e., Ingleside, Texas, Houma/Harvey, Louisiana). We have considered whether vessels transiting to and from the project area from ports in the Gulf of Mexico could potentially encounter Rice's whales. BOEM anticipates one round trip will be conducted from the Gulf of Mexico to the WDA during year two of Project construction. As noted in the BA, project vessels will adhere to any current or future vessel strike avoidance guidelines for large whale conservation. The proposed action includes a number of measures for any project vessels operating in the Gulf of Mexico (see Table 3-20 in BOEM's BA and Appendix A of this Opinion). Based on the vessel transit routes, which are anticipated to be south and west of the distribution of Rice's whales, it is extremely unlikely that any Rice's whales will co-occur with project vessels; implementation of the vessel strike avoidance measures that are part of the proposed action further reduce the potential for any effects to Rice's whales. As such, any effects to Rice's whales are extremely unlikely to occur. No take is anticipated. As all effects will be discountable, the proposed action is not likely to adversely affect the Rice's whale.

Hawksbill sea turtle (Eretmochelys imbricate) – Endangered

The hawksbill sea turtle is typically found in tropical and subtropical regions of the Atlantic, Pacific, and Indian Oceans, including the coral reef habitats of the Caribbean and Central

America. Hawksbill turtles generally do not migrate north of Florida and their presence north of Florida is rare (NMFS and USFWS 1993).

Given their rarity in waters north of Florida; the presence of hawksbill sea turtles in the action area is limited to the portion of the action area in the Gulf of Mexico and off the Florida coast that may be transited by project vessels. As noted in section 3.0, project activities in this area are expected to be limited to one vessel roundtrip for the vessel traveling between a port in the Gulf of Mexico and the project site over the three-year construction schedule. While sea turtles, including hawksbills, are vulnerable to vessel strike, given the low numbers and dispersed nature of hawksbills in the areas where vessels will transit, the small number of vessel trips (one round trip), it is extremely unlikely that any hawksbill sea turtles will co-occur with this project vessel. As such, vessel strike of hawksbill sea turtles are extremely unlikely to occur. As all effects of the proposed action will be discountable, the proposed action is not likely to adversely affect the hawksbill sea turtle. No take is anticipated from any project activity.

Gulf Sturgeon (Acipenser oxyrinchus desotoi) – Threatened
The Gulf sturgeon is a sub-species of the Atlantic sturgeon that can be found from Lake Pontchartrain and the Pearl River system in Louisiana and Mississippi to the Suwannee River in Florida (USFWS and NMFS 2009). Historically the species ranged from the Mississippi River east to Tampa Bay. Gulf sturgeon spawn in rivers in the spring and fall and spend the summer months between the upstream spawning areas and the estuary. In the winter, adults will move into marine waters but younger fish remain in the estuarine and freshwater habitats for their first few years.

The only portion of the action area that could potentially overlap with the range of Gulf sturgeon is the single vessel transit in the Gulf of Mexico. The single vessels trip to/from the Gulf of Mexico (i.e., one roundtrip transit over year two of construction) is anticipated to occur between the Maryland Wind WDA and a ports in the Gulf of Mexico (i.e., Ingleside, Texas, Houma/Harvey, Louisiana). The distribution of Gulf sturgeon within the Gulf of Mexico is limited to the northeastern areas of the Gulf. Vessels transiting between the WDA and ports in the Gulf of Mexico (i.e., Ingleside, Texas, Houma/Harvey, Louisiana) are not expected to transit the portion of the Gulf of Mexico where Gulf sturgeon occur. As such, we do not expect any effects on Gulf sturgeon caused by project vessels. The proposed action will have no effect on Gulf sturgeon.

Oceanic White Tip Shark (Carcharhinus longimanus) – Threatened
The oceanic whitetip shark 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 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 (Young et al. 2017). In the central and eastern Atlantic, the species occurs from Madeira, Portugal south to the Gulf of Guinea, and possibly in the Mediterranean Sea.

The lease area and cable corridors, as well as the area where noise from project construction, operation, and decommissioning, and where survey activities will occur is outside of the deep offshore areas where Oceanic whitetip sharks occur. Vessel strikes are not identified as a threat in the status review (Young et al., 2017), listing determination (83 FR 4153) or the recovery outline (NMFS 2018). We have no information to suggest that vessels in the ocean have any effects on oceanic white tip sharks. Considering the lack of any reported vessel strikes, their swim speed and maneuverability (Papastamatiou et al. 2017), and the slow speed of ocean-going vessels, vessel strikes are extremely unlikely even if migrating individuals occur along the vessel transit routes. No take is anticipated. As all effects of the proposed action will be discountable, the proposed action is not likely to adversely affect the oceanic white tip shark.

Gulf of Maine DPS of Atlantic salmon (Salmo salar) – Endangered
The only remaining populations of Gulf of Maine DPS Atlantic salmon are in Maine. Smolts migrate from their natal rivers in Maine north to foraging grounds in the Western North Atlantic off Canada and Greenland (Fay et al. 2006). After one or more winters at sea, adults return to their natal river to spawn. The only portion of the action area that overlaps with the range of Atlantic salmon are the vessel transit routes to and from the Cianbro Modular Manufacturing Facility (Brewer, Maine) located in the Penobscot River. As noted in section 3 of this Opinion, up to four roundtrips throughout the three-year construction phase are anticipated to occur between the Maryland WDA and Brewer, ME. However, even if migrating salmon occurred along the routes of vessels transiting between the Maryland WDA and Brewer, Maine, we do not anticipate any effects to Atlantic salmon. There is no evidence of interactions between vessels and Atlantic salmon. Vessel strikes are not identified as a threat in the listing determination (74 FR 29344) or the recent recovery plan (NMFS and USFWS 2019). We have no information to suggest that vessels in the ocean have any effects on migrating Atlantic salmon and we do not expect there would be any due to Atlantic salmon migrating at depths below the draft of project vessels. Therefore, we do not expect any effects to Atlantic salmon even if migrating individuals co-occur with project vessels moving between the project site and Brewer, Maine. The proposed action will have no effect on the Gulf of Maine DPS of Atlantic salmon.

Nassau Grouper (Epinephelus striatus) – Threatened
Nassau grouper are reef fish found in tropical and subtropical waters of the western North Atlantic. This includes Bermuda, Florida, Bahamas, the Yucatan Peninsula, and throughout the Caribbean to southern Brazil. There has been one verified report of Nassau grouper in the Gulf of Mexico at Flower Gardens Bank. They generally live among shallow reefs, but can be found in depths to 426 ft. (NMFS 2013). The range of Nassau grouper is described as including the southeastern portion of the Gulf of Mexico between the Florida coast and the Yucatan Peninsula (NMFS 2013). As described in NMFS 2013, the Nassau grouper is considered a reef fish, but it transitions through a series of ontogenetic shifts of 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 progressively deeper with increasing size and maturation into predominantly reef habitat (e.g., 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 (Sadovy and Eklund 1999 in NMFS 2013), although they can be found from the shoreline to about 100-130 m. Larger adults tend to occupy deeper, more rugose, reef areas (Semmens et al. 2007a in NMFS 2013).

Overlap with the range of Nassau grouper and the action area is limited to the portion of the action area where a single vessels transiting between the WDA and ports in the Gulf of Mexico (i.e., Ingleside, Texas, Houma/Harvey, Louisiana) would move through the southeastern portion of the Gulf of Mexico into the Atlantic Ocean. Given the primary distribution of Nassau grouper over reef habitats, which will be avoided by the transiting vessels, there is a low potential for occurrence of Nassau grouper in the areas where vessels will transit. Further, the near-bottom distribution of Nassau grouper in the water column makes it extremely unlikely that there would be any interactions with any project vessels. Vessel strikes are not identified as a threat in the biological report that supported the listing determination (NMFS 2013), listing determination (81 FR 42268), or the recovery outline (NMFS 2018). We have no information to suggest that vessels in the ocean have any effects on Nassau grouper. Therefore, we do not expect any effects to this species even if individuals co-occur with project vessels. The proposed action will have no effect on Nassau grouper.

Scalloped Hammerhead Shark (Sphyrna lewini) – Southwest Atlantic DPS, Threatened
Miller et al. (2014) describe the scalloped hammerhead shark as a circumglobal species that lives in coastal warm temperate and tropical seas. It occurs over continental and insular shelves, as well as adjacent deep waters. Scalloped hammerhead sharks are highly mobile and partly migratory, making migrations along continental margins as well as between oceanic islands in tropical waters. While scalloped hammerheads occur in the Northwest Atlantic and Gulf of Mexico, those individuals are part of DPSs that are not listed under the ESA (79 FR 38214, July 3, 2014). The Southwest Atlantic DPS of scalloped hammerheads is listed as threatened under the ESA; however, the action area does not overlap with the range of the Southwest Atlantic DPS (see Figure 1 in 79 FR 38214). As such, no ESA listed scalloped hammerhead sharks are expected to be exposed to any effects of the proposed action. The proposed action will have no effect on the Southwest Atlantic DPS of scalloped hammerhead shark.

Smalltooth Sawfish (Pristis pectinate) – Endangered
Smalltooth sawfish live in shallow, coastal waters of tropical seas and estuaries of the Atlantic Ocean and sometimes enter the lower reaches of tropical freshwater river systems. The historical range for smalltooth sawfish in the western Atlantic extended from Brazil to the Gulf of Mexico and eastern seaboard of the U.S. (Carlson et al. 2013 in NMFS 2018). However, the species has been wholly or nearly extirpated from large areas of its historical range, and in U.S. waters smalltooth sawfish are now found only off the coast of Florida (NMFS 2018). Small, juvenile smalltooth sawfish are generally restricted to mangroves and estuaries around the Florida peninsula, where project vessels will not travel. Larger adults have a broader distribution and could be found in the southeastern Gulf of Mexico in nearshore waters along the Florida shoreline. Given the distribution of the species in nearshore waters, the occurrence of smalltooth sawfish along the deepwater areas that will be used by project vessels to transit between the WDA and ports in the Gulf of Mexico (i.e., Ingleside, Texas, Houma/Harvey, Louisiana) is extremely unlikely. Vessel strikes are not identified as a threat in the listing determination (68 FR 15674), the most-recent 5-year review (NMFS 2018), or the recovery plan (NMFS 2009). We have no information to suggest that vessels in the ocean have any effects on smalltooth sawfish. Therefore, we do not expect any effects to this species even if individuals unexpectedly occurred along the vessel transit routes to be traveled by project vessels. The proposed action will have no effect on smalltooth sawfish.

ESA Listed Corals – Threatened and Endangered
There are six species of corals protected under the ESA that occur in the action area: Elkhorn coral (*Acropora palmata*); Staghorn coral (*Acropora cervicornis*); Boulder star coral (*Orbicella franksi*); Mountainous star coral (*Orbicella faveolata*); Lobed star coral (*Orbicella annularis*); Rough cactus coral (*Mycetophyllia ferox*); and Pillar coral (*Dendrogyra cylindrus*) (79 FR 53851). The only activity that overlaps with the distribution of these species is the one anticipated round trip vessel transit between a port in the Gulf of Mexico and the WDA, including transit along the U.S. South Atlantic coast. Transit routes for project vessels may co-occur with coral habitats, however, no impacts to corals are anticipated along vessel transit routes as water depths exclude the potential for vessel hulls and propellers to interact with the sessile species, and no anchoring will occur in areas where corals could be present. No effects to any of these coral species are anticipated; the proposed action will have no effect on any species of ESA listed corals.

4.2 Critical Habitat

Critical Habitat Designated for North Atlantic right whales
On January 27, 2016, NMFS issued a final rule designating critical habitat for North Atlantic right whales (81 FR 4837). Critical habitat includes two areas (Units) located in the Gulf of Maine and Georges Bank Region (Unit 1) and off the coast of North Carolina, South Carolina, Georgia and Florida (Unit 2). Project vessels transiting to/from the Cianbro Modular Manufacturing Facility (Brewer, ME*)* may transit through Unit 1. Project vessels transiting to/from the Port of Charleston and ports in the Gulf of Mexico may transit through Unit 2. No other effects of the project will extend to Units 1 and 2. As explained below, we have determined that the proposed project will have no effect on critical habitat designated for North Atlantic right whales.

Consideration of Potential Effects to Unit 1
As identified in the final rule (81 FR 4837), the physical and biological features essential to the conservation of the North Atlantic right whale that provide foraging area functions in Unit 1 are: 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; 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; late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region. Outside of potential vessel transits, there are no project activities that overlap with Unit 1. Vessel transits that may occur within Unit 1 will have no effect on any of the physical or biological features of critical habitat. Here, we explain our consideration of whether any project activities located outside of Unit 1 may affect Unit 1.

We have considered whether the proposed action would have any effects to right whale critical habitat. Copepods in critical habitat originate from Jordan, Wilkinson, and George's Basin. The effects of the proposed action, including those of vessels going to/from Brewer, ME, do not extend to these areas, and we do not expect any effects to the generation of copepods in these areas that could be attributable to the proposed action. The proposed action will also not affect any of the physical or oceanographic conditions that serve to aggregate copepods in critical habitat. Offshore wind farms can reduce wind speed and wind stress which can lead to less mixing, lower current speeds, and higher surface water temperature (Afsharian et al. 2019), cause wakes that will result in detectable changes in vertical motion and/or structure in the water column (e.g. Christiansen & Hasager 2005, Broström 2008), as well as detectable wakes downstream from a wind farm by increased turbidity (Vanhellemont and Ruddick, 2014). However, there is no information to suggest that effects from the Maryland Wind project would extend to Unit 1. The Maryland Wind project is a significant distance from right whale critical habitat and, thus, it is not anticipated to affect the oceanographic features of that critical habitat. Further, the Maryland Wind project is not anticipated to cause changes to the physical or biological features of critical habitat by worsening climate change. Therefore, we have determined that the proposed action will have no effect on Unit 1 of right whale critical habitat.

Consideration of Potential Effects to Unit 2

As identified in the final rule (81 FR 4837), the physical and biological features essential to the conservation of the North Atlantic right whale, which provide calving area functions in Unit 2, are: (i) Sea surface conditions associated with Force 4 or less on the Beaufort Scale; (ii) Sea surface temperatures of 7 °C to 17 °C; and, (iii) Water depths of 6 to 28 m, where these features simultaneously co-occur over contiguous areas of at least 231 nmi^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.

Vessel transits will have no effect on the features of Unit 2; this is because vessel operations do not affect sea surface state, water temperature, or water depth. Therefore, we have determined that the proposed action will have no effect on Unit 2 of right whale critical habitat.

Summary of Effects to Right Whale Critical Habitat

We have determined that because the proposed action will have no effect on any of the PBFs, the proposed action will have no effect on the critical habitat designated for North Atlantic right whales.

Critical Habitat Designated for the Gulf of Maine DPS of Atlantic Salmon

Critical habitat has been designated for the GOM DPS of Atlantic salmon (74 FR 29300; June 19, 2009). The critical habitat designation for the GOM DPS of Atlantic salmon is for habitats that contain the physical and biological features necessary for the conservation of the species. Within the GOM DPS, these features include: 1) sites for spawning and rearing, and 2) sites for migration (excluding marine migration[10]). Project vessels transiting to/from the Cianbro Modular Manufacturing Facility (Brewer, Maine*)* will transit through critical habitat for Atlantic salmon in the Penobscot River. As explained below, we have determined that project vessels will have no effect on critical habitat designated for GOM DPS of Atlantic salmon.

[10] Although successful marine migration is essential to Atlantic salmon, NMFS was not able to identify the essential features of marine migration and feeding habitat or their specific locations at the time critical habitat was designated.

Sites for spawning and rearing
Given the life history of Atlantic salmon, and because the Cianbro Modular Manufacturing Facility (Brewer, Maine) is located in a tidal reach of the Penobscot River, Maryland Wind project vessels will have no effect on spawning sites for Gulf of Maine Atlantic salmon. The only portions of the area that overlap with rearing habitat are the vessel transit routes to and from Brewer, ME in the main stem of the Penobscot River. Due to the limited number of project vessels transiting the main stem Penobscot River (i.e., one vessel during each of the four vessel trips originating in Maine expected over the three-year construction phase) and the degree of spatial overlap between transit routes and rearing habitat, no effects from vessel noise and temporary increases in turbidity associated with vessel movement through the river are anticipated. Based upon this reasoning, we have determined that the proposed action will have no effect on sites for spawning and rearing.

Sites for migration
Project vessels transiting to/from the Cianbro Modular Manufacturing Facility (Brewer, Maine*)* will not result in a migration barrier for a number of reasons; 1) project vessels will only affect a small portion of the river at any given time; 2) there is no evidence of interactions between vessels and Atlantic salmon because Atlantic salmon are expected to migrate at depths below the draft of project vessels; and lastly, the vessels will be loaded or unloaded at the Cianbro Modular Manufacturing Facility by tying up at an existing berth along the bank of the Penobscot River. This will ensure that there is always a sufficient zone of passage for any migrating adult Atlantic salmon that may co-occur with project vessels. Vessel operations will not alter the habitat in any way that would increase the risk of predation. There will be no water quality impacts of vessel operations. Finally, as vessel operations will not affect the natural structure of the nearshore habitat, there will be no reduction in the capacity of substrate, food resources, and natural cover to meet the conservation needs of listed Atlantic salmon. Based upon this reasoning, we have determined that the proposed action will have no effect on sites for migration.

Critical Habitat Designated for the Gulf of Maine and Carolina DPSs of Atlantic sturgeon
Critical habitat has been designated for all five DPSs of Atlantic sturgeon (82 FR 39160; effective date September 18, 2017). The action area overlaps with the Penobscot River critical habitat unit designated for the Gulf of Maine DPS, the Delaware River critical habitat unit designated for the New York Bight DPS, and the Santee-Cooper unit designated for the Carolina DPS. Effects to critical habitat designated for the New York Bight DPS are addressed in sections 6 and 7 of this Opinion. The only project activity that overlaps with critical habitat for the Gulf of Maine DPS of Atlantic sturgeon is the transit of project vessels to or from the Cianbro Modular Manufacturing Facility (Brewer, ME). The only project activity that overlaps with critical habitat for the Carolina DPS of Atlantic sturgeon is the transit of project vessels to or from the Nexans Cable Facility (Charleston, SC).

Penobscot River Critical Habitat Unit (Gulf of Maine DPS)
The critical habitat designation for the Gulf of Maine DPS is for habitats that support successful Atlantic sturgeon reproduction and recruitment. The Penobscot River critical habitat unit extends from the Milford Dam at approximately river km 62 downstream to where the main stem river drainage discharges at its mouth into Penobscot Bay. In order to determine if the proposed action may affect critical habitat, we consider whether it would impact the habitat in a way that would

affect its ability to support reproduction and recruitment. Specifically, we consider the effects of the action on the physical features of the critical habitat. The essential features identified in the final rule are the same for all critical habitat designated for all five DPSs:

> (1) Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;
>
> (2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;
>
> (3) Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (i) Unimpeded movement of adults to and from spawning sites; (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and, (iii) Staging, resting, or holding of subadults or spawning condition adults. Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.
>
> (4) Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: (i) Spawning; (ii) Annual and interannual adult, subadult, larval, and juvenile survival; and, (iii) 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 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

Feature One: Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0–0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages

During spring freshets tidal freshwater extends to Winterport (river km 29), and during low flow months the salt front extends upstream as far as Hamden (river km 40) (ASMFC, 1998). The two lowermost dams on the Penobscot River, Great Works Dam and Veazie Dam (at river km 56), were removed in 2012 and 2013, respectively, opening up all known historical Atlantic sturgeon habitat in the Penobscot River, and access to more of the tidal freshwater habitat. Side scan sonar surveys of the impoundments, conducted before the impoundments were removed to support deconstruction permitting and engineering studies, showed that greater than 95% of the beds of each impoundment were bedrock, boulder, and cobble (CR Environmental, 2008; classification from Madden et al., 2005). Finer fractions, mostly small gravel sizes and sand, were generally limited to littoral zones and/or found interstitially with larger materials (Collins et al., 2020).

The vessel transit routes between the Maryland Wind WDA and the Cianbro Modular Manufacturing Facility may overlap with the portion of the Penobscot River that contains PBF 1 during moderate to high flow conditions, when the upper estuary above km 20 is fresh. However, project vessels will have no effect on this feature. This is because the project vessels will have no effect on salinity and will not interact with the bottom in this reach and therefore, there would be no impact to hard bottom habitat. The vessels will be loaded or unloaded at the Cianbro Modular Manufacturing Facility by tying up at an existing berth and is not expected to set an anchor. Vessels will operate in the channel where there is adequate water depth to prevent bottoming out or otherwise scouring the riverbed. Vessel operations are not expected to affect the behavior of Atlantic sturgeon and therefore would not affect access to areas where PBF 1 are present. The vessels' operations will not preclude or delay the development of hard bottom habitat in the part of the river with salinity less than 0.5 ppt because it will not impact the river bottom in any way or change the salinity of portions of the river where hard bottom is found. Based on these considerations, the project will have no effect on PBF 1; that is, there will be no effect on how the PBF supports the conservation needs of Atlantic sturgeon in the action area.

Feature Two: Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development

In considering effects to PBF 2, we consider whether the proposed action will have any effect on areas of soft substrate within transitional salinity zones between the river mouth and spawning sites for juvenile foraging and physiological development; therefore, we consider effects of the action on soft substrate and salinity and any change in the value of this feature in the action area. The upper part of the Penobscot River estuary (river km 34 to river km 43) is characterized as freshwater, with depths of 2.5 – 9 meters depending on tide and position in the river, and are predominantly cobble and gravel substrate. The middle part (river km 26 to river km 31) has an average water depth of 7.5 meters with maximum salinity of 2.5 ppt (i.e., oligohaline waters) in June, and muddy substrate with high levels of organic matter (mostly decaying wood chips and sawdust), whereas the lower part of the estuary (river km 21 to river km 24) has salinities of approximately 15 ppt during summer, and a predominance of sand substrate (Dzaugis, 2013).

Project vessels will have no effect on this feature as they will not have any effect on salinity, and they will not interact with the river bottom in this reach of the river.

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

In considering effects to PBF 3, we consider whether the proposed action will have any effect on water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: unimpeded movements of adults to and from spawning sites; seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and; staging, resting, or holding of subadults or spawning condition adults. We also consider whether the proposed action will affect water depth or water flow, given water that is too shallow can be a barrier to sturgeon movements, and an alteration in water flow could similarly impact the movements of sturgeon in the river, particularly early life stages that are dependent on downstream drift. Therefore, we consider effects of the action on water depth and water flow and whether the action results in barriers to passage that impede the movements of Atlantic sturgeon.

Water of appropriate depth and absent physical barriers to passage between the river mouth and spawning sites necessary to support: (i) Unimpeded movement of adults to and from spawning sites; (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and, (iii) Staging, resting, or holding of subadults or spawning condition adults, is present throughout the extent of critical habitat designated in the Penobscot River. Water depths in the main river channels is also 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.

Vessels transiting to or from the Maryland Wind project site to the Cianbro Modular Manufacturing Facility will travel through the portion of the Penobscot River critical habitat unit containing PBF 3. Project vessels will have no effect on this feature as they will not have any effect on water depth or water flow and will not be physical barriers to passage for any life stage of Atlantic sturgeon that may occur in this portion of the action area. Therefore, there will be no effect on PBF 3.

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

In considering effects to PBF 4, we consider whether the proposed action will have any effect on water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment. Therefore, we consider effects of the action on 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. We also consider whether the action will have effects to access to this feature, temporarily or permanently and consider the effect of the action on the action area's ability to develop the feature over time.

Vessels transiting to or from the Maryland Wind project site to the Cianbro Modular Manufacturing Facility will travel through the portion of the Penobscot River critical habitat unit containing PBF 4. Project vessels will have no effect on this feature as they will not have any effect on temperature, salinity or dissolved oxygen.

Santee-Cooper Critical Habitat Unit (Carolina DPS)

The critical habitat designation for the Carolina DPS is for habitats that support successful Atlantic sturgeon reproduction and recruitment. Carolina Unit 7 includes the Santee River (below the Wilson Dam), the Rediversion Canal (below the St. Stephens Dam), the North Santee River, the South Santee River, and Tailrace Canal – West Branch Cooper River (below Pinopolis Dam) and the main stem Cooper River.

On May 4, 2020, NMFS Southeast Regional Office issued a Biological Opinion to the USACE on the effects of construction and operation of the Nexans Cable Facility (NMFS SERO 2020). The subsea cable plant is located along the Cooper River in Charleston, South Carolina, within Unit 7 of the critical habitat designated for the Carolina DPS.

In the 2020 Nexans Biological Opinion, NMFS concluded that the construction and use by vessels of the Nexans Facility was likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the Carolina DPS of Atlantic sturgeon (NMFS SERO 2020). As explained in the 2020 Nexans Biological Opinion, NMFS determined that there would be temporary and permanent effects to the critical habitat in the Copper River as a result of dredging and riprap associated with the construction of the facility. No effects of vessel use on critical habitat were anticipated in the Opinion (NMFS SERO 2020, Section 3.1) and we do not expect any will occur as a result of the Maryland Wind project vessel's use of this facility.

Summary of Effects to Atlantic Sturgeon Critical Habitat

We have determined that the proposed action will have no effect on PBFs 1, 2, 3 and 4. Based on this conclusion and its supporting rationale, the action will have no effect on critical habitat designated for the Gulf of Maine DPS and Carolina DPS of Atlantic sturgeon.

Critical Habitat for the Northwest Atlantic Ocean DPS of Loggerhead Sea Turtles

Critical habitat for the Northwest Atlantic Ocean DPS of loggerhead sea turtles was designated in 2014 (79 FR 39855). Specific areas for designation include 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of habitat types: Nearshore reproductive habitat, winter area, breeding areas, constricted migratory corridors, and/or Sargassum habitat. There is no critical habitat designated in the WDA. The only project activities that may overlap with Northwest Atlantic loggerhead DPS critical habitat are vessels transiting to or from the project site from ports in the Gulf of Mexico (i.e., Ingleside, Texas, Houma/Harvey, Louisiana). As explained below, the proposed action will have no effect on this critical habitat.

Nearshore Reproductive

The PBF of nearshore reproductive habitat is described as a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season. Primary Constituent Elements (PCEs) that support this habitat are the following: (1) Nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 CFR 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.

The occasional project vessel transits that may occur within the designated nearshore reproductive habitat will have no effect on nearshore reproductive habitat for the following reasons: 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; and, vessel transits would not promote predators or disrupt wave patterns necessary for orientation or create excessive longshore currents.

Winter

The PBF of winter habitat is described as warm water habitat south of Cape Hatteras, North Carolina near the western edge of the Gulf Stream used by a high concentration of juveniles and adults during the winter months. PCEs that support this habitat are the following: (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.

The occasional project vessel transits that may occur within the designated winter habitat will have no effect on this habitat because they will not: 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, affect or change water depths between 20 and 100 m.

Breeding
The PBFs of concentrated breeding habitat are sites with high densities of both male and female adult individuals during the breeding season. PCEs that support this habitat are the following: (1) High densities of reproductive male and female loggerheads; (2) Proximity to primary Florida migratory corridor; and, (3) Proximity to Florida nesting grounds.
The occasional project vessel transits that may occur within the designated breeding habitat will have no effect on this habitat because they will not: affect the density of reproductive male or female loggerheads or result in any alterations of habitat in proximity to the primary Florida migratory corridor or Florida nesting grounds.

Constricted Migratory Corridors
The PBF of constricted migratory habitat is high use migratory corridors that are constricted (limited in width) by land on one side and the edge of the continental shelf and Gulf Stream on the other side. PCEs that support this habitat are the following: (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.
The occasional project vessel transits that may occur within the designated winter habitat will have no effect on this habitat because they will not result in any alterations of habitat in the constricted continental shelf area and will not affect passage conditions in this area.

Sargassum
The PBF of loggerhead *Sargassum* habitat is developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially Sargassum. PCEs that support this habitat are the following: (i) Convergence zones, surface-water downwelling 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; (ii) Sargassum in concentrations that support adequate prey abundance and cover; (iii) 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, (iv) 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.

The occasional project vessel transits that may occur within the designated *Sargassum* habitat will have no effect on: conditions that result in convergence zones, surface-water downwelling 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; the concentration of Sargassum; the availability of prey within Sargassum; or the depth of water in any area.

Summary of Effects to Critical Habitat
We have determined that because the proposed action will have no effect on any of the PBFs, the proposed action will have no effect on the critical habitat designated for the Northwest Atlantic DPS of loggerhead sea turtles.

Critical Habitat for Elkhorn (Acropora palmate) and Staghorn (A. cervicornis) Corals
NMFS designated critical habitat for elkhorn and staghorn corals includes four specific areas: the Florida area, the Puerto Rico area, the St. John/St. Thomas area, and the St. Croix area (73 FR 72210, November 26, 2008. The Florida area encompasses approximately 1,329 square miles (3,442 square kilometers) of marine habitat and is within the action area; however, vessels transiting between the WDA and ports in the Gulf of Mexico (i.e., Ingleside, Texas, Houma/Harvey, Louisiana) are not expected to transit through the area designated as critical habitat due to its shallow depths (i.e., critical habitat extends out to depths of 30 m). As described in the final listing rule, the physical and biological feature (PBF) essential to conservation of these species is substrate of suitable quality and availability (i.e., natural consolidated hard substrate or dead coral skeleton that is free from fleshy or turf macroalgae cover and sediment cover) to support successful larval settlement and recruitment, and reattachment and recruitment of fragments. Even if project vessels did transit through areas designated as critical habitat, these vessel transits would not affect this PBF as no substrate-disturbing activities (e.g., anchoring) are expected in this portion of the action area. No effects to this critical habitat are anticipated as a result of the proposed action.

5.0 STATUS OF THE SPECIES AND CRITICAL HABITAT IN THE ACTION AREA

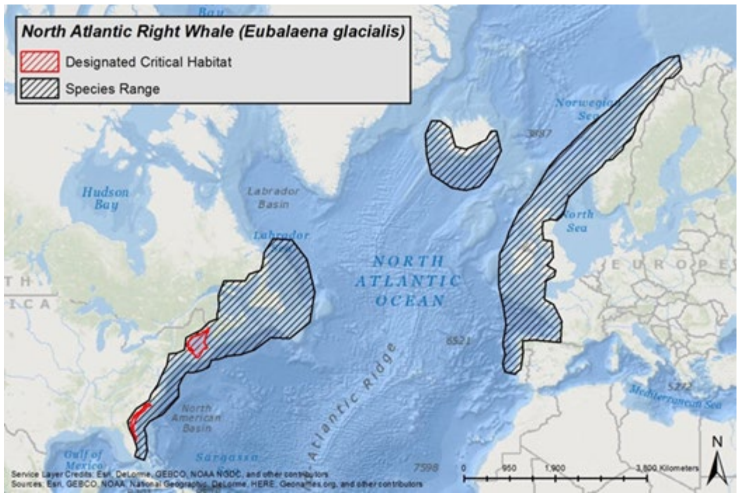
5.1 Marine Mammals

5.1.1 North Atlantic Right Whale (Eubalaena glacialis)
There are three species classified as right whales (genus *Eubalaena*): North Pacific (*E. japonica*), Southern (*E. australis*), and North Atlantic (*E. glacialis*). The North Atlantic right whale is the only species of right whale that occurs in the North Atlantic Ocean (Figure 5.1.1) and, therefore, is the only species of right whale that may occur in the action area.

North Atlantic right whales occur primarily in the western North Atlantic Ocean. However, there have been acoustic detections, reports, and/or sightings of North Atlantic right whales in waters off Greenland (east/southeast), Newfoundland, northern Norway, and Iceland, as well as within Labrador Basin (Hamilton et al. 1998, Jacobsen et al. 2004, Knowlton et al. 1992, Mellinger et al. 2011). These latter sightings/detections are consistent with historic records documenting North Atlantic right whales south of Greenland, in the Denmark straits, and in eastern North Atlantic waters (Kraus et al. 2007). There is also evidence of possible historic

North Atlantic right whale calving grounds in the Mediterranean Sea (Rodrigues et al. 2018), an area not currently considered as part of this species' historical range.

Figure 5.1.1. Approximate historic range and currently designated U.S. critical habitat of the North Atlantic right whale



The North Atlantic right whale is distinguished by its stocky body and lack of a dorsal fin. The species was listed as endangered on December 2, 1970. We used information available in the most recent five-year review for North Atlantic right whales (NMFS 2022), the most recent stock assessment report (Hayes et al. 2022 and Hayes et al. 2023), and the scientific literature to summarize the status of the species, as follows.

Life History

The maximum lifespan of North Atlantic right whales is unknown, but one individual reached at least 70 years of age (Hamilton et al. 1998, Kenney 2009). Previous modeling efforts suggest that in 1980, females had a life expectancy of approximately 51.8 years of age, which was twice that of males at the time (Fujiwara and Caswell 2001); however, by 1995, female life expectancy was estimated to have declined to approximately 14.5 years (Fujiwara and Caswell 2001). Most recent estimates indicate that North Atlantic right whale females are only living to 45 and males to age 65 (https://www.fisheries.noaa.gov/species/north-atlantic-right-whale). Females, ages 5+, have reduced survival relative to males, ages 5+, resulting in a decrease in female abundance relative to male abundance (Pace et al. 2017). Specifically, state-space mark-recapture model estimates show that from 2010-2015, males declined just under 4.0%, and females declined approximately 7% (Pace et al. 2017).

Gestation is estimated to be between 12 and 14 months, after which calves typically nurse for around one year (Cole et al. 2013, Kenney 2009, Kraus and Hatch 2001, Lockyer 1984). After weaning a calf, females typically undergo a 'resting' period before becoming pregnant again, presumably because they need time to recover from the energy deficit experienced during lactation (Fortune et al. 2013, Fortune et al. 2012, Pettis et al. 2017a). From 1983 to 2005, annual average calving intervals ranged from 3 to 5.8 years (overall average of 4.23 years) (Kraus et al. 2007). Between 2006 and 2015, annual average calving intervals continued to vary within this range, but in 2016 and 2017 longer calving intervals were reported (6.3 to 6.6 years in

2016 and 10.2 years in 2017) (Hayes et al. 2018a, Pettis and Hamilton 2015, Pettis and Hamilton 2016, Pettis et al. 2018a, Pettis et al. 2018b, Pettis et al. 2020). There were no calves recorded in 2018. Annual average calving interval between 2019 and 2022 ranged from a low of 7 in 2019 to a high of 9.2 in 2021 (Pettis et al. 2022). The calving index is the annual percentage of reproductive females assumed alive and available to calve that was observed to produce a calf. This index averaged 47% from 2003 to 2010 but has dropped to an average of 17% since 2010 (Moore et al. 2021). The percentage of available females that had calves ranged from 11.9% to 30.5% from 2019-2022 (Pettis et al. 2022). Females have been known to give birth as young as five years old, but the mean age of a female first giving birth is 10.2 years old (n=76, range 5 to 23, SD 3.3) (Moore et al. 2021). Taken together, changes to inter-birth interval and age to first reproduction suggest that both parous (having given birth) and nulliparous (not having given birth) females are experiencing delays in calving. These calving delays correspond with the recent distribution shifts. The low reproductive rate of right whales is likely the result of several factors including nutrition (Fortune et al. 2013, Moore et al. 2021). Evidence also indicates that North Atlantic right whales are growing to shorter adult lengths than in earlier decades (Stewart et al. 2021) and are in poor body condition compared to southern right whales (Christiansen et al. 2020). As stated in Hayes et al. 2023, all these changes may result from a combination of documented regime shifts in primary feeding habitats (Meyer-Gutbrod and Greene 2014; Meyer-Gutbrod et al. 2021; Record et al. 2019), and increased energy expenditures related to non-lethal entanglements (Rolland et al. 2016; Pettis et al. 2017b; van der Hoop 2017). As noted in the 2022 Five-Year Review (NMFS 2022), poor body condition, arrested growth, and maternal body length have led to reduced reproductive success and are contributors to low birth rates for the population over the past decade (Christiansen et al. 2020; Reed et al. 2022; Stewart et al. 2021; Stewart et al. 2022).

Pregnant North Atlantic right whales migrate south, through the mid-Atlantic region of the U.S., to low latitudes during late fall where they overwinter and give birth in shallow, coastal waters (Kenney 2009, Krzystan et al. 2018). During spring, these females and new calves migrate to high latitude foraging grounds where they feed on large concentrations of copepods, primarily *C. finmarchicus* (Mayo et al. 2018, NMFS 2017). Some non-reproductive North Atlantic right whales (males, juveniles, non-reproducing females) also migrate south, although at more variable times throughout the winter. Others appear to not migrate south and remain in the northern feeding grounds year round or go elsewhere (Bort et al. 2015, Mayo et al. 2018, Morano et al. 2012, NMFS 2017, Stone et al. 2017). Nonetheless, calving females arrive to the southern calving grounds earlier and stay in the area more than twice as long as other demographics (Krzystan et al. 2018). Little is known about North Atlantic right whale habitat use in the mid-Atlantic, but recent acoustic data indicate near year round presence of at least some whales off the coasts of New Jersey, Virginia, and North Carolina (Davis et al. 2017, Hodge et al. 2015, Salisbury et al. 2016, Whitt et al. 2013). While it is generally not known where North Atlantic right whales mate, some evidence suggests that mating may occur in the northern feeding grounds (Cole et al. 2013, Matthews et al. 2014).

Population Dynamics

Today, North Atlantic right whales are primarily found in the western North Atlantic, from their calving grounds in lower latitudes off the coast of the southeastern United States to their feeding grounds in higher latitudes off the coast of New England and Nova Scotia (Hayes et al. 2018a).

Beginning in 2010, a change in seasonal residency patterns has been documented through visual and acoustic monitoring with declines in presence in the Bay of Fundy, Gulf of Maine, and Great South Channel, and more animals being observed in Cape Cod Bay, the Gulf of Saint Lawrence, the mid-Atlantic, and south of Nantucket, Massachusetts (Daoust et al. 2018, Davies et al. 2019, Davis et al. 2017, Hayes et al. 2018a, Hayes et al. 2019, Meyer-Gutbrod et al. 2018, Moore et al. 2021, Pace et al. 2017, Quintana-Rizzo et al. 2021). Right whales have been observed nearly year round in the area south of Martha's Vineyard and Nantucket, with highest sightings rates between December and May (Leiter et al., 2017, Stone et al. 2017, Quintana-Rizzo et al. 2021, O'Brien et al. 2022). Increased detections of right whales in the Gulf of St. Lawrence have been documented from late spring through the fall (Cole et al. 2016, Simard et al. 2019, DFO 2020). There are two recognized populations of North Atlantic right whales, an eastern, and a western population. Very few individuals likely make up the population in the eastern Atlantic, which is thought to be functionally extinct (Best et al. 2001). However, in recent years, a few known individuals from the western population have been seen in the eastern Atlantic, suggesting some individuals may have wider ranges than previously thought (Kenney 2009). Specifically, there have been acoustic detections, reports, and/or sightings of North Atlantic right whales in waters off Greenland (east/southeast), Newfoundland, northern Norway, and Iceland, as well as within Labrador Basin (Jacobsen et al. 2004, Knowlton et al. 1992, Mellinger et al. 2011). It is estimated that the North Atlantic historically (i.e., pre-whaling) supported between 9,000 and 21,000 right whales (Monsarrat et al. 2016). The western population may have numbered fewer than 100 individuals by 1935, when international protection for right whales came into effect (Kenney et al. 1995).

Genetic analyses, based upon mitochondrial and nuclear DNA analyses, have consistently revealed an extremely low level of genetic diversity in the North Atlantic right whale population (Hayes et al. 2018a, Malik et al. 2000, McLeod and White 2010, Schaeff et al. 1997). Waldick et al. (2002) concluded that the principal loss of genetic diversity occurred prior to the 18th century, with more recent studies hypothesizing that the loss of genetic diversity may have occurred prior to the onset of Basque whaling during the 16th and 17th century (Mcleod et al. 2008, Rastogi et al. 2004, Reeves et al. 2007, Waldick et al. 2002). The persistence of low genetic diversity in the North Atlantic right whale population might indicate inbreeding; however, based on available data, no definitive conclusions can be reached at this time (Hayes et al. 2019, Radvan 2019, Schaeff et al. 1997). By combining 25 years of field data (1980-2005) with high-resolution genetic data, Frasier et al. (2013) found that North Atlantic right whale calves born between 1980 and 2005 had higher levels of microsatellite (nuclear) heterozygosity than would be expected from this species' gene pool. The authors concluded that this level of heterozygosity is due to postcopulatory selection of genetically dissimilar gametes and that this mechanism is a natural means to mitigate the loss of genetic diversity, over time, in small populations (Frasier et al. 2013).

In the western North Atlantic, North Atlantic right whale abundance was estimated to be 270 animals in 1990 (Pace et al. 2017). From 1990 to 2011, right whale abundance increased by approximately 2.8% per year, despite a decline in 1993 and no growth between 1997 and 2000 (Pace et al. 2017). However, since 2011, when the abundance peaked at 481 animals, the population has been in decline, with a 99.99% probability of a decline of just under 1% per year (Pace et al. 2017). Between 1990 and 2015, survival rates appeared relatively stable, but differed between the sexes, with males having higher survivorship than females (males: 0.985 ± 0.0038; females: 0.968 ± 0.0073) leading to a male-biased sex ratio (approximately 1.46 males per female) (Pace et al. 2017).

As reported in the most recent final SAR (Hayes et al. 2023), the western North Atlantic right whale stock size is estimated based on a published state-space model of the sighting histories of individual whales identified using photo-identification techniques (Pace et al. 2017; Pace 2021). Sightings histories were constructed from the photo-ID recapture database as it existed in December 2021, and included photographic information up through November 2020. Using a hierarchical, state-space Bayesian open population model of these histories produced a median abundance value (N_{est}) as of November 30, 2020 of 338 individuals (95% Credible Interval (CI): 325–350). The minimum population estimate included in the most recent SAR is 332 (Hayes et al. 2023). Linden 2023[11] updates the population size estimate of North Atlantic right whales at the beginning of 2022 using the most recent year of available sightings data (collected through December 2022) and the existing modeling approach. Using the established capture-recapture framework (Pace et al. 2017), the estimated population size in 2022 was 356 whales, with a 95% credible interval ranging from 346 to 363. Linden notes that given uncertainty in the accuracy of the terminal year estimate (Pace 2021), interpretations should focus on the multi-year population trend. The draft 2023 SAR is currently under review and revision. As reported in the publicly available draft (Hayes et al. 2024, DRAFT), a median abundance value (Nest) as of December 31, 2021, is 340 individuals (95% Credible Interval: 333-348). The sharp decrease observed from 2015-2020 appears to have slowed, though the right whale population continues to experience annual mortalities above recovery thresholds.

Each year, scientists at NMFS' Northeast Fisheries Science Center estimate the right whale population abundance and share that estimate at the North Atlantic Right Whale Consortium's annual meeting in a "Report Card." This estimate is considered preliminary and undergoes further review before being included in the draft North Atlantic Right Whale Stock Assessment Report. Each draft stock assessment report is peer-reviewed by one of three regional Scientific Review Groups, revised after a public comment period, and published. In the 2023 Annual Report Card (Pettis and Hamilton 2024), the population estimate for 2022 is reported as 356 (+7/-10) (consistent with Linden 2023, cited above). Pettis et al. (2022) report that fifteen mother calf pairs were sighted in 2022, down from 18 in 2021. There were no first time mothers sighted in 2022. Initial analyses detected at least 16 new entanglements in 2022: five whales seen with gear and 11 with new scarring from entanglements. Additionally, there was one non-fatal vessel strike detected. No carcasses were detected. Of the 15 calves born in 2022, one is known to have died and another is thought likely to have died. During the 2022-2023 season, there were 11 mothers with associated calves and one newborn documented alone that was later found dead. Through May 22, 2024, 19 mother-calf pairs have been sighted in the 2023-2024 calving season; of these, 4 are thought to be first time mothers[12]. One calf (mother Juno) had been sighted with injuries consistent with a vessel strike and was later found dead (March 3, Cumberland Island,

[11] Available at: https://www.fisheries.noaa.gov/s3/2023-10/TM314-508-0.pdf

[12] https://mission.cmaquarium.org/2023-2024-right-whale-calving-season/; last accessed May 22, 2024

Georgia). Additionally, four other calves are considered “missing” and are presumed mortalities as the mothers have been seen alone since being sighted with their calves[13].

In addition to finding an overall decline in the North Atlantic right whale population, Pace et al. (2017) also found that between 1990 and 2015, the survival of age 5+ females relative to 5+ males has been reduced; this has resulted in diverging trajectories for male and female abundance. Specifically, there was an estimated 142 males (95% CI=143-152) and 123 females (95% CI=116-128) in 1990; however, by 2015, model estimates show the species was comprised of 272 males (95% CI=261-282) and 186 females (95% CI=174-195; Pace et al. 2017). Calving rates also varied substantially between 1990 and 2015 (i.e., 0.3% to 9.5%), with low calving rates coinciding with three periods (1993-1995, 1998-2000, and 2012-2015) of decline or no growth (Pace et al. 2017). Using generalized linear models, Corkeron et al. (2018) found that between 1992 and 2016, North Atlantic right whale calf counts increased at a rate of 1.98% per year. Using the highest annual estimates of survival recorded over the time series from Pace et al. (2017), and an assumed calving interval of approximately four years, Corkeron et al. (2018) suggests that the North Atlantic right whale population could potentially increase at a rate of at least 4% per year if there was no anthropogenic mortality.[14] This rate is approximately twice that observed, and the analysis indicates that adult female mortality is the main factor influencing this rate (Corkeron et al. 2018). Right whale births remain significantly below what is expected and the average inter-birth interval remains high (Pettis et al. 2022). Additionally, there were no first-time mothers in 2022, underscoring recent research findings that fewer adult, nulliparous females are becoming reproductively active (Reed et al., 2022).

Status

The North Atlantic right whale is listed under the ESA as endangered. Anthropogenic mortality and sub-lethal stressors (i.e., entanglement) that affect reproductive success are currently affecting the ability of the species to recover (Corkeron et al. 2018, Stewart et al. 2021), currently, none of the species recovery goals (see below) have been met. With whaling now prohibited, the two major known human causes of mortality are vessel strikes and entanglement in fishing gear (Hayes et al. 2018a). Estimates of total annual anthropogenic mortality (i.e., ship strike and entanglement in fishing gear), as well as the number of undetected anthropogenic mortalities for North Atlantic right whales are presented in the annual stock assessment reports. These anthropogenic threats appear to be worsening (Hayes et al. 2018a).

On June 7, 2017, NMFS declared an Unusual Mortality Event (UME) for the North Atlantic right whale, as a result of 17 observed right whale mortalities in the U.S. and Canada. Under the Marine Mammal Protection Act, a UME is defined as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response." As of

[13] https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-updates; last accessed May 22, 2024

[14] Based on information in the North Atlantic Right Whale Catalog, the mean calving interval is 4.69 years (P. Hamilton 2018, unpublished, in Corkeron et al. 2018). Corkeron et al. (2018) assumed a 4 year calving interval as the approximate mid-point between the North Atlantic Right Whale Catalog calving interval and observed calving intervals for southern right whales (i.e., 3.16 years for South Africa, 3.42 years for Argentina, 3.31 years for Auckland Islands, and 3.3 years for Australia).

May 23, 2024, there are 40 confirmed mortalities for the UME (including a juvenile female stranded on Martha's Vineyard in January 2024; while cause of death is pending the animal was previously observed with an entanglement, no evidence of vessel strike has been reported), 34 serious injuries (including the calf of #1612 observed in January 2024 with vessel strike injuries), and 65 sublethal injuries or illness (for more information on UMEs, see https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-unusual-mortality-events). Mortalities are recorded as vessel strike (15), entanglement (9), perinatal (2), unknown/undetermined (3), not examined (10), and pending (1; the January 24 female noted above).[15]

The North Atlantic right whale population continues to decline. As noted above, between 1990 to 2011, right whale abundance increased by approximately 2.8% per year; however, since 2011 the population has been in decline (Pace et al. 2017). The 2023 SAR reports an overall abundance decline between 2011 and 2020 of 23.5% (CI=21.4% to 26.0%) (Hayes et al. 2023). Recent modeling efforts indicate that low female survival, a male biased sex ratio, and low calving success are contributing to the population's current decline (Pace et al. 2017). For instance, five new calves were documented in 2017 calving season, zero in 2018, and seven in 2019 (Pettis et al. 2018a, Pettis et al. 2018b, Pettis et al. 2020), these numbers of births are well below the number needed to compensate for expected mortalities. More recently, there were 10 calves in the 2020 calving season, 18 calves in 2021, and 15 in 2022. Two of the 2020 calves and one of the 2021 calves died or were seriously injured due to vessel strikes. Two additional calves were reported in the 2021 season, but were not seen as a mother/calf pair. One animal stranded dead with no evidence of human interaction and initial results suggest the calf died during birth or shortly thereafter. The second animal was an anecdotal report of a calf off the Canary Islands. Two calves in 2022 are suspected to have died, with the causes of death unknown. As noted above, 11 mother-calf pairs were sighted in the 2022-2023 calving season[16]. Long-term photographic identification data indicate new calves rarely go undetected (Kraus et al. 2007, Pace et al. 2017). While there are likely a multitude of factors involved, low calving has been linked to poor female health (Rolland et al. 2016) and reduced prey availability (Devine et al. 2017, Johnson et al. 2017, Meyer-Gutbrod and Green 2014, Meyer-Gutbrod and Greene 2018, Meyer-Gutbrod et al. 2018). A recent study comparing North Atlantic right whales to other right whale species found that juvenile, adult, and lactating female North Atlantic right whales all had lower body condition scores compared to the southern right whale populations, with lactating females showing the largest difference; however, North Atlantic right whale calves were in good condition (Christiansen et al. 2020). While some of the difference could be the result of genetic isolation and adaptations to local environmental conditions, the authors suggest that the magnitude indicates that North Atlantic right whale females are in poor condition, which could be suppressing their growth, survival, age of sexual maturation and calving rates. In addition, they conclude that the observed differences are most likely a result of differences in the exposure to anthropogenic factors (Christiansen et al. 2020). Furthermore, entanglement in fishing gear appears to have substantial health and energetic costs that affect both survival and reproduction

[15] https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2024 -north-atlantic-right-whale-unusual-mortality-event; last accessed February 10, 2024

[16] https://www.fisheries.noaa.gov/national/endangered-species-conservation/north-atlantic-right-whale-calving-season-2023

(Hayes et al. 2018a, Hunt et al. 2016, Lysiak et al. 2018, Pettis et al. 2017, Robbins et al. 2015, Rolland et al. 2017, van der Hoop et al. 2017).

Kenney et al. (2018) projected that if all other known or suspected impacts (e.g., vessel strikes, calving declines, climate change, resource limitation, sublethal entanglement effects, disease, predation, and ocean noise) on the population remained the same between 1990 and 2016, and none of the observed fishery related mortality and serious injury occurred, the projected population in 2016 would be 12.2% higher (506 individuals). Furthermore, if the actual mortality resulting from fishing gear is double the observed rate (as estimated in Pace et al. 2017), eliminating all mortalities (observed and unobserved) could have resulted in a 2016 population increase of 24.6% (562 individuals) and possibly over 600 in 2018 (Kenney 2018). Given the above information, North Atlantic right whales' resilience to future perturbations affecting health, reproduction, and survival is expected to be very low (Hayes et al. 2018a). The observed (and clearly biased low) human-caused mortality and serious injury was 7.7 right whales per year from 2015 through 2019 (Hayes et al. 2022). Using the refined methods of Pace et al. (2021), the estimated annual rate of total mortality for the period 2014–2018 was 27.4, which is 3.4 times larger than the 8.15 total derived from reported mortality and serious injury for the same period (Hayes et al. 2022). The 2023 SAR reports the observed human-caused mortality and serious injury was 8.1 right whales per year from 2016 through 2020 (Hayes et al. 2023). Using the refined methods of Pace et al. (2021), the estimated annual rate of total mortality for the period 2015–2019 was 31.2, which is 4.1 times larger than the 7.7 total derived from reported mortality and serious injury for the same period. Using a matrix population projection model, it is estimated that by 2029 the population will decline from 160 females to the 1990 estimate of 123 females if the current rate of decline is not altered (Hayes et al. 2018a). Climate change poses a significant threat to the recovery of North Atlantic right whales. The information presented here is summarized from a more complete description of this threat in the 2022 5-Year Review (NMFS 2022). The documented shift in North Atlantic right whale summer habitat from the Gulf of Maine to waters further north in the Gulf of St. Lawrence in the early 2010s is considered to be related to an oceanographic regime shift in Gulf of Maine waters linked to a northward shift of the Gulf Stream which caused the availability of the primary North Atlantic right whale prey, the copepod *Calanus finmarchicus*, to decline locally, forcing North Atlantic right whales to forage in areas further north (Meyer-Gutbrod et al. 2021; Record et al. 2019; Sorochan et al. 2019). The shift of North Atlantic right whale distribution into waters further north also created policy challenges for the Canadian government, which had to implement new regulations in areas that were not protected because they were not documented as right whale habitat in the past (Davies and Brillant 2019; Meyer-Gutbrod et al. 2018; Record et al. 2019).

When prey availability is low, North Atlantic right whale calving rates decline, a well-documented phenomenon through periods of low prey availability in the 1990s and the 2010s; without increased prey availability in the future, low population growth is predicted (Meyer-Gutbrod and Greene 2018). Prey densities in the Gulf of St. Lawrence have fluctuated irregularly in the past decade, limiting suitable foraging habitat for North Atlantic right whales in some years and further limiting reproductive rates (Bishop et al. 2022; Gavrilchuck et al. 2020; Gavrilchuck et al. 2021; Lehoux et al. 2020).

Recent studies have investigated the spatial and temporal role of oceanography on copepod availability and distribution and resulting effects on foraging North Atlantic right whales. Changes in seasonal current patterns have an effect on the density of *Calanus* species in the Gulf of St. Lawrence, which may lead to further temporal variations over time (Sorochan et al. 2021a). Brennan et al. (2019) developed a model to estimate seasonal fluctuations in *C. finmarchicus* availability in the Gulf of St. Lawrence, which is highest in summer and fall, aligning with North Atlantic right whale distribution during those seasons. Pendleton et al. (2022) found that the date of maximum occupancy of North Atlantic right whales in Cape Cod Bay shifted 18.1 days later between 1998 and 2018 and was inversely related to the spring thermal transition date, when the regional ocean temperature surpasses the mean annual temperature for that location, which has trended towards moving earlier each year as an effect of climate change. This inverse relationship may be due to a 'waiting room' effect, where North Atlantic right whales wait and forage on adequate prey in the waters of Cape Cod Bay while richer prey develops in the Gulf of St. Lawrence, and then migrate directly there rather than following migratory pathways used previously (Pendleton et al. 2022; Ganley et al. 2022). Although the date of maximum occupancy in Cape Cod Bay has shifted to later in the spring, initial sightings of individual North Atlantic right whales have started earlier, indicating that they may be using regional water temperature as a cue for migratory movements between habitats (Ganley et al. 2022).

North Atlantic right whales rely on late stage or diapause copepods, which are more energy-rich, for prey; diving behavior is highly reliant on where in the vertical strata *C. finmarchicus* is distributed (Baumgartner et al. 2017). There is evidence that *C. finmarchicus* are reaching the diapause phase at deeper depths to account for warming water on the Newfoundland Slope and Scotian Shelf, forcing North Atlantic right whales to forage deeper and further from shore (Krumhansl et al. 2018; Sorochan et al. 2021a).

Several studies have already used the link between *Calanus* distribution and North Atlantic right whale distribution to determine suitable habitat, both currently and in the future (Gavrilchuk et al. 2020; Pershing et al. 2021; Silber et al. 2017; Sorochan et al. 2021b). Plourde et al. (2019) used suitable habitat modeling using *Calanus* density to confirm new North Atlantic right whale hot spots for summer feeding in Roseway Basin and Grand Manan and identified other potential aggregation areas further out on the Scotian Shelf. Gavrilchuk et al. (2021) determined suitable habitat for reproductive females in the Gulf of St. Lawrence, finding declines in foraging habitat over a 12- year period and indicating that the prey biomass in the area may become insufficient to sustain successful reproduction over time. Ross et al. (2021) used suitable habitat modeling to predict that the Gulf of Maine habitat would continue to decline in suitability until 2050 under a range of climate change scenarios. Similarly, models of future copepod density in the Gulf of Maine have predicted declines of up to 50 percent under high greenhouse gas emission scenarios by 2080- 2100 (Grieve et al. 2017). It is clear that climate change does and will continue to have an impact on the availability, supply, aggregation, and distribution of *C. finmarchicus*, and North Atlantic right whale abundance and distribution will continue to vary based on those impacts; however, more research must be done to better understand these factors and associated impacts (Sorochan et al. 2021b). Climate change will likely have other secondary effects on North Atlantic right whales, such as an increase in harmful algal blooms of the toxic dinoflagellate

Alexandrium catenella due to warming waters, increasing the risk of North Atlantic right whale exposure to neurotoxins (Boivin-Rioux et al. 2021; Pershing et al. 2021).

Factors outside the Action Area Affecting the Status of the Right Whale: Fishery Interactions and Vessel Strikes in Canadian Waters
In Canada, right whales are protected under the Species at Risk Act (SARA) and the Fisheries Act. The right whale was considered a single species and designated as endangered in 1980. SARA includes provisions against the killing, harming, harassing, capturing, taking, possessing, collecting, buying, selling, or trading of individuals or its parts (SARA Section 32) and damage or destruction of its residence (SARA Section 33). In 2003, the species was split to allow separate designation of the North Atlantic right whale, which was listed as endangered under SARA in May 2003. All marine mammals are subject to the provisions of the marine mammal regulations under the Fisheries Act. These include requirements related to approach, disturbance, and reporting. In the St. Lawrence estuary and the Saguenay River, the maximum approach distance for threatened or endangered whales is 1,312 ft. (400 m).

North Atlantic right whales have died or been seriously injured in Canadian waters by vessel strikes and entanglement in fishing gear (DFO 2014). Serious injury and mortality events are rarely observed where the initial entanglement occurs. After an event, live whales or carcasses may travel hundreds of miles before ever being observed, including into U.S. waters given prevailing currents. It is unknown exactly how many serious injuries and mortalities have occurred in Canadian waters historically. However, at least 14 right whale carcasses and 20 injured right whales were sighted in Canadian waters between 1988 and 2014 (Davies and Brillant 2019); 25 right whale carcasses were first sighted in Canadian waters or attributed to Canadian fishing gear from 2015 through 2019. In the sections to follow, information is provided on the fishing and shipping industry in Canadian waters, as well as measures the Canadian government is taking (or will be taking) to reduce the level of serious injuries and mortalities to North Atlantic rights resulting from incidental entanglement in fishing gear or vessel strikes.

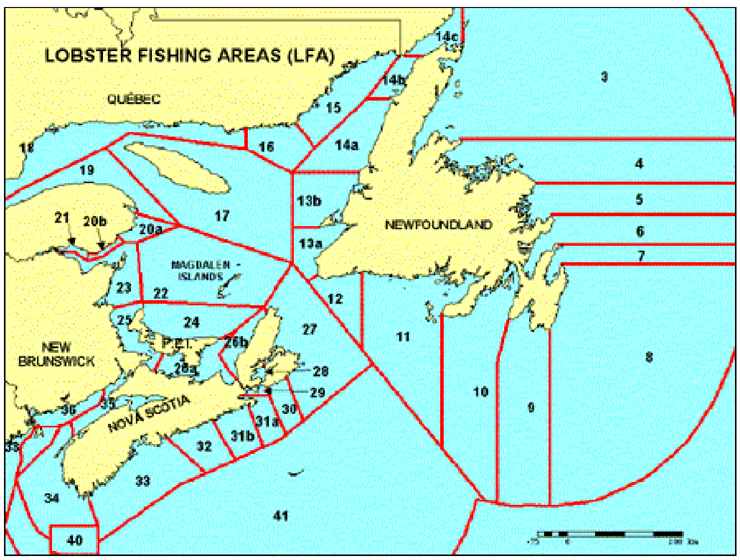
Fishery Interactions in Canadian Waters
There are numerous fisheries operating in Canadian waters. Rock and toad crab fisheries, as well as fixed gear fisheries for cod, Atlantic halibut, Greenland halibut, winter flounder, and herring have historically had few interactions. While these fisheries deploy gear that pose some risk, this analysis focuses on fisheries that have demonstrated interactions with ESA listed species (i.e., lobster, snow crab, mackerel, and whelk). Based on information provided by the Department of Fisheries and Oceans Canada (DFO), a brief summary of these fisheries is provided below.

The American lobster fishery is DFO's largest fishery, by landings. It is managed under regional management plans with 41 Lobster Fisheries Areas (Figure 5.1.2); in which 10,000 licensed harvesters across Atlantic Canada and Quebec participate.[17] In addition to the one permanent closure in Lobster Fishery Area 40 (Figure 5.1.2), fisheries are generally closed during the summer to protect molts. Lobster fishing is most active in the Gulf of Maine, Bay of Fundy,

[17] Of the 41 Lobster Fisheries Areas, one is for the offshore fishery, and one is closed for conservation.

Southern Gulf of St. Lawrence, and coastal Nova Scotia. Most fisheries take place in shallow waters less than 130 ft. (40 m) deep and within 8 nmi (15 km) of shore, although some fisheries will fish much farther out and in waters up to 660 ft. (200 m) deep. Management measures are tailored to each Area and include limits on the number of licenses issued, limits on the number of traps, limited and staggered fishing seasons, limits on minimum and maximum carapace size (which differs depending on the Area), protection of egg-bearing females (females must be notched and released alive), and ongoing monitoring and enforcement of fishing regulations and license conditions. The Canadian lobster fisheries use trap/pot gear consistent with the gear used in the American lobster fishery in the U.S. While both Canada and the U.S. lobster fisheries employ similar gears, the two nations employ different management strategies that result in divergent prosecution of the fisheries.

Figure 5.1.2. Lobster fishing areas in Atlantic Canada (https://www.dfo-mpo.gc.ca/fisheries-peches/commercial-commerciale/atl-arc/lobster-homard-eng.html)



The snow crab fishery is DFO's second largest fishery, by landings. It is managed under regional management plans with approximately 60 Snow Crab Management Areas in Canada spanning four regions (Scotia-Fundy, Southern Gulf of St. Lawrence, Northern Gulf of St. Lawrence, and Newfoundland and Labrador). Approximately 4,000 crab fishery licenses are issued annually[18]. The management of the snow crab fishery is based on annual total allowable catch, individual quotas, trap and mesh restrictions, minimum legal size, mandatory release of female crabs, minimum mesh size of traps, limited seasons, and areas. Protocols are in place to close grids when a percentage of soft-shell crabs in catches is reached. Harvesters use baited conical traps and pots set on muddy or sand-mud bottoms usually at depths of 230-460 ft. (70-140 m). Annual permit conditions have been used since 2017 to minimize the impacts to North Atlantic right whales, as described below.

[18] https://www.dfo-mpo.gc.ca/stats/commercial/licences-permis/licences-permis-atl-eng.htm#Species; Last accessed February 12, 2023

DFO manages the Atlantic mackerel fishery under one Atlantic management plan, established in 2007. Management measures include fishing seasons, total allowable catch, gear, Safety at Sea fishing areas, licensing, minimum size, fishing gear restrictions, and monitoring. The plan allows the use of the following gear: gillnet, handline, trap net, seine, and weir. When established, the DFO issued 17,182 licenses across four regions, with over 50% of these licenses using gillnet gear. In 2020, DFO issued 7,812 licenses; no gear information was available. Commercial harvest is timed with the migration of mackerel into and out of Canadian waters. In Nova Scotia, gillnet and trap fisheries for mackerel take place primarily in June and July. Mackerel generally arrive in southwestern Nova Scotia in May and Cape Breton in June. Migration out of the Gulf of St. Lawrence begins in September, and the fishery can continue into October or early November. They may enter the Gulf of St. Lawrence, depending on temperature conditions. The gillnet fishery in the Gulf of St. Lawrence also occurs in June and July. Most nets are fixed, except for a drift fishery in Chaleurs Bay and the part of the Gulf between New Brunswick, Prince Edward Island, and the Magdalen Islands.

Conservation harvesting plans are used to manage waved whelk in Canadian waters, which are harvested in the Gulf of St. Lawrence, Quebec, Maritimes, and Newfoundland and Labrador regions. The fishery is managed using quotas, fishing gear requirements, dockside monitoring, traps limits, seasons, tagging, and area requirements. In 2017, there were 240 whelk license holders in Quebec; however, only 81 of them were active. Whelk traps are typically weighted at the bottom with cement or other means and a rope or other mechanism is positioned in the center of the trap to secure the bait. Between 50 and 175 traps are authorized per license. The total number of authorized traps for all licenses in each fishing area varies between 550 and 6,400 traps, while the number of used or active traps is lower, with 200 to 1,700 traps per fishing area. Since 2017, the Government of Canada has implemented measures to protect right whales from entanglement. These measures have included seasonal and dynamic closures for fixed gear fisheries, changes to the fishing season for snow crab, reductions in traps in the mid-shore fishery in Crab Fishing Area 12, and license conditions to reduce the amount of rope in the water. Measures to better track gear, require reporting of gear loss, require reporting of interactions with marine mammals, and increased surveillance for right whales have also been implemented. Measures to reduce interactions with fishing gear are adjusted annually. In 2021, mandatory closures for non-tended fixed gear fisheries, including lobster and crab, will be put in place for 15 days when right whales are sighted. If a whale is detected in days 9-15 of the closure, the closure will be extended. In the Bay of Fundy and the critical habitats in the Roseway and Grand Manan basins, this extension will be for an additional 15 days. If a right whale is detected in the Gulf of St. Lawrence, the closure will be season-long (until November 15, 2021). Outside the dynamic area, closures are considered on a case-by-case basis. There are also gear marking and reporting requirements for all fixed gear fisheries. The Government of Canada will also continue to support industry trials of innovative fishing technologies and methods to prevent and mitigate whale entanglement. This includes authorizing ropeless gear trials in closed areas in 2021. Measures to implement weak rope or weak-breaking points were delayed and will be implemented by 2024. Measures related to maximum rope diameters, sinking rope between traps and reductions in vertical and floating rope will be implemented after 2022. More information on these measures is available at https://www.dfo-mpo.gc.ca/fisheries-peches/commercial-commerciale/atl-arc/narw-bnan/management-gestion-eng.html.

In August 2016, NMFS published the MMPA Import Provisions Rule (81 FR 54389, August 15, 2016), which established criteria for evaluating a harvesting nation's regulatory program for reducing marine mammal bycatch and the procedures for obtaining authorization to import fish and fish products into the United States. Specifically, to continue in the international trade of seafood products with the United States, other nations must demonstrate that their marine mammal mitigation measures for commercial fisheries are, at a minimum, equivalent to those in place in the United States. A five-year exemption period (beginning January 1, 2017) was created in this process to allow foreign harvesting nations time to develop, as appropriate, regulatory programs comparable in effectiveness to U.S. programs at reducing marine mammal bycatch. To comply with its requirements, it is essential that these interactions are reported, documented, and quantified. To guarantee that fish products have access to the U.S. markets, DFO must implement procedures to reliably certify that the level of mortality caused by fisheries does not exceed U.S. standards. DFO must also demonstrate that the regulations in place to reduce accidental death of marine mammals are comparable to those of the United States.

Vessel Strikes in Canadian Waters

Vessel strikes are a threat to right whales throughout their range. In Canadian waters where rights whales are present, vessels include recreational and commercial vessels, small and large vessels, and sail, and power vessels. Vessel categories include oil and gas exploration, fishing and aquaculture, cruise ships, offshore excursions (whale and bird watching), tug/tow, dredge, cargo, and military vessels. At the time of development of the Gulf of St. Lawrence management plan, approximately 6,400 commercial vessels transited the Cabot Strait and the Strait of Belle Isle annually. This represents a subset of the vessels in this area as it only includes commercial vessels (DFO 2013). To address vessel strikes in Canadian waters, the International Maritime Organization (IMO) amended the Traffic Separation Scheme in the Bay of Fundy to reroute vessels around high use areas. In 2007, IMO adopted and Canada implemented a voluntary seasonal Area to Be Avoided (ATBA) in Roseway Basin to further reduce the risk of vessel strike (DFO 2020). In addition, Canada has implemented seasonal speed restrictions and developed a proposed action plan to identify specific measures needed to address threats and achieve recovery (DFO 2020).

The Government of Canada has also implemented measures to mitigate vessel strikes in Canadian waters. Each year since August 2017, the Government has implemented seasonal speed restrictions (maximum 10 knots) for vessels 20 m or longer in the western Gulf of St. Lawrence. In 2019, the area was adjusted and the restriction was expanded to apply to vessels greater than 13 m. Smaller vessels are encouraged to respect the limit. Dynamic area management has also been used in recent years. Currently, there are two shipping lanes, south and north of Anticosti Island, where dynamic speed restrictions (mandatory slowdown to 10 knots) can be activated when right whales are present. In 2020 and 2021, the Government of Canada also implemented a trial voluntary speed restriction zone from Cabot Strait to the eastern edge of the dynamic shipping zone at the beginning and end of the season and a mandatory restricted area in or near Shediac Valley mid-season. More information is available at https://www.tc.gc.ca/en/services/marine/navigation-marine-conditions/protecting-north-atlantic-right-whales-collisions-ships-gulf-st-lawrence.html. Modifications to measures in 2021 include refining the size, location, and duration of the mandatory restricted area in and near Shediac Valley and expanding the speed limit exemption in waters less than 20 fathoms to all commercial fishing vessels. In 2022, a variety of measures were in place to reduce the risk of vessel strike including vessel speed limits and restricted access areas.

Critical Habitat
Critical habitat for North Atlantic right whales has been designated in U.S. waters as described in Section 4.0 of this Opinion.

Recovery Goals
Recovery is the process of restoring endangered and threatened species to the point where they no longer require listing under and the corresponding safeguards of the Endangered Species Act. A recovery plan serves as a road map for species recovery—the plan outlines the path and tasks required to restore and secure self-sustaining wild populations. It is a non-regulatory document that describes, justifies, and schedules the research and management actions necessary to support recovery of a species. The goal of the 2005 Recovery Plan for the North Atlantic right whale (NMFS, 2005) is to promote the recovery of North Atlantic right whales to a level sufficient to warrant their removal from the List of Endangered and Threatened Wildlife and Plants under the ESA. The intermediate recovery goal is to reclassify the species from endangered to threatened. The recovery strategy identified in the Recovery Plan focuses on reducing or eliminating deaths and injuries from anthropogenic activities, namely shipping and commercial fishing operations; developing demographically-based recovery criteria; the characterization, monitoring, and protection of important habitat; identification and monitoring of the status, trends, distribution and health of the species; conducting studies on the effects of other potential threats and ensuring that they are addressed, and conducting genetic studies to assess population structure and diversity. The plan also recognizes the need to work closely with State, other Federal, international and private entities to ensure that research and recovery efforts are coordinated. The recovery plan includes the following downlisting criteria, the achievement of which would demonstrate significant progress toward full recovery:
North Atlantic right whales may be considered for reclassifying to threatened when all of the following have been met: 1) The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population; 2) The population has increased for a period of 35 years at an average rate of increase equal to or greater than 2% per year; 3) None of the known threats to North Atlantic right whales (summarized in the five listing factors) are known to limit the population's growth rate; and 4) Given current and projected threats and environmental conditions, the right whale population has no more than a 1% chance of quasi-extinction in 100 years.

Specific criteria for delisting North Atlantic right whales are not included in the recovery plan; as described in the recovery plan, conditions related to delisting are too distant and hypothetical to realistically develop specific criteria. The current abundance of North Atlantic right whales is currently an order of magnitude less than an abundance at which NMFS would even consider delisting the species. The current dynamics indicate that the North Atlantic right whale population is in decline, rather than recovering, and decades of population growth at rates considered typical for large whales would be required before the population could attain an abundance that may suggest that delisting was appropriate to consider. Specific criteria for delisting North Atlantic right whales will be included in a future revision of the recovery plan well before the population is at a level when delisting becomes a reasonable decision (NMFS 2005).

The most recent five-year review for right whales was completed in 2022 (NMFS 2022). The recommendation in that review was for the status to remain as endangered. As described in the report, the North Atlantic right whale faces continued threat of human-caused mortality due to lethal interactions with commercial fisheries and vessel traffic. As stated in the 5-Year Review, there is also uncertainty regarding the effect of long-term sublethal entanglements, emerging environmental stressors including climate change, and the compounding effects of multiple continuous stressors that may be limiting North Atlantic right whale calving and recovery. In addition, the North Atlantic right whale population has been in a state of decline since 2010. Management measures in the United States have been in place for an extended period of time and continued modifications are underway/anticipated, and measures in Canada since 2017 also suggest continued progress toward implementing conservation regulations. Despite these efforts to reduce the decline and promote recovery, progress toward right whale recovery has continued to regress.

5.1.2 Fin Whale (Balaenoptera physalus)

Globally there is one species of fin whale, *Balaenoptera physalus*. Fin whales occur in all major oceans of the Northern and Southern Hemispheres (NMFS 2010a) (Figure 5.1.3). Within this range, three subspecies of fin whales are recognized: *B. p. physalus* in the Northern Hemisphere, and *B. p. quoyi* and *B. p. patachonica* (a pygmy form) in the Southern Hemisphere (NMFS 2010a). For management purposes in the northern Hemisphere, the United States divides, *B. p. physalus,* into four stocks: Hawaii, California/Oregon/Washington, Alaska (Northeast Pacific), and Western North Atlantic (Hayes et al. 2019, NMFS 2010a).

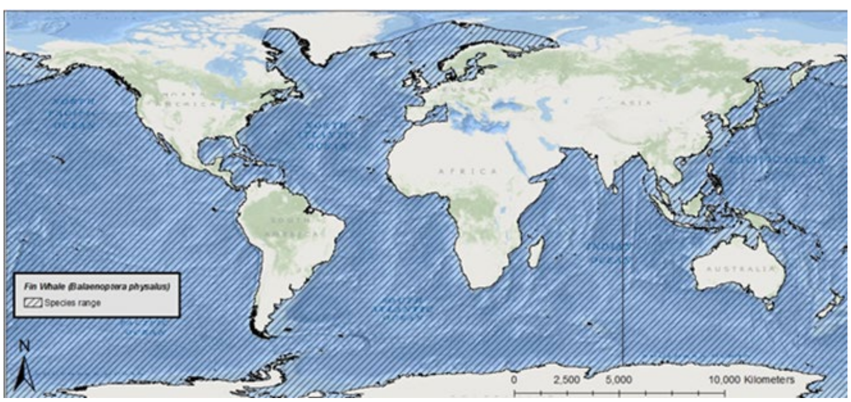


Figure 5.1.3. Range of the fin whale

Fin whales are distinguishable from other whales by a sleek, streamlined body, with a V-shaped head, a tall hooked dorsal fin, and a distinctive color pattern of a black or dark brownish-gray body and sides with a white ventral surface. The lower jaw is gray or black on the left side and creamy white on the right side. The fin whale was listed as endangered on December 2, 1970 (35 FR 18319).

Information available from the recovery plan (NMFS 2010a), recent stock assessment reports (Carretta et al. 2019a, Hayes et al. 2022, Muto et al. 2019), the five-year status review (NMFS 2019b), as well as the recent International Union for the Conservation of Nature's (IUCN) fin whale assessment (Cooke 2018b) were used to summarize the life history, population dynamics and status of the species as follows.

Life History
Fin whales can live, on average, 80 to 90 years. They have a gestation period of less than one year, and calves nurse for six to seven months. Sexual maturity is reached between 6 and 10 years of age with an average calving interval of two to three years. They mostly inhabit deep, offshore waters of all major oceans. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed, although some fin whales appear to be residential to certain areas.

Population Dynamics
The pre-exploitation estimate for the fin whale population in the entire North Atlantic was approximately 30,000-50,000 animals (NMFS 2010a), and for the entire North Pacific Ocean, approximately 42,000 to 45,000 animals (Ohsumi and Wada 1974). In the Southern Hemisphere, prior to exploitation, the fin whale population was approximately 40,000 whales (Mizroch et al. 1984b). In the North Atlantic Ocean, fin whales were heavily exploited from 1864 to the 1980s; over this timeframe, approximately 98,000 to 115,000 fin whales were killed (IWC 2017). Between 1910 and 1975, approximately 76,000 fin whales were recorded taken by modern whaling in the North Pacific; this number is likely higher as many whales killed were not identified to species or while killed, were not successfully landed (Allison 2017). Over 725,000 fin whales were killed in the Southern Hemisphere from 1905 to 1976 (Allison 2017).
In the North Atlantic Ocean, the IWC has defined seven management stocks of fin whales: (1) North Norway (2) East Greenland and West Iceland (EGI); (3) West Norway and the Faroes; (4) British Isles, Spain and Portugal; (5) West Greenland and (6) Nova Scotia, (7) Newfoundland and Labrador (Donovan 1991, NMFS 2010a). Based on three decades of survey data in various portions of the North Atlantic, the IWC estimates that there are approximately 79,000 fin whales in this region. Under the present IWC scheme, fin whales off the eastern United States, Nova Scotia and the southeastern coast of Newfoundland are believed to constitute a single stock; in U.S. waters, NMFS classifies these fin whales as the Western North Atlantic stock (Donovan 1991, Hayes et al. 2019, NMFS 2010a). NMFS' best estimate of abundance for the Western North Atlantic Stock of fin whales is 6,802 individuals (N_{min}=5,573); this estimate is the sum of the 2016 NOAA shipboard and aerial surveys and the 2016 Canadian Northwest Atlantic International Sightings Survey (Hayes et al. 2022). Currently, there is no population estimate for the entire fin whale population in the North Pacific (Cooke 2018b). However, abundance estimates for three stocks in U.S. Pacific Ocean waters do exist: Northeast Pacific (N= 3,168; N_{min}=2,554), Hawaii (N=154; N_{min}=75), and California/Oregon/Washington (N= 9,029; N_{min}=8,127) (Nadeem et al. 2016). Abundance data for the Southern Hemisphere stock remain highly uncertain; however, available information suggests a substantial increase in the population has occurred (Thomas et al. 2016).

In the North Atlantic, estimates of annual growth rate for the entire fin whale population in this region is not available (Cooke 2018b). However, in U.S. Atlantic waters NMFS has determined that until additional data are available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for the Western North Atlantic stock (Hayes et al. 2019). In the North Pacific, estimates of annual growth rate for the entire fin whale population in this region is not available (Cooke 2018b). However, in U.S. Pacific waters, NMFS has determined that until additional data are available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for the Northeast Pacific stock (Muto et al. 2019, NMFS 2016b). Overall population growth rates and total abundance estimates for the Hawaii stock of fin whales are not available at this time (Carretta et al. 2018). Based on line transect studies between 1991-2014, there was estimated a 7.5% increase in mean annual abundance in fin whales occurring in waters off California, Oregon, and Washington; to date, this represents the best available information on the current population trend for the overall California/Oregon/Washington stock of fin whales (Carretta et al. 2019a, Nadeem et al. 2016).[19] For Southern Hemisphere fin whales, as noted above, overall information suggests a substantial increase in the population; however, the rate of increase remains poorly quantified (Cooke 2018b).

Archer et al. (2013) examined the genetic structure and diversity of fin whales globally. Full sequencing of the mitochondrial DNA genome for 154 fin whales sampled in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere, resulted in 136 haplotypes, none of which were shared among ocean basins suggesting differentiation at least at this geographic scale. However, North Atlantic fin whales appear to be more closely related to the Southern Hemisphere population, as compared to fin whales in the North Pacific Ocean, which may indicate a revision of the subspecies delineations is warranted. Generally, haplotype diversity was found to be high both within and across ocean basins (Archer et al. 2013). Such high genetic diversity and lack of differentiation within ocean basins may indicate that despite some populations having small abundance estimates, the species may persist long-term and be somewhat protected from substantial environmental variance and catastrophes. Archer et al. 2019 suggests that within the Northern Hemisphere, populations in the North Pacific and North Atlantic oceans can be considered at least different subspecies, if not different species.

Status

The fin whale is endangered because of past commercial whaling. Prior to commercial whaling, hundreds of thousands of fin whales existed. Fin whales may be killed under "aboriginal subsistence whaling" in Greenland, under Japan's scientific whaling program, and Iceland's formal objection to the IWC's ban on commercial whaling. Additional threats include vessel strikes, reduced prey availability due to overfishing or climate change, and sound. The species' overall large population size may provide some resilience to current threats, but trends are largely unknown. The total annual estimated average human-caused mortality and serious injury for the western North Atlantic fin whale for the period 2015−2019 is 1.85 (1.45 incidental fishery interactions and 0.40 vessel collisions) (Henry et al. 2022). Hayes et al. 2022 notes that these represent a minimum estimate of human-caused mortality, which is, almost certainly biased low.

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[19] Since 2005, the fin whale abundance increase has been driven by increases off northern California, Oregon, and Washington; numbers off Central and Southern California have remained stable (Carretta et al. 2020, Nadeem et al. 2016).

Critical Habitat
No critical habitat has been designated for the fin whale.

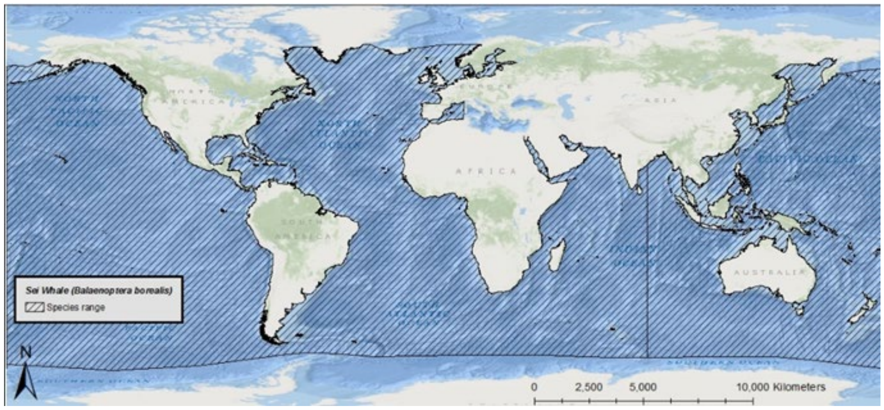
Recovery Goals
The goal of the 2010 Recovery Plan for the fin whale (NMFS 2010a) is to promote the recovery of fin whales to the point at which they can be downlisted from endangered to threatened status, and ultimately to remove them from the list of Endangered and Threatened Wildlife and Plants, under the provisions of the ESA. The intermediate goal is to reclassify the species from endangered to threatened. The recovery plan also includes downlisting and delisting criteria. Key elements for the recovery program for fin whales are:

1. Coordinate state, federal, and international actions to implement recovery actions and maintain international regulation of whaling for fin whales;
2. Determine population discreteness and population structure of fin whales;
3. Develop and apply methods to estimate population size and monitor trends in abundance;
4. Conduct risk analysis;
5. Identify, characterize, protect, and monitor habitat important to fin whale populations in U.S. waters and elsewhere;
6. Investigate causes and reduce the frequency and severity of human-caused injury and mortality;
7. Determine and minimize any detrimental effects of anthropogenic noise in the oceans;
8. Maximize efforts to acquire scientific information from dead, stranded, and/or entrapped fin whales; and,
9. Develop post-delisting monitoring plan.

In February 2019, NMFS published a Five-Year Review for fin whales. This 5-year review indicates that, based on a review of the best available scientific and commercial information, that the fin whale should be downlisted from endangered to threatened. The review also recommended that NMFS consider whether listing at the subspecies or distinct population segment level is appropriate in terms of potential conservation benefits and the use of limited agency resources (NMFS 2019). To date, no changes to the listing for fin whales have been proposed.

5.1.3 Sei Whale (Balaenoptera borealis)
Globally there is one species of sei whale, *Balaenoptera borealis borealis*. Sei whales occur in subtropical, temperate, and subpolar marine waters across the Northern and Southern Hemispheres (Figure 5.1.4) (Cooke 2018a, NMFS 2011a). For management purposes, in the Northern Hemisphere, the United States recognizes four sei whale stocks: Hawaii, Eastern North Pacific, and Nova Scotia (NMFS 2011a).

Figure 5.1.4. Range of the sei whale



Sei whales are distinguishable from other whales by a long, sleek body that is dark bluish-gray to black in color and pale underneath, and a single ridge located on their rostrum. The sei whale was listed as endangered on December 2, 1970 (35 FR 18319).

Information available from the recovery plan (NMFS 2011a), recent stock assessment reports (Carretta et al. 2019a, Hayes et al. 2022, Hayes et al. 2017), 5-Year Review (NMFS 2021), as well as the recent IUCN sei whale assessment (Cooke 2018a) were used to summarize the life history, population dynamics and status of the species as follows.

Life History

Sei whales can live, on average, between 50 and 70 years. They have a gestation period of 10 to 12 months, and calves nurse for six to nine months. Sexual maturity is reached between 6 and 12 years of age with an average calving interval of two to three years. Sei whales mostly inhabit continental shelf and slope waters far from the coastline. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed on a range of prey types, including: plankton (copepods and krill), small schooling fishes, and cephalopods.

Population Dynamics

There are no estimates of pre-exploitation sei whale abundance in the entire North Atlantic Ocean; however, approximately 17,000 sei whales were documented caught by modern whaling in the North Atlantic (Allison 2017). In the North Pacific, the pre-whaling sei abundance was estimated to be approximately 42,000 (Tillman 1977 as cited in (NMFS 2011a)). In the Southern Hemisphere, approximately 63,100 to 65,000 occurred in the Southern Hemisphere prior to exploitation (Mizroch et al. 1984a, NMFS 2011a).

In 1989, the entire North Atlantic sei whale population was estimated to be 10,300 whales (Cattanach et al. 1993 as cited in (NMFS 2011a). While other surveys have been completed in portions of the North Atlantic since 1989, the survey coverage levels in these studies are not as complete as those done in Cattanach et al. (1993) (Cooke 2018a). As a result, to date, updated abundance estimates for the entire North Atlantic population of sei whales are not available. However, in the western North Atlantic, Palka et al. (2017) has provided a recent abundance estimate for the Nova Scotia stock of sei whales. Based on survey data collected from Halifax, Nova Scotia, to Florida between 2010 and 2013, it is estimated that there are approximately

6,292 sei whales (N_{min}=3,098) (Palka et al. 2017); this estimate is considered the best available scientific information for the Nova Scotia stock (NMFS 2021). In the North Pacific, an abundance estimate for the entire North Pacific population of sei whales is not available. However, in the western North Pacific, it is estimated that there are 35,000 sei whales (Cooke 2018a). In the eastern North Pacific (considered east of longitude 180º), two stocks of sei whales occur in U.S. waters: Hawaii and Eastern North Pacific. Abundance estimates for the Hawaii stock are 391 sei whales (N_{min}=204), and for Eastern North Pacific stock, 519 sei whales (N_{min}=374) (Carretta et al. 2019a). In the Southern Hemisphere, recent abundance of sei whales is estimated at 9,800 to 12,000 whales. Population growth rates for sei whales are not available at this time as there are little to no systematic survey efforts to study sei whales; however, in U.S. waters, NMFS has determined that until additional data is available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for the Hawaii, Eastern North Pacific, and Hawaii stocks of sei whales (Hayes 2019).

Based on genetic analyses, there appears to be some differentiation between sei whale populations in different ocean basins. In an early analysis of genetic variation in sei whales, some differences between Southern Ocean and the North Pacific sei whales were detected (Wada and Numachi 1991). However, more recent analyses of mtDNA control region variation show no significant differentiation between Southern Ocean and the North Pacific sei whales, though both appear to be genetically distinct from sei whales in the North Atlantic (Huijser et al. 2018). Within each ocean basin, there appears to be intermediate to high genetic diversity and little genetic differentiation despite there being different managed stocks (Danielsdottir et al. 1991, Kanda et al. 2011, Kanda et al. 2006, Kanda et al. 2013, Kanda et al. 2015).

Status

The sei whale is endangered because of past commercial whaling. Now, only a few individuals are taken each year by Japan. Current threats include vessel strikes, fisheries interactions (including entanglement), climate change (habitat loss and reduced prey availability), and anthropogenic sound. Given the species' overall abundance, they may be somewhat resilient to current threats. However, trends are largely unknown, especially for individual stocks, many of which have relatively low abundance estimates. The most recent 5-year average human-caused mortality and serious injury rate for sei whales in the North Atlantic is 0.80 (0.4 incidental fishery interactions, 0.2 vessel collisions, 0.2 other human-caused mortality; Hayes et al. 2022). These represent a minimum estimate of human-caused mortality, which is almost certainly biased low.

Critical Habitat

No critical habitat has been designated for the sei whale.

Recovery Goals

The 2011 Recovery Plan for the sei whale (NMFS 2011b) indicates that, "because the current population status of sei whales is unknown, the primary purpose of this Recovery Plan is to provide a research strategy to obtain data necessary to estimate population abundance, trends, and structure and to identify factors that may be limiting sei whale recovery." The goal of the Recovery Plan is to promote the recovery of sei whales to the point at which they can be downlisted from Endangered to Threatened status, and ultimately to remove them from the list of

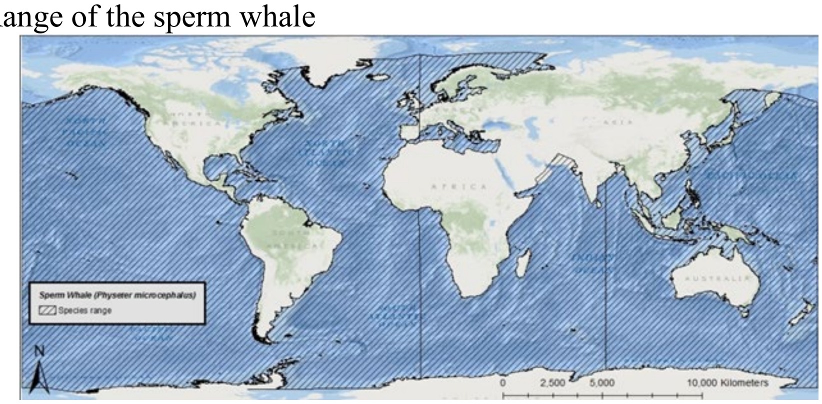
Endangered and Threatened Wildlife and Plants, under the provisions of the ESA. The intermediate goal is to reclassify the species from endangered to threatened. The recovery plan incorporates an adaptive management strategy that divides recovery actions into three tiers. Tier I involves: 1) continued international regulation of whaling (i.e., a moratorium on commercial sei whaling); 2) determining population size, trends, and structure using opportunistic data collection in conjunction with passive acoustic monitoring, if determined to be feasible; and 3) continued stranding response and associated data collection.

NMFS completed the most recent five-year review for sei whales in 2021 (NMFS 2021). In that review, NMFS concluded that the listing status should remain unchanged. They also concluded that recovery criteria outlined in the sei whale recovery plan (NMFS 2011b) do not reflect the best available and most up-to date information on the biology of the species. The 5-Year review states that currently, there is insufficient data to undertake an assessment of the sei whale's present status due to a number of uncertainties and unknowns for this species: (1) lack of scientifically reliable population estimates for the North Atlantic and Southern Hemisphere; (2) lack of comprehensive information on status and trends; (3) existence of critical knowledge gaps; and (4) emergence of potential new threats. Thus, further research is needed to fill critical knowledge gaps.

5.1.4 Sperm Whale (Physter macrocephalus)

Globally there is one species of sperm whale, *Physeter macrocephalus*. Sperm whales occur in all major oceans of the Northern and Southern Hemispheres (NMFS 2010b)(Figure 5.1.5). For management purposes, in the Northern Hemisphere, the United States recognizes six sperm whale stocks: California/Oregon/Washington, Hawaii, North Pacific, North Atlantic, Northern Gulf of Mexico, and Puerto Rico and the U.S. Virgin Islands (NMFS 2010b); see NMFS Marine Mammal Stock Assessment Reports: https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-stock-assessment-reports-species-stock).

Figure 5.1.5. Range of the sperm whale



The sperm whale is the largest toothed whale and distinguishable from other whales by its extremely large head, which takes up 25 to 35% of its total body length and a single blowhole asymmetrically situated on the left side of the head near the tip. The sperm whale was originally listed as endangered on December 2, 1970 (35 FR 18319).

Information available from the recovery plan (NMFS 2010b), recent stock assessment reports (Carretta et al. 2018, Hayes et al. 2020, Muto et al. 2019), status review (NMFS 2015b), as well as the recent IUCN sperm whale assessment (Taylor et al. 2019) were used to summarize the life history, population dynamics and status of the species as follows.

Life History

The average lifespan of sperm whales is estimated to be at least 50 years (Whitehead 2009). They have a gestation period of one to one and a half years, and calves nurse for approximately two years, though they may begin to forage for themselves within the first year of life (Tønnesen et al. 2018). Sexual maturity is reached between 7 and 13 years of age for females with an average calving interval of four to six years. Male sperm whales reach full sexual maturity in their 20s. Sperm whales mostly inhabit areas with a water depth of 600 m or more, and are uncommon in waters less than 300 m deep. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed primarily on squid; other prey includes octopus and demersal fish (including teleosts and elasmobranchs).

Population Dynamics

Pre-whaling, the global population of sperm whales was estimated to be approximately 1,100,000 animals (Taylor et al. 2019, Whitehead 2002). By 1880, due to whaling, the population was approximately 71% of its original level (Whitehead 2002). In 1999, ten years after the end of large-scale whaling, the population was estimated to be about 32% of its original level (Whitehead 2002).

The most recent global sperm whale population estimate is 360,000 whales (Whitehead 2009). There are no reliable estimates for sperm whale abundance across the entire (North and South) Atlantic Ocean. However, estimates are available for two of three U.S. stocks in the western North Atlantic Ocean; the Northern Gulf of Mexico stock is estimated to consist of 763 individuals (N_{min}=560) (Waring et al. 2016) and the North Atlantic stock is estimated to consist of 4,349 individuals (N_{min}=3,451) (Hayes 2019). There are insufficient data to estimate abundance for the Puerto Rico and U.S. Virgin Islands stock. Similar to the Atlantic Ocean, there are no reliable estimates for sperm whale abundance across the entire (North and South) Pacific Ocean. However, estimates are available for two of three U.S. stocks that occur in the eastern Pacific; the California/Oregon/ Washington stock is estimated to consist of 1,997 individuals (N_{min}=1,270; Carretta et al. 2019b), and the Hawaii stock is estimated to consist of 4,559 individuals (N_{min}=3,478) (Carretta et al. 2019a). We are aware of no reliable abundance estimates for sperm whales in other major oceans in the Northern and Southern Hemispheres. Although maximum net productivity rates for sperm whales have not been clearly defined, population growth rates for sperm whale populations are expected to be low (i.e., no more than 1.1% per year) (Whitehead 2002). In U.S. waters, NMFS determined that, until additional data is available, the cetacean maximum theoretical net productivity rate of 4.0% will be used for, among others, the North Atlantic, Northern Gulf of Mexico, and Puerto Rico and the U.S. Virgin Islands stocks of sperm whales (Carretta et al. 2019a, Carretta et al. 2019b, Hayes 2019, Muto et al. 2019, Waring et al. 2010, Waring et al. 2016).

Ocean-wide genetic studies indicate sperm whales have low genetic diversity, suggesting a recent bottleneck, but strong differentiation between matrilineally related groups (Lyrholm and

Gyllensten 1998). Consistent with this, two studies of sperm whales in the Pacific Ocean indicate low genetic diversity (Mesnick et al. 2011, Rendell et al. 2012). Furthermore, sperm whales from the Gulf of Mexico, the western North Atlantic Ocean, the North Sea, and the Mediterranean Sea all have been shown to have low levels of genetic diversity (Engelhaupt et al. 2009). As none of the stocks for which data are available have high levels of genetic diversity, the species may be at some risk to inbreeding and 'allee' effects[20], although the extent to which is currently unknown. Sperm whales have a global distribution and can be found in relatively deep waters in all ocean basins. While both males and females can be found in latitudes less than 40 degrees, only adult males venture into the higher latitudes near the poles.

Status

The sperm whale is endangered as a result of past commercial whaling. Although the aggregate abundance worldwide is probably at least several hundred thousand individuals, the extent of depletion and degree of recovery of populations are uncertain. Commercial whaling is no longer allowed, however, illegal hunting may occur. Continued threats to sperm whale populations include vessel strikes, entanglement in fishing gear, competition for resources due to overfishing, loss of prey and habitat due to climate change, and sound. The Deepwater Horizon Natural Resource Damage Assessment Trustees assessed effects of oil exposure on sea turtles and marine mammals. Sperm whales in the Gulf of Mexico were impacted by the oil spill with 3% of the stock estimated to have died (DWH NRDA Trustees 2016). The most recent SAR for sperm whales in the North Atlantic notes that there were no documented reports of fishery-related mortality or serious injury to the North Atlantic stock in the U.S. EEZ during 2013–2017 (Hayes et al. 2020); there are also no reports in NMFS records from 2018-2023. The species' large population size shows that it is somewhat resilient to current threats. The most recent Five-Year Review for sperm whales was completed in 2015 (NMFS 2015). In that review, NMFS concluded that no change to the listing status was recommended.

Critical Habitat

No critical habitat has been designated for the sperm whale.

Recovery Goals

The goal of the Recovery Plan is to promote recovery of sperm whales to a point at which they can be downlisted from endangered to threatened status, and ultimately to remove them from the list of Endangered and Threatened Wildlife and Plants, under the provisions of the ESA. The primary purpose of the Recovery Plan is to identify and take actions that will minimize or eliminate effects of human activities that are detrimental to the recovery of sperm whale populations. Immediate objectives are to identify factors that may be limiting abundance, recovery, and/or productivity, and cite actions necessary to allow the populations to increase. The Recovery Plan includes downlisting and delisting criteria (NMFS 2010b).

5.2 Sea Turtles

Kemp's ridley and leatherback sea turtles are currently listed under the ESA at the species level; green and loggerhead sea turtles are listed at the DPS level. Therefore, we include information

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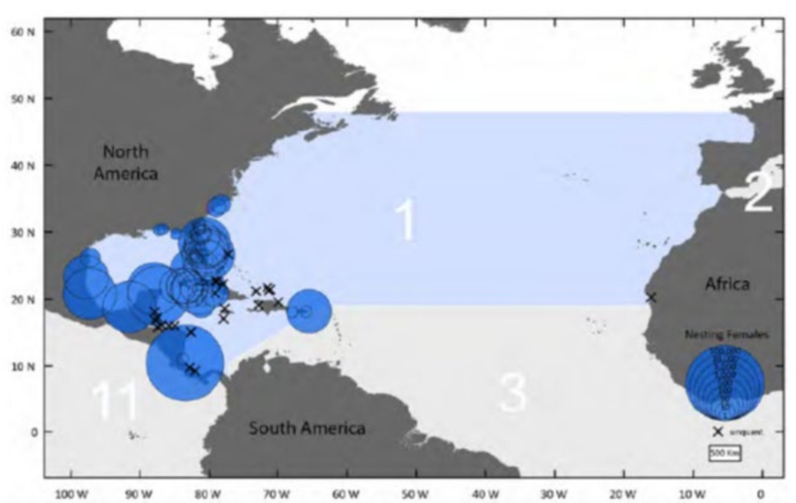
[20] Allee effects are broadly characterized as a decline in individual fitness in populations with a small size or density.

on the range-wide status of Kemp's ridley and leatherback sea turtles to provide the overall status of each species. Information on the status of loggerhead and green sea turtles is for the DPS affected by this action.

5.2.1 Green Sea Turtle (Chelonia mydas, North Atlantic DPS)

The green sea turtle has a circumglobal distribution, occurring throughout tropical, subtropical and, to a lesser extent, temperate waters. They commonly inhabit nearshore and inshore waters. It is the largest of the hardshell marine turtles, growing to a weight of approximately 350 lbs. (159 kg) and a straight carapace length of greater than 3.3 ft. (1 m). The species was listed under the ESA on July 28, 1978 (43 FR 32800) as endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed 11 DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057). The North Atlantic DPS of green turtle is found in the North Atlantic Ocean and Gulf of Mexico (Figure 5.2.1) and is listed as threatened. Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5° N, 77° W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48° N, 77° W) in the north. The range of the DPS then extends due east along latitudes 48° N and 19° N to the western coasts of Europe and Africa.

Figure 5.2.1. Range of the North Atlantic distinct population segment green turtle (1), with location and abundance of nesting females (Seminoff et al. 2015).



We used information available in the 2015 Status Review (Seminoff et al. 2015), relevant literature, and recent nesting data from the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) to summarize the life history, population dynamics and status of the species, as follows.

Life History

Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, Quintana Roo), United States (Florida) and Cuba support nesting concentrations of particular interest in the North Atlantic DPS (Seminoff et al. 2015). The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79% of nesting females for the DPS (Seminoff et al. 2015). In the southeastern United States, females generally nest between May and September (Seminoff et al.

2015, Witherington et al. 2006). Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest (Hirth 1997, Seminoff et al. 2015). The remigration interval (period between nesting seasons) is two to five years (Hirth 1997, Seminoff et al. 2015). Nesting occurs primarily on beaches with intact dune structure, native vegetation, and appropriate incubation temperatures during the summer months.

Sea turtles are long-lived animals. Size and age at sexual maturity have been estimated using several methods, including mark-recapture, skeletochronology, and marked known-aged individuals. Skeletochronology analyzes growth marks in bones to obtain growth rates and age at sexual maturity estimates. Estimates vary widely among studies and populations, and methods continue to be developed and refined (Avens and Snover 2013). Early mark-recapture studies in Florida estimated the age at sexual maturity 18-30 years (Frazer and Ehrhart 1985, Goshe et al. 2010, Mendonça 1981). More recent estimates of age at sexual maturity are as high as 35–50 years (Avens and Snover 2013, Goshe et al. 2010), with lower ranges reported from known age (15–19 years) turtles from the Cayman Islands (Bell et al. 2005) and Caribbean Mexico (12–20 years) (Zurita et al. 2012). A study of green turtles that use waters of the southeastern United States as developmental habitat found the age at sexual maturity likely ranges from 30 to 44 years (Goshe et al. 2010). Green turtles in the Northwestern Atlantic mature at 2.8-33+ ft. (85–100+ cm) straight carapace lengths (SCL) (Avens and Snover 2013).

Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat other invertebrate prey (Seminoff et al. 2015).

Population Dynamics

The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the DPS. Evidence from mitochondrial DNA studies indicates that there are at least four independent nesting subpopulations in Florida, Cuba, Mexico, and Costa Rica (Seminoff et al. 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

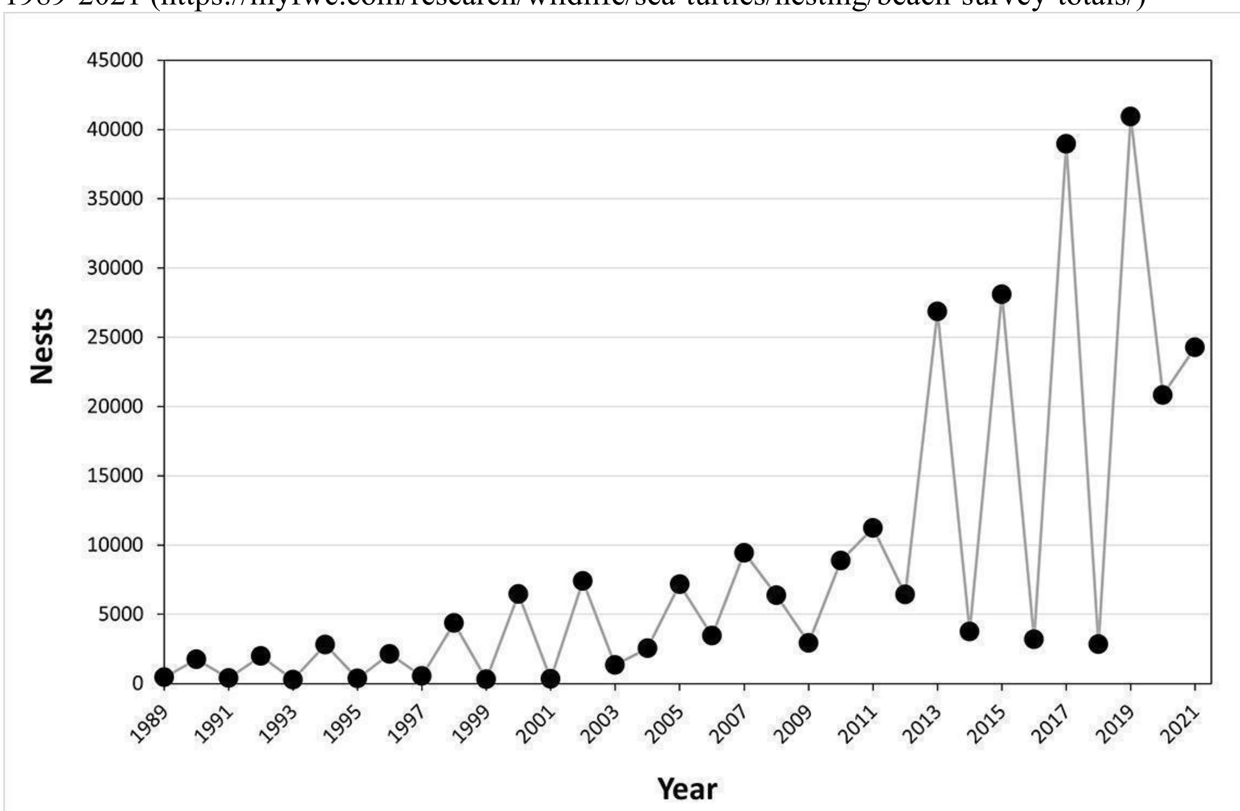
Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at seventy-three nesting sites (using data through 2012), and available data indicated an increasing trend in nesting (Seminoff et al. 2015). Counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. The status review for green sea turtles assessed population trends for seven nesting sites with more than10 years of data collection in the North Atlantic DPS. The results were variable with some sites showing no trend and others increasing. However, all major nesting populations (using data through 2011-2012) demonstrated increases in abundance (Seminoff et al. 2015).

Recent data is available for the southeastern United States. The FWRI monitors sea turtle nesting through the Statewide Nesting Beach Survey (SNBS) and Index Nesting Beach Survey (INBS). Since 1979, the SNBS has surveyed approximately 215 beaches to collect information on the distribution, seasonality, and abundance of sea turtle nesting in Florida. Since 1989, the INBS has been conducted on a subset of SNBS beaches to monitor trends through consistent effort and specialized training of surveyors. The INBS data uses a standardized data-collection protocol to allow for comparisons between years and is presented for green, loggerhead, and leatherback sea turtles. The index counts represent 27 core index beaches and do not represent Florida's total annual nest counts because they are collected only on a subset of Florida's beaches (27 out of 224 beaches) and only during a 109-day time window (15 May through 31 August). The index nest counts represent approximately 67% of known green turtle nesting in Florida (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/).

Green turtle nest counts have increased eightyfold since standardized nest counts began in 1989. In 2021, green turtle nest counts on the 27-core index beaches reached more than 24,000 nests recorded. Nesting green turtles tend to follow a two-year reproductive cycle and, typically, there are wide year-to-year fluctuations in the number of nests recorded. Green turtles set record highs in 2011, 2013, 2015, 2017, and 2019. The nest count in 2021 did not set another record high but was only marginally higher than 2020, an unusually high "low year." FWRI reports that changes in the typical two-year cycle have been documented in the past as well (e.g., 2010-2011) and are not reason of concern.

Figure 5.2.2. Number of green sea turtle nests counted on core index beaches in Florida from 1989-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/)



Status
Historically, green sea turtles in the threatened North Atlantic DPS were hunted for food, which was the principal cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, which is between 30 and 40 years (Seminoff et al. 2015). While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

Critical Habitat
Critical habitat for the North Atlantic DPS of green sea turtles surrounds Culebra Island, Puerto Rico (66 FR 20058, April 6, 2016), which is outside the action area. On July 19, 2023, NMFS published a proposed rule to designate specific areas in the marine environment as critical habitat for six DPSs of the green sea turtle, including the North Atlantic DPS. A portion of the proposed critical habitat overlaps with the action area; however, we have not identified any effects of the action on the proposed critical habitat.

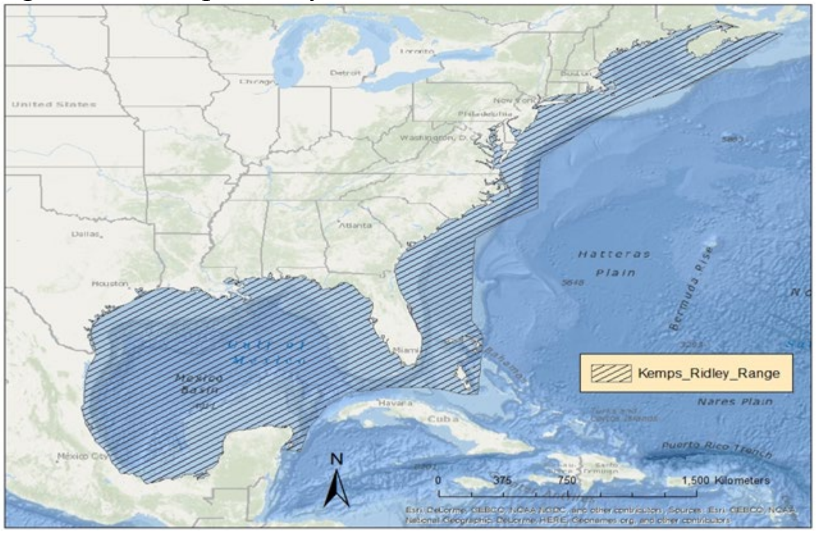
Recovery Goals
The most recent Recovery Plan for the U.S. population of green sea turtles in the Atlantic was published in 1991. The goal of the 1991 Recovery Plan is to delist the species once the recovery criteria are met (NMFS and U.S.FWS 1991). The recovery plan includes criteria for delisting related to nesting activity, nesting habitat protection, and reduction in mortality.
Priority actions to meet the recovery goals include:

1. Providing long-term protection to important nesting beaches.
2. Ensuring at least a 60% hatch rate success on major nesting beaches.
3. Implementing effective lighting ordinances/plans on nesting beaches.
4. Determining distribution and seasonal movements of all life stages in the marine environment.
5. Minimizing commercial fishing mortality.
6. Reducing threat to the population and foraging habitat from marine pollution.

5.2.2 Kemp's Ridley Sea Turtle (Lepidochelys kempii)
The range of Kemp's ridley sea turtles extends from the Gulf of Mexico to the Atlantic coast (Figure 5.2.3). They have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomás and Raga 2008). They are the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell. The species was first listed under the Endangered Species Conservation Act (35 FR 18319, December 2, 1970) in 1970. The species has been listed as endangered under the ESA since 1973.

We used information available in the revised recovery plan (NMFS et al. 2011), the five-year review (NMFS and USFWS 2015), and published literature to summarize the life history, population dynamics and status of the species, as follows.

Figure 5.2.3. Range of the Kemp's ridley sea turtle



Life History

Kemp's ridley nesting is essentially limited to the western Gulf of Mexico. Approximately 97% of the global population's nesting activity occurs on a 90-mile (146-km) stretch of beach that includes Rancho Nuevo in Mexico (Wibbels and Bevan 2019). In the United States, nesting occurs primarily in Texas and occasionally in Florida, Alabama, Georgia, South Carolina, and North Carolina (NMFS and USFWS 2015). Nesting occurs from April to July in large arribadas (synchronized large-scale nesting). The average remigration interval is two years, although intervals of 1 and 3 years are not uncommon (NMFS et al. 2011, TEWG 1998, 2000). Females lay an average of 2.5 clutches per season (NMFS et al. 2011). The annual average clutch size is 95 to 112 eggs per nest (NMFS and USFWS 2015). The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats (Epperly et al. 2013, NMFS and USFWS 2015, Snover et al. 2007). Modeling indicates that oceanic-stage Kemp's ridley turtles are likely distributed throughout the Gulf of Mexico into the northwestern Atlantic (Putman et al. 2013). Kemp's ridley nearing the age when recruitment to nearshore waters occurs are more likely to be distributed in the northern Gulf of Mexico, eastern Gulf of Mexico, and the western Atlantic (Putman et al. 2013).

Several studies, including those of captive turtles, recaptured turtles of known age, mark-recapture data, and skeletochronology, have estimated the average age at sexual maturity for Kemp's ridleys between 5 to 12 years (captive only) (Bjorndal et al. 2014), 10 to 16 years (Chaloupka and Zug 1997, Schmid and Witzell 1997, Schmid and Woodhead 2000, Zug et al. 1997), 9.9 to 16.7 years (Snover et al. 2007), 10 and 18 years (Shaver and Wibbels 2007), 6.8 to 21.8 years (mean 12.9 years) (Avens et al. 2017).

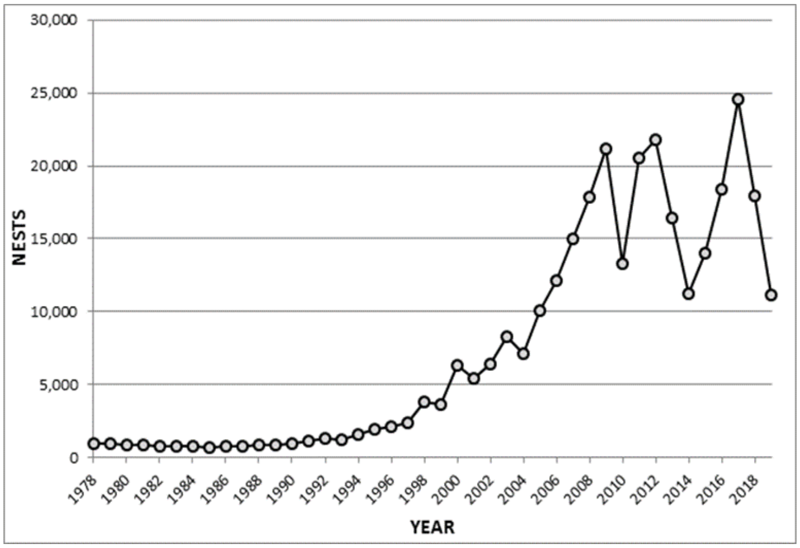
During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida and along the U.S. Atlantic coast from southern Florida to the Mid-Atlantic and New England. The NEFSC caught a juvenile Kemp's ridley during a research project in deep water south of Georges Bank (NEFSC, unpublished data). In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter. As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2011). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 ft. (37 m) deep (Seney and Landry 2008, Shaver et al. 2005, Shaver and Rubio 2008), although they can also be found in deeper offshore waters. As larger juveniles and adults, Kemp's ridleys forage on swimming crabs, fish, mollusks, and tunicates (NMFS et al. 2011).

Population Dynamics
Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased at 15% annually (Heppell et al. 2005). However, due to recent declines in nest counts, decreased survival of immature and adult sea turtles, and updated population modeling, this rate is not expected to continue and the overall trend is unclear (Caillouet et al. 2018, NMFS and USFWS 2015). In 2019, there were 11,090 nests, a 37.61% decrease from 2018, and a 54.89% decrease from 2017, which had the highest number (24,587) of nests (Figure 5.2.4; unpublished data). The reason for this recent decline is uncertain. In 2021, 198 Kemp's ridley nests were found in Texas – the largest number recorded in Texas since 1978 was in 2017, when 353 nests were documented.

Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of 2 years, and a sex ratio of 3.17 females: 1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019). Genetic variability in Kemp's ridley turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS et al. 2011). If this holds true, rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS et al. 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

Status
The Kemp's ridley was listed as endangered at the species level in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances in Mexico prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. Nesting beaches in Texas have been re-established. Fishery interactions are the main threat to the species. Other threats include habitat destruction, oil spills, dredging, disease, cold stunning, and climate change. The current population trend is uncertain. While the population has increased, recent nesting numbers have been variable. In addition, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation affecting survival and nesting success is low.

Figure 5.2.4. Kemp's ridley nest totals from Mexican beaches (Gladys Porter Zoo nesting database 2019)



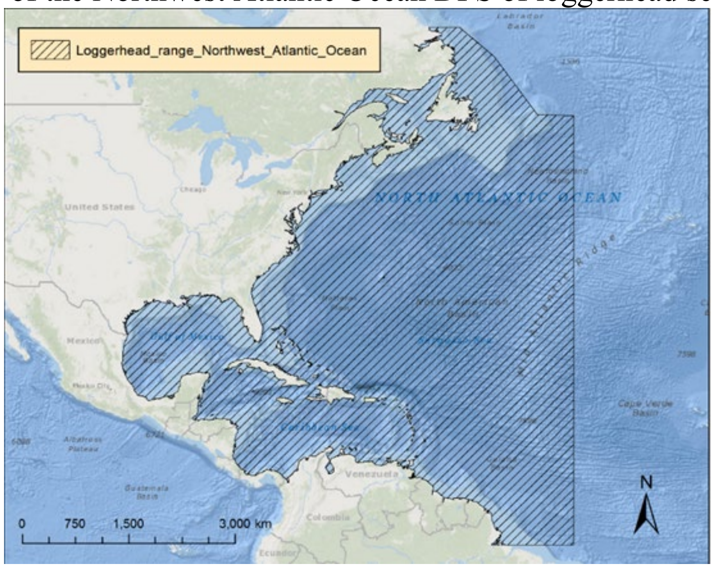
Critical Habitat
Critical habitat has not been designated for Kemp's ridley sea turtles.

Recovery Goals
As with other recovery plans, the goal of the 2011 Kemp's ridley recovery plan (NMFS, USFWS, and SEMARNAT 2011) is to conserve and protect the species so that the listing is no longer necessary. The recovery criteria relate to the number of nesting females, hatchling recruitment, habitat protection, social and/or economic initiatives compatible with conservation, reduction of predation, TED or other protective measures in trawl gear, and improved information available to ensure recovery. In 2015, the bi-national recovery team published a number of recommendations including four critical actions (NMFS and USFWS 2015). These include: (a) continue funding by the major funding institutions at a level of support needed to run the successful turtle camps in the State of Tamaulipas, Mexico, in order to continue the high level of hatchling production and nesting female protection; (b) increase turtle excluder device (TED) compliance in U.S. and MX shrimp fisheries; (c) require TEDs in U.S. skimmer trawl fisheries and other trawl fisheries in coastal waters where fishing overlaps with the distribution of Kemp's ridleys; (d) assess bycatch in gillnets in the Northern Gulf of Mexico and State of Tamaulipas, Mexico, to determine whether modifications to gear or fishing practices are needed. The most recent Five-Year Review was completed in 2015 (NMFS and USFWS 2015) with a recommendation that the status of Kemp's ridley sea turtles should remain as endangered. In the Plan, the Services recommend that efforts continue towards achieving the major recovery actions in the 2015 plan with a priority for actions to address recent declines in the annual number of nests.

5.2.3 Loggerhead Sea Turtle (Caretta caretta, Northwest Atlantic Ocean DPS)
Loggerhead sea turtles are circumglobal and are found in the temperate and tropical regions of the Indian, Pacific, and Atlantic Oceans. The loggerhead sea turtle is distinguished from other

turtles by its reddish-brown carapace, large head and powerful jaws. The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800, July 28, 1978). On September 22, 2011, the NMFS and USFWS designated nine distinct population segments of loggerhead sea turtles, with the Northwest Atlantic Ocean DPS listed as threatened (76 FR 58868). The Northwest Atlantic Ocean DPS of loggerheads is found along eastern North America, Central America, and northern South America (Figure 5.2.5).

Figure 5.2.5. Range of the Northwest Atlantic Ocean DPS of loggerhead sea turtles



We used information available in the 2009 Status Review (Conant et al. 2009), the final listing rule (76 FR 58868, September 22, 2011), the relevant literature, and recent nesting data from the FWRI to summarize the life history, population dynamics and status of the species, as follows.

Life History

Nesting occurs on beaches where warm, humid sand temperatures incubate the eggs. Northwest Atlantic females lay an average of five clutches per year. The annual average clutch size is 115 eggs per nest. Females do not nest every year. The average remigration interval is three years. There is a 54% emergence success rate (Conant et al. 2009). As with other sea turtles, temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in coastal waters. Some juveniles may periodically move between the oceanic zone and coastal waters (Bolten 2003, Conant et al. 2009, Mansfield 2006, Morreale and Standora 2005, Witzell 2002). Coastal waters provide important foraging, inter-nesting, and migratory habitats for adult loggerheads. In both the oceanic zone and coastal waters, loggerheads are primarily carnivorous, although they do consume some plant matter as well (Conant et al. 2009). Loggerheads have been documented to feed on crustaceans, mollusks, jellyfish and salps, and algae (Bjorndal 1997, Donaton et al. 2019, Seney and Musick 2007). Avens et al. (2015) used three approaches to estimate age at maturation. Mean age predictions associated with minimum and mean maturation straight carapace lengths were 22.5-25 and 36-38 years for females and 26-28 and 37-42 years for males. Male and female sea turtles have similar post-maturation longevity, ranging from 4 to 46 (mean 19) years (Avens et al. 2015).

Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. MtDNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71%-88%) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madeira, Canary Islands and Andalusia, Gulf of Mexico, and Brazil (Masuda 2010). LaCasalla et al. (2013) found that loggerheads, primarily juveniles, caught within the Northeast Distant (NED) waters of the North Atlantic mostly originated from nesting populations in the southeast United States and, in particular, Florida. They found that nearly all loggerheads caught in the NED came from the Northwest Atlantic DPS (mean = 99.2%), primarily from the large eastern Florida rookeries. There was little evidence of contributions from the South Atlantic, Northeast Atlantic, or Mediterranean DPSs (LaCasella et al. 2013). A more recent analysis assessed sea turtles captured in fisheries in the Northwest Atlantic and included samples from 850 (including 24 turtles caught during fisheries research) turtles caught from 2000-2013 in coastal and oceanic habitats (Stewart et al. 2019). The turtles were primarily captured in pelagic longline and bottom otter trawls. Other gears included bottom longline, hook and line, gillnet, dredge, and dip net. Turtles were identified from 19 distinct management units; the western Atlantic nesting populations were the main contributors with little representation from the Northeast Atlantic, Mediterranean, or South Atlantic DPSs (Stewart et al. 2019). There was a significant split in the distribution of small (≤ 2 ft. (63 cm) SCL) and large (> 2 ft. (63 cm) SCL) loggerheads north and south of Cape Hatteras, North Carolina. North of Cape Hatteras, large turtles came mainly from southeast Florida (44%±15%) and the northern United States management units (33%±16%); small turtles came from central east Florida (64%±14%). South of Cape Hatteras, large turtles came mainly from central east Florida (52%±20%) and southeast Florida (41%±20%); small turtles came from southeast Florida (56%±25%). The authors concluded that bycatch in the western North Atlantic would affect the Northwest Atlantic DPS almost exclusively (Stewart et al. 2019).

Population Dynamics

A number of stock assessments and similar reviews (Conant et al. 2009, Heppell et al. 2005, NMFS SEFSC 2001, 2009, Richards et al. 2011, TEWG 1998, 2000, 2009) have examined the stock status of loggerheads in the Atlantic Ocean, but none has been able to develop a reliable estimate of absolute population size. As with other species, counts of nests and nesting females are commonly used as an index of abundance and population trends, even though there are doubts about the ability to estimate the overall population size.

Based on genetic analysis of nesting subpopulations, the Northwest Atlantic Ocean DPS is divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant et al. 2009). A more recent analysis using expanded mtDNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct (Shamblin et al. 2014). The recent genetic analyses suggest that the Northwest Atlantic Ocean DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012).

The Northwest Atlantic Ocean's loggerhead nesting aggregation is considered the largest in the world (Casale and Tucker 2017). Using data from 2004-2008, the adult female population size of the DPS was estimated at 20,000 to 40,000 females (NMFS SEFSC 2009). More recently, Ceriani and Meylan (2017) reported a 5-year average (2009-2013) of more than 83,717 nests per year in the southeast United States and Mexico (excluding Cancun (Quintana Roo, Mexico). These estimates included sites without long-term (≥10 years) datasets. When they used data from 86 index sites (representing 63.4% of the estimated nests for the whole DPS with long-term datasets, they reported 53,043 nests per year. Trends at the different index nesting beaches ranged from negative to positive. In a trend analysis of the 86 index sites, the overall trend for the Northwest Atlantic DPS was positive (+2%) (Ceriani and Meylan 2017). Uncertainties in this analysis include, among others, using nesting females as proxies for overall population abundance and trends, demographic parameters, monitoring methodologies, and evaluation methods involving simple comparisons of early and later 5-year average annual nest counts. However, the authors concluded that the subpopulation is well monitored and the data evaluated represents 63.4 % of the total estimated annual nests of the subpopulation and, therefore, are representative of the overall trend (Ceriani and Meylan 2017).

About 80% of loggerhead nesting in the southeast United States occurs in six Florida counties (NMFS and USFWS 2008). The Peninsula Florida Recovery Unit and the Northern Recovery Unit represent approximately 87% and 10%, respectively of all nesting effort in the Northwest Atlantic DPS (Ceriani and Meylan 2017, NMFS and USFWS 2008). As described above, FWRI's INBS collects standardized nesting data. The index nest counts for loggerheads represent approximately 53% of known nesting in Florida. There have been three distinct intervals observed: increasing (1989-1998), decreasing (1998-2007), and increasing (2007-2021). At core index beaches in Florida, nesting totaled a minimum of 28,876 nests in 2007 and a maximum of 65,807 nests in 2016 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In 2019, more than 53,000 nests were documented. In 2020, loggerhead turtles had another successful nesting season with more than 49,100 nests documented. The nest counts in Figure 5.2.6 represent peninsular Florida and do not include an additional set of beaches in the Florida Panhandle and southwest coast that were added to the program in 1997. Nest counts at these Florida Panhandle index beaches have an upward trend since 2010 (Figure 5.2.7).

Figure 5.2.6. Annual nest counts of loggerhead sea turtles on Florida core index beaches in peninsular Florida, 1989-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/)

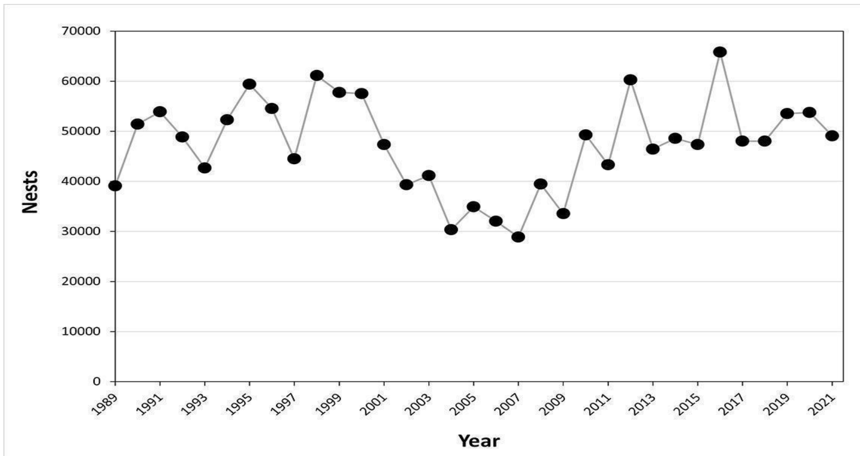
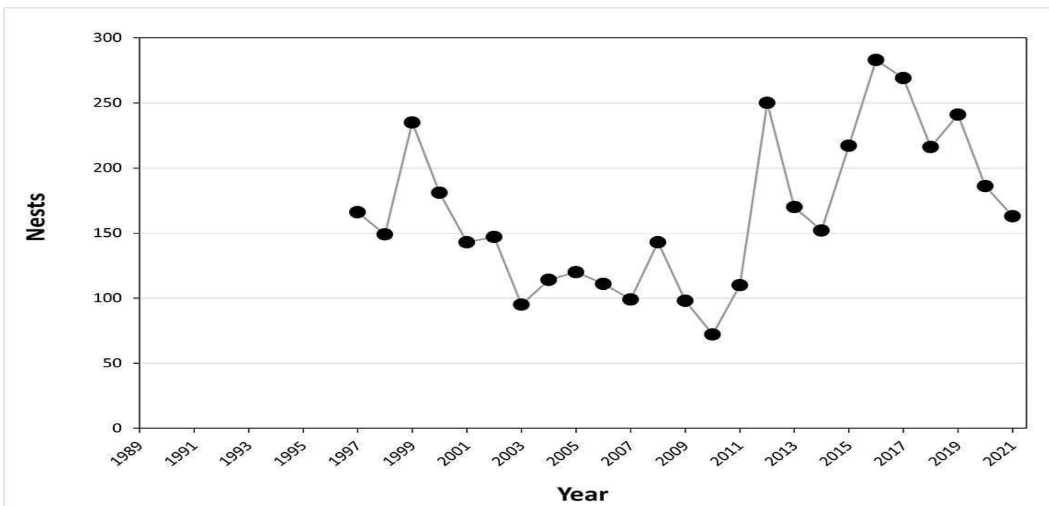


Figure 5.2.7. Annual nest counts of loggerhead sea turtles on index beaches in the Florida Panhandle, 1997-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/)



The annual nest counts on Florida's index beaches fluctuate widely, and we do not fully understand what drives these fluctuations. In assessing the population, Ceriani and Meylan (2017) and Bolten et al. (2019) looked at trends by recovery unit. Trends by recovery unit were variable.

The Peninsular Florida Recovery Unit extends from the Georgia-Florida border south and then north (excluding the islands west of Key West, Florida) through Pinellas County on the west coast of Florida. Annual nest counts from 1989 to 2018 ranged from a low of 28,876 in 2007 to a high of 65,807 in 1998 (Bolten et al. 2019). More recently (2008-2018), counts have ranged from 33,532 in 2009 to 65,807 in 2016 (Bolten et al. 2019). Nest counts taken at index beaches in Peninsular Florida showed a significant decline in loggerhead nesting from 1989 to 2007, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Trend analyses have been completed for various periods. From 2009 through 2013, a 2% decrease for this recovery unit was reported (Ceriani and Meylan 2017). Using a longer time series from 1989-2018, there was no significant change in the number of annual nests (Bolten et al. 2019). It is important to recognize that an increase in the number of nests has been observed since 2007. The recovery team cautions that using short term trends in nesting abundance can be misleading and trends should be considered in the context of one generation (50 years for loggerheads) (Bolten et al. 2019).

The Northern Recovery Unit, ranging from the Florida-Georgia border through southern Virginia, is the second largest nesting aggregation in the DPS. Annual nest totals for this recovery unit from 1983 to 2019 have ranged from a low of 520 in 2004 to a high of 5,555 in 2019 (Bolten et al. 2019). From 2008 to 2019, counts have ranged from 1,289 nests in 2014 to 5,555 nests in 2019 (Bolten et al. 2019). Nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and USFWS 2008). Recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer-term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3% (Bolten et al. 2019). The Dry Tortugas Recovery Unit includes all islands west of Key West, Florida. A census on Key West from 1995 to 2004 (excluding 2002) estimated a mean of 246 nests per year, or about 60 nesting females (NMFS and USFWS 2008). No trend analysis is available because there was not an adequate time series to evaluate the Dry Tortugas recovery unit (Ceriani et al. 2019, Ceriani and Meylan 2017), which accounts for less than 1% of the Northwest Atlantic DPS (Ceriani and Meylan 2017).

The Northern Gulf of Mexico Recovery Unit is defined as loggerheads originating from beaches in Franklin County on the northwest Gulf coast of Florida through Texas. From 1995 to 2007, there were an average of 906 nests per year on approximately 300 km of beach in Alabama and Florida, which equates to about 221 females nesting per year (NMFS and USFWS 2008). Annual nest totals for this recovery unit from 1997-2018 have ranged from a low of 72 in 2010 to a high of 283 in 2016 (Bolten et al. 2019). Evaluation of long-term nesting trends for the Northern Gulf of Mexico Recovery Unit is difficult because of changed and expanded beach coverage. However, there are now over 20 years of Florida index nesting beach survey data. A number of trend analyses have been conducted. From 1995 to 2005, the recovery unit exhibited a significant declining trend (Conant et al. 2009, NMFS, and USFWS 2008). Nest numbers have increased in recent years (Bolten et al. 2019) (see https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). In the 2009-2013 trend analysis by Ceriani and Meylan (2017), a 1% decrease for this recovery unit was reported, likely due to diminished nesting on beaches in Alabama, Mississippi, Louisiana, and Texas. A longer-term analysis from 1997-2018 found that there has been a non-significant increase of 1.7% (Bolten et al. 2019).

The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán Peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita et al. 2003). Other significant nesting sites are found throughout the Caribbean, including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003), and over 100 nests annually in Cay Sal in the Bahamas (NMFS and USFWS 2008). In the trend analysis by Ceriani and Meylan (2017), a 53% increase for this Recovery Unit was reported from 2009 through 2013.

Status
Fisheries bycatch is the highest threat to the threatened Northwest Atlantic DPS of loggerhead sea turtles (Conant et al. 2009). Other threats include boat strikes, marine debris, coastal development, habitat loss, contaminants, disease, and climate change. Nesting trends for each of the loggerhead sea turtle recovery units in the Northwest Atlantic Ocean DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

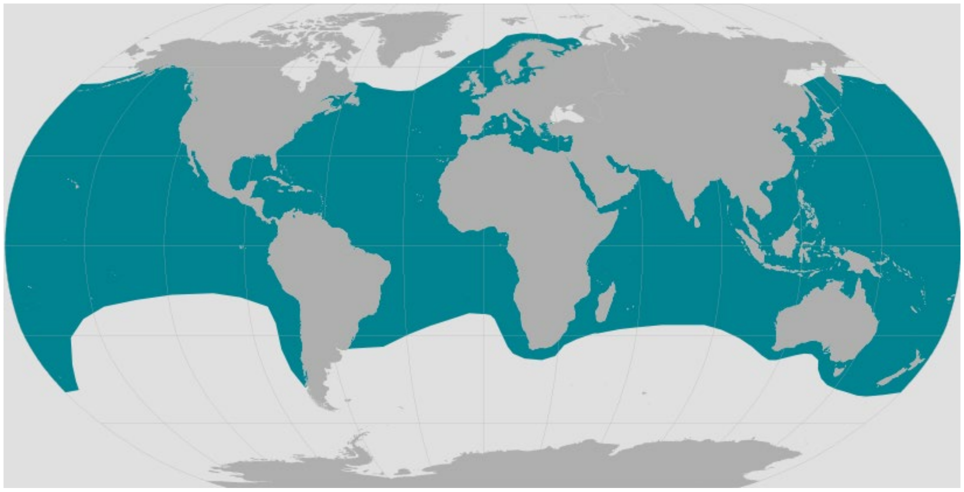
Critical Habitat
Critical habitat for the Northwest Atlantic DPS was designated in 2014 (see Section 4).

Recovery Goals
The recovery goal for the Northwest Atlantic loggerhead is to ensure that each recovery unit meets its recovery criteria, alleviating threats to the species so that protection under the ESA is not needed. The recovery criteria relate to the number of nests and nesting females, trends in abundance on the foraging grounds, and trends in neritic strandings relative to in-water abundance. The 2008 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads includes the complete downlisting/delisting criteria (NMFS and U.S. FWS 2008). The recovery objectives to meet these goals include:

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.
8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

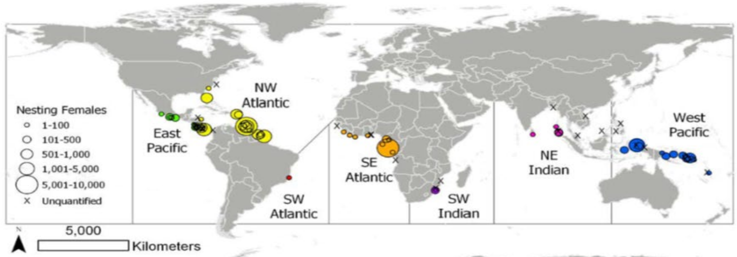
5.2.4 Leatherback Sea Turtle (Dermochelys coriacea)
The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (Figure 5.2.8).

Figure 5.2.8. Range of the leatherback sea turtle



Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their plastron. The species was first listed under the Endangered Species Conservation Act (35 FR 8491, June 2, 1970) and has been listed as endangered under the ESA since 1973. In 2020, seven leatherback populations that met the discreteness and significance criteria of the distinct population segment policy were identified (NMFS and USFWS 2020). The population found within the action area is the Northwest Atlantic population segment (NW Atlantic) (Figure 5.2.9). NMFS and USFWS concluded that the seven populations, which met the criteria for DPSs, all met the definition of an endangered species. However, NMFS and USFWS determined that the listing of DPSs was not warranted; leatherbacks continue to be listed as a species at the global level (85 FR 48332, August 10, 2020). Therefore, information is presented on the range-wide status of the species. We used information available in the five-year review (NMFS and USFWS 2013), the critical habitat designation (44 FR 17710, March 23, 1979), the most recent status review (NMFS and USFWS 2020), relevant literature, and recent nesting data from the Florida FWRI to summarize the life history, population dynamics and status of the species, as follows.

Figure 5.2.9. Leatherback sea turtle DPSs and nesting beaches (NMFS and USFWS 2020)



Life History

Leatherbacks are a long-lived species. Preferred nesting grounds are in the tropics; though, nests span latitudes from 34 °S in Western Cape, South Africa to 38 °N in Maryland (Eckert et al. 2012, Eckert et al. 2015). Females lay an average of five to seven clutches (range: 1-14 clutches) per season, with 20 to over 100 eggs per clutch (Eckert et al. 2012, Reina et al. 2002, Wallace et al. 2007). The average clutch frequency for the NW Atlantic population segment is 5.5 clutches per season (NMFS and USFWS 2020). In the western Atlantic, leatherbacks lay about 82 eggs per clutch (Sotherland et al. 2015). Remigration intervals are 2-4 years for most populations (range 1-11 years) (Eckert et al. 2015, NMFS and USFWS 2020); the remigration interval for the NW Atlantic population segment is approximately 3 years (NMFS and USFWS 2020). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergence success) is approximately 50% worldwide (Eckert et al. 2012).

Age at sexual maturity has been challenging to obtain given the species physiology and habitat use (Avens et al. 2019). Past estimates ranged from 5-29 years (Avens et al. 2009, Spotila et al. 1996). More recently, Avens et al. (2020) used refined skeletochronology to assess the age at sexual maturity for leatherback sea turtles in the Atlantic and the Pacific. In the Atlantic, the mean age at sexual maturity was 19 years (range 13-28) and the mean size at sexual maturity was 4.2 ft. (129.2 cm) CCL (range (3.7-5 ft. (112.8-153.8 cm)). In the Pacific, the mean age at sexual maturity was 17 years (range 12-28) and the mean size at sexual maturity was 4.2 ft. (129.3 cm) CCL (range 3.6- 5 ft. (110.7-152.3 cm)) (Avens et al. 2019).

Leatherbacks have a greater tolerance for colder waters compared to all other sea turtle species due to their thermoregulatory capabilities (Paladino et al. 1990, Shoop and Kenney 1992, Wallace and Jones 2008). Evidence from tag returns, satellite telemetry, and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between temperate/boreal and tropical waters (Bond and James 2017, Dodge et al. 2015, Eckert et al. 2006, Fossette et al. 2014, James et al. 2005a, James et al. 2005b, James et al. 2005c, NMFS and USFWS 1992). Tagging studies collectively show a clear separation of leatherback movements between the North and South Atlantic Oceans (NMFS and USFWS 2020).

Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33% more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005c, Wallace et al. 2006). Studies on the foraging ecology of leatherbacks in the North Atlantic show that leatherbacks off Massachusetts primarily consumed lion's mane, sea nettles, and ctenophores (Dodge et al. 2011). Juvenile and small sub-adult leatherbacks may spend more time in oligotrophic (relatively low plant nutrient usually accompanied by high dissolved oxygen) open ocean waters where prey is more difficult to find (Dodge et al. 2011). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals are dependent upon foraging success and duration (Hays 2000, Price et al. 2004).

Population Dynamics

The distribution is global, with nesting beaches in the Pacific, Atlantic, and Indian Oceans. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (NMFS and USFWS 2020, Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011).

Analyses of mtDNA from leatherback sea turtles indicates a low level of genetic diversity (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian Oceans suggest that each of the rookeries represent demographically independent populations (NMFS and USFWS 2013). Using genetic data, combined with nesting, tagging, and tracking data, researchers identified seven global regional management units (RMU) or subpopulations: Northwest Atlantic, Southeast Atlantic, Southwest Atlantic, Northwest Indian, Southwest Indian, East Pacific, and West Pacific (Wallace et al. 2010). The status review concluded that the RMUs identified by Wallace et al. (2010) are discrete populations and, then, evaluated whether any other populations exhibit this level of genetic discontinuity (NMFS and USFWS 2020).

To evaluate the RMUs and fine-scale structure in the Atlantic, Dutton et al. (2013) conducted a comprehensive genetic re-analysis of rookery stock structure. Samples from eight nesting sites in the Atlantic and one in the southwest Indian Ocean identified seven management units in the Atlantic and revealed fine scale genetic differentiation among neighboring populations. The mtDNA analysis failed to find significant differentiation between Florida and Costa Rica or between Trinidad and French Guiana/Suriname (Dutton et al. 2013). While Dutton et al. (2013) identified fine-scale genetic partitioning in the Atlantic Ocean, the differences did not rise to the level of marked separation or discreteness (NMFS and USFWS 2020). Other genetic analyses corroborate the conclusions of Dutton et al. (2013). These studies analyzed nesting sites in French Guiana (Molfetti et al. 2013), nesting and foraging areas in Brazil (Vargas et al. 2019), and nesting beaches in the Caribbean (Carreras et al. 2013). These studies all support three discrete populations in the Atlantic (NMFS and USFWS 2020). While these studies detected fine-scale genetic differentiation in the NW, SW, and SE Atlantic populations, the status review team determined that none indicated that the genetic differences were sufficient to be considered marked separation (NMFS and USFWS 2020).

Population growth rates for leatherback sea turtles vary by ocean basin. An assessment of leatherback populations through 2010 found a global decline overall (Wallace et al. 2013). Using datasets with abundance data series that are 10 years or greater, they estimated that leatherback populations have declined from 90,599 nests per year to 54,262 nests per year over three generations ending in 2010 (Wallace et al. 2013).

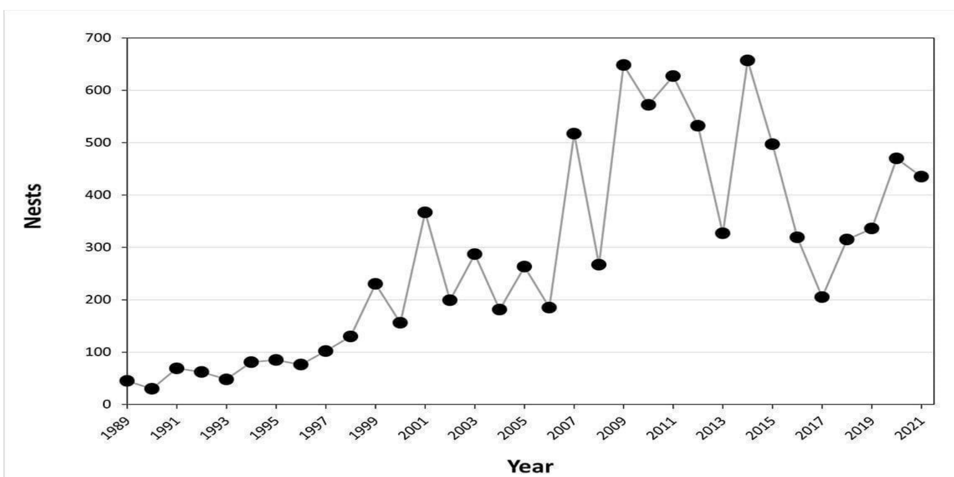
Several more recent assessments have been conducted. The Northwest Atlantic Leatherback Working Group was formed to compile nesting abundance data, analyze regional trends, and provide conservation recommendations. The most recent, published IUCN Red List assessment for the NW Atlantic Ocean subpopulation estimated 20,000 mature individuals and approximately 23,000 nests per year (estimate to 2017) (Northwest Atlantic Leatherback Working Group 2019). Annual nest counts show high inter-annual variability within and across nesting sites (Northwest Atlantic Leatherback Working Group 2018). Using data from 24 nesting sites in 10 nations within the NW Atlantic population segment, the leatherback status review estimated that the total index of nesting female abundance for the NW Atlantic population segment is 20,659 females (NMFS and USFWS 2020). This estimate only includes nesting data from recently and consistently monitored nesting beaches. An index (rather than a census) was developed given that the estimate is based on the number of nests on main nesting beaches with recent and consistent data and assumes a 3-year remigration interval. This index provides a minimum estimate of nesting female abundance (NMFS and USFWS 2020). This index of nesting female abundance is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG 2007). As described above, the IUCN Red List Assessment estimated 20,000 mature individuals (male and female). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS and USFWS 2020).

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007, Tiwari et al. 2013b). However, based on more recent analyses, leatherback nesting in the Northwest Atlantic is showing an overall negative trend, with the most notable decrease occurring during the most recent period of 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). The analyses for the IUCN Red List assessment indicate that the overall regional, abundance-weighted trends are negative (Northwest Atlantic Leatherback Working Group 2018, 2019). The dataset for trend analyses included 23 sites across 14 countries/territories. Three periods were used for the trend analysis: long-term (1990-2017), intermediate (1998-2017), and recent (2008-2017) trends. Overall, regional, abundance-weighted trends were negative across the periods and became more negative as the time-series became shorter. At the stock level, the Working Group evaluated the NW Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean. The NW Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all periods, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as declines in Guyana, Suriname, Cayenne, and Matura. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017. The Northern Caribbean and Western Caribbean stocks also declined over all three periods. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent time period. The Working Group identified anthropogenic sources (fishery bycatch, vessel strikes), habitat loss, and changes in life history parameters as possible drivers of nesting abundance declines (Northwest Atlantic Leatherback Working Group 2018). Fisheries bycatch is a well-documented threat to leatherback turtles. The Working Group discussed entanglement in vertical line fisheries off New England and Canada as potentially important mortality sinks. They also noted that vessel strikes result in mortality annually in feeding habitats off New England. Off nesting beaches in Trinidad and the Guianas, net fisheries take leatherbacks in high numbers (~3,000/yr.) (Eckert 2013, Lum 2006, Northwest Atlantic Leatherback Working Group 2018).

Similarly, the leatherback status review concluded that the NW Atlantic population segment exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Significant declines have been observed at nesting beaches with the greatest historical or current nesting female abundance, most notably in Trinidad and Tobago, Suriname, and French Guiana. Though some nesting aggregations (see status review document for information on specific nesting aggregations) indicated increasing trends, most of the largest ones are declining. The declining trend is considered to be representative of the population segment (NMFS and USFWS 2020). The status review found that fisheries bycatch is the primary threat to the NW Atlantic population (NMFS and USFWS 2020).

Leatherback sea turtles nest in the southeastern United States. From 1989-2019, leatherback nests at core index beaches in Florida have varied from a minimum of 30 nests in 1990 to a maximum of 657 in 2014 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). Leatherback nest numbers reached a peak in 2014 followed by a steep decline (2015-2017) and a promising increase (2018-2021) (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/) (Figure 5.2.10). The status review found that the median trend for Florida from 2008-2017 was a decrease of 2.1% annually (NMFS and USFWS 2020). Surveyors counted 435 leatherback nests on the 27 core index beaches in 2021. These counts do not include leatherback nesting at the beginning of the season (before May 15), nor do they represent all the beaches in Florida where leatherbacks nest; however, the index provided by these counts remains a representative reflection of trends. However, while green turtle nest numbers on Florida's index beaches continue to rise, Florida hosts only a few hundred nests annually and leatherbacks can lay as many as 11 clutches during a nesting season. Thus, fluctuations in nest count may be the result of a small change in number of females. More years of standardized nest counts are needed to understand whether the fluctuation is natural or warrants concern.

Figure 5.2.10. Number of leatherback sea turtle nests on core index beaches in Florida from 1989-2021 (https://myfwc.com/research/wildlife/sea-turtles/nesting/)



For the SW Atlantic population segment, the status review estimates the total index of nesting female abundance at approximately 27 females (NMFS and USFWS 2020). This is similar to the IUCN Red List assessment that estimated 35 mature individuals (male and female) using nesting data since 2010. Nesting has increased since 2010 overall, though the 2014-2017 estimates were lower than the previous three years. The trend is increasing, though variable (NMFS and USFWS 2020). The SE Atlantic population segment has an index of nesting female abundance of 9,198 females and demonstrates a declining nest trend at the largest nesting aggregation

(NMFS and USFWS 2020). The SE population segment exhibits a declining nest trend (NMFS and USFWS 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Mazaris et al. 2017, Santidrián Tomillo et al. 2017, Santidrián Tomillo et al. 2007, Sarti Martínez et al. 2007, Tapilatu et al. 2013). For an IUCN Red List evaluation, datasets for nesting at all index beaches for the West Pacific population were compiled (Tiwari et al. 2013a). This assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles (Tiwari et al. 2013a). Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation declined at a rate of almost 6% per year from 1984 to 2011 (Tapilatu et al. 2013). More recently, the leatherback status review estimated the total index of nesting female abundance of the West Pacific population segment at 1,277 females, and the population exhibits low hatchling success (NMFS and USFWS 2020). The total index of nesting female abundance for the East Pacific population segment is 755 nesting females. It has exhibited a decreasing trend since monitoring began with a 97.4% decline since the 1980s or 1990s, depending on nesting beach (Wallace et al. 2013). The low productivity parameters, drastic reductions in nesting female abundance, and current declines in nesting place the population segment at risk (NMFS and USFWS 2020).

Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately 10 females nest per year from 1994 to 2004, and about 296 nests per year were counted in South Africa (NMFS and USFWS 2013). A 5-year status review in 2013 found that, in the southwest Indian Ocean, populations in South Africa are stable (NMFS and USFWS 2013). More recently, the 2020 status review estimated that the total index of nesting female abundance for the SW Indian population segment is 149 females and that the population is exhibiting a slight decreasing nest trend (NMFS and USFWS 2020). While data on nesting in the NE Indian Ocean populations segment is limited, the population is estimated at 109 females. This population has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS and USFWS 2020).

Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. There has been a global decline overall. For all population segments, including the NW Atlantic population, fisheries bycatch is the primary threat to the species (NMFS and USFWS 2020). Leatherback turtle nesting in the Northwest Atlantic showed an overall negative trend through 2017, with the most notable decrease occurring during the most recent time frame of 2008 to 2017 (Northwest Atlantic Leatherback Working Group 2018). Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. Therefore, the leatherback status review in 2020 concluded that the NW Atlantic population exhibits an overall decreasing trend in annual nesting activity (NMFS and USFWS 2020). Threats to leatherback sea turtles include loss of nesting habitat, fisheries bycatch, vessel strikes, harvest of eggs, and marine debris, among others (Northwest Atlantic Leatherback Working Group 2018). Because of the threats, once large nesting areas in the Indian and Pacific Oceans are now functionally extinct (Tiwari et al. 2013a) and there have been range-wide reductions in population abundance. The species' resilience to additional perturbation both within the NW Atlantic and worldwide is low.

Critical Habitat
Critical habitat has been designated for leatherback sea turtles in the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands (44 FR 17710, March 23, 1979) and along the U.S. West Coast (77 FR 4170, January 26, 2012), both of which are outside the action area.

Recovery Goals
There are separate recovery plans for the U.S. Caribbean, Gulf of Mexico, and Atlantic (NMFS and USFWS 1992) and the U.S. Pacific (NMFS and USFWS 1998) populations of leatherback sea turtles. Neither plan has been recently updated. As with other sea turtle species, the recovery plans for leatherbacks include criteria for considering delisting. These criteria relate to increases in the populations, nesting trends, nesting beach and habitat protection, and implementation of priority actions. Criteria for delisting in the recovery plan for the U.S. Caribbean, Gulf of Mexico, and Atlantic are described here.
Delisting criteria

1. Adult female population increases for 25 years after publication of the recovery plan, as evidenced by a statistically significant trend in nest numbers at Culebra, Puerto Rico; St. Croix, U.S. Virgin Islands; and the east coast of Florida.
2. Nesting habitat encompassing at least 75% of nesting activity in the U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership.
3. All priority-one tasks have been successfully implemented (see the recovery plan for a list of priority one tasks).

Major recovery actions in the U.S. Caribbean, Gulf of Mexico, and Atlantic include actions to:

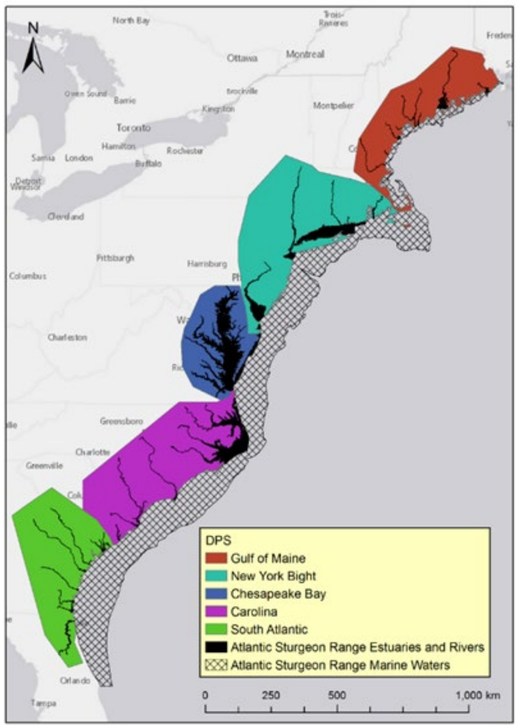
1. Protect and manage terrestrial and marine habitats.
2. Protect and manage the population.
3. Inform and educate the public.
4. Develop and implement international agreements.

The 2013 Five-Year Review (NMFS and USFWS 2013) concluded that the leatherback turtle should not be delisted or reclassified and notes that the 1991 and 1998 recovery plans are dated and do not address the major, emerging threat of climate change.

5.3 Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*)
An estuarine-dependent anadromous species, Atlantic sturgeon occupy ocean and estuarine waters, including sounds, bays, and tidal-affected rivers from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (77 FR 5880, April 6, 2012) (Figure 5.3.1). On February 6, 2012, NMFS listed five DPSs of Atlantic sturgeon under the ESA: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (77 FR 5880 and 77 FR 5914). The Gulf of Maine DPS is listed as threatened, and the New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs are listed as endangered. Critical habitat has been designated for the five DPSs of Atlantic sturgeon (82 FR 39160, August 17, 2017) in rivers of the eastern United States. The conservation objective identified in the final rule is to increase the abundance of each DPS by facilitating increased successful reproduction and recruitment to the

marine environment. Critical habitat designated in the Delaware River for the New York Bight DPS of Atlantic sturgeon is the only critical habitat that may be affected by the proposed action. The area within the Delaware River designated as critical habitat for Atlantic sturgeon extends from the Delaware River at the crossing of the Trenton-Morrisville Route 1 Toll Bridge, downstream for 137 RKMs to where the main stem river discharges at its mouth into Delaware Bay. Effects to this designated critical habitat were considered in Section 4.0 of this Opinion.

Figure 5.3.1. Representative distribution of rivers of origin for ESA listed Atlantic sturgeon DPSs



Information available from the 2007 Atlantic sturgeon status review (ASSRT 2007), 2017 ASMFC benchmark stock assessment (ASMFC 2017), final listing rules (77 FR 5880 and 77 FR 5914; February 6, 2012), material supporting the designation of Atlantic sturgeon critical habitat (NMFS 2017a), and Five-Year Reviews completed for the Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs (NMFS 2022a, b, c; NMFS 2023 a and b) were used to summarize the life history, population dynamics, and status of the species.

Life History
Atlantic sturgeon are a late maturing, anadromous species (ASSRT 2007, Balazik et al. 2010, Hilton et al. 2016, Sulak and Randall 2002). Sexual maturity is reached between the ages of 5 to 34 years. Sturgeon originating from rivers in lower latitudes (e.g., South Carolina rivers) mature faster than those originating from rivers located in higher latitudes (e.g., Saint Lawrence River) (NMFS 2017a).

Atlantic sturgeon spawn in freshwater (ASSRT 2007, NMFS 2017b) at sites with flowing water and hard bottom substrate (Bain et al. 2000, Balazik et al. 2012b, Gilbert 1989, Greene et al.

2009, Hatin et al. 2002, Mohler 2003, Smith and Clugston 1997, Vladykov and Greeley 1963). Water depths of spawning sites are highly variable, but may be up to 88.5 ft. (27 m) (Bain et al. 2000, Crance 1987, Leland 1968, Scott and Crossman 1973). Based on tagging records, Atlantic sturgeon return to their natal rivers to spawn (ASSRT 2007), with spawning intervals ranging from one to five years in males (Caron et al. 2002, Collins et al. 2000b, Smith 1985) and two to five years in females (Stevenson and Secor 1999, Van Eenennaam et al. 1996, Vladykov and Greeley 1963). Some Atlantic sturgeon river populations may have up to two spawning seasons comprised of different spawning adults (Balazik and Musick 2015, Collins et al. 2000b), although the majority likely have just one, either in the spring or fall.[21] There is evidence of spring and fall spawning for the South Atlantic DPS (77 FR 5914, February 6, 2012, Collins et al. 2000b, NMFS and USFWS 1998b) (Collins et al. 2000b, NMFS and USFWS 1998), spring spawning for the Gulf of Maine and New York Bight DPSs (NMFS 2017a), and fall spawning for the Chesapeake and Carolina DPSs (Balazik et al. 2012a, Smith et al. 1984). Telemetry and empirical data suggest that there may be two potential spawning runs: a spring run from late March to early May and a fall run around September after an extended staging period in the lower river (Balazik et al. 2012a, Balazik and Musick 2015).

Following spawning, males move downriver to the lower estuary and remain there until outmigration in the fall (Bain 1997, Bain et al. 2000, Balazik et al. 2012a, Breece et al. 2013, Dovel and Berggren 1983a, Greene et al. 2009, Hatin et al. 2002, Ingram et al. 2019, Smith 1985, Smith et al. 1982). Females move downriver and may leave the estuary and travel to other coastal estuaries until outmigration to marine waters in the fall (Bain 1997, Bain et al. 2000, Balazik et al. 2012a, Breece et al. 2013, Dovel and Berggren 1983a, Greene et al. 2009, Hatin et al. 2002, NMFS 2017a, Smith 1985, Smith et al. 1982). Atlantic sturgeon deposit eggs on hard bottom substrate. They hatch into the yolk sac larval stage approximately 94 to 140 hours after deposition (Mohler 2003, Murawski and Pacheco 1977, Smith et al. 1980, Van Den Avyle 1984, Vladykov and Greeley 1963). Once the yolk sac is absorbed (eight to twelve days post-hatching), sturgeon are larvae. Shortly after, they become young of year and then juveniles. The juvenile stage can last months to years in the brackish waters of the natal estuary (ASSRT 2007, Calvo et al. 2010, Collins et al. 2000a, Dadswell 2006, Dovel and Berggren 1983b, Greene et al. 2009, Hatin et al. 2007, Holland and Yelverton 1973, Kynard and Horgan 2002, Mohler 2003, Schueller and Peterson 2010, Secor et al. 2000, Waldman et al. 1996). Size and age that individuals leave their natal river for the marine environment is variable at the individual and geographic level; age and size of maturity is similarly variable. Upon reaching the sub-adult phase, individuals enter the marine environment, mixing with adults and sub-adults from other river systems (Bain 1997, Dovel and Berggren 1983a, Hatin et al. 2007, McCord et al. 2007) (NMFS 2017a). Once sub-adult Atlantic sturgeon have reached maturity/the adult stage, they will remain in marine or estuarine waters, only returning far upstream to the spawning areas when they are ready to spawn (ASSRT 2007, Bain 1997, Breece et al. 2016, Dunton et al. 2012, Dunton et al. 2015, Savoy and Pacileo 2003).

The life history of Atlantic sturgeon can be divided up into seven general categories as described in Table 5.3.1 below (adapted from ASSRT 2007). Note that the size and duration information

[21] Although referred to as spring spawning and fall spawning, the actual time of Atlantic sturgeon spawning may not occur during the astronomical spring or fall season (Balazik and Musick 2015).

presented in the table below should be considered a generalization and there is individual and geographic variation.

Table 5.3.1. General descriptions of Atlantic sturgeon life history stages

Age Class	Typical Size	General Duration	Representative Description
Egg	~2 mm – 3 mm diameter (Van Eenennaam et al. 1996)(p. 773)	Hatching occurs ~3-6 days after egg deposition and fertilization (ASSRT 2007)(p. 4))	Fertilized or unfertilized
Yolk-sac larvae (YSL)	~6mm – 14 mm (Bath et al. 1981)(pp. 714-715))	8-12 days post hatch (ASSRT 2007)(p. 4))	Negative photo-taxic, nourished by yolk sac
Post yolk-sac larvae (PYSL)	~14mm – 37mm (Bath et al. 1981)(pp. 714-715))	12-40 days post hatch	Free swimming; feeding; Silt/sand bottom, deep channel; fresh water
Young of Year (YOY)	0.3 grams <410mm TL	From 40 days to 1 year	Fish that are > 40 days and < one year; capable of capturing and consuming live food
Juveniles	>410mm and <760mm TL	1 year to time at which first coastal migration is made	Fish that are at least age 1 and are not sexually mature and do not make coastal migrations.
Subadults	>760 mm and <1500 mm TL	From first coastal migration to sexual maturity	Fish that are not sexually mature but make coastal migrations
Adults	>1500 mm TL	Post-maturation	Sexually mature fish

Population Dynamics

An index of population abundances for Atlantic sturgeon in oceanic waters off the Northeast coast of the U.S. during 2006-2011 was developed by Kocik et al. 2013. The report includes annual swept area abundance estimates of Atlantic sturgeon in nearshore areas derived from

Northeast Area Monitoring and Assessment Program surveys conducted during 2007-2012.[22] For this Opinion, we are relying on the population estimates derived from the NEAMAP swept area biomass assuming a 50% catchability (i.e., net efficiency x availability) rate. We consider that the NEAMAP surveys sample an area utilized by Atlantic sturgeon but do not sample all the locations and times where Atlantic sturgeon are present. We also consider that the trawl net captures some, but likely not all, of the Atlantic sturgeon present in the sampling area. Therefore, we assume that net efficiency and the fraction of the population exposed to the NEAMAP surveys in combination result in a 50% catchability (NMFS 2013). The 50% catchability assumption reasonably accounts for the robust, yet not complete, sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear. As these estimates are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date, we believe these estimates continue to serve as the best available scientific information.
Based on the above approach, the overall abundance of Atlantic sturgeon in U.S. Atlantic waters is estimated to be 67,776 fish (see table16 in Kocik et al. 2013). Based on genetic frequencies of occurrence in the sampled area, this overall population estimate was subsequently partitioned by DPS (Table 5.3.2). Given the proportion of adults to sub-adults in the NMFS NEFSC observer data (approximate ratio of 1:3), we have also estimated the number of adults and sub-adults originating from each DPS. However, this cannot be considered an estimate of the total number of sub-adults because it only considers those sub-adults that are of a size that are present and vulnerable to capture in commercial trawl and gillnet gear in the marine environment.
It is important to note the NEAMAP-based estimates do not include young-of-the-year (YOY) fish and juveniles in the rivers; therefore, the NEAMAP-based estimates underestimate the total population size as they do not account for multiple year classes of Atlantic sturgeon that do not occur in the marine environment where the NEAMAP surveys take place. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of sub-adult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. However, the estimated number of sub-adults in marine waters is a minimum count because it only considers those sub-adults that are captured in a portion of the action area and are present in the marine environment, which is only a fraction of the total number of sub-adults. In regards to adult Atlantic sturgeon, the estimated population in marine waters is also a minimum count as the NEAMAP surveys sample only a portion of the action area, and therefore a portion of the Atlantic sturgeon's range.

Table 5.3.2. Calculated population estimates based upon the NEAMAP survey swept area model, assuming 50% efficiency

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Sub-adults (of size vulnerable to capture in fisheries)
GOM	7,455	1,864	5,591

[22] Since fall 2007, NEAMAP trawl surveys (spring and fall) have been conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to 60 ft. (18.3 m). Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations.

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Sub-adults (of size vulnerable to capture in fisheries)
NYB	34,566	8,642	25,925
CB	8,811	2,203	6,608
Carolina	1,356	339	1,017
SA	14,911	3,728	11,183
Canada (outside of the 5 ESA listed DPSs)	*678*	*170*	*509*

Precise estimates of population growth rate (intrinsic rates) are unknown for the five listed DPSs of Atlantic sturgeon due to a lack of long-term abundance data. The Commission's 2017 stock assessment referenced a population viability assessment (PVA) that was done to determine population growth rates for the five DPSs based on a few long-term survey programs, but most results were statistically insignificant or utilized a model for which the available data did not or poorly fit. In any event, the population growth rates reported from that PVA ranged from -1.8% to 4.9% (ASMFC 2017).

The genetic diversity of Atlantic sturgeon throughout its range has been well-documented (ASSRT 2007, Bowen and Avise 1990, O'Leary et al. 2014, Ong et al. 1996, Waldman et al. 1996, Waldman and Wirgin 1998). Overall, these studies have consistently found populations to be genetically diverse, and the majority can be readily differentiated. Relatively low rates of gene flow reported in population genetic studies (Fritts et al. 2016, Savoy et al. 2017, Wirgin et al. 2002) indicate that Atlantic sturgeon return to their natal river to spawn, despite extensive mixing in coastal waters.

The marine range of U.S. Atlantic sturgeon extends from Labrador, Canada, to Cape Canaveral, Florida. As Atlantic sturgeon travel long distances in these waters, all five DPSs of Atlantic sturgeon have the potential to be anywhere in this marine range. Based on a recent genetic mixed stock analysis (Kazyak et al. 2021; the Maryland Wind WDA falls within the "MID Offshore" area described in that paper.), we expect Atlantic sturgeon in the portions of the action area north of Cape Hatteras to originate from the five DPSs at the following frequencies: New York Bight (55.3%), Chesapeake (22.9%), South Atlantic (13.6%), Carolina (5.8%), and Gulf of Maine (1.6%) DPSs. It is possible that a small fraction (0.7%) of Atlantic sturgeon in the area may be Canadian origin (Kazyak et al. 2021); Canadian-origin Atlantic sturgeon are not listed under the ESA. This represents the best available scientific information on the likely genetic makeup of individuals occurring in the lease area, the cable routes, and vessel transit routes north of Cape Hatteras. The portion of the action area south of Cape Hatteras falls with the "SOUTH" region described in Kazyak et al. 2021; Atlantic sturgeon in this portion of the action area are expected to be nearly all from the South Atlantic DPS (91.2%) and the Carolina DPS (6.2%), with few individuals from the Chesapeake Bay and New York Bight DPSs. The only activities in this portion of the action area are limited vessel trips moving along the U.S. Atlantic south coast between the WDA and ports in the South Atlantic and Gulf of Mexico.

Based on fishery-independent, fishery dependent, tracking, and tagging data, Atlantic sturgeon appear to primarily occur inshore of the 164 ft. (50 m) depth contour (Dunton et al. 2012, Dunton et al. 2010, Erickson et al. 2011, Laney et al. 2007, O'Leary et al. 2014, Stein et al. 2004a, b, Waldman et al. 2013, Wirgin et al. 2015a, Wirgin et al. 2015b). However, they are not restricted to these depths and excursions into deeper (e.g., 250 ft. (75 m)) continental shelf waters have been documented (Colette and Klein-MacPhee 2002, Collins and Smith 1997, Erickson et al. 2011, Stein et al. 2004b, Timoshkin 1968). Data from fishery-independent surveys and tagging and tracking studies also indicate that some Atlantic sturgeon may undertake seasonal movements along the coast (Dunton et al. 2010, Erickson et al. 2011, Hilton et al. 2016, Oliver et al. 2013, Post et al. 2014, Wippelhauser 2012). For instance, studies found that satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight, at depths greater than 66 ft. (20 m), during winter and spring; while, in the summer and fall, Atlantic sturgeon concentrations shifted to the northern portion of the Mid-Atlantic Bight at depths less than 66 ft. (20 m) (Erickson et al. 2011).

In the marine range, several marine aggregation areas occur adjacent to estuaries and/or coastal features formed by bay mouths and inlets along the U.S. eastern seaboard (i.e., waters off North Carolina; Chesapeake Bay; Delaware Bay; New York Bight; Massachusetts Bay; Long Island Sound; and Connecticut and Kennebec River Estuaries). Depths in these areas are generally no greater than 82 ft. (25 m) (Bain et al. 2000, Dunton et al. 2010, Erickson et al. 2011, Laney et al. 2007, O'Leary et al. 2014, Oliver et al. 2013, Savoy and Pacileo 2003, Stein et al. 2004b, Waldman et al. 2013, Wippelhauser 2012, Wippelhauser and Squiers 2015). Although additional studies are still needed to clarify why Atlantic sturgeon aggregate at these sites, there is some indication that they may serve as thermal refugia, wintering sites, or marine foraging areas (Dunton et al. 2010, Erickson et al. 2011, Stein et al. 2004b).

Status

Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 (ASSRT 2007). They are currently present in 36 rivers and are probably present in additional rivers that provide sufficient forage base, depth, and access (ASSRT 2007). The benchmark stock assessment evaluated evidence for spawning tributaries and sub-populations of U.S. Atlantic sturgeon in 39 rivers. They confirmed (eggs, embryo, larvae, or YOY observed) spawning in ten rivers, considered spawning highly likely (adults expressing gametes, discrete genetic composition) in nine rivers, and suspected (adults observed in upper reaches of tributaries, historical accounts, presence of resident juveniles) spawning in six rivers. Spawning in the remaining rivers was unknown (ten) or suspected historical (four) (ASMFC 2017). The decline in abundance of Atlantic sturgeon has been attributed primarily to the large U.S. commercial fishery, which existed for the Atlantic sturgeon through the mid-1990s. Based on management recommendations in the ISFMP, adopted by the ASMFC in 1990, commercial harvest in Atlantic coastal states was severely restricted and ultimately eliminated from most coastal states (ASMFC 1998a). In 1998, the Commission placed a 20-40 year moratorium on all Atlantic sturgeon fisheries until the spawning stocked could be restored to a level where 20 subsequent year classes of adult females were protected (ASMFC 1998a, b). In 1999, NMFS closed the U.S. EEZ to Atlantic sturgeon retention, pursuant to the ACA (64 FR 9449; February 26, 1999). However, many state fisheries for sturgeon were closed prior to this.

As described in the listing rules and in the 2022 and 2023 5-year reviews, the most significant threats to Atlantic sturgeon are incidental catch, dams that block access to spawning habitat in southern rivers, poor water quality, dredging of spawning areas, water withdrawals from rivers, and vessel strikes. Climate change related impacts on water quality (e.g., temperature, salinity, dissolved oxygen, contaminants) also have the potential to affect Atlantic sturgeon populations using impacted river systems.

The ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017). Based on historic removals and estimated effective population size, the 2017 stock assessment concluded that all five Atlantic sturgeon DPSs are depleted relative to historical levels. However, the 2017 stock assessment does provide some evidence of population recovery at the coastwide scale, and mixed population recovery at the DPS scale (ASMFC 2017). The 2017 stock assessment also concluded that a variety of factors (i.e., bycatch, habitat loss, and ship strikes) continue to impede the recovery rate of Atlantic sturgeon (ASMFC 2017). While bycatch in federal and state fisheries is a primary source of anthropogenic mortality of Atlantic sturgeon, to date, ESA section 7 consultations conducted by NMFS on federal fisheries (e.g., NMFS 2021 "batched fisheries Opinion") have concluded that these activities will not jeopardize the continued existence of any Atlantic sturgeon DPSs. New data indicates that bycatch in at least some of the federal fisheries considered in the 2021 consultation is, however, higher than what we considered in the 2021 biological opinion, and the batch consultation on the authorization of multiple federal fisheries is currently being reinitiated.

Despite the depleted status, the Commission's assessment did include signs that the coastwide index is above the 1998 value (95% probability). Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. By DPS, the assessment concluded that there was a 51% probability that the Gulf of Maine DPS abundance has increased since 1998 but a 74% probability that mortality for this DPS exceeds the mortality threshold used for the assessment. There is a relatively high (75%) probability that the New York Bight DPS abundance has increased since 1998, and a 31% probability that mortality exceeds the mortality threshold used for the assessment. There is also a relatively high (67%) probability that the Carolina DPS abundance has increased since 1998, and a relatively high probability (75%) that mortality for this DPS exceeds the mortality threshold used in the assessment. However, the index from the Chesapeake Bay DPS (highlighted red) only had a 36% chance of being above the 1998 value and a 30% probability that the mortality for this DPS exceeds the mortality threshold for the assessment. There was not enough information available to assess the abundance for the South Atlantic DPS relative to the 1998 moratorium, but the assessment did conclude that there was 40% probability that the mortality for this DPS exceeds the mortality threshold used in the assessment (ASMFC 2017). 5-Year reviews for each DPS, completed by NMFS in 2022 and 2023, summarize information that has become available since the listing. No changes to the classification for any DPS is recommended in the 5-year reviews (NMFS 2022 a, b, and c, NMFS 2023 a, b).

Recovery Goals

A Recovery Plan has not been completed for any DPS of Atlantic sturgeon. In 2018, NMFS published a Recovery Outline[23] to serve as an initial recovery-planning document. In this, the recovery vision is stated, "Subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future." The Outline also includes steps that are expected to serve as an initial recovery action plan. These include protecting extant subpopulations and the species' habitat through reduction of threats; gathering information through research and monitoring on current distribution and abundance; and addressing vessel strikes in rivers, the effects of climate change and bycatch.

5.3.1 Gulf of Maine DPS

The Gulf of Maine DPS includes the following: 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, MA. Within this range, Atlantic sturgeon historically spawned in the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT, 2007). Spawning occurs in the Kennebec River and may at least occasionally occur in the Androscoggin River below the Brunswick Dam (Wipplehauser et al. 2017). Despite the presence of suitable spawning habitat in a number of other rivers, there is no evidence of recent spawning in the remaining rivers. Atlantic sturgeons that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT, 2007). The movement of subadult and adult sturgeon between rivers, including to and from the Kennebec River and the Penobscot River, demonstrates that coastal and marine migrations are key elements of Atlantic sturgeon life history for the Gulf of Maine DPS (ASSRT, 2007; Fernandes, *et al.*, 2010).

The current status of the Gulf of Maine DPS is affected by historical and modern fisheries dating as far back as the 1800s (Squiers *et al.*, 1979; Stein *et al.*, 2004; ASMFC 2007). Incidental capture of Atlantic sturgeon in state and Federal fisheries continues today. As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast Fishery Management Plans. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Some of the impacts from the threats that contributed to the decline of the Gulf of Maine DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999, the Veazie Dam on the Penobscot River). There are strict regulations on the use of fishing gear in Maine state waters that incidentally catch sturgeon. In addition, there have been reductions in fishing

[23] https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf; last accessed September 30, 2023.

effort in state and federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC, 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, MA, with only 8% (e.g., 7 of the 84 fish) of interactions observed in the Mid Atlantic/Carolina region being assigned to the Gulf of Maine DPS (Wirgin and King, 2011). Tagging results also indicate that Gulf of Maine DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south. However, data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35 percent originated from the Gulf of Maine DPS (Wirgin *et al.*, 2012).

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). NMFS has determined that the Gulf of Maine DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

In 2022, we completed the 5-year review for the Gulf of Maine DPS in February 2022 (NMFS 2022a); the review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.2 New York Bight DPS

The New York Bight DPS includes the following: all anadromous Atlantic sturgeon spawned in the watersheds that drain into coastal waters from Chatham, MA to the Delaware-Maryland border on Fenwick Island. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco, 1977; Secor, 2002; ASSRT, 2007). Spawning still occurs in the Delaware and Hudson Rivers. There is no recent evidence (within the last 15 years) of spawning in the Taunton River (ASSRT, 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT, 2007; Savoy, 2007; Wirgin and King, 2011).

In 2014, several presumed age-0 Atlantic sturgeon were captured in the Connecticut River; the available information indicates that successful spawning took place in 2013 by a small number of adults. Genetic analysis of the juveniles indicates that the adults were likely migrants from the South Atlantic DPS (Savoy et al. 2017). As noted by the authors, this conclusion is counter to prevailing information regarding straying of adult Atlantic sturgeon. As these captures represent the only contemporary records of possible natal Atlantic sturgeon in the Connecticut River and the genetic analysis is unexpected, more information is needed to establish the frequency of spawning in the Connecticut River and whether there is a unique Connecticut River population of Atlantic sturgeon. At this time, we are not able to conclude whether the juvenile sturgeon detected are indicative of sustained spawning in the river or whether they were the result of a single spawning event due to unique straying of the adults from the South Atlantic DPS's spawning rivers (see additional explanation in NMFS 2022b).

There are no abundance estimates for the entire New York Bight DPS or for the entirety of the (i.e., all age classes) Hudson River or Delaware River populations. The abundance of the Hudson River Atlantic sturgeon riverine population prior to the onset of expanded exploitation in the 1800s is unknown but has been conservatively estimated at 10,000 adult females (Secor, 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor, 2002; ASSRT, 2007; Kahnle *et al.*, 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson River riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.*, 2007). Kahnle *et al.* (1998; 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. A decline in the abundance of young Atlantic sturgeon appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.*, 1998; Sweka *et al.*, 2007; ASMFC, 2010). At the time of listing, catch-per-unit-effort (CPUE) data suggested that recruitment remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (Sweka *et al.*, 2007; ASMFC, 2010). In examining the CPUE data from 1985-2007, there are significant fluctuations during this time. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s while the CPUE is generally higher in the 2000s as compared to the 1990s. Recent analyses suggest that the abundance of juvenile Atlantic sturgeon belonging to the Hudson River spawning population has increased, with double the average catch rate for the period from 2012-2019 compared to the previous eight years, from 2004-2011 (Pendleton and Adams 2021).

There is limited new information on the spawning population abundance in the Hudson River since the time of listing; Kazyak et al. (2020) used side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon to estimate a Hudson River spawning run size of 466 sturgeon (95% CRI = 310-745) in 2014. Another method for assessing the number of spawning adults is through determinations of effective population size (the number of individuals that effectively participates in producing the next generation, see NMFS 2022b for more information). The estimates of effective population size for the Hudson River spawning population from separate studies and based on different age classes are relatively similar to each other: 198 (95% CI=171.7-230.7) based on sampling of subadults captured off of Long Island across multiple years, 156 (95% CI=138.3-176.1) based on sampling of natal juveniles in multiple years (O'Leary et al. 2014; Waldman et al. 2019), and 144.2 (95% CI=82.9-286.6) based on samples from a combination of juveniles and adults (ASMFC 2017).

As described in the Status Review and listing rule, in addition to capture in fisheries operating in Federal waters, bycatch and mortality also occur in state fisheries; however, the primary fishery (shad) that impacted juvenile sturgeon in the Hudson River, has now been closed and there is no indication that it will reopen soon. In the Hudson River, sources of potential mortality include vessel strikes and entrainment in dredges. Impingement at water intakes, including the Danskammer, Roseton, and Indian Point power plants has been documented in the past; all three of these facilities have recently shut down. Recent information from surveys of juveniles (see above) indicates that the number of young Atlantic sturgeon in the Hudson River is increasing compared to recent years, but is still low compared to the 1970s. There is currently not enough information regarding any life stage to establish a trend for the entire Hudson River population. There is no total abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman, 1999; Secor, 2002).

Sampling in 2009 to target young-of- the year (YOY) Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 mm TL (Fisher, 2009) and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron in Calvo *et al.*, 2010). Genetics information collected from 33 of the 2009-year class YOY indicates that at least three females successfully contributed to the 2009-year class (Fisher, 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning is still occurring in the Delaware River, the relatively low numbers suggest the existing riverine population is limited in size. The Delaware Division of Fish and Wildlife (DFW) has conducted juvenile abundance surveys in the Delaware River in most years since 2010. The estimated abundance in 2014 was 3,656 (95% CI = 1,935–33,041) age 0-1 juvenile Atlantic (Hale et al. 2016). Estimates for the Delaware River spawning population by the same authors and using the same methods as described above for the Hudson River were: 108.7 (95% CI=74.7-186.1) and 40 (95% CI=34.7-46.2) for samples from subadults and natal juveniles, respectively (O'Leary et al. 2014; Waldman et al. 2019), and 56.7 (95% CI=42.5-77.0) based on samples from a combination of juveniles and adults (ASMFC 2017).

Some of the impacts from the threats that contributed to the decline of the New York Bight DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally managed fisheries, and vessel strikes remain significant threats to the New York Bight DPS.

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.*, 2004; ASMFC 2007). As explained above, currently available estimates indicate that at least 4% of adults may be killed as a result of bycatch in fisheries authorized under federal Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1-2% were from the New York Bight DPS. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat, and altering the benthic forage base. Both the Hudson and Delaware rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey, and a number of Atlantic sturgeon have been killed during Delaware River channel maintenance and deepening activities.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks further upstream passage; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. Connectivity may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area.

New York Bight DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Hudson and Delaware over the past decades (Lichter *et al.* 2006; EPA, 2008). Both the Hudson and Delaware rivers, as well as other rivers in the New York Bight region, were heavily polluted in the past from industrial and sanitary sewer discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds as developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes occur in the Delaware and Hudson rivers. A summary of recently available information is included in NMFS 2022 b. NMFS has only minimum counts of the number of Atlantic sturgeon that are struck and killed by vessels because only sturgeon that are found dead with evidence of a vessel strike are counted. New research, including a study that intentionally placed Atlantic sturgeon carcasses along the Delaware River in areas used by the public, suggests that most Atlantic sturgeon carcasses are not found and, when found, many are not reported to NMFS or to our sturgeon salvage co-investigators (Balazik et al. 2012b, Balazik, pers. comm. in ASMFC 2017; Fox et al. 2020). Based on the reporting rates in their study, Fox et al. estimated that a total of 199 and 213 carcasses were present along the Delaware Estuary shoreline in 2018 and 2019, respectively. Delaware State University (DSU) collaborated with the Delaware Division of Fish and Wildlife (DDFW) in an effort to document vessel strikes in 2005. Approximately 200 reported carcasses with over half being attributed to vessel strikes based on a gross examination of wounds have been documented through 2019 (DiJohnson 2019).

Information from carcass studies indicates that only a small percentage of carcasses in the Delaware River are documented and reported (Fox et al. 2020). One hundred thirty-eight (138) sturgeon carcasses were observed on the Hudson River and reported to the NYSDEC between 2007 and 2015. Of these, 69 are suspected of having been killed by vessel strike. Genetic analysis has not been completed on any of these individuals to date, given that the majority of

Atlantic sturgeon in the Hudson River belong to the New York Bight DPS; we assume that the majority of the dead sturgeon reported to NYSDEC belonged to the New York Bight DPS. Given the time of year in which the fish were observed (predominantly May through July), it is likely that many of the adults were migrating through the river to the spawning grounds. Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman, 1997; ASMFC, 2007; Kahnle *et al.*, 2007; Brown and Murphy, 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the New York Bight DPS. We determined that the New York Bight DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

In 2018, we announced the initiation of a 5-year review for the New York Bight DPS. We reviewed and considered new information for the New York Bight DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the DPS in February 2022 (NMFS 2022b); the review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.3 Chesapeake Bay DPS

The Chesapeake Bay (CB) DPS includes the following: all anadromous Atlantic sturgeon that spawn or 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. The marine range of Atlantic sturgeon from the CB DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the CB DPS and the adjacent portion of the marine range are shown in Figure 5.3.1. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). Based on the review by Oakley (2003), 100% of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e., dams) are located upriver of where spawning is expected to have historically occurred (ASSRT 2007).
At the time of listing, the James River was the only known spawning river for the Chesapeake Bay DPS (ASSRT, 2007; Hager, 2011; Balazik et al., 2012). Since the listing, evidence has been provided of both spring and fall spawning populations for the James River, as well as fall spawning in the Pamunkey River, a tributary of the York River, and fall spawning in Marshyhope Creek, a tributary of the Nanticoke River (Hager et al., 2014; Kahn et al., 2014; Balazik and Musick, 2015; Richardson and Secor, 2016). Detections of acoustically-tagged adult Atlantic sturgeon along with historical evidence suggests that Atlantic sturgeon belonging to the Chesapeake Bay DPS may be spawning in the Mattaponi and Rappahannock rivers as well (Hilton et al. 2016; ASMFC 2017a; Kahn et al. 2019). However, information for these populations is limited and the research is ongoing.

Several threats play a role in shaping the current status of Chesapeake Bay DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19^{th} century (Hildebrand and Schroeder 1928; Vladykov and Greeley 1963; ASMFC 1998b; Secor 2002; Bushnoe *et al.* 2005;

ASSRT 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor 2002; Bushnoe *et al.* 2005; ASSRT 2007; Balazik *et al.* 2010). Habitat disturbance caused by in-river work, such as dredging for navigational purposes, is thought to have reduced available spawning habitat in the James River (Holton and Walsh 1995; Bushnoe *et al.* 2005; ASSRT 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the CB DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low tidal exchange and flushing rate, large surface-to-volume ratio, and strong stratification during the spring and summer months (Pyzik *et al.* 2004; ASMFC 1998a; ASSRT 2007; EPA 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor 2005, 2010). Heavy industrial development during the 20th century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery.
Although there have been improvements in some areas of the Bay's health, the ecosystem remains in poor condition. At this time, we do not have sufficient information to quantify the extent that degraded water quality affects habitat or individuals in the Chesapeake Bay watershed.

More than 100 Atlantic sturgeon carcasses have been salvaged in the James River since 2007 and additional carcasses were reported but could not be salvaged (Greenlee et al. 2019). Many of the salvaged carcasses had evidence of a fatal vessel strike. In addition, vessel struck Atlantic sturgeon have been found in other parts of the Chesapeake Bay DPS's range including in the York and Nanticoke river estuaries, within Chesapeake Bay, and near the mouth of the Bay since the DPS was listed as endangered (NMFS Sturgeon Salvage Permit Reporting; Secor et al. 2021).

In the marine and coastal range of the CB DPS from Canada to Florida, fisheries bycatch in federally and state-managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (Stein *et al.* 2004b; ASMFC TC 2007; ASSRT 2007).

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally managed fisheries, Canadian fisheries, and vessel strikes remain significant threats to the CB DPS of Atlantic sturgeon. Of the 35% of Atlantic sturgeon incidentally caught in the Bay of Fundy, about 1% were CB DPS fish (Wirgin *et al.* 2012). Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007). The CB DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery. In 2018, we announced the initiation of a 5-year review for the Chesapeake Bay DPS. We reviewed and considered new information for the Chesapeake Bay DPS that has become available since this DPS was listed as endangered in February 2012. We completed the 5-year review for the Chesapeake Bay DPS in February 2022 (NMFS 2022c); the review includes a summary of additional information available since the listing determination, including information on life history and threats.. Based on the best scientific and commercial data available at the time of the review, we concluded that no change to the listing status is warranted.

5.3.4 Carolina DPS

The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida.

Rivers in the Carolina DPS considered to be spawning rivers include the Neuse, Roanoke, Tar-Pamlico, Cape Fear, and Northeast Cape Fear rivers, and the Santee-Cooper and Pee Dee river (Waccamaw and Pee Dee rivers) systems. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated and the current status of the spawning population in the Ashley River is unknown. We have no information, current or historical, of Atlantic sturgeon using the Chowan and New Rivers in North Carolina. Recent telemetry work by Post et al. (2014) indicates that Atlantic sturgeon do not use the Sampit, Ashley, Ashepoo, and Broad-Coosawhatchie Rivers in South Carolina. These rivers are short, coastal plains rivers that most likely do not contain suitable habitat for Atlantic sturgeon. Fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002, Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same period. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with a potential extirpation in an additional system. The ASSRT estimated the remaining river populations within the DPS to have fewer than 300 spawning adults; this is thought to be a small fraction of historic population sizes (ASSRT 2007).

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Atlantic sturgeon spawning and juvenile developmental habitat by blocking over 60 percent of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen (DO)) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat utilized by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee rivers have been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the Carolina DPS. The removal of large amounts of water from the system will alter flows, temperature, and DO. Existing water allocation issues will likely be compounded by population growth and potentially, by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the Carolina DPS. Little data exists on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Carolina DPS Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.).

In the 2023 5-year review for the Carolina DPS, NMFS SERO reviewed and considered new information for the DPS that has become available since this DPS was listed as endangered in February 2012. In the review, NMFS concluded that the Carolina DPS's demographic risk is "High" because of its productivity (i.e., relatively few adults compared to historical levels and irregular spawning success), abundance (i.e., riverine populations vary significantly and abundance is generally low in the DPS, overall), and spatial distribution (i.e., riverine populations and connectivity vary, creating inconsistent population coverage across the DPS and potentially limited ability to repopulate extirpated river populations). However, NMFS also concluded that the Carolina DPS' potential to recover is also "High" because man-made threats that have a major impact on the species' ability to persist have been identified (e.g., bycatch in federally-managed fisheries, dams blocking access to spawning habitat, dredging, vessel strikes), the DPS' response to those threats are well understood, management or protective actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions).The review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, the review concluded that no change to the listing status is warranted. (NMFS 2023a).

5.3.5 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 Rivers (ACE) Basin 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, St. Marys, and Satilla Rivers. Recent telemetry work by Post et al. (2014) indicates that Atlantic sturgeon do not use the Sampit, Ashley, Ashepoo, and Broad-Coosawhatchie Rivers in South Carolina. These rivers are short, coastal plains rivers that most likely do not contain suitable habitat for Atlantic sturgeon. Post et al. (2014) also found Atlantic sturgeon only use the portion of the Waccamaw River downstream of Bull Creek. Due to manmade structures and alterations, spawning areas in the St. Johns River are not accessible and therefore do not support a reproducing population.

Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in the state prior to 1890. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the South Atlantic DPS has been extirpated. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The ASSRT estimated the abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, to be less than 1 percent of what they were historically (ASSRT 2007).
The South Atlantic DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the South Atlantic DPS. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced DO and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns River. Reductions in water quality from terrestrial activities have modified habitat utilized by the South Atlantic DPS. Non-point source inputs are causing low DO in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low DO has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low DO and the negative (metabolic, growth, and feeding) effects caused by low DO increase when water temperatures are concurrently high, as they are within the range of the South Atlantic DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the South Atlantic DPS. Large withdrawals of over 240 million gallons per day (mgd) of water occur in the Savannah River for power generation and municipal uses. However, users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the South Atlantic DPS are likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and DO. Water shortages and "water wars" are already occurring in the rivers occupied by the South Atlantic DPS and will likely be compounded in the future by population growth and potentially by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower DO, all of which are current stressors to the South Atlantic DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast, from which they have never rebounded. Further, continued overutilization of Atlantic sturgeon as bycatch in commercial fisheries is an ongoing impact to the South Atlantic DPS. The loss of large subadults and adults as a result of bycatch impacts Atlantic sturgeon populations because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Little data exist on bycatch in the Southeast and high levels of bycatch underreporting are suspected. Further, a total population abundance for the DPS is not available, and it is therefore not possible to calculate the percentage of the DPS subject to bycatch mortality based on the available bycatch mortality rates for individual fisheries. However, fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low DO). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently no mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch. Though statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species, such as Atlantic sturgeon, and their habitat, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the South Atlantic DPS, even with existing controls on some pollution sources. Current regulatory regimes are not necessarily effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

In the 2023 5-year review for the South Atlantic DPS, NMFS SERO reviewed and considered new information for the DPS that has become available since this DPS was listed as endangered in February 2012. In the review, NMFS concluded that the South Atlantic DPS' demographic risk is "High" because of its productivity (i.e., relatively few adults compared to historical levels and irregular spawning success), abundance (i.e., riverine populations vary significantly and abundance is generally low in the DPS, overall), and spatial distribution (i.e., riverine populations and connectivity vary, creating inconsistent population coverage across the DPS and potentially limited ability to repopulate extirpated river populations). However, NMFS also concluded that the South Atlantic DPS' potential to recover is also "High" because man-made threats that have a major impact on the species' ability to persist have been identified (e.g., bycatch in federally-managed fisheries, dams blocking access to spawning habitat, dredging, vessel strikes), the DPS' response to those threats are well understood, management or protective actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions).The review includes a summary of additional information available since the listing determination, including information on life history and threats. Based on the best scientific and commercial data available at the time of the review, the review concluded that no change to the listing status is warranted. (NMFS 2023a).

5.3.6 Critical Habitat Designated for the New York Bight DPS of Atlantic Sturgeon

Critical habitat has been designated for the five DPSs of Atlantic sturgeon (82 FR 39160, August 17, 2017) in rivers of the eastern United States. The conservation objective identified in the final rule is to increase the abundance of each DPS by facilitating increased successful reproduction and recruitment to the marine environment. Specific occupied areas designated as critical habitat for the New York Bight DPS of Atlantic sturgeon contain approximately 547 km (340 miles) of aquatic habitat in the Connecticut, Housatonic, Hudson, and Delaware rivers. The critical habitat designated in each of these rivers contains all of the physical and biological features identified below. The geographic areas designated as critical habitat for the New York Bight DPS include: (1) Connecticut River from the Holyoke Dam downstream to where the main stem river discharges at its mouth into Long Island Sound; (2) Housatonic River from the Derby Dam downstream to where the main stem discharges at its mouth into Long Island Sound; (3) Hudson River from the Troy Lock and Dam (also known as the Federal Dam) downstream to where the main stem river discharges at its mouth into New York City Harbor; and, (4) Delaware River at the crossing of the Trenton-Morrisville Route 1 Toll Bridge, downstream to where the main stem river discharges at its mouth into Delaware Bay. As identified in the final rule, the physical features that are essential to the conservation of the species and that may require special management considerations or protection are:

1) Hard bottom substrate (*e.g.,* rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (*i.e.,* 0.0 to 0.5 parts per thousand (ppt) range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;
2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;
3) Water of appropriate depth and absent physical barriers to passage (*e.g.,* locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support:
    i) Unimpeded movement of adults to and from spawning sites;
    ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and
    iii) Staging, resting, or holding of subadults or spawning condition adults.

   Water depths in main river channels must also be deep enough (*e.g.,* at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.

4) Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support:
    i) Spawning;
    ii) Annual and interannual adult, subadult, larval, and juvenile survival; and
    iii) 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 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

Critical habitat designated in the Delaware River for the New York Bight DPS of Atlantic sturgeon is the only critical habitat that may be affected by the proposed action. The area within the Delaware River designated as critical habitat for Atlantic sturgeon extends from the Delaware River at the crossing of the Trenton-Morrisville Route 1 Toll Bridge, downstream for 137 RKMs to where the main stem river discharges at its mouth into Delaware Bay. The Delaware River critical habitat unit from the mouth of the river to Paulsboro, New Jersey (approximately RKM 145). The critical habitat designation is bank-to-bank within the Delaware River. Each critical habitat unit contains all four of the physical features (referred to as physical or biological features (PBF)); however, only PBFs 2, 3, and 4 occur in the action area. In the Delaware River, the area upstream of RKM 122 is considered to have the salinity levels consistent with the requirements of PBF 1. Information on the PBFs within the action area is contained in the *Environmental Baseline* section.

5.4 Shortnose Sturgeon (*Acipenser brevirostrum*)

The only activity considered in this Opinion that may adversely affect shortnose sturgeon is vessel traffic in the Delaware River. Shortnose sturgeon are fish that occur in rivers and estuaries along the East Coast of the U.S. and Canada (SSSRT, 2010). They have a head covered in bony plates, as well as protective armor called scutes extending from the base of the skull to the caudal peduncle. Other distinctive features include a subterminal, protractile tube-like mouth and chemosensory barbels for benthic foraging (SSSRT, 2010). Sturgeon have been present in North America since the Upper Cretaceous period, more than 66 million years ago. The information below is a summary of available information on the species. More thorough discussions can be found in the cited references as well as the Shortnose Sturgeon Status Review Team's (SSSRT) Biological Assessment (2010).

Life History and General Habitat Use
There are differences in life history, behavior, and habitat use across the range of the species. Current research indicates that these differences are adaptations to unique features of the rivers where these populations occur. For example, there are differences in larval dispersal patterns in the Connecticut River (MA) and Savannah River (GA) (Parker, 2007). There are also morphological and behavioral differences. Growth and maturation occurs more quickly in southern rivers but fish in northern rivers grow larger and live longer. We provide general life history attributes in Table 5.4.1.

Table 5.4.1. Shortnose sturgeon general life history for the species throughout its range

Stage	Typical Size (mm)	General Duration	Behaviors/Habitat Used
Egg	3-4	13 days postspawn	stationary on bottom; Cobble and rock, fresh, fast flowing water (0.4-0.8 m/s)
Yolk Sac Larvae	7-15	8-12 days post hatch	Photonegative; swim up and drift behavior; form aggregations with other YSL; Cobble and rock, stay at bottom near spawning site
Post Yolk Sac Larvae	15 - 57	12-40 days post hatch	Free swimming; feeding; Silt bottom, deep channel; fresh water
Young of Year	57 – 140 (north); 57-300 (south)	From 40 days post-hatch to one year	Deep, muddy areas upstream of the salt wedge
Juvenile	140 to 450-550 (north); 300 to 450-550 (south)	1 year to maturation	Increasing salinity tolerance with age; same habitat patterns as adults
Adult	450-1100 average; (max recorded 1400)	Post-maturation	Freshwater to estuary with some individuals making nearshore coastal migrations

Shortnose sturgeon live on average for 30-40 years (Dadswell et al., 1984). Males mature at approximately 5-10 years and females mature between age 7 and 13, with later maturation occurring in more northern populations (Dadswell et al., 1984). Females typically spawn for the first time 5 years post-maturation (age 12-18; Dadswell, 1979; Dadswell et al., 1984) and then spawn every 3-5 years (Dadswell, 1979; Dadswell et al., 1984;). Males spawn for the first time approximately 1-2 years after maturity with spawning typically occurring every 1-2 years (Kieffer and Kynard, 1996; NMFS, 1998; Dadswell et al., 1984). Shortnose sturgeon are iteroparous (spawning more than once during their life) and females release eggs in multiple "batches" during a 24 to 36-hour period (total of 30,000-200,000 eggs). Multiple males are likely to fertilize the eggs of a single female.

Cues for spawning are thought to include water temperature, day length and river flow (Kynard et al, 2012, Kynard et al. 2016). Shortnose sturgeon spawn in freshwater reaches of their natal rivers when water temperatures reach 9–15°C in the spring (Dadswell, 1979; Taubert, 1980a and b; Kynard, 1997). Spawning occurs over gravel, rubble, and/or cobble substrate (Dadswell, 1979, Taubert, 1980a and b; Buckley and Kynard, 1985b; Kynard, 1997) in areas with average bottom velocities between 0.4 and 0.8 m/s. Depths at spawning sites are variable, ranging from 1.2 - 27 m (multiple references in SSSRT (2010)). Eggs are small and demersal and stick to the rocky substrate where spawning occurs.

Shortnose sturgeon occur in waters between 0-34°C (Dadswell et al., 1984; Heidt & Gilbert, 1978); with temperatures above 28°C considered to be stressful. Depths used are highly variable, ranging from shallow mudflats while foraging to deep channels up to 30 m (Dadswell et al*.,* 1984; Dadswell, 1979). Salinity tolerance increases with age; while young of the year must remain in freshwater, adults have been documented in the ocean with salinities of up 30 parts-per-thousand (ppt) (Holland and Yeverton, 1973; Saunders and Smith, 1978). Dissolved oxygen affects distribution, with preference for DO levels at or above 5mg/l and adverse effects anticipated for prolonged exposure to DO less than 3.2mg/L (Secor and Niklitschek 2001). Shortnose sturgeon feed on benthic insects, crustaceans, mollusks, and polychaetes (Dadswell et al., 1984). Both juvenile and adult shortnose sturgeon primarily forage over sandy-mud bottoms, which support benthic invertebrates (Carlson and Simpson, 1987; Kynard, 1997). Shortnose sturgeon have also been observed feeding off plant surfaces (Dadswell et al*.,* 1984).

Following spawning, adult shortnose sturgeon disperse quickly down river to summer foraging grounds areas and remain in areas downstream of their spawning grounds throughout the remainder of the year (Buckley and Kynard, 1985a, Dadswell et al., 1984; Buckley and Kynard, 1985b; O'Herron et al., 1993).

In northern rivers, shortnose aggregate during the winter months in discrete, deep (3-10m) freshwater areas with minimal movement and foraging (Kynard et al., 2012; Buckley and Kynard, 1985a; Dadswell, 1979, Li et al., 2007; Dovel et al., 1992; Bain et al., 1998a and b). In the winter, adults in southern rivers spend much of their time in the slower moving waters downstream near the salt-wedge and forage widely throughout the estuary (Collins and Smith, 1993, Weber et al., 1998). Prespawning sturgeon in some northern and southern systems migrate into an area in the upper tidal portion of the river in the fall and complete their migration in the spring (Rogers and Weber, 1995). Older juveniles typically occur in the same overwintering areas as adults while young of the year remain in freshwater (Jenkins et al*.,* 1993; Jarvis et al. 2001).

Listing History

Shortnose sturgeon were listed as endangered in 1967 (32 FR 4001), and the species remained on the endangered species list with the enactment of the ESA in 1973. Shortnose sturgeon are thought to have been abundant in nearly every large East Coast river prior to the 1880s (see McDonald, 1887; Smith and Clugston, 1997). Pollution and overfishing, including bycatch in the shad fishery, were listed as principal reasons for the species' decline. The species remains listed as endangered throughout its range. While the 1998 Recovery Plan refers to Distinct

Population Segments (DPS), the process to designate DPSs for this species has not been undertaken. The SSSRT published a Biological Assessment for shortnose sturgeon in 2010. The report summarized the status of shortnose sturgeon within each river and identified stressors that continue to affect the abundance and stability of these populations.

Current Status

There is no current total population estimate for shortnose sturgeon rangewide. Information on populations and metapopulations is presented below. In general, populations in the Northeast are larger and more stable than those in the Southeast (SSSRT, 2010). Population size throughout the species' range is considered to be stable; however, most riverine populations are below the historic population sizes and most likely are below the carrying capacity of the river (Kynard, 1996).

Population Structure

There are 19 documented populations of shortnose sturgeon ranging from the St. Johns River, Florida (possibly extirpated from this system) to the Saint John River in New Brunswick, Canada. There is a large gap in the middle of the species range with individuals present in the Chesapeake Bay separated from populations in the Carolinas by a distance of more than 400 km. Currently, there are significantly more shortnose sturgeon in the northern portion of the range.

Developments in genetic research as well as differences in life history support the grouping of shortnose sturgeon into five genetically distinct groups, all of which have unique geographic adaptations (see Grunwald et al., 2008; Grunwald et al., 2002; King et al., 2001; Waldman et al., 2002b; Walsh et al., 2001; Wirgin et al., 2009; Wirgin et al., 2002; SSSRT, 2010). These groups are: 1) Gulf of Maine; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast. The Gulf of Maine, Delaware/Chesapeake Bay, and Southeast groups function as metapopulations[24]. The other two groups (Connecticut/Housatonic and the Hudson River) function as independent populations. While there is migration within each metapopulation (i.e., between rivers in the Gulf of Maine and between rivers in the Southeast) and occasional migration between populations (e.g., Connecticut and Hudson), interbreeding between river populations is limited to very few individuals per generation; this results in morphological and genetic variation between most river populations (see Walsh et al., 2001; Grunwald et al., 2002; Waldman et al., 2002; Wirgin et al., 2005). Indirect gene flow estimates from mtDNA indicate an effective migration rate of less than two individuals per generation. This means that while individual shortnose sturgeon may move between rivers, very few sturgeon are spawning outside their natal river; it is important to remember that the result of physical movement of individuals is rarely genetic exchange.

Summary of Status of Northeast Rivers

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[24] A metapopulation is a group of populations in which distinct populations occupy separate patches of habitat separated by unoccupied areas (Levins 1969). Low rates of connectivity through dispersal, with little to no effective movement, allow individual populations to remain distinct as the rate of migration between local populations is low enough not to have an impact on local dynamics or evolutionary lineages (Hastings and Harrison 1994). This interbreeding between populations, while limited, is consistent, and distinguishes metapopulations from other patchy populations.

In NMFS' Greater Atlantic Region, shortnose sturgeon are known to spawn in the Kennebec, Androscoggin, Merrimack, Connecticut, Hudson, and Delaware Rivers. Shortnose sturgeon are also known to occur in the Penobscot and Potomac Rivers; although it is unclear if spawning is currently occurring in those systems.

Gulf of Maine Metapopulation

Tagging and telemetry studies indicate that shortnose sturgeon are present in the Penobscot, Kennebec, Androscoggin, Sheepscot, and Saco Rivers. Individuals have also been documented in smaller coastal rivers; however, the duration of presence has been limited to hours or days and the smaller coastal rivers are thought to be only used occasionally (Zydlewski et al., 2011). Since the removal of the Veazie and Great Works Dams (2013 and 2012, respectively), in the Penobscot River, shortnose sturgeon range from the Bay to the Milford Dam. Shortnose sturgeon now are presumed to have access to their full historical range. Adult and large juvenile sturgeon have been documented to use the river. While potential spawning sites have been identified, no spawning has been documented. Foraging and overwintering are known to occur in the river. Nearly all prespawn females and males detected in the Penobscot River have been documented to return to the Kennebec or Androscoggin Rivers. Robust design analysis with closed periods in the summer and late fall estimated seasonal adult abundance ranging from 636-1285 (weighted mean), with a low estimate of 602 (95% CI: 409.6-910.8) and a high of 1306 (95% CI: 795.6-2176.4) (Fernandes, 2008; Fernandes et al., 2010; Dionne, 2010 in Maine DMR (2010)).

Delaware River-Chesapeake Bay Metapopulation

Shortnose sturgeon range from Delaware Bay up to at least Scudders Falls (river kilometer 223); there are no dams within the species' range on this river. The population is considered stable (comparing 1981-1984 to 1999-2003) at around 12,000 adults (Hastings et al., 1987 and ERC, 2006b). Spawning occurs primarily between Scudders Falls and the Trenton rapids. Overwintering and foraging also occur in the river. Shortnose sturgeon have been documented to use the Chesapeake-Delaware Canal to move from the Chesapeake Bay to the Delaware River. In Chesapeake Bay, shortnose sturgeon have most often been found in Maryland waters of the mainstem bay and tidal tributaries such as the Susquehanna, Potomac, and Rappahannock Rivers (Kynard et al., 2016; SSSRT, 2010). Spells (1998), Skjeveland et al. (2000), and Welsh et al. (2002) all reported one capture each of adult shortnose sturgeon in the Rappahannock River. Recent documented use of Virginia waters of Chesapeake Bay is currently limited to two individual shortnose sturgeon: one captured in 2016 (Balazik, 2017) and a second sturgeon (a confirmed gravid female) caught in 2018 in the James River (Balazik, pers. comm. 2018). Spawning has not been documented in any tributary to the Bay although suitable spawning habitat and two prespawn females with late stage eggs have been documented in the Potomac River. Current information indicates that shortnose sturgeon are present year round in the Potomac River with foraging and overwintering taking place there. Shortnose sturgeon captured in the Chesapeake Bay are not genetically distinct from the Delaware River population.

Southeast Metapopulation

There are no shortnose sturgeon between Maryland waters of the Chesapeake Bay and the Carolinas. Shortnose sturgeon are only thought to occur in the Cape Fear River and Yadkin-Pee Dee River in North Carolina and are thought to be present in very small numbers.

The Altamaha River supports the largest known population in the Southeast with successful self-sustaining recruitment. The most recent population estimate for this river was 6,320 individuals (95% CI = 4,387-9,249; DeVries, 2006). The population contains more juveniles than expected. Comparisons to previous population estimates suggest that the population is increasing; however, there is high mortality between the juvenile and adult stages in this river. This mortality is thought to result from incidental capture in the shad fishery, which occurs at the same time as the spawning period (DeVries, 2006).

The only available estimate for the Cooper River is of 300 spawning adults at the Pinoplis Dam spawning site (based on 1996-1998 sampling; Cooke et al., 2004). This is likely an underestimate of the total number of adults as it would not include non-spawning adults. Estimates for the Ogeechee River were 266 (95%CI=236-300) in 1993 (Weber, 1996; Weber et al., 1998); a more recent estimate (sampling from 1999-2004; Fleming et al., 2003) indicates a population size of 147 (95% CI = 104-249). While the more recent estimate is lower, it is not significantly different from the previous estimate. Available information indicates the Ogeechee River population may be experiencing juvenile mortality rates greater than other southeastern rivers.

Spawning is also occurring in the Savannah River, the Congaree River, and the Yadkin-Pee Dee River. There are no population estimates available for these rivers. Occurrence in other southern rivers is limited, with capture in most other rivers limited to fewer than five individuals. They are thought to be extremely rare or possibly extirpated from the St. Johns River in Florida as only a single specimen was found by the Florida Fish and Wildlife Conservation Commission during extensive sampling of the river in 2002/2003. In these river systems, shortnose sturgeon occur in nearshore marine, estuarine, and riverine habitat.

Threats

Because sturgeon are long-lived and slow growing, stock productivity is relatively low; this can make the species vulnerable to rapid decline and slow recovery (Musick, 1999). In well studied rivers (e.g., Hudson, upper Connecticut), researchers have documented significant year to year recruitment variability (up to 10 fold over 20 years in the Hudson and years with no recruitment in the CT). However, this pattern is not unexpected given the life history characteristics of the species and natural variability in hydrogeologic cues relied on for spawning.

The small amount of effective movement between populations means recolonization of currently extirpated river populations is expected to be very slow and any future recolonization of any rivers that experience significant losses of individuals would also be expected to be very slow. Despite the significant decline in population sizes over the last century, gene diversity in shortnose sturgeon is moderately high in both mtDNA (Quattro et al., 2002; Wirgin et al., 2005; Wirgin et al., 2000) and nDNA (King et al., 2001) genomes.

A population of sturgeon can go extinct as a consequence of demographic stochasticity (fluctuations in population size due to random demographic events); the smaller the metapopulation (or population), the more prone it is to extinction. Anthropogenic impacts acting on top of demographic stochasticity further increase the risk of extinction.

All shortnose sturgeon populations are highly sensitive to increases in juvenile mortality that would result in reductions in the number of adult spawners (Anders et al., 2002; Gross et al., 2002; Secor, 2002). Populations of shortnose sturgeon that do not have reliable natural recruitment are at increased risk of experiencing population decline leading to extinction (Secor et al., 2002). Elasticity studies of shortnose sturgeon indicate that the highest potential for increased population size and stability comes from YOY and juveniles as compared to adults (Gross et al., 2002); that is, increasing the number of YOY and juveniles has a more significant long term impact to the population than does increasing the number of adults or the fecundity of adults.

The Shortnose Sturgeon Recovery Plan (NMFS, 1998) and the Shortnose Sturgeon Status Review Team's Biological Assessment of shortnose sturgeon (2010) identify habitat degradation or loss and direct mortality as principal threats to the species' survival. Natural and anthropogenic factors continue to threaten the recovery of shortnose sturgeon and include: poaching, bycatch in riverine fisheries, habitat alteration resulting from the presence of dams, in-water and shoreline construction, including dredging; degraded water quality which can impact habitat suitability and result in physiological effects to individuals including impacts on reproductive success; direct mortality resulting from dredging as well as impingement and entrainment at water intakes; and, loss of historical range due to the presence of dams. Shortnose sturgeon are also occasionally killed as a result of research activities. The total number of sturgeon affected by these various threats is not known. Climate change, particularly shifts in seasonal temperature regimes and changes in the location of the salt wedge, may impact shortnose sturgeon in the future (more information on Climate Change is presented in Section 5.0). More information on threats experienced in the action area is presented in the Environmental Baseline Section of this Opinion.

Recovery Plan

The 1998 Recovery Plan (NMFS, 1998) outlines the steps necessary for recovery and indicates that each population may be a candidate for downlisting (i.e., to threatened) when it reaches a minimum population size that is large enough to prevent extinction and will make the loss of genetic diversity unlikely; the minimum population size for each population has not yet been determined. The Recovery Outline contained within the 1998 Recovery Plan includes three major tasks: (1) establish delisting criteria; (2) protect shortnose sturgeon populations and habitats; and, (3) rehabilitate habitats and population segments. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. In many rivers, particularly in the Southeast, habitat is compromised and continues to impact the ability of sturgeon populations to recover. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. The loss of any population or metapopulation would result in the loss of biodiversity and would create (or widen) a gap in the species' range.

5.5 Giant Manta Ray *(Mobula birostris)*

The giant manta ray *(Manta birostris)* is listed as threatened under the ESA (83 FR 2916, January 22, 2018); NMFS has determined that the designation of critical habitat is not prudent (84 FR 66652, December 5, 2019). On December 4, 2019, NMFS published a recovery outline for the giant manta ray (NMFS 2019), which serves as an interim guidance to direct recovery efforts for giant manta ray. In January 2023 (88 FR 81351), the scientific name of the species was revised to from *Manta birostris* to *Mobula birostris*; no other changes to the species' status accompanied this name game.

Species Description and Distribution

The giant manta ray is the largest living ray, with a wingspan reaching a width of up to 7 m (23 ft), and an average size between 4-5 m (15-16.5 ft). The giant manta ray is recognized by its large diamond-shaped body with elongated wing-like pectoral fins, ventrally placed gill slits, laterally placed eyes, and wide terminal mouth. In front of the mouth, it has 2 structures called cephalic lobes that extend and help to introduce water into the mouth for feeding activities (making them the only vertebrate animals with 3 paired appendages). Giant manta rays have 2 distinct color types: chevron (mostly black back dorsal side and white ventral side) and black (almost completely black on both ventral and dorsal sides). Most of the chevron variants have a black dorsal surface and a white ventral surface with distinct patterns on the underside that can be used to identify individuals (Miller and Klimovich 2017). There are bright white shoulder markings on the dorsal side that form 2 mirror image right-angle triangles, creating a T-shape on the upper shoulders.

The giant manta ray can be found in all ocean basins. In terms of range, within the Northern hemisphere, the species has been documented as far north as southern California and New Jersey on the U.S. west and east coasts, respectively, and Mutsu Bay, Aomori, Japan, the Sinai Peninsula and Arabian Sea, Egypt, and the Azores Islands (CITES 2013; Gudger 1922; Kashiwagi et al. 2010; Moore 2012). In the Southern Hemisphere, the species occurs as far south as Peru, Uruguay, South Africa, New Zealand and French Polynesia (CITES 2013; Mourier 2012). Within its range, the giant manta ray inhabits tropical, subtropical, and temperate bodies of water and is commonly found offshore, in oceanic waters, and near productive coastlines (Figure 5.5.1) (Kashiwagi et al. 2011; Marshall et al. 2009).

Figure 5.5.1 The Extent of Occurrence (dark blue) and Area of Occupancy (light blue) based on species distribution (Lawson et al. 2017).

Life History Information

Giant manta rays make seasonal long-distance migrations, aggregate in certain areas and remain resident, or aggregate seasonally (Dewar et al. 2008; Girondot et al. 2015; Graham et al. 2012; Stewart et al. 2016). The giant manta ray is a seasonal visitor along productive coastlines with regular upwelling, in oceanic island groups, and at offshore pinnacles and seamounts. The timing of these visits varies by region and seems to correspond with the movement of zooplankton, current circulation and tidal patterns, seasonal upwelling, seawater temperature, and possibly mating behavior. They have also been observed in estuarine waters near oceanic inlets, with use of these waters as potential nursery grounds (Adams and Amesbury 1998; Medeiros et al. 2015; Milessi and Oddone 2003) J. Pate, Florida Manta Project, unpublished data).

Giant manta rays are known to aggregate in various locations around the world in groups usually ranging from 100-1,000 (Graham et al. 2012; Notarbartolo di Sciara and Hillyer 1989; Venables 2013). These sites function as feeding sites, cleaning stations, or sites where courtship interactions take place (Graham et al. 2012; Heinrichs et al. 2011; Venables 2013). The appearance of giant manta rays in these locations is generally predictable. For example, food availability due to high productivity events tends to play a significant role in feeding site aggregations (Heinrichs et al. 2011; Notarbartolo di Sciara and Hillyer 1989). Giant manta rays have also been shown to return to a preferred site of feeding or cleaning over extended periods of time (Dewar et al. 2008; Graham et al. 2012; Medeiros et al. 2015). In addition, giant and reef manta rays in Keauhou and Ho"ona Bays in Hawaii, appear to exhibit learned behavior. These manta rays learned to associate artificial lighting with high plankton concentration (primary food source) and shifted foraging strategies to include sites that had artificial lighting at night (Clark 2010). While little is known about giant manta ray aggregation sites, the Flower Garden Banks National Marine Sanctuary (FGBNMS) located 100 nautical miles offshore of Galveston, Texas and the surrounding region might represent the first documented nursery habitat for giant manta ray (Stewart et al. 2018). Stewart et al. (2018) found that the FGBNMS provides nursery habitat for juvenile giant manta rays because small age classes have been observed consistently across years at both the population and individual level. The FGBNMS may be an optimal nursery ground because of its location near the edge of the continental shelf and proximity to abundant pelagic food resources. In addition, small juveniles are frequently observed along a portion of Florida's east coast, indicating that this area may also function as a nursery ground for juvenile giant manta rays. Since directed visual surveys began in 2016, juvenile giant manta rays are regularly observed in the shallow waters (less than 5 m depth) from Jupiter Inlet to Boynton Beach Inlet (J Pate, Florida Manta Project, unpublished data). However, the extent of this purported nursery ground is unknown as the survey area is limited to a relatively narrow geographic area along Florida's east coast.

The giant manta ray appears to exhibit a high degree of plasticity in terms of its use of depths within its habitat. Tagging studies have shown that the giant manta rays conduct night descents from 200-450 m depths (Rubin et al. 2008; Stewart et al. 2016) and are capable of diving to depths exceeding 1,000 m (A. Marshall et al. unpublished data 2011, cited in Marshall et al. (2011)). Stewart et al. (2016) found diving behavior may be influenced by season, and more specifically, shifts in prey location associated with the thermocline, with tagged giant manta rays (n=4) observed spending a greater proportion of time at the surface from April to June and in deeper waters from August to September. Overall, studies indicate that giant manta rays have a more complex depth profile of their foraging habitat than previously thought, and may actually be supplementing their diet with the observed opportunistic feeding in near-surface waters (Burgess et al. 2016; Couturier et al. 2013). Giant manta rays primarily feed on planktonic organisms such as euphausiids, copepods, mysids, decapod larvae and shrimp, but some studies have noted their consumption of small and moderately sized fishes (Miller and Klimovich 2017). While it was previously assumed, based on field observations, that giant manta rays feed predominantly during the day on surface zooplankton, results from recent studies (Burgess et al. 2016; Couturier et al. 2013) indicate that these feeding events are not an important source of the dietary intake. When feeding, giant manta rays hold their cephalic lobes in an "O" shape and open their mouth wide, which creates a funnel that pushes water and prey through their mouth and over their gill rakers. They use many different types of feeding strategies, such as barrel rolling (doing somersaults repeatedly) and creating feeding chains with other mantas to maximize prey intake.

The giant manta ray is viviparous (i.e., gives birth to live young). They are slow to mature and have very low fecundity and typically give birth to only one pup every 2 to 3 years. Gestation lasts approximately 10-14 months. Females are only able to produce between 5 and 15 pups in a lifetime (CITES 2013; Miller and Klimovich 2017). The giant manta ray has one of the lowest maximum population growth rates of all elasmobranchs (Dulvy et al. 2014; Miller and Klimovich 2017). The giant manta rays generation time (based on *M. alfredi* life history parameters) is estimated to be 25 years (Miller and Klimovich 2017).

Although giant manta rays have been reported to live at least 40 years, not much is known about their growth and development. Maturity is thought to occur between 8-10 years of age (Miller and Klimovich 2017). Males are estimated to mature at around 3.8 m disc width (slightly smaller than females) and females at 4.5 m disc width (Rambahiniarison et al. 2018).

Status and Population Dynamics

There are no current or historical estimates of global abundance of giant manta rays, with most estimates of subpopulations based on anecdotal observations. The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 2013) found that only ten populations of giant manta rays had been actively studied, 25 other aggregations have been anecdotally identified, all other sightings are rare, and the total global population may be small. Subpopulation abundance estimates range between 42 and 1,500 individuals, but are anecdotal and subject to bias (Miller and Klimovich 2017). The largest subpopulations and records of individuals come from the Indo-Pacific and eastern Pacific. Ecuador is thought to be home to the largest identified population (n=1,500) of giant manta rays in the world, with large aggregation sites within the waters of the Machalilla National Park and the Galapagos Marine Reserve (Hearn et al. 2014). Within the Indian Ocean, numbers of giant manta rays identified through citizen science in Thailand's waters (primarily on the west coast, off Khao Lak and Koh Lanta) was 288 in 2016. These numbers reportedly surpass the estimate of identified giant mantas in Mozambique (n=254), possibly indicating that Thailand may be home to the largest aggregation of giant manta rays within the Indian Ocean (MantaMatcher 2016). Miller and Klimovich (2017) concluded that giant manta rays are at risk throughout a significant portion of their range, due in large part to the observed declines in the Indo-Pacific. There have been decreases in landings of up to 95% in the Indo-Pacific, although similar declines have not been observed in areas with other subpopulations, such as Mozambique and Ecuador. In the U.S. Atlantic, the giant manta rays appear to have a seasonal pattern of occurrence along the east coast of Florida, showing up with greater frequencies (and in greater numbers) in the spring and summer months (84 FR 66652; December 5, 2019). Available sightings data indicate the seasonal visitation of manta rays to Florida's inshore waters, possible juvenile habitat, and possible residency. The numbers, location, and peak timing of the manta rays to this area varies by year (H. Webb unpublished data). In 2015, an aerial survey conducted by the Georgia Aquarium peaked at 1,144 manta rays sighted in the inshore waters of northeast Florida, but with a notable decline in manta rays observed in the study area since 2015 (H. Webb unpublished data). In addition, juvenile giant manta rays have also been regularly observed inshore off southeast Florida. Since 2016, researchers with the Marine Megafauna Foundation (MMF) have been conducting annual surveys along a small transect off Palm Beach, Florida, between Jupiter Inlet and Boynton Beach Inlet (~44 km, 24 nm) (J. Pate, MMF, pers. comm. to M. Miller, NMFS OPR, 2018). Results from these surveys indicate that juvenile manta rays are present in these waters for the majority of the year (observations span from May to December), with re-sightings data that suggest some manta rays may remain in the area for extended periods of time or return in subsequent years (J. Pate unpublished data). In the Gulf of Mexico, within the FGBNMS, 95 unique individuals have been recorded between 1982 and 2017 (Stewart et al. 2018).

Threats

The giant manta ray faces many threats, including fisheries interactions, environmental contaminants (microplastics, marine debris, petroleum products, etc.), vessel strikes, entanglement, and global climate change. Overall, the predictable nature of their appearances, combined with slow swimming speed, large size, and lack of fear towards humans, may increase their vulnerability to threats (Convention on Migratory Species 2014; O'Malley et al. 2013). The ESA status review determined that the greatest threat to the species results from fisheries related mortality (Miller and Klimovich 2017); (83 FR 2916, January 22, 2018).

<u>Commercial Harvest and Fisheries Bycatch</u>

Commercial harvest and incidental bycatch in fisheries is cited as the primary cause for the decline in the giant manta ray and threat to future recovery (Miller and Klimovich 2017). We anticipate that these threats will continue to affect the rate of recovery of the giant manta ray. Worldwide giant manta ray catches have been recorded in at least 30 large and small-scale fisheries covering 25 countries (Lawson et al. 2017). Demand for the gills of giant manta rays and other mobula rays has risen dramatically in Asian markets. With this expansion of the international gill raker market and increasing demand for manta ray products, estimated harvest of giant manta rays, particularly in many portions of the Indo-Pacific, frequently exceeds numbers of identified individuals in those areas and are accompanied by observed declines in sightings and landings of the species of up to 95% (Miller and Klimovich 2017). In the Indian Ocean, manta rays (primarily giant manta rays) are mainly caught as bycatch in purse seine and gillnet fisheries (Oliver et al. 2015). In the western Indian Ocean, data from the pelagic tuna purse seine fishery suggests that giant manta and mobula rays, together, are an insignificant portion of the bycatch, comprising less than 1% of the total non-tuna bycatch per year (Chassot et al. 2009; Romanov 2002). In the U.S., bycatch of giant manta rays has been recorded in the coastal migratory pelagic gillnet, gulf reef fish bottom longline, Atlantic shark gillnet, pelagic longline, pelagic bottom longline, and trawl fisheries. Incidental capture of giant manta ray is also a rare occurrence in the elasmobranch catch within U.S. Atlantic and Gulf of Mexico, with the majority that are caught released alive. In addition to directed harvest and bycatch in commercial fisheries, the giant manta ray is incidentally captured by recreational fishers using vertical line (i.e., handline, bandit gear, and rod-and-reel). Researchers frequently report giant manta rays having evidence of recreational gear interactions along the east coast of Florida (i.e., manta rays have embedded fishing hooks with attached trailing monofilament line) (J. Pate, Florida Manta Project, unpublished data). Internet searches also document recreational interactions with giant manta rays. For example, recreational fishers will search for giant manta rays while targeting cobia, as cobia often accompany giant manta rays (anglers will cast at manta rays in an effort to hook cobia). In addition, giant manta rays are commonly observed swimming near or underneath public fishing piers where they may become foul-hooked. The current threat of mortality associated with recreational fisheries is expected to be low, given that we have no reports of recreational fishers retaining giant manta ray. However, bycatch in recreational fisheries remains a potential threat to the species.

Vessel Strike

Vessel strikes can injure or kill giant manta rays, decreasing fitness or contributing to non-natural mortality (Couturier et al. 2012; Deakos et al. 2011). Giant manta rays can be frequently observed traveling just below the surface and will often approach or show little fear toward humans or vessels (Coles 1916a), which can also make them extremely vulnerable to vessel strikes (Deakos 2010). Five giant manta rays were reported to have been struck by vessels from 2016 through 2018; individuals had injuries (i.e., fresh or healed dorsal surface propeller scars) consistent with a vessel strike. These interactions were observed by researchers conducting surveys from Boynton Beach to Jupiter, Florida (J. Pate, Florida Manta Project, unpublished data). The giant manta ray is frequently observed in nearshore coastal waters and feeding at inlets along the east coast of Florida. As vessel traffic is concentrated in and around inlets and nearshore waters, this overlap exposes the giant manta ray in these locations to an increased likelihood of potential vessel strike injury. Yet, few instances of confirmed or suspected mortalities of giant manta ray attributed to vessel strike injury (e.g., via strandings) have been documented. This lack of documented mortalities could also be the result of other factors that influence carcass detection (i.e., wind, currents, scavenging, decomposition etc.).

Microplastics

Filter-feeding megafauna are particularly susceptible to high levels of microplastic ingestion and exposure to associated toxins due to their feeding strategies, target prey, and, for most, habitat overlap with microplastic pollution hotspots (Germanov et al. 2019). Giant manta rays are filter feeders, and, therefore can ingest microplastics directly from polluted water or indirectly through-contaminated planktonic prey (Miller and Klimovich 2017). The effects of ingesting indigestible particles include blocking adequate nutrient absorption and causing mechanical damage to the digestive tract. Microplastics can also harbor high levels of toxins and persistent organic pollutants, and introduce these toxins to organisms via ingestion. These toxins can bioaccumulate over decades in long-lived filter feeders, leading to a disruption of biological processes (e.g., endocrine disruption), and potentially altering reproductive fitness (Germanov et al. 2019). Jambeck et al. (2015) found that the Western and Indo- Pacific regions are responsible for the majority of plastic waste. These areas also happen to overlap with some of the largest known aggregations of giant manta rays. For example, in Thailand, where recent sightings data have identified over 288 giant manta rays (MantaMatcher 2016), mismanaged plastic waste is estimated to be on the order of 1.03 million tonnes annually, with up to 40% of this entering the marine environment (Jambeck et al. 2015). Approximately 1.6 million tonnes of mismanaged plastic waste is being disposed of in Sri Lanka, again with up to 40% entering the marine environment (Jambeck et al. 2015), potentially polluting the habitat used by the nearby Maldives aggregation of manta rays. While the ingestion of plastics is likely to negatively affect the health of the species, the levels of microplastics in manta ray feeding grounds and frequency of ingestion are presently being studied to evaluate the impact on these species (Germanov et al. 2019).

Mooring and Anchor Lines

Mooring and boat anchor line entanglement may also wound giant manta rays or cause them to drown (Deakos et al. 2011; Heinrichs et al. 2011). There are numerous anecdotal reports of giant manta rays becoming entangled in mooring and anchor lines (C. Horn, NMFS, unpublished data), as well as documented interactions encountered by other species of manta rays (C. Horn, NMFS, unpublished data). For example, although a rare occurrence, reef manta rays on occasion entangle themselves in anchor and mooring lines. Deakos (2010) suggested that manta rays become entangled when the line makes contact with the front of the head between the cephalic lobes, the animal's reflex response is to close the cephalic lobes, thereby trapping the rope between the cephalic lobes, entangling the manta ray as the animal begins to roll in an attempt to free itself. In Hawaii, on at least 2 occasions, a reef manta ray was reported to have died after entangling in a mooring line (A. Cummins, pers. comm. 2007, K. Osada, pers. comm. 2009; cited in Deakos (2011)). In Maui, Hawaii, Deakos et al. (2011) observed that 1 out of 10 reef manta rays had an amputated or disfigured non-functioning cephalic lobe, likely a result of line entanglement. Mobulid researchers indicate that entanglements may significantly affect the manta rays fitness (Braun et al. 2015; Convention on Migratory Species 2014; Couturier et al. 2012; Deakos et al. 2011; Germanov and Marshall 2014; Heinrichs et al. 2011). However, there is very little quantitative information on the frequency of these occurrences and no information on the impact of these injuries on the overall health of the species.

Climate Change Effects

Because giant manta rays are migratory and considered ecologically flexible (e.g., low habitat specificity), they may be less vulnerable to the impacts of climate change compared to other sharks and rays (Chin et al. 2010). However, as giant manta rays frequently rely on coral reef habitat for important life history functions (e.g., feeding, cleaning) and depend on planktonic food resources for nourishment, both of which are highly sensitive to environmental changes (Brainard et al. 2011; Guinder and Molinero 2013), climate change is likely to have an impact on their distribution and behavior. Coral reef degradation from anthropogenic causes, particularly climate change is projected to increase through the future. Specifically, annual, globally averaged surface ocean temperatures are projected to increase by approximately 0.7°C by 2030 and 1.4°C by 2060 compared to the 1986-2005 average (Intergovernmental Panel on Climate Change 2013), with the latest climate models predicting annual coral bleaching for almost all reefs by 2050 (Heron et al. 2016). Declines in coral cover have been shown to result in changes in coral reef fish communities (Jones et al. 2004) (Graham et al. 2008). Therefore, the projected increase in coral habitat degradation may potentially lead to a decrease in the abundance of fish that clean giant manta rays (e.g., *Labroides* spp., *Thalassoma* spp., and *Chaetodon* spp.) and an overall reduction in the number of cleaning stations available to manta rays within these habitats. Decreased access to cleaning stations may negatively affect the fitness of giant manta rays by hindering their ability to reduce parasitic loads and dead tissue, which could lead to increases in diseases and declines in reproductive fitness and survival rates.

Changes in climate and oceanographic conditions, such as acidification, are also known to affect zooplankton structure (size, composition, and diversity), phenology, and distribution (Guinder and Molinero 2013). As such, the migration paths and locations of both resident and seasonal aggregations of giant manta rays, which depend on these animals for food, may similarly be altered (Couturier et al. 2012). As research to understand the exact impacts of climate change on marine phytoplankton and zooplankton communities is still ongoing, the severity of this threat has yet to be fully determined (Miller and Klimovich 2017).

6.0 ENVIRONMENTAL BASELINE

The "environmental baseline" "refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. The environmental baseline includes the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early Section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process. The impacts to listed species or designated critical habitat from Federal agency activities or existing Federal agency facilities that are not within the agency's discretion to modify are part of the environmental baseline." (50 CFR §402.02). "Early" consultation in this definition refers to "a process requested by a Federal agency on behalf of a prospective applicant under section 7(a)(3) of the Act" (50 CFR§§402.02, 402.11) which is governed by formalized procedures set forth in 50 CFR§402.11 that are separate and distinct from those set forth in 50 CFR§402.14 for formal consultations initiated under ESA Section 7(a)(2). "Early consultation" under 50 CFR §402.11 and ESA Section 7(a)(3) should not be confused with formal consultation initiated and in its early stages or planned for initiation under 50 CFR§402.14 ESA Section 7(a)(2). Only projects that have completed "formal consultation" under ESA Section 7(a)(2) or completed "early consultation" under ESA Section 7(a)(3) are included in the environmental baseline for this Opinion.

There are a number of existing activities that regularly occur in various portions of the action area, including operation of vessels and federal and state authorized fisheries. Other activities that occur occasionally or intermittently include scientific research, military activities, and geophysical and geotechnical surveys. There are also environmental conditions caused or exacerbated by human activities (i.e., water quality and noise) that may affect listed species in the action area. Some of these stressors result in mortality or serious injury to individual animals (e.g., vessel strike, fisheries), whereas others result in non-lethal impacts or impacts that are indirect. For all of the listed species considered here, given their extensive movements in and out of the action area and throughout their range as well as the similarities of stressors throughout the action area and other parts of their range the status of the species in the action area is the same as the rangewide status presented in the *Status of the Species* section of this Opinion. Below, we describe the conditions of the action area, present a summary of the best available information on the use of the action area by listed species, and address the impacts to listed species of federal, state, and private activities in the action area that meet the definition of "environmental baseline." Consistent with that definition, future offshore wind projects, as well as activities caused by aspects of their development and operation, that are not the subjects of a completed Section 7 consultation are not in the *Environmental Baseline* for the Maryland Wind Offshore Wind project. All planned and reasonably foreseeable offshore wind projects proposed for review and approval by BOEM will undergo a future formal ESA Section 7 consultation when initiation is requested. When an ESA Section 7 consultation is completed on a wind project, the effects of the action associated with that project would be considered in the *Environmental Baseline* for the next wind project in line for formal Section 7 consultation. Thus, all offshore wind projects and associated activities that have undergone and completed the formal ESA Section 7 process are included in the environmental baseline of this Opinion. The Maryland Wind project will then be included in the environmental baseline for the ESA Section 7 reviews for future offshore wind projects to the extent its effects on listed species may occur in the action area for those future projects.

As described above in Section 3.4, the action area includes the WDA (i.e., the WFA and the cable routes to shore), project-related vessel routes in the identified portion of the U.S. EEZ along the Atlantic coast and the Gulf of Mexico, and the geographic extent of effects caused by project-related activities in those areas. The Maryland Wind project area is located within multiple defined marine areas. The broadest area, the U.S. Northeast Shelf Large Marine Ecosystem, extends from the Gulf of Maine to Cape Hatteras, North Carolina (Kaplan 2011). The WDA is located within the Southern Mid-Atlantic Bight sub-region of the U.S. Northeast Shelf Ecosystem, which is distinct from other regions based on differences in productivity, species assemblages and structure, and habitat features (Cook and Auster 2007). The action area also overlaps with the Mid-Atlantic Bight, which is bounded by Cape Cod, MA to the north and Cape Hatteras, NC to the south. The physical oceanography of this region is influenced by the seafloor, freshwater input from multiple rivers and estuaries, large-scale weather patterns, and tropical or winter coastal storm events. Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011).

Seasonally, the Mid-Atlantic region experiences one of the largest transitions in stratification in any part of the ocean around the world, from the cold, well-mixed conditions in winter months to one of the largest top-to-bottom temperature differences in the summer (Castelao et al. 2010, Houghton et al. 1982, Miles et al. 2021). From spring through early summer, a strong thermocline develops across the length of the Mid-Atlantic Bight, isolating a continuous mid-shelf "cold pool" of water that extends from Nantucket to Cape Hatteras (Houghton et al. 1982, Kaplan 2011, Miles 2021). Through summer, the thermocline strengthens and the cold pool becomes more stable as a result of surface heating and freshwater runoff (Castelao et al. 2010). The stable summer cold pool is a relatively slow-moving feature, which moves back and forth between the coast and shelf in response to surface wind forcing during periods of upwelling and downwelling. During the fall, more frequent strong wind events and decreasing surface heat over increasingly shorter daily daylight hours shifts the balance between heat input and vertical mixing. This results in reduced stratification, which ultimately breaks down the cold pool (Bigelow 1933, Castelao et al 2010, Gong et al 2010, Lentz 2017, Lentz et al 2003, Miles et al 2021). These cold pool "seasons" of spring setup, summer stability, and fall breakdown are associated with and drivers of important biological and ecological processes, such as foraging and migration amongst marine vertebrates (Scales et al 2014).

Shelf currents in the Maryland Wind project area generally flow from north to south year round direction (BOEM 2023). These bottom currents are also influenced by local bathymetry and regional density gradients. Prominent bottom features of the Mid-Atlantic Bight include a series of ridges and troughs. The Maryland Wind project area has seafloor characteristics that are generally consistent with the broader Mid-Atlantic. The project area has gentle slopes, soft-bottom sediment with sand and patches of gravel and silt/sand mixes (BOEM 2023). Steeper sloping areas are located in the western portions of the Maryland Wind Offshore Wind Lease Area (BOEM 2023). The Virginian Atlantic Ecoregion spans from Long Island, New York to Cape Hatteras, North Carolina. The eastward-turning Gulf Stream is located offshore and affects the broader climate and conditions of the Virginian Atlantic ecoregion where the project is located (BOEM 2023). Coastal watersheds such as Delaware Bay are a prominent feature of the region.

The action area includes coastal and inland waters following the export cable route's path towards the coastline and the proposed landfall site at the Indian River Substation. Inland waters include the Indian River and Indian River Bay. The Indian River Bay Watershed overlays the Northern Atlantic Coastal Plain aquifer, which extends from New Jersey to North Carolina (BOEM 2023). A substantial source of fresh water flowing into the Delmarva coastal bays comes from ground water flowing through the surficial aquifer, the uppermost aquifer in the system (Krantz et al. 2004). Krantz et al. (2004) used geophysical and geotechnical data to show advective flow that produces plumes of fresh ground water 1,312 to 1,969 feet (400 to 600 meters) wide and 66 feet (20 meters) thick that extend more than 0.6 miles (1 kilometers) beneath the bay, where incised valleys are filled with 3 to 7 feet (1 to 2 meters) of silt and peat that act as a semi confining layer to restrict the downward flow of salt water.

6.1 Summary of Information on Listed Large Whale Presence in the Action Area

North Atlantic right whale (Eubalaena glacialis)
North Atlantic right whale presence and behavior in the action area is best understood in the context of their range. North Atlantic right whales occur in the Northwest Atlantic Ocean from calving grounds in coastal waters of the southeastern United States to feeding grounds in New England waters into Canadian waters and the Canadian Bay of Fundy, Scotian Shelf, and Gulf of St. Lawrence extending to the waters of Greenland and Iceland (Hayes et al. 2023; 81 FR 4837). The few published sightings of right whales in the Gulf of Mexico (Moore and Clark 1963, Schmidly and Melcher 1974, Ward Geiger et al. 2011) represent either geographic anomalies or a more extensive historic range beyond the sole known calving and wintering ground in the waters of the southeastern U.S. (Waring et al. 2009; 81 FR 4837). The Gulf of Mexico is not considered part of the species range (NMFS 2015; 81 FR 4837) and no right whales are expected to occur in the Gulf of Mexico portion of the action area.

In the late fall, pregnant female right whales move south to their calving grounds off Georgia and Florida, while the majority of the population likely remains on the feeding grounds or disperses along the eastern seaboard. There is at least one case of a calf apparently being born in the Gulf of Maine (Patrician et al. 2009), and another newborn was detected in Cape Cod Bay in 2013

(CCS, unpublished data, as cited in Hayes et al. 2022); however, calving outside of the southeastern U.S. is considered to be extremely rare. A review of visual and passive acoustic monitoring data in the western North Atlantic demonstrated nearly continuous year-round presence across their entire habitat range (for at least some individuals), including in waters previously thought to be used only seasonally by individuals migrating along the coast (e.g., waters off New Jersey and Virginia). This suggests that not all of the population undergoes a consistent annual migration (Bort et al. 2015, Cole et al. 2013, Davis et al. 2017, Hayes et al. 2020, Leiter et al. 2017, Morano et al. 2012, Whitt et al. 2013). Surveys have demonstrated several areas where North Atlantic right whales congregate seasonally, including the coastal waters of the southeastern U.S.; the Great South Channel; Jordan Basin; Georges Basin along the northeastern edge of Georges Bank; Cape Cod; Massachusetts Bay; and the continental shelf south of New England (Brown et al. 2002, Cole et al. 2013, Hayes et al. 2020, Leiter et al. 2017). Several recent studies (Meyer-Gutbrod et al. 2015, 2021, Davis et al. 2017, Davies et al. 2019, Gowan et al. 2019, Simard et al. 2019) suggest spatiotemporal habitat-use patterns are in flux both with regards to a shift northward (Meyer-Gutbrod et al. 2021), changing migration patterns (Gowan et al. 2019), as well as changing numbers in existing known high-use areas (Davis et al. 2017, 2019, 2020).

North Atlantic right whales have been observed in or near state and federal waters off Maryland and Delaware during all four seasons; however, they are most common in spring when they are migrating north and in fall during their southbound migration (Kenney and Vigness-Raposa 2010, Roberts et al. 2016, 2023). These seasonal occurrence observations are aligned with findings from aerial survey data collected between 2017-2020, where North Atlantic right whales were seen in adjacent state and federal waters off New York (up to 120 nm from the coast) during all seasons except summer (Zoidis et al. 2021).

North Atlantic right whales use the waters off of Maryland and Delaware for migration and these waters are considered a Biologically Important Area (BIA) for migration (NOAA 2023). Long-term PAM results presented by Davis et al. (2017) indicate North Atlantic right whales are present along the entire eastern seaboard of North America year-round. These data also indicate North Atlantic right whale distribution started to shift in 2010 from previously prevalent northern grounds, such as the Bay of Fundy and greater Gulf of Maine, to more time spent in mid-Atlantic regions year-round.

Aerial and PAM surveys suggest North Atlantic right whales are more common in the Mid-Atlantic region during winter and spring; however, recent analysis of detections from PAM indicate some year-round presence (Davis et al. 2017; Bailey et al. 2018). Barco et al. (2015) reported pulses of North Atlantic right whale sightings during winter months offshore the Maryland and Delaware WEAs, with some individuals displaying potential feeding behaviors. The species has been detected acoustically in every month of the year in the vicinity of the Maryland WEA, though the highest presence occurred from November through April (Bailey et al. 2018). A higher acoustic occurrence was noted for the species after 2010 in the Mid-Atlantic region, likely due to broad-scale distribution shifts in prey species (Davis et al. 2017).

Based on these data, North Atlantic right whales are most likely to occur offshore Maryland and Delaware during seasonal movements north or south between important feeding and breeding grounds (Knowlton et al. 2002; Firestone et al. 2008; NMFS 2023g). The highest relative abundance and density of North Atlantic right whales are expected during January, February, and March, though year-round presence in the vicinity of the Project area is possible (Roberts et al. 2022). The species is less commonly observed in the region during July, August, and September when they are more likely to be in northern feeding grounds described above. Vessels transiting from Brewer, Maine may encounter North Atlantic right whales.

As described in the BA and proposed MMPA ITA, the best available information regarding marine mammal densities in the portion of the action area encompassing the project area is provided by habitat-based density models produced by the Duke University Marine Geospatial Ecology Laboratory (Roberts et al., 2016, 2022) This data was used to develop mean monthly density estimates for North Atlantic right whales in different parts of the action area; the mean density for each month was determined by calculating the unweighted mean of all 5- by 5-km grid cells partially or fully within the analysis polygon. Density estimates were produced for the lease area (plus a 5.25 km buffer), the nearshore areas where cofferdams will be installed, and the area where HRG surveys will take place. Density estimates for the lease area are presented in Table 6.1 below (reproduced from Table 12 in the proposed MMPA ITA).

Table 6.1. Mean Monthly Density Estimates for North Atlantic right whales within a 5.25 km Buffer around the Lease Area

Monthly Densities (animals per 100 km^2)											
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec
0.075	0.076	0.063	0.045	0.008	0.003	0.001	0.001	0.002	0.004	0.011	0.036

Source: Table 12, 89 FR 504

Density estimates indicate that February is the month with the highest density of right whales in the WDA and that North Atlantic right whales are most likely to occur in and around the lease area from November through May, with the highest probability of occurrence extending from December through April.

In summary, we anticipate individual right whales to occur year round in the action area in both coastal, shallower waters as well as offshore, deeper waters. We expect these individuals to be moving throughout the action area, making seasonal migrations, occasionally foraging in parts of the action area when copepod patches of sufficient density are present, and calving during the winter months in southern waters of the action area (i.e., waters off Georgia and Florida that may be occasionally transited by project vessels transiting between the WDA and Ingleside, TX and Houma/Harvey, LA). As noted above, right whales are generally not expected to occur in the Gulf of Mexico with any presence being rare and limited to occasional, sporadic out of range individuals.

Nova Scotia Stock of Sei whale (Balaenoptera borealis)

In the action area, sei whales are expected to be present in the WDA, most likely in the deeper areas furthest from the coast, and may be present along the oceanic portions of all potential vessel transit routes. The presence and behavior of sei whales in the action area is best understood in the context of their range in the Atlantic, which extends from southern Europe/northwestern Africa to Norway in the east, and from the southeastern United States (or occasionally the Gulf of Mexico and Caribbean Sea; Mead 1977) to West Greenland in the west (Gambell 1977; Gambell 1985b; Horwood 1987). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. EEZ, the Gulf of Maine, Georges Bank, and south of New England (Halpin et al. 2009, Hayes et al. 2017, Hayes et al. 2020). Sei whales are very rare in the Gulf of Mexico with recent sightings limited to stranded individuals in the northern Gulf of Mexico (NMFS 2011). Sei whales are not documented as inhabitants of the Gulf of Mexico in NMFS' stock assessment reports (Waring 2016) and it is extremely unlikely that they would occur along the routes used by project vessels moving to or from ports in the Gulf of Mexico.

Sei whales occurring in the Mid-Atlantic Bight belong to the Nova Scotia stock (Hayes et al. 2020). They can be found in deeper waters of the continental shelf edge waters of the northeastern United States and northeastward to south of Newfoundland (Hain et al. 1985, Prieto et al., 2014). Documented sei whale sightings along the U.S. Atlantic Coast south of Cape Cod are relatively uncommon compared to other baleen whales (CETAP 1982; Kagueux et al. 2010; Hayes et al. 2020). Sei whale sightings in U.S. Atlantic waters are typically centered on mid-shelf and the shelf edge and slope (Olsen et al. 2009).

Sei whales often occur along the shelf edge to feed, but also use shallower shelf waters, particularly during certain years when oceanographic conditions force planktonic prey to shelf and inshore waters (Payne et al. 1990, Schilling et al. 1992, Waring et al. 2004). Although known to eat fish in other oceans, sei whales off the northeastern U.S. are largely planktivorous, feeding primarily on euphausiids and copepods (Flinn et al. 2002, Hayes et al. 2017). These aggregations of prey are largely influenced by the dynamic oceanographic processes in the region. LaBrecque et al. (2015) defined a May to November feeding BIA for sei whales that extends from the 82-foot (25-m) contour off coastal Maine and Massachusetts east to the 656-foot (200-m) contour in the central Gulf of Maine, including the northern shelf break area of Georges Bank, the Great South Channel, and the southern shelf break area of Georges Bank from 328 to 6,562 feet (100–2,000 m). This feeding BIA does not overlap with the Maryland Wind WDA.

Sei whales are present seasonally in the offshore waters of the Maryland Wind project area, though they have been observed year-round near the continental slope (Palka et al. 2021). Available data suggest sei whales primarily occur offshore near the shelf break, only occasionally traveling closer to shore to feed (Palka et al. 2021; Hayes et al. 2022).
PAM analyses indicate sei whales had a higher acoustic occurrence after 2010 in the Mid Atlantic, likely due to distributional shifts in their prey (Davis et al. 2020). Sei whales were not detected during recent acoustic and visual surveys in the vicinity of the Delaware and Maryland WEAs (Barco et al. 2015; Bailey et al. 2018). Habitat-based marine mammal density data indicate the highest densities in the vicinity of the Project area would most likely occur in April and the lowest in August (Roberts et al. 2022). As the species is unlikely to occur south of Cape

Hatteras, North Carolina, sei whales are not likely to be encountered by vessels transiting to and from the Gulf of Mexico. Sei whales are also present throughout the North Atlantic (NMFS 2023h), including within the Action Area in vessel transit lanes from the port in Maine. The majority of sei whale sightings in the Action Area are most likely concentrated in offshore waters between 328 and 3,280 feet (100 and 1,000 meters) deep.

Mean monthly density estimates of sei whales in and around the WDA were derived using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016, 2022). Model results indicate that sei whale density in the lease area plus a 5.25 km buffer in all directions is generally low, peaking in April at densities averaging 0.061 individuals per 100 km^2 (Table 12, 89 FR 504; citing Roberts et al. 2023). Based on the information presented here, we expect sei whales to be at least occasionally present in the deeper water portions of the WDA and in the offshore portions of vessel routes between the WDA and ports in MD, DE, NY, MN, NJ and VA.

In summary, we anticipate individual or small groups of sei whales to occur in the offshore portions of the action area year round, with presence in more shallow, inshore waters and shelf portions of the action area, including the lease area, cable corridors, and vessel transit routes primarily in the spring and summer months. We expect individuals in the action area to be making seasonal migrations, and to be foraging when krill are present.

Sperm whale (Physeter macrocephalus)
In the action area, sperm whales are present in the more offshore portion of the WDA, in the Gulf of Mexico, and may be present along the oceanic portions of all potential vessel transit routes. Sperm whales in the Gulf of Mexico belong to the Northern Gulf of Mexico stock while sperm whales in the other portions of the action area belong to the North Atlantic stock (Hayes et al. 2020). Sperm whales are widely distributed throughout the deep waters of the North Atlantic, primarily along the continental shelf edge, over the continental slope, and into mid-ocean regions (Hayes et al., 2020). They are found at higher densities in areas such as the Bay of Biscay, to the west of Iceland, and towards northern Norway (Rogan et al. 2017) as well as around the Azores. This offshore distribution is more commonly associated with the Gulf Stream edge and other features (Waring et al. 1993, Waring et al. 2001). Calving for the species occurs in low latitude waters outside of the action area. Most sperm whales that are seen at higher latitudes are solitary males, with females generally remaining further south.

Northern Gulf of Mexico stock of sperm whales
In the northern Gulf of Mexico (i.e., U.S. Gulf of Mexico), systematic aerial and ship surveys indicate that sperm whales inhabit continental slope and oceanic waters where they are widely distributed and present year round (Hayes et al. 2021). The best abundance estimate (Nest) for the northern Gulf of Mexico sperm whale is 1,180 (CV=0.22). This estimate is from summer 2017 and summer/fall 2018 oceanic surveys covering waters from the 200-m isobath to the seaward extent of the U.S. EEZ (Garrison et al. 2020). An Unusual Mortality Event (UME) was declared for cetaceans in the northern Gulf of Mexico beginning 1 March 2010 and ending 31 July 2014 (Litz et al. 2014; https://www.fisheries.noaa.gov/national/marine- life-distress/2010-2014-cetacean-unusual-mortality-event-northern-gulf-mexico). It included cetaceans that stranded prior to the Deepwater Horizon (DWH) oil spill, during the spill, and after. Exposure to

the DWH oil spill was determined to be the primary underlying cause of the elevated stranding numbers in the northern Gulf of Mexico after the spill (e.g., Schwacke et al. 2014; Venn-Watson et al. 2015; Colegrove et al. 2016; DWH NRDAT 2016 in Hayes et al. 2021). Sperm whales in the Gulf of Mexico experienced increased mortality related to oil exposure resulting from the DWH incident (Hayes et al. 2021).

North Atlantic stock of sperm whales
Sperm whales are widely distributed throughout the deep waters of the North Atlantic, primarily along the continental shelf edge, over the continental slope, and into mid-ocean regions (Hayes et al., 2020). They are found at higher densities in areas such as the Bay of Biscay, to the west of Iceland, and towards northern Norway (Rogan et al. 2017) as well as around the Azores. This offshore distribution is more commonly associated with the Gulf Stream edge and other features (Waring et al. 1993, Waring et al. 2001). Calving occurs in low latitude waters outside of the action area. Most sperm whales that are seen at higher latitudes are solitary males, with females generally remaining further south.

In the U.S. Atlantic EEZ waters, there appears to be a distinct seasonal distribution pattern (CETAP 1982, Scott and Sadove 1997). In spring, the center of distribution shifts northward to east of Delaware and Virginia and is widespread throughout the central portion of the Mid-Atlantic Bight and the southern portion of Georges Bank. In summer, the distribution of sperm whales includes the area east and north of Georges Bank and into the Northeast Channel region, as well as the continental shelf (inshore of the 100-m isobath) south of New England. In the fall, sperm whale occurrence south of New England on the continental shelf is at its highest level. In winter, sperm whales are concentrated east and northeast of Cape Hatteras.

The average depth of sperm whale sightings observed during the CeTAP surveys was 5,880 ft. (1,792 m) (CETAP 1982). Female sperm whales and young males usually inhabit waters deeper than 3,280 ft. (1,000 m) and at latitudes less than 40° N (Whitehead 2002). Sperm whales feed on larger organisms that inhabit the deeper ocean regions including large- and medium-sized squid, octopus, and medium-and large-sized demersal fish, such as rays, sharks, and many teleosts (NMFS 2015; Whitehead 2002). Although primarily a deep-water species, sperm whales are known to visit shallow coastal regions when there are sharp increases in bottom depth where upwelling occurs resulting in areas of high planktonic biomass (Clarke 1956, Best 1969, Clarke et al. 1978, Jaquet 1996).

Sperm whales are commonly observed near the continental shelf edge, continental slope, and mid ocean regions in association with bathymetric features, though they also occur on the continental shelf in some regions (Hayes et al. 2020). In the Mid-Atlantic, sperm whales have been observed spending a significant amount of time near Norfolk Canyon and in waters more than 6,000 feet (1,800 meters) deep (U.S. Department of the Navy 2017). Sperm whales have been known to concentrate off Cape Hatteras during winter months, with a northward migration to Virginia and Delaware (Costidis et al. 2017). Predictive density mapping based on long-term survey data indicates sperm whales are strongly associated with the continental shelf edge throughout much of the year, entering shelf waters in the Mid-Atlantic generally during the late spring to early fall (Roberts et al. 2022).

Sperm whale detections within the Delaware and Maryland WEAs are limited, with records generally limited to the shelf break region and occasionally in deeper waters off the Mid-Atlantic Bight (Garrison 2020; Palka et al. 2021). Habitat-based marine mammal density data indicate the highest densities in the vicinity of the Project area would most likely occur in May and the lowest in August through October (Roberts et al. 2022). Sperm whales are also present throughout the North Atlantic and Gulf of Mexico (NMFS 2023i), including within vessel transit lanes from ports in Maine, and the Gulf of Mexico. During the Northern leg of the 2021 AMAPPS shipboard survey, sperm whales were among the most common large whale species detected during acoustic monitoring efforts in the survey area which ranged from south of Massachusetts to east of Virginia in waters beyond the 100 m depth contour.

As part of the application for an MMPA ITA for the Maryland Wind project, TRC (2023) used data from Roberts et al. (2016, 2022) to calculate mean monthly density estimates within 5.25 km of the Maryland Wind lease area. In the lease area, monthly density of sperm whales ranges from 0.000-0.00006 sperm whales/km^2, with the lowest density in August to October, and with the highest density in May. Sperm whales are considered to be rare in the lease area.

In summary, individual adult sperm whales are anticipated to occur infrequently in deeper, offshore waters of the North Atlantic portion of the action area primarily in summer and fall months, with a small number of individuals potentially present year round. These individuals are expected to be moving in or near the WDA as they make seasonal migrations, and to be foraging along the shelf break. As sperm whales typically forage at deep depths (500-1,000 m) (NMFS 2018) well beyond that of the lease area, foraging is not expected to occur in WDA. Additionally, sperm whales may occur along the vessel transit routes south of the WDA, with presence most likely in more offshore waters. Sperm whales are also present in the Gulf of Mexico year round.

Western North Atlantic stock of fin whales (Balaenoptera physalus)
In the action area, fin whales are present in the WDA and may be present along the oceanic portions of a majority of vessel transit routes. Fin whale presence and behavior in the action area is best understood in the context of their range. Fin whale presence in the North Atlantic is limited to waters north of Cape Hatteras, NC. In general, fin whales in the central and eastern Atlantic tend to occur most abundantly over the continental slope and on the shelf seaward of the 200-m isobath (Rørvik et al. 1976 in NMFS 2010). In contrast, off the eastern United States they are centered along the 100-m isobath but with sightings well spread out over shallower and deeper water, including submarine canyons along the shelf break (Kenney and Winn 1987; Hain et al. 1992). Fin whales do not occur in the Gulf of Mexico.

Fin whales occurring in the Mid-Atlantic belong to the western North Atlantic stock (Hayes et al. 2019). They are typically found along the 328-foot (100-meter) isobath but also in shallower and deeper water, including submarine canyons along the shelf break (Kenney and Winn 1986). Fin whales are migratory, moving seasonally into and out of feeding areas, but the overall migration pattern is complex and specific routes are unknown (NMFS 2018a). Fin whales are believed to use the North Atlantic water primarily for feeding and more southern waters for calving. Movement of fin whales from the Labrador/Newfoundland region south into the West Indies during the fall have been reported (Clark 1995). Neonate strandings along the U.S. Mid-Atlantic coast from October through January indicate a possible offshore calving area (Hain et al. 1992). The species occur year-round in a wide range of latitudes and longitudes, but the density of individuals in any one area changes seasonally. Thus, their movements overall are patterned and consistent, but distribution of individuals in a given year may vary according to their energetic and reproductive condition, and climatic factors (NMFS 2010).

The northern Mid-Atlantic Bight represents a major feeding ground for fin whales as the physical and biological oceanographic structure of the area aggregates prey. This feeding area extends in a zone east from Montauk, Long Island, New York, to south of Nantucket (LaBrecque et al. 2015, Kenney and Vigness-Raposa 2010; NMFS 2010a) and is a location where fin whales congregate in dense aggregations and sightings frequently occur (Kenney and Vigness-Raposa 2010); however, the Maryland Wind project area is located outside of this area. Fin whales in this area feed on krill (*Meganyctiphanes norvegica* and *Thysanoessa inermis*) and schooling fish such as capelin (*Mallotus villosus*), herring (*Clupea harengus*), and sand lance (*Ammodytes* spp.) (Borobia et al. 1995) by skimming the water or lunge feeding. This area is used extensively by feeding fin whales from March to October. Several studies suggest that distribution and movements of fin whales along the east coast of the United States is influenced by the availability of sand lance (Kenney and Winn 1986, Payne 1990).

Acoustic studies in Estabrook et al. (2019, 2020) detected fin whales in the New York Bight every month of the year in their study period from 2017 to 2019. The results of these acoustic studies are consistent with the observations in Zoidis et al. (2021) where fin whales were sighted at least once in each month of the calendar year across the 3 years and in each survey season, throughout the study area across all habitat zones. While these studies were north of the WDA, given the geographic proximity to the WDA they are informative of potential presence of fin whales in the WDA. Based on the occurrence of a cow-calf pair observed in August 2008, results from the EBS provide support for the possibility of nearshore waters off New Jersey serving as nursery habitat (NJDEP 2010, Whitt et al. 2015).

AMAPPS surveys detected fin whales in the Wind Energy Areas in the fall 2012 aerial, spring 2013 aerial, spring 2014 aerial, spring and summer 2017 aerial, winter 2018 aerial, and summer 2016 shipboard surveys (NEFSC and SEFSC 2012, 2013, 2014, 2016, 2018, 2019, 2022). Fin whales were also recorded in the north of the project area within the Ocean Wind WDA during the summer 2017 HRG survey (Alpine 2017b) and during the Geotechnical 1A Survey in winter 2017–2018 (Smultea Environmental Sciences 2018). Fin whales are distributed throughout the continental shelf in the Mid-Atlantic region, but data indicate highest densities near the shelf break offshore the Maryland and Delaware WEAs (Barco et al. 2015; BOEM 2012; CETAP 1982; Palka et al. 2021; Roberts et al. 2022). Surveys conducted around the Delaware and Maryland WEAs show observations of fin whales in this region are highest during winter and spring, though low abundance year-round presence is likely (Palka et al. 2021). Acoustic analyses indicate heightened presence from November to March (Bailey et al. 2018), which is corroborated by 10 years of passive acoustic monitoring (PAM) data collected by Davis et al. (2020). Bailey et al. (2018) further reported that fin whales are the most frequently detected vocalizing cetacean species, with the majority of detections offshore of the Maryland WEA.

Mean monthly density estimates of fin whales in the project area were derived using the Duke University Marine Geospatial Ecology Laboratory model results (Roberts et al. 2016, 2022, as reported in TRC 2023). Model results indicate that fin whale density in the lease area is considerably variable between months with peaks in August and January with densities ranging from 0.028 (August) to 0. 214 (January) individuals per 100 km^2 throughout the year (Table 12, 89 FR 504; citing Roberts et al. 2023).

Because fin whales have a worldwide distribution and are largely open-ocean dwellers, we expect fin whales to occur along all portions of the vessel transit routes to ports located within the Mid-Atlantic and along only a portion of the vessel transit route to the ports in the Gulf of Mexico. This is because fin whales are common in state and federal waters principally from Cape Hatteras, NC northward.

In summary, we anticipate individual fin whales to occur in the WDA year-round, with the possibility that monthly density peaks will vary inter-annually. We expect these individuals to be making seasonal coastal migrations, and to be foraging during spring and summer months. Fin whales occur year-round in a wide range of latitudes and longitudes, thus they may be present along the vessel transit routes north of Cape Hatteras, NC year round. No fin whales are anticipated in the Gulf of Mexico portion of the action area.

6.2 Summary of Information on Listed Sea Turtles in the Action Area

Four ESA listed species of sea turtles (leatherback sea turtles, North Atlantic DPS of green sea turtles, Northwest Atlantic Ocean DPS of loggerhead sea turtles, Kemp's ridley sea turtles) make seasonal migrations into the U.S. Mid-Atlantic and are present in portions of the action area. Individuals from all four species are seasonally present in the WDA, typically from late spring/early summer through the fall; these species are also seasonally present in the coastal and oceanic waters that may be transited by project vessels traveling to ports located within Delaware, Maryland, New York, New Jersey, and the Chesapeake Bay. Sea turtles are present year round in the South Atlantic and Gulf of Mexico and their range overlaps with the coastal and oceanic waters that may be transited by project vessels traveling to/from Ingleside, Texas and Houma/Harvey, Louisiana.

The four species of sea turtles considered here are highly migratory. One of the main factors influencing sea turtle presence in mid-Atlantic waters and north is seasonal temperature patterns (Ruben and Morreale 1999) as waters in these areas are not warm enough to support sea turtle presence year round. In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas to foraging grounds as water temperatures warm in the spring. The trend is reversed in the fall as water temperatures cool. By December, sea turtles have passed Cape Hatteras, returning to more southern waters for the winter (Braun-McNeill and Epperly 2002, Ceriani et al. 2012, Griffin et al. 2013, James et al. 2005b, Mansfield et al. 2009, Morreale and Standora 2005, Morreale and Standora 1998, NEFSC and SEFSC 2011, Shoop and Kenney 1992, TEWG 2009, Winton et al. 2018). Water temperatures too low or too high may affect feeding rates and physiological functioning (Milton and Lutz 2003); metabolic rates may be suppressed when a sea turtle is exposed for a prolonged period to temperatures below 8-10°C (George 1997, Milton and Lutz 2003, Morreale et al. 1992). That said, loggerhead sea turtles have been found in waters as low as 7.1-8°C (Braun-McNeill et al. 2008, Smolowitz et al. 2015, Weeks et al. 2010). However, in assessing critical habitat for loggerhead sea turtles, the review team considered the water-temperature habitat range for loggerheads to be above 10° C (NMFS 2013). Sea turtles are most likely to occur in the action area when water temperatures are above this temperature, although depending on seasonal weather patterns and prey availability, they could be also present in months when water temperatures are cooler (as evidenced by fall and winter cold stunning records as well as year round stranding records). Given the warmer water temperatures, sea turtles are present in waters off the U.S. south Atlantic and in the Gulf of Mexico year round.

AMAPPS aerial abundance surveys in summer 2021 indicate that loggerhead and leatherback turtles are relatively common in waters of the southern Mid-Atlantic Bight while Kemp's ridley turtles and green turtles are less common (NEFSC and SEFSC 2022). Sea turtle nesting does not often or normally occur in Delaware, and there are no nesting beaches or other critical habitats in the vicinity of the project area (GARFO 2021). For this reason, sea turtles in the lease area are adults or juveniles; due to the distance from any nesting beaches, no hatchlings occur in the lease area.

Sea turtles feed on a variety of both pelagic and benthic prey, and change diets through different life stages. Adult loggerhead and Kemp's ridley sea turtles are carnivores that feed on crustaceans, mollusks, and occasionally fish, green sea turtles are herbivores and feed primarily on algae, seagrass, and seaweed, and leatherback sea turtles are pelagic feeders that forage throughout the water column primarily on gelatinivores. As juveniles, loggerhead and green sea turtles are omnivores (Wallace et al. 2009, Dodge et al. 2011, BA - Eckert et al. 2012, https://www.seeturtles.org/sea-turtle-diet, Murray et al 2013, Patel et al. 2016). The distribution of pelagic and benthic prey resources is primarily associated with dynamic oceanographic processes, which ultimately affect where sea turtles forage (Polovina et al. 2006). During late-spring, summer, and early-fall months when water temperatures are suitable, the physical and biological structure of both the pelagic and benthic environment in the lease area and cable corridor provide habitat for both the four species of sea turtles in the region as well as their prey.

Additional species-specific information is presented below. It is important to note that most of these data sources report sightings data that is not corrected for the percentage of sea turtles that were unobservable due to being under the surface. As such, many of these sources represent a minimum estimate of sea turtles in the area.

Leatherback sea turtles

Leatherbacks are a predominantly pelagic species that ranges into cooler waters at higher latitudes than other sea turtles; their large body size makes the species easier to observe in aerial and shipboard surveys. The CETAP regularly documented leatherback sea turtles on the OCS between Cape Hatteras and Nova Scotia during summer months in aerial and shipboard surveys conducted from 1978 through 1988. The greatest concentrations were observed between Long Island and the Gulf of Maine (Shoop and Kenney 1992). AMAPPS surveys conducted from 2010 through 2021 routinely documented leatherbacks in Delware's offshore waters and surrounding areas during summer months (NEFSC and SEFSC 2018, 2022; Palka 2021).

Key foraging destinations include, among others, the eastern coast of the United States (Eckert et al. 1998, 2012). Satellite tagging studies provide information on leatherback sea turtle behavior and movement in the action area. These studies show that leatherback sea turtles move throughout most of the North Atlantic from the equator to high latitudes. Based on tracking data for leatherbacks tagged off North Carolina (n=21), many of the tagged leatherbacks spent time in shelf waters from North Carolina, up the Mid-Atlantic shelf and into southern New England and the Gulf of Maine. After coastal residency, some leatherbacks undertook long migrations while tagged. Some migrated far offshore of the Mid-Atlantic, past Bermuda, even as far as the Mid-Atlantic Trench region. Others went towards Florida, the Caribbean, or Central America (Palka et al. 2021). This data indicates that leatherbacks are present throughout the action area at all depths of the water column and may be present along the vessel transit routes from the South Atlantic and Gulf of Mexico.

Most observations of leatherbacks offshore Maryland and Delaware have been concentrated along the continental shelf edge or open ocean waters, but tagging data indicate some individuals may travel closer to shore (Sea Turtle Conservancy 2023; Palka et al. 2021). Data from the NMFS sea turtle stranding and salvage network show 31 strandings of leatherback sea turtles in Maryland and Delaware between January 1, 2013, and May 1, 2023, largely the result of traditional stranding reasons[25], though six were the result of incidental capture (NMFS 2022f). There have been no recorded leatherback sea turtle nesting events in the Mid-Atlantic. Stranding data between 2018 and 2021 reported only five leatherback sea turtles in Delaware (NMFS 2022f).

In the BA (Table 6-13), BOEM presents densities for sea turtles in the WDA . Abundance estimates were corrected to represent the abundance in the entire offshore planning area and then scaled by the full offshore planning area to obtain a density in units of animals per km^2. Model results indicate that leatherback sea turtle density in the WDA is highest in the summer (0.02706 animals/100 km^2), with all other seasons having the same modeled density (0.02040 animals/100 km^2).

Sasso et al. (2021) presents information on the use of the Gulf of Mexico by leatherbacks. Individuals are present year round with highest abundance during the summer and early autumn as post-nesting turtles enter the Gulf from Caribbean nesting beaches during the summer and move to the Caribbean in the late fall. The summer and early fall period coincides with the period of greatest abundance of the leatherback's preferred jellyfish prey. The northeastern Gulf of Mexico off the Florida Panhandle and the southeastern Gulf of Mexico in the Bay of Campeche off the state of Tabasco, Mexico have been identified as primary foraging areas.

Based on the information presented here, we anticipate leatherback sea turtles to occur in the WDA (i.e., the lease area and cable corridors) during the warmer months, typically between May and November. Leatherbacks are also expected along the vessel transit routes used by project vessels transiting to and from ports in the South Atlantic with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

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[25] A "traditional stranding" is defined as when a dead, sick, or injured sea turtle is found washed ashore, floating, or underwater, and when it is not an incidental capture, a post-hatchling, or a cold-stunning. Traditional strandings do not involve healthy, uninjured sea turtles (NMFS 2022f).

Northwest Atlantic DPS of Loggerhead sea turtles

The loggerhead sea turtle is commonly found throughout the North Atlantic including the Gulf of Mexico, the northern Caribbean, the Bahamas archipelago (Dow et al. 2007), and eastward to West Africa, the western Mediterranean, and the west coast of Europe (NMFS and USFWS 2008). The range of the Northwest Atlantic DPS is the Northwest Atlantic Ocean north of the equator, south of 60° N. Lat., and west of 40° W. Long. Northwest Atlantic DPS loggerheads occur in the oceanic portions of the action area west of 40°W, inclusive of the Gulf of Mexico.

Extensive tagging results suggest that tagged loggerheads occur on the continental shelf along the United States Atlantic from Florida to North Carolina year-round but also highlight the importance of summer foraging areas on the Mid-Atlantic shelf, which includes the WDA (Winton et al. 2018).

During the CETAP surveys, one of the largest observed aggregations of loggerheads was documented in shallow shelf waters northeast of Long Island (Shoop and Kenney 1992), north of the action area; however, this data is informative of loggerhead habitat use in the action area. Loggerheads were most frequently observed in areas ranging from 72 to 160 feet (22 and 49 m) deep. Over 80% of all sightings were in waters less than 262 feet (80 m), suggesting a preference for relatively shallow OCS habitats (Shoop and Kenney 1992). Juvenile loggerheads are prevalent in the nearshore waters of Long Island from July through mid-October (Morreale et al. 1992; Morreale and Standora 1998), accounting for more than 50% of live strandings and incidental captures (Morreale and Standora 1998).

In the summer of 2010, as part of the AMAPPS project, the NEFSC and SEFSC estimated the abundance of juvenile and adult loggerhead sea turtles in the portion of the northwestern Atlantic continental shelf between Cape Canaveral, Florida and the mouth of the Gulf of St. Lawrence, Canada (NMFS and SEFSC 2011b). The abundance estimates were based on data collected from an aerial line-transect sighting survey as well as satellite tagged loggerheads. The preliminary regional abundance estimate was about 588,000 individuals (approximate inter-quartile range of 382,000-817,000) based on only the positively identified loggerhead sightings, and about 801,000 individuals (approximate inter-quartile range of 521,000-1,111,000) when based on the positively identified loggerheads and a portion of the unidentified sea turtle sightings (NMFS 2011b). The loggerhead was the most frequently observed sea turtle species in 2010 to 2017 AMAPPS aerial surveys of the Atlantic continental shelf.

Barco et al. (2018) estimated loggerhead sea turtle abundance and density in the southern portion of the Mid-Atlantic Bight and Chesapeake Bay using data from 2011-2012. During aerial surveys off Virginia and Maryland, loggerhead sea turtles were the most common turtle species detected, followed by greens and leatherbacks, with few Kemp's ridleys documented. Density varied both spatially and temporally. Loggerhead abundance and density estimates in the ocean were higher in the spring (May-June) than the summer (July-August) or fall (September-October). Ocean abundance estimates of loggerheads ranged from highs of 27,508-80,503 in the spring months of May-June to lows of 3,005-17,962 in the fall months of September-October (Barco et al. 2018).

AMAPPS data, along with other sources, have been used in recent modeling studies. Winton et al. (2018) modeled the spatial distribution of satellite-tagged loggerhead sea turtles in the Western North Atlantic. The Mid-Atlantic Bight was identified as an important summer foraging area and the results suggest that the area may support a larger proportion of the population, over 50% of the predicted relative density of loggerheads north of Cape Hatteras from June to October (NMFS 2019a, Winton et al. 2018). Using satellite telemetry observations from 271 large juvenile and adult sea turtles collected from 2004 to 2016, the models predicted that overall densities were greatest in the shelf waters of the U.S. Atlantic coast from Florida to North Carolina. Tagged loggerheads primarily occupied the continental shelf from Long Island, New York to Florida, with some moving offshore. Monthly variation in the Mid-Atlantic Bight indicated migration north to the foraging grounds from March to May and migration south from November to December. In late spring and summer, predicted densities were highest in the shelf waters from Maryland to New Jersey. In the cooler months, the predicted densities in the Mid-Atlantic Bight were higher offshore (Winton et al. 2018). South of Cape Hatteras, there was less seasonal variability and predicted densities were high in all months. Many of the individuals tagged in this area remained in the general vicinity of the tagging location. The authors did caution that the model was driven, at least in part, by the weighting scheme chosen, is reflective only of the tagged population, and has biases associated with the non-random tag deployment. Most loggerheads tagged in the Mid-Atlantic Bight were tagged in offshore shelf waters north of Chesapeake Bay in the spring. Thus, loggerheads in the nearshore areas of the Mid-Atlantic Bight may have been under-represented (Winton et al. 2018).

To better understand loggerhead behavior on the Mid-Atlantic foraging grounds, Patel et al. (2016) used a remotely operated vehicle (ROV) to document the feeding habitats (and prey availability), buoyancy control, and water column use of 73 loggerheads recorded from 2008-2014. When the mouth and face were in view, loggerheads spent 13% of the time feeding on non-gelatinous prey and 2% feeding on gelatinous prey. Feeding on gelatinous prey occurred near the surface to depths of 52.5 ft. (16 m). Non-gelatinous prey were consumed on the bottom. Turtles spent approximately 7% of their time on the surface (associated with breathing), 42% in the near surface region, 44% in the water column, 0.4% near bottom, and 6% on bottom. When diving to depth, turtles displayed negative buoyancy, making staying at the bottom easier (Patel et al. 2016).

Patel et al. (2018) evaluated temperature-depth data from 162 satellite tags deployed on loggerhead sea turtles from 2009 to 2017 when the water column is highly stratified (June 1 – October 4). Turtles arrived in the Mid-Atlantic Bight in late May as the Cold Pool formed and departed in early October when the Cold Pool started to dissipate. The Cold Pool is an oceanographic feature that forms annually in late May. During the highly stratified season, tagged turtles were documented throughout the water column from June through September. Fewer bottom dives occurred north of Hudson Canyon early (June) and late (September) in the foraging season (Patel et al. 2018).

Data from the NMFS sea turtle stranding and salvage network show 458 strandings of loggerhead sea turtles in Maryland and Delaware between January 1, 2013, and May 1, 2023, largely the result of traditional stranding reasons (NMFS 2022f). Loggerhead sea turtles are commonly documented nesting on southern beaches in Virginia (Funk 2020; USFWS 2012). The first successful loggerhead nesting event was documented in Maryland in 2017 when approximately 100 hatchlings emerged from a nest in Assateague Island National Seashore (Helf 2017; NPS 2017). According to the Maryland Park Service, loggerhead sea turtle nesting north of Virginia is rare, and though sea turtles have made attempts in the past to nest on Assateague's beach, this is the first reported group of hatchlings to make it to the water (Helf 2017). Loggerhead sea turtles have also nested in Delaware; the first loggerhead nesting event was documented in July 2018 on Fenwick Island, Delaware (DNREC 2018). However, nesting events in Maryland and Delaware are considered rare as the primary nesting sites for this population are typically located in Florida and Mexico; there are no comprehensive nesting data available for Maryland or Delaware given the uncommon occurrence of sea turtle nests (Ryan 2018). Additionally, from 2018 to 2021, there have been 79 reported strandings of loggerhead sea turtles in Delaware, 56 of which were reported in inshore waters (NMFS 2022).

In the BA (Table 6-13), the modeled mean seasonal densities were estimated. Loggerheads were the most numerous of all turtle species in the Maryland Wind lease area with a peak in the spring (3.319 per km^2) with predicted absence in the winter (BOEM 2023). Based on the information presented here, we anticipate loggerheads from the Northwest Atlantic DPS to occur in the WDA (i.e., the lease area and cable corridors) during the warmer months, typically between May and November. Loggerheads are also expected along the vessel transit routes used by project vessels transiting to southern ports with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

Kemp's ridley sea turtles

Kemp's ridleys are distributed throughout the Gulf of Mexico and U.S. Atlantic coastal waters, from Florida to New England. Adult Kemp's ridleys primarily occupy nearshore coastal (neritic) habitats. Many adult Kemp's ridleys remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS, USFWS, and SEAMARNAT 2011). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 m) deep (Landry and Seney 2008; Shaver et al. 2005; Shaver and Rubio 2008), although they can also be found in deeper offshore waters.

During spring and summer, juvenile Kemp's ridleys generally occur in the shallow coastal waters of the northern Gulf of Mexico and along the United States Atlantic coast from southern Florida to the Mid-Atlantic and New England. In addition, the NEFSC caught a juvenile Kemp's ridley during a recent research project in deep water south of Georges Bank (NEFSC unpublished data, as cited in NMFS [2020a]). In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 m) deep (Seney and Landry 2008; Shaver et al. 2005; Shaver and Rubio 2008), although they can also be found in deeper offshore waters.

Juvenile and subadult Kemp's ridley sea turtles are known to travel as far north as Long Island Sound and Cape Cod Bay during summer and autumn foraging (NMFS, USFWS and SEAMARNAT 2011). Visual sighting data are limited because this small species is difficult to observe using aerial survey methods (Kraus et al. 2016), and most surveys do not cover its preferred shallow bay and estuary habitats. Data from the NMFS sea turtle stranding and salvage network show 58 strandings of Kemp's ridley sea turtles in Maryland and Delaware between

January 1, 2013, and May 1, 2023, largely the result of traditional stranding reasons (NMFS 2022f). No Kemp's ridley sea turtle nesting events have been recorded in Maryland or Delaware; the nearest reported nesting site was one nest in Virginia in 2012, the first ever Kemp's ridley sea turtle nest in that state (USFWS 2012). Nesting in the mid-Atlantic, including within the Project area, is considered very rare. Stranding data between 2018 and 2021 show the species is less common in this region, as only 10 stranded Kemp's ridley sea turtles have been reported in Delaware (NMFS 2022f).

The modeled density of Kemp's ridley sea turtles off the within the project area is summarized in Table 6-13 of the BA with a seasonal peak in summer (.00226 per km^2) and equal densities during the rest of the year of .00220 p km^2 (BOEM 2023)

Based on the information presented here, we anticipate Kemp's ridley turtles to occur in the WDA (i.e., the lease area and cable corridors) during the warmer months, typically between June and August. We expect the highest likelihood of occurrence to be in coastal nearshore areas adjacent to the Indian River Bay, where the project's export cable system will make landfall in the Indian River, as Kemp's ridley sea turtles are known to seek protected shallow-water habitats. Kemp's ridleys are also expected along the vessel transit routes used by project vessels transiting to southern ports with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

North Atlantic DPS of Green sea turtles

Most green turtles spend the majority of their lives in coastal foraging grounds. These areas include fairly shallow waters both open coastline and protected bays and lagoons. In addition to coastal foraging areas, oceanic habitats are used by oceanic-stage juveniles, migrating adults, and, on some occasions, by green turtles that reside in the oceanic zone for foraging. Green sea turtles are likely to be present seasonally in the WDA and to occur in portions of the vessel traffic component of the action area. Green sea turtles are present year round in the Gulf of Mexico and nesting occurs at some Gulf of Mexico beaches (NMFS and USFWS 2007).

This species is typically observed in U.S. waters in the Gulf of Mexico or coastal waters south of Virginia (USFWS 2021). Juveniles and subadults are occasionally observed in Atlantic coastal waters as far north as Massachusetts (NMFS and USFWS 1991), including the waters of Long Island Sound and Cape Cod Bay, which are both, located north of the Maryland Wind project area (CETAP 1982). Five green turtle sightings were recorded off the Long Island shoreline in aerial surveys conducted from 2010 to 2013 (NEFSC and SEFSC 2018). Green sea turtles were also positively identified in 2010 to 2017 AMAPPS aerial surveys of the Atlantic continental shelf.

Data from the NMFS sea turtle stranding and salvage network show 14 strandings of green sea turtles in Maryland and Delaware between January 1, 2013, and May 1, 2023, largely the result of traditional stranding reasons (NMFS 2022). In 2011, the first green sea turtle was reported nesting on the beaches of Cape Henlopen State Park, Delaware, laying 194 eggs at Herring Point (Egger 2011). No nesting has been observed within Maryland. Given this, nesting green sea turtles can occur within the Project area; however, it is expected to be rare. Additionally, from 2018 to 2021, only four stranded green sea turtles have been reported in Delaware (NMFS

2022f). Within the BA in Table 6-13, BOEM (2023) presented the modeling performed by TRC (2023) to estimate density of sea turtle species within the project area and green sea turtles were estimated to have a peak of 0.05041 per km^2 in the summer with all other seasons having the same modeled density of .03802 per km^2. These and other sources of information indicate that green sea turtles occur periodically in shallow nearshore waters of Mid-Atlantic Bight, but their presence offshore in the Lease Area is also possible.

Based on the information presented here, we anticipate green sea turtles to occur in the WDA during the warmer months, typically between June and August. Green sea turtles are also expected along the vessel transit routes used by project vessels transiting to the southern ports, with seasonal presence dependent on latitude, as well as in the Gulf of Mexico (year round).

6.3 Summary of Information on Listed Marine Fish Presence in the Action Area

Atlantic sturgeon (Acipenser oxyrinchus oxyrinchus)

Adult and subadult (not sexually mature, but have left their natal rivers; typically less than 150cm in total length,) Atlantic sturgeon from all five DPSs undertake seasonal, nearshore (i.e., typically depths less than 50 meters), coastal marine migrations along the United States eastern coastline including in waters of southern New England (Dunton et al. 2010, Erickson et al. 2011). Given their anticipated distribution in depths primarily 50 m and less, Atlantic sturgeon are not expected to occur in the deep, open-ocean portion of the action area that will be transited by project vessels traveling to/from distant ports. In addition to at least occasional presence in the WDA as well as Indian River Bay, Atlantic sturgeon may also occur along the transit routes to the Paulsboro Marine Terminal and New Jersey Wind Port (transiting Delaware Bay and the lower Delaware River), Sparrows Point in Baltimore, MD and Port of Virginia/Hampton Roads (transiting channels within the Chesapeake Bay entrance), the Cianbro Modular Manufacturing Facility in Brewer, ME (transiting the Penobscot Bay and Penobscot River estuary), the Nexans Cable Plant (transiting the Cooper River), and the Port of New York/New Jersey (transiting New York Bay). Atlantic sturgeon do not occur in the Gulf of Mexico.

Atlantic sturgeon demonstrate strong spawning habitat fidelity and extensive migratory behavior (Savoy et al. 2017). Adults and subadults migrate extensively along the Atlantic coastal shelf (Erickson et al. 2011; Savoy et al. 2017), and use the coastal nearshore zone to migrate between river systems (ASSRT 2007; Eyler et al. 2004). Erickson et al. (2011) found that adults remain in nearshore and shelf habitats ranging from 6 to 125 feet (2 to 38 m) in depth, preferring shallower waters in the summer and autumn and deeper waters in the winter and spring. Data from capture records, tagging studies, and other research efforts (Damon-Randall et al. 2013; Dunton et al. 2010; Stein et al. 2004a, 2004b; Zollett 2009) indicate the potential for occurrence in the action area during all months of the year. Individuals from every Atlantic sturgeon DPS have been captured in the Virginian marine ecoregion (Cook and Auster 2007; Wirgin et al. 2015a, 2015b), which extends from Cape Cod, Massachusetts, to Cape Lookout, North Carolina.

Based on tag data, sturgeon migrate to southern waters (e.g. off the coast of North Carolina and Virginia) during the fall, and migrate to more northern waters (e.g. off the coast of New York, southern New England, as far north as the Bay of Fundy) during the spring (Dunton et al. 2010, Erickson et al. 2011, Wippelhauser et al. 2017). In areas with gravel, sand and/or silt bottom habitats and relatively shallow depths (primarily <50 meters), sturgeon may also be foraging during these trips on prey including mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Stein et al. 2004b, Dadswell 2006, Dunton et al. 2010, Erickson et al. 2011).

Atlantic sturgeon aggregate in several distinct areas along the Mid-Atlantic coastline; Atlantic sturgeon are most likely to occur in areas adjacent to estuaries and/or coastal features formed by bay mouths and inlets (Stein et al. 2004a; Laney et al 2007; Erickson et al. 2011; Dunton et al. 2010). These aggregation areas are located within the coastal waters off North Carolina; waters between the Chesapeake Bay and Delaware Bay; the southern New Jersey coast near the mouth of Delaware Bay; and the southwest shores of Long Island (Laney et al 2007; Erickson et al. 2011; Dunton et al. 2010). With the exception of the area off Long Island (which is outside the action area), these waters are in the action area but are further inshore than the routes that will be transited by project vessels moving between U.S. ports and the WDA. These aggregation areas are believed to be where Atlantic sturgeon overwinter and/or forage (Laney et al 2007; Erickson et al. 2011; Dunton et al. 2010). Based on five fishery-independent surveys, Dunton et al. (2010) identified several “hotspots” for Atlantic sturgeon captures, all located in depths of less than 20 m adjacent to estuaries including the Hudson River/NY Bight, Delaware Bay, Chesapeake Bay, Cape Hatteras, and Kennebec River. These “hotspots” are aggregation areas that are most often used during the spring, summer, and fall months (Erickson et al. 2011; Dunton et al. 2010). Areas between these sites are used by sturgeon migrating to and from these areas, as well as to spawning grounds found within natal rivers. Adult sturgeon return to their natal river to spawn in the spring. The nearest river to the lease area and the cable corridors that is known to regularly support Atlantic sturgeon spawning is the Delaware River. The nearest river to the vessel transit route to and from ports in the South Atlantic that is known to regularly support Atlantic sturgeon spawning is the Cooper River.

Dunton et al. (2015) caught sturgeon as bycatch in waters less than 50 feet deep during the New York summer flounder fishery, and Atlantic sturgeon occurred along eastern Long Island in all seasons except for the winter, with the highest frequency in the spring and fall. The species migrates along coastal New York from April to June and from October to November (Dunton et al. 2015). Ingram et al. (2019) studied Atlantic sturgeon distribution using acoustic tags and determined peak seasonal occurrence in the offshore waters of the OCS from November through January, whereas tagged individuals were uncommon or absent from July to September. The authors reported that the transition from coastal to offshore areas, predictably associated with photoperiod and river temperature, typically occurred in the autumn and winter months. Migratory adults and sub-adults have been collected in shallow nearshore areas of the continental shelf (32.9–164 feet [10–50 m]) on any variety of bottom types (silt, sand, gravel, or clay). Evidence suggests that Atlantic sturgeon orient to specific coastal features that provide foraging opportunities linked to depth-specific concentrations of fauna. Concentration areas of Atlantic sturgeon near Chesapeake Bay and North Carolina were strongly correlated with the coastal features formed by the bay mouth, inlets, and the physical and biological features produced by outflow plumes (Kingsford and Suthers 1994, as cited in Stein et al. 2004a). They are also known to commonly aggregate in areas that presumably provide optimal foraging opportunities, such as the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, and Delaware Bay (Dovel and Berggren 1983; Johnson et al. 1997; Rochard et al. 1997; Kynard et al. 2000; Eyler et al. 2004; Stein et al. 2004a; Dadswell 2006, as cited in ASSRT 2007).

Stein et al. (2004a, 2004b) reviewed 21 years of sturgeon bycatch records in the Mid-Atlantic OCS to identify regional patterns of habitat use and association with specific habitat types. Atlantic sturgeon were routinely captured in waters within and in immediate proximity to the action area, most commonly in waters ranging from 33 to 164 feet (10–50 m) deep. Sturgeon in this area were most frequently associated with coarse gravel substrates within a narrow depth range, presumably associated with depth-specific concentrations of preferred prey fauna.

In 2011, telemetered Atlantic sturgeon were detected in nearshore waters off the coast of Maryland, along the southern end of the Delmarva Peninsula. Atlantic sturgeon were observed in shallow, well-mixed, relatively warm fresh water near the 82-ft (25-m) isobath and appeared to be associated with a water mass tied to Delaware Bay (Oliver et al. 2013).

Ingram et al. (2019) studied Atlantic sturgeon distribution in the New York Wind Energy Area by monitoring the movements of tagged Atlantic sturgeon from November 2016 through February 2018 on an array of 24 acoustic receivers (see Figure 1 in Ingram et al. 2019 for acoustic receiver locations). While this area is north of the action area, it is reasonable to expect that distribution and use of the Maryland Wind WDA would be similar, given the similar geography and habitat conditions. Total confirmed detections for Atlantic Sturgeon ranged from 1 to 310 detections per individual, with a total of 5,490 valid detections of 181 unique individuals. Detections of 181 unique Atlantic sturgeon were documented with detections being highly seasonal peaking from November through January, with tagged individuals uncommon (less than 2 individuals detected) or absent in July, August, and September. As described in the paper, Atlantic Sturgeon were detected on all transceivers in the array including the most offshore receiver, located 44.3 km offshore (21 total detections of 5 unique fish). Total counts and detections of unique fish were highest at the receivers nearer to shore and appeared to decrease with distance from shore. Counts at each station ranged between 21–909 total detections and 4–59 unique detections of Atlantic sturgeon. Fifty-five individuals were documented in multiple years. The authors reported that the transition from coastal to offshore areas, predictably associated with photoperiod and river temperature, typically occurred in the autumn and winter months. During this time, individual Atlantic sturgeon were actively moving throughout the area. Residence events, defined in the paper as “a minimum of two successive detections of an individual at a single transceiver station over a minimum period of two hours. Residence events are completed by either a detection of the individual on another transceiver station or a period of 12 hours without detection.” Residence events were uncommon (only 22 events over the study period) and of short duration (mean of 10 hours) and were generally limited to receivers with depths of less than 30 m. The authors indicate that the movement patterns may be suggestive of foraging but could not draw any conclusions. By assuming the maximum observed rate of movement of 0.86 m/s and maximum straight-line distance of 40.6 km between stations from the transceiver-distance matrix, the minimum transit time for an Atlantic Sturgeon through the NY WEA at its longest point was estimated to be 13.1 hrs. As described by the authors, the absence of Atlantic Sturgeon in the NY WEA during the summer months, particularly from June through September, suggests a putative shift to nearshore habitat and corresponds with periods of known-residence in shallow, coastal waters that are associated with juvenile and sub-adult aggregations as well as adult spawning migrations.

Rothermel et al. 2020 and Secor et al. 2020 report on a study that used a gradient-based array of acoustic telemetry receivers to evaluate the seasonal incidence and movement behavior of Atlantic sturgeon (and striped bass) in the near-shelf region off the coast of Maryland and Delaware, inclusive of the Maryland WEA. The study documented the presence of tagged Atlantic sturgeon (n=352 individuals) from November 2016 - December 2018. Approximately 50% of the Atlantic sturgeon were detected in only one season, while 34% were detected in two seasons, and 14% in three seasons. Individual occurrence was generally transient, with very few individuals present in the area monitored by the receiver array for more than 24 hours. Sturgeon were most likely to be present from early spring to early summer and early fall to early winter, with very few individuals present in late summer and late winter; sturgeon were generally absent from late spring to early fall. The average time of an individual in the detection radius of receivers was approximately 3 hours, with the mean number of unique days detected was 1.6. Individuals moved quickly through the array, with speeds of approximately 0.33 m/s during southern migrations and 0.18 m/s during northern migrations. The authors conclude that the Maryland WEA is used by transient, migratory individuals which may engage in foraging opportunistically. These findings are similar to those of Ingram et al. 2019 for the NY WEA.

Given the documentation of tagged Atlantic sturgeon in the WEA (Secor et al. 2020, Rothermel et al. 2020), we expectAtlantic sturgeon to occur in the WEA in the early spring through early summer and early fall - early winter, with few Atlantic sturgeon present from late spring to early fall. Atlantic sturgeon are expected to be transient in the WEA, with individuals present for less than 24 hours with the primary behavior being migration with occasional opportunistic foraging.

Atlantic Sturgeon in New York Harbor

As described above, existing data and studies on acoustically tagged Atlantic sturgeon indicate that adults and subadults are the only life stages likely to occur in the general vicinity of vessel transit routes to/from the Port of New York/New Jersey. The literature suggests that Atlantic sturgeon use New York Bay in the general vicinity of the Port of New York/New Jersey as a migratory corridor and that their occurrence in this area is highly transitory (NMFS, 2022). Acoustic telemetry studies indicate that Atlantic sturgeon migrate inbound through upper New York Bay towards upriver spawning and foraging areas in May, continuing into June. They use deeper main-channel waters for this in-migration and migrate back to the ocean during summer through fall, again using main-channel waters as their travel corridor.

Atlantic Sturgeon in the Cooper River

Atlantic sturgeon use of the portion of the lower Cooper River that would be transited by project vessels from the Nexans facility is described in section 4.1 of NMFS 2020 Nexans Biological Opinion and incorporated here by reference.

Atlantic Sturgeon in the in the Penobscot River estuary and Penobscot Bay

Atlantic sturgeon adults and subadults are likely to be present in the in the general vicinity of vessel transit routes to/from the Cianbro Modular Manufacturing Facility (Brewer, ME) in the Penobscot River in the spring as they move from oceanic overwintering sites to upstream foraging and resting sites and then migrate back out of the area as they move to lower reaches of the estuary or oceanic areas in the late summer. During other times of the year, individuals are likely migrating within the marine environment or transitioning from and to overwintering and foraging areas within larger rivers along the coast (e.g., Kennebec and Androscoggin). Tracking data from tagged Atlantic sturgeon indicates that during the spring and summer, individuals are most likely to occur within rkm 21-24.5 (Fernandes et al. 2010). During this time, most Atlantic sturgeon are located between a 1.5 km stretch from rkm 23 to rkm 24.5. During the winter months, subadult Atlantic sturgeon are most likely to occur over a two km stretch around rkm 36.5 (Fernandes et al. 2010). Atlantic sturgeon in the in the general vicinity of vessel transit routes to/from the Cianbro facility are likely to have originated from the Gulf of Maine DPS and New York Bight DPS with the majority of individuals originating from the Gulf of Maine DPS, and all of those individuals originating from the Kennebec River.

Atlantic Sturgeon in Indian River Bay

Atlantic sturgeon may be present within Indian River Bay from October to December prior to migrating further offshore to deeper waters. However, the Delaware Division of Fish and Wildlife has conducted trawl surveys from April through October at 12 sample stations within the Indian River, Indian River Bay, and the Rehoboth Bay since 1986 without a sturgeon ever being recorded (USACE 2017).

Summary of Atlantic sturgeon distribution in the action area

In summary, Atlantic sturgeon occur in most of the action area; with the exception being the Gulf of Mexico and waters transited by project vessels with depths greater than 50m. This means that in addition to the WDA and riverine/estuarine portions of the action area that will be transited by project vessels identified above, Atlantic sturgeon will only be present in the nearshore (less than 50 m depth) portion of the vessel transit routes and will not be present in the open ocean areas transited by vessels moving between the WDA and identified ports. In the portion of the action area including the lease area and along the cable corridors, the majority of individuals will be from the New York Bight DPSs. Along vessel transit routes to and from ports in the South Atlantic, the majority of individuals will be from the South Atlantic DPS (Kazyak et al. 2021). Considering the action area as a whole, individuals from all five DPSs may be present.

Critical Habitat for the New York Bight DPS of Atlantic sturgeon

Critical habitat has been designated for the five DPSs of Atlantic sturgeon (82 FR 39160, August 17, 2017) in rivers of the eastern United States. Critical habitat designated in the Delaware River for the New York Bight DPS of Atlantic sturgeon is the only critical habitat in the action area that may be affected by the proposed action. As described in section 5, the Delaware River portion of the action area overlaps with the Delaware River critical habitat unit and PBFs 2, 3, and 4 are present in the action area.

Activities that have and may continue to impact PBF 2 include those that may alter salinity and those that result in the loss or disturbance of soft sediment within the transitional salinity zone. These include activities that result in sediment disturbance and subsequent sediment deposition that buries prey species (where that deposited sediment is not immediately swept away with the current), direct removal or displacement of soft bottom substrate (e.g., dredging, construction), activities that result in the contamination or degradation of habitat reducing or eliminating populations of benthic invertebrates, and activities that influence the salinity gradient (e.g., climate change, deepening of the river channel, and flow management).

Actions that may affect PBF 3 include activities that present physical barriers that may impede sturgeon passage. While there are structures that sturgeon maneuver around within the Delaware

River portion of the action area, there are no permanent barriers to movement (e.g., dams) in this area.

Actions that may affect PBF 4 include activities that affect temperature, salinity, and/or dissolved oxygen (DO). Water quality factors such as temperature, salinity, and DO are interrelated environmental variables, and in the Delaware River are constantly changing from influences of the tide, weather, season, etc. A number of human activities directly affect the temperature, salinity, and oxygen values within the Delaware River. Overall, water quality in the Delaware River has improved dramatically since the mid-20th century; however there are times and locations when temperature, salinity, and/or DO may not meet all requirements identified in PBF 4.
More information on the status of Atlantic sturgeon critical habitat in the Delaware River is contained in section 6.2.3 of the 2022 NJWP Biological Opinion and is incorporated here by reference; the information presented above is a summary of that information.

Shortnose sturgeon
The only portions of the action area that overlap with the distribution of shortnose sturgeon are the Delaware River where vessels transiting to/from the Paulsboro Marine Terminal and New Jersey Wind Port will travel; the upper Chesapeake Bay and C-D canal where vessels transiting to/from the Sparrows Point facility may travel; the Cooper River where vessels transiting to/from the Nexans cable facility will travel; the Penobscot River where vessels transiting to/from the Cianbro Modular Manufacturing Facility will travel; and in the New York Harbor where vessels transiting to/from the Port of New York/New Jersey will travel.

Shortnose sturgeon in the Delaware River
The February 25, 2022 NJWP Biological Opinion and the November 2023 Paulsboro Biological Opinion discuss the status of shortnose sturgeon including the threats/stressors that affect this population in the Delaware River in Section 6 in each Opinion. That information is incorporated by reference and briefly summarized here. Shortnose sturgeon occur in the Delaware River from the lower bay upstream to at least Lambertville, New Jersey (RKM 238). The portion of the Delaware River that overlaps with the action area is downstream of the area where spawning and rearing of early life stages occurs; young-of-the-year, juveniles, and adults are expected to be present in the Delaware River portion of the action area. The Delaware River population of shortnose sturgeon is the second largest in the United States. Historical estimates of the size of the population are not available as historic records of sturgeon in the river did not discriminate between Atlantic and shortnose sturgeon. The most recent population estimate for the Delaware River is 12,047 (95% CI= 10,757-13,580) and is based on mark recapture data collected from January 1999 through March 2003 (ERC 2006a). Comparisons between the population estimate by ERC Inc. and the earlier estimate by Hastings et al. (1987) of 12,796 (95% CI=10,228-16,367) suggests that the population is stable, but not increasing.

Shortnose sturgeon in the Delaware River are affected by a number of threats including impingement at water intakes, habitat alteration and water quality, dredging, bycatch in commercial and recreational fisheries, water quality, in-water construction activities, and vessel traffic.

Shortnose sturgeon in the Chesapeake Bay
Shortnose sturgeon have been documented to use the Chesapeake-Delaware Canal to move from the Chesapeake Bay to the Delaware River. The current abundance of shortnose sturgeon in the Chesapeake Bay is unknown. Incidental capture of shortnose sturgeon was reported to the USFWS and MDDNR between 1996-2008 as part of an Atlantic Sturgeon Reward Program. During this time, 80 shortnose sturgeon were documented in the Maryland waters of the Bay and in several tidal tributaries. To date, no shortnose sturgeon have been recorded in Virginia waters of the Bay. Spawning has not been documented in any tributary to the Bay although suitable spawning habitat and two pre-spawning females with late stage eggs have been documented in the Potomac River. Current information indicates that shortnose sturgeon are present year round in the Potomac River with foraging and overwintering taking place there. Shortnose sturgeon captured in the Chesapeake Bay are not genetically distinct from the Delaware River population. (SSSRT 2010).

Shortnose sturgeon in New York Harbor
Shortnose sturgeon occur throughout the Hudson River and are most abundant in the freshwater and low salinity reaches of the river (Bain 1997). Shortnose sturgeon were documented as far south as the Manhattan/Staten Island area in June, November, and December 2003 (Dynegy 2003). While there are a few records of shortnose sturgeon in Upper New York Bay, shortnose sturgeon were recently captured near Liberty Island (NMFS, 2022). We expect that any occurrence of shortnose sturgeon in the general vicinity of vessel transit routes to/from the Port of New York/New Jersey would be highly incidental and transitory.

Shortnose sturgeon in the Cooper River
Shortnose sturgeon may occur along vessel transit routes to/from the Nexans cable facility (transiting Charleston Harbor and the lower Cooper River). The May 4, 2020 Biological Opinion for dredging, rip-rap installation, and wharf construction at the Nexans Plant in Goose Creek, South Carolina discusses the status of shortnose sturgeon in the Cooper River in section 4.1.1 and is incorporated here by reference.

Shortnose sturgeon in the in the Penobscot River estuary and Penobscot Bay
Shortnose sturgeon adults and subadults occur in the portion of the Penobscot River and estuary that overlaps with vessel transit routes to/from the Cianbro Modular Manufacturing Facility (Brewer, ME). While spawning is not known to occur in the Penobscot River, shortnose sturgeon are present year round. Telemetry data suggests that subadult and adult shortnose sturgeon move extensively within the Penobscot river system during spring and early summer and can be found over mudflats outside the main river channel (Fernandes et al. 2006).Shortnose sturgeon overwinter in the upper river and migrate downstream in the spring (mid-April) and are present in the lower river and estuary through the early summer. By July, most shortnose sturgeon begin migrating back upstream to the overwintering area, with all shortnose sturgeon present at the overwintering site by mid to late October. Tracking data from tagged shortnose sturgeon indicates that during the spring and summer, individuals are most likely to occur within rkm 21-24.5 (Fernandes et al. 2010). During the winter months, adult shortnose sturgeon are most likely to occur over a 2 km stretch around rkm 36.5 (Fernandes et al., 2010).

Summary of shortnose sturgeon distribution in the action area

Based on the information presented here, we anticipate along the vessel transit routes used by project vessels transiting to and from ports in the Delaware, Cooper, and Penobscot Rivers as well as the upper Chesapeake Bay and C&D Canal. We also anticipate that shortnose sturgeon are occasionally present in New York Harbor. We do not expect shortnose sturgeon to occur in the WFA nor along the Maryland Wind submarine export cable route.

Giant Manta Ray
Within the northwestern Atlantic, the giant manta ray is distributed as far north as approximately 40°N Latitude (off the coast of New Jersey), in the Gulf of Mexico, and in the US Virgin Islands and Puerto Rico. Although the giant manta ray is commonly observed in shallow coastal waters and estuaries, their preference is for deeper waters and thermal fronts associated with the shelf break north of Cape Hatteras, North Carolina (Farmer et al. 2022). Species distribution models described in Farmer et al. (2002) indicate that giant manta rays occur north of Cape Hatteras during warmer months when water temperatures are highest (June to October).

There are records of giant manta rays from standardized surveys in the waters offshore Delaware and Maryland (Farmer et al. 2022) as well as ancillary reports made by fishermen and recreational boaters in the Mid-Atlantic region (e.g., Eichmann 2016). Sightings data from the Southeast Fisheries Science Center and the North Atlantic Whale Consortium indicate that giant manta rays may occur in the lease area, particularly in the summer and fall when they are abundant in the Mid-Atlantic (Farmer et al. 2022). Despite extremely limited reported sightings in bays (NMFS 2022), Farmer et al. (2022)'s distribution model predictions suggest seasonal trends with high probability occurrence in large bays (e.g., Chesapeake Bay).
Based on the information presented here, we anticipate giant manta ray to occur in the WDA during warmer months, typically between June to October. The giant manta ray is also expected to be seasonally present along the vessel transit routes used by project vessels transiting to and from ports in the South Atlantic and Gulf of Mexico. Occurrence north of approximately Atlantic City, NJ is not expected.

6.4 Consideration of Federal, State, and Private Activities in the Action Area

Activities in the Coastal and Riverine Portions of the Action Area
Project vessels are expected to transit portions of Delaware Bay and a portion of the Delaware River (to/from Paulsboro Marine Terminal and the New Jersey Wind Port), the Chesapeake Bay entrance channels, upper Chesapeake Bay, and the C-D Canal (to/from Sparrow's Point), the Charleston Harbor and the lower Cooper River (to/from the Port of Charleston), the Indian River Inlet and Bay (to/from HDD sites), and portions of Penobscot Bay and a portion of the Penobscot River (to/from the Brewer Module Facility in Brewer, ME). In addition to fishing activity and vessel traffic, portions of these areas have navigation channels that are maintained by dredging, and are affected by routine in-water construction activities such as dock, pier, and wharf maintenance and construction. Manta rays are not expected to occur in these portions of the action area.

Loggerhead, Kemp's ridley, and green sea turtles and Atlantic and shortnose sturgeon are vulnerable to serious injury and mortality in hopper dredges that are used to maintain federal navigation channels in the action area, including channels in New York Harbor, Chesapeake

Bay, Charleston Harbor, the Delaware River, and the Penobscot River. NMFS has completed ESA section 7 consultations on these actions; measures are in place to avoid and minimize take and in all cases, NMFS has determined that the proposed actions are not likely to jeopardize the continued existence of any listed species. We expect that mortality of sturgeon and sea turtles as a result of maintenance dredging and channel deepening will continue in the action area over the life of the Maryland Wind Project.

As mentioned in section 2 of this Opinion, NMFS has completed ESA section 7 consultations on the construction and use of three of the ports that may be used by Maryland Wind vessels. Please refer to information in that section for additional information on effects of those actions on Atlantic and shortnose sturgeon.

Fishing Activity in the Action Area

Commercial and recreational fishing occurs throughout the action area. The lease area and cable corridor occupies a portion of NMFS statistical area 621. Transit routes to southern ports, including those in the Gulf of Mexico overlap with a number of other statistical areas (see, https://www.fisheries.noaa.gov/resource/map/greater-atlantic-region-statistical-areas). Commercial fishing in the action area is authorized by the individual states or by NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA). Fisheries that operate pursuant to the MSFCMA have undergone consultation pursuant to Section 7 of the ESA. These biological opinions are available online (available at: https://www.fisheries.noaa.gov/new-england-mid-atlantic/consultations/section-7-biological-opinions-greater-atlantic-region). The accompanying Incidental Take Statements, which describe the amount or extent of incidental take anticipated to occur in these fisheries, are included with each opinion.

Given that fisheries occurring in the action area are known to interact with large whales, the past and ongoing risk of capture and entanglement in the action area is considered here. The degree of risk in the future may change in association with fishing practices and accompanying regulations. It is important to note that in nearly all cases, the location where a whale first encountered entangling gear is unknown and the location reported is the location where the entangled whale was first sighted. The risk of entanglement in fishing gear to fin, sei, and sperm whales in the lease area appears to be low given the low interaction rates in the U.S. EEZ as a whole.

We have reviewed the most recent data available on reported entanglements for the ESA listed whale stocks that occur in the action area (Hayes et al. 2020, 2022, and 2023; Henry et al. 2022,2023). As reported in Hayes et al. 2022, for the most recent 5-year period of review (2015-2019) in the U.S. Atlantic, the minimum rate of serious injury or mortality resulting from fishery interactions was 1.45/year for fin whales, 0.4 for sei whales. For the period 2016-2020, the annual detected (observed) human-caused mortality and serious injury for right whales averaged 5.7 entanglements per year (Hayes et al. 2023). The minimum rate of serious injury or mortality resulting from fishery interaction is zero for sperm whales as reported in the most recent SAR for sperm whales in the North Atlantic (Hayes et al. 2020). For the Gulf of Mexico, Hayes et al. (2021) reports the estimated mean annual fishery-related mortality and serious injury for sperm whales during 2014–2018 was 0.2 sperm whales (CV=1.00) due to interactions with the large pelagic longline fishery. In all cases, the authors note that this is a minimum estimate of the amount of entanglement and resultant serious injury or mortality. These data represent only known mortalities and serious injuries; more, undocumented mortalities and serious injuries have likely occurred and gone undetected due to the offshore habitats where large whales occur. Hayes et al. (2020) notes that no confirmed fishery-related mortalities or serious injuries of sei whales have been reported in the NMFS Sea Sampling bycatch database and that a review of the records of stranded, floating, or injured sei whales for the period 2015 through 2019 on file at NMFS found 3 records with substantial evidence of fishery interaction causing serious injury or mortality. Hayes et al. (2020), reports that sperm whales have not been documented as bycatch in the observed U.S. Atlantic commercial fisheries. No confirmed fishery-related mortalities or serious injuries of fin whales have been reported in the NMFS Sea Sampling bycatch database and a review of the records of stranded, floating, or injured fin whales for the period 2015 through 2019 with substantial evidence of fishery interactions causing injury or mortality are captured in the total observed incidental fishery interaction rate reported above (Hayes et al. 2022).

We also reviewed available data that post-dates the information presented in the most recent stock assessment reports. As explained in the Status of the Species section of this Opinion, there is an active UME for North Atlantic right whales[26]. Of the 139 right whales in the UME (as of June 4, 2024), 9 mortalities are attributed to entanglement as well as 30 serious injuries and 49 sublethal injuries. We note that 1 mortality is listed as "pending"; this is the female stranded on Martha's Vineyard in January 2024. While no cause of death has been determined, preliminary indications are that there was no sign of vessel strike and that the individual had previously been documented with an entanglement. None of the whales recorded as part of the UME were first documented in the WDA[27]. The closest location to the WDA was an animal documented offshore of Virginia Beach, VA with chronic entanglement (gear present, January 2018 RW# 3893). We reviewed information on serious injury and mortalities reported in Henry et al. 2022 and 2023. On July 6, 2016, a live fin whale was observed 60 nm northeast of Virginia Beach, VA with monofilament and lures in tow along its left flipper area. It is unknown where this entanglement actually occurred. Henry et al. 2022 presented one documented human-caused mortality event for North Atlantic right whales in the coastal area near the Chesapeake Bay since 2016. On January 22, 2018, right whale 3893 was found 55 nm east of Virginia Beach, VA with extensive, severe constricting entanglement including partial amputation of right pectoral accompanied by severe proliferative bone growth (same animal noted above). Henry et al. 2022 and 2023 include no records of entangled sei, fin, or sperm whales first reported in waters between the Chesapeake and Delaware Bays.

Given the co-occurrence of fisheries and large whales in the action area, it is assumed that there have been entanglements in the action area in the past and that this risk will persist at some level throughout the life of the project. However, it is important to note that several significant actions have been taken to reduce the risk of entanglement in fisheries that operate in the action area including ongoing implementation of the Atlantic Large Whale Take Reduction Plan. The goal of the ALWTRP is to reduce injuries and deaths of large whales due to incidental entanglement

[26] Information in this paragraph related to the UME is available at: *https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2024 -north-atlantic-right-whale-unusual-mortality-event*; last accessed on June 4 , 2024

[27] https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=e502f7daf4af43ffa9776c17c2aff3ea: Last accessed February 27, 2024

in fishing gear. The ALWTRP is an evolving plan that changes as NMFS learns more about why whales become entangled and how fishing practices might be modified to reduce the risk of entanglement. It has several components including restrictions on where and how gear can be set; research into whale populations and whale behavior, as well as fishing gear interactions and modifications; outreach to inform and collaborate with fishermen and other stakeholders; and a large whale disentanglement program that seeks to safely remove entangling gear from large whales whenever possible. All states that regulate fisheries in the U.S. portion of the action area codify the ALWTRP measures into their state fishery regulations.

Atlantic sturgeon are captured as bycatch in trawl and gillnet fisheries. An analysis of the NEFOP/ASM bycatch data from 2000-2015 (ASMFC 2017) found that most trips that encountered Atlantic sturgeon were in depths less than 20 meters and water temperatures between 45-60°F. The ASMFC (2017) report did not provide updated mortality rates for trawls and gillnets, so we are using the values from Miller and Shepard (2011) as the best available scientific information; average mortality in bottom otter trawls was 4% and mortality averaged 30% in gillnets (Miller and Shepard 2011)). The most recent five years of data in the NMFS NEFOP and ASM database were queried for the number of reports of Atlantic sturgeon bycatch in the statistical area that overlaps with the lease area and cable routes (621[28]). The NEFOP program samples a percentage of trips from the Gulf of Maine to approximately Cape Hatteras while the ASM program provides additive coverage for the New England groundfish fisheries, extending from Maine to New York. For the most recent five-year period that data are available (2019-2023), a total of 44 Atlantic sturgeon were reported as bycatch in statistical area 621, this represents approximately 5.7% of the total bycatch of Atlantic sturgeon in the Maine to Cape Hatteras area where the NEFOP, and Maine to New York area where the ASM program, operates. Incidental capture of Atlantic sturgeon is expected to continue in the action area at a similar rate over the life of the proposed action. While the rate of encounter is low and survival is relatively high (96% in otter trawls and 70% in gillnets; ASMFC 2017), bycatch is expected to be the primary source of mortality of Atlantic sturgeon in the Atlantic Ocean portion of the action area. Atlantic sturgeon do not occur in the Gulf of Mexico.

Sea turtles are vulnerable to capture in trawls as well as entanglement in gillnets and vertical lines. Using the same data source as for Atlantic sturgeon, from 2013-2022 there were a total of 25 incidents of observed sea turtle bycatch in fisheries in area 621 (10 loggerheads, 2 Kemp's ridley, 2 greens, and 11 leatherbacks); the most recent record was from 2023 and the turtles were captured in a mix of gear (braided line, pound net, monofilament, monofilament net, unknown line, and multiple types of vertical lines). In statistical area 625, within 2013-2022 there have been a total of 34 observed incidents of sea turtle bycatch (13 loggerheads, 7 Kemp's ridley, 2 greens, and 12 leatherback) with the same mix of gear as statistical area 621. Leatherback sea turtles are particularly vulnerable to entanglement in vertical lines. Since 2005, 379 leatherbacks have been reported entangled in vertical lines in the Northeast Region. In response to high numbers of leatherback sea turtles found entangled in the vertical lines of fixed gear in the Northeast Region, NMFS established the Northeast Atlantic Coast Sea Turtle Disentanglement Network (STDN). Formally established in 2002, the STDN is an important component of the National Sea Turtle Stranding and Salvage Network. The STDN works to reduce serious injuries

[28] Map available at:
https://www.greateratlantic.fisheries.noaa.gov/educational_resources/gis/gallery/gafostatisticalareas.html

and mortalities caused by entanglements and is active throughout the action area responding to reports of entanglements. The Southeast STDN provides similar services in the South Atlantic and Gulf of Mexico. Where possible, turtles are disentangled and may be brought back to rehabilitation facilities for treatment and recovery. Sea turtles are also captured in fisheries operating in the Gulf of Mexico and in offshore areas where pelagic fisheries such as the Atlantic Highly Migratory Species (HMS) fishery occurs. Sea turtles are also vulnerable to interactions with fisheries occurring off the U.S. South Atlantic coast including the Atlantic shrimp trawl fishery. For all fisheries for which there is a fishery management plan (FMP) or for which any federal action is taken to manage that fishery, the impacts have been evaluated via Section 7 consultation. Past consultations have addressed the effects of federally permitted fisheries on ESA listed species, sought to minimize the adverse impacts of the action on ESA listed species, and, when appropriate, the Incidental Take Statement in applicable Biological Opinions have exempted the incidental taking of these species (e.g, NMFS 2013a and 2021 “batched fisheries” Opinions). Incidental capture and entanglement of sea turtles is expected to continue in the action area at a similar rate over the life of the proposed action. Safe release and disentanglement protocols help to reduce the severity of impacts of these interactions and these efforts are expected to continue over the life of the project.

Giant manta rays are susceptible to capture by trawl, longline, vertical longline, and gillnets based on records of their capture in fisheries using these gear types. An annual estimate of giant manta ray interactions was determined based on the number of observed cases in the NEFSC observer/sea sampling database from 2010-2019 (NEFSC observer/sea sampling database from 2010-2019, unpublished data). From 2010-2019, two records from bottom trawl activities in federal waters were confirmed by photo to be giant manta rays. Two *Mobulidae* records for gillnet activities in state waters were not able to be identified to species. For the purpose of analysis in the NMFS 2021 “batched fisheries” Opinion, both unidentified rays were assumed to be giant manta rays. All four interactions occurred off North Carolina. The number of interactions occurring annually is variable and influenced by sea temperatures, species abundances, fishing effort, and other factors that are difficult to predict. Because of this variability, it is unlikely that giant manta rays will be consistently impacted year after year. In the four cases observed between 2010-2019, the records indicate all animals were encountered alive and released alive. Additionally, all of the giant manta ray interactions in gillnet or trawl gear recorded in the NEFSC observer/sea sampling database (13 between 2001 and 2019) indicate the animals were encountered alive and released alive. Furthermore, during 2005-2012, ten giant manta rays caught in gillnet gear used in the Gulf of Mexico and South Atlantic Coastal Migratory Pelagic Fishery were observed to be released alive. Incidental capture of giant manta ray is expected to continue in the action area at a similar rate over the life of the proposed action. Safe release protocols help to reduce the severity of impacts of these interactions and these efforts are expected to continue over the life of the project.

Vessel Operations

The action area is used by a variety of vessels ranging from small recreational fishing vessels to large commercial cargo ships. Commercial vessel traffic in the action area includes research, tug/barge, liquid tankers, cargo, military and search-and-rescue vessels, and commercial fishing vessels.

Vessel Traffic between the Lease Area and Ports to the North and South
Vessel traffic along the eastern U.S. coast mainly consists of tug and barge, fishing vessels, tankers, container ships, and passenger vessels; military vessels also transit the area conducting training and operations. Vessels typically travel offshore before entering a traffic separation scheme heading into port. Traffic generally travels in a north to south or south to north direction. Throughout Mid-Atlantic and southern New England waters as well as into the Gulf of Maine, commercial vessel traffic is significant throughout the year with a number of major U.S. ports located along the coast. To the south, these ports include ones in the Chesapeake Bay/Hampton Roads area, VA and Charleston Harbor, SC. To the north, these ports include ones in the Delaware Bay and New York/New Jersey Harbor. Vessel traffic is heaviest in the nearshore waters, near major ports, in the shipping lanes. Recreational vessel traffic is high throughout these areas but is generally close to shore compared to commercial vessel travel.

The Gulf of Mexico is known for a high level of commercial shipping activity and many large ports, especially those with transiting bulk carriers (Wiggins et al. 2016). AIS data for the Gulf of Mexico shows a variety of vessel traffic for the region ranging from cargo, fishing, passenger, pleasure, tankers, and tug-tows. Ports located within the Gulf of Mexico support large amounts of shipping traffic (e.g., the ports of Houston, TX and Corpus Christi, TX have annual tonnage of 240,933,408 and 85,674,968 respectively).[29] Gulf of Mexico vessel traffic is routed with shipping fairways, traffic separations schemes, and traffic lanes.

Vessel Traffic in the In-Land and Riverine Portions of the Action Area
The USACE publishes data on waterborne traffic movements involving the transport of goods on navigable waters of the U.S. (https://www.iwr.usace.army.mil/About/Technical-Centers/WCSCWaterborne-Commerce-Statistics-Center-2/WCSC-Waterborne-Commerce/). The data includes both self-propelled and non-self-propelled vessels but does not include non-commercial vessels such as recreational vessels. Vessel movements are reported as “trips.” A trip is the movement of a vessel from a starting point to an end point. A vessel trip may be the loading of cargo on a vessel to the offloading site of the cargo or it may be the transport of the working crew to (or from) a work site (e.g., dredging site). Thus, one vessel may have multiple trips during a day as it loads and unloads cargo or transports crew back and forth to a work site. The data includes ferry movements but movements of vessels exclusively engaged in construction (e.g. supporting a dredge) are not included, although movements of supplies and materials to and from a construction site must be reported. Movements of tugboats moving large ships in channels and harbors traveling less than one mile are not reported. Movements of towboats engaged in fleeting activities less than one mile are also not reported. In the spreadsheet, trips are reported as the annual number of trips by vessels of a given draft within a waterway or section of waterway. The Waterborne Commerce data available to us includes data from 2017 to 2021. For this analysis, we used data from this timeframe to characterize the baseline vessel trips in the Philadelphia to the Sea Federal Navigation Channel in the Delaware River, Indian River Bay and River, and the Penobscot River.

In order to characterize baseline vessel transits through the mouth of the Chesapeake Bay, we used data from the USCG’s 2021 Port Access Route Study for Approaches to the Chesapeake Bay, VA (USCG 2021). The Coast Guard Navigation Center Traffic Analysis (Enclosure 1 in

[29] marinecadastre.gov; Last accessed February 27, 2024

USCG 2021) evaluates annual trends and significant variations relating to the quantity, characteristics, and routes of the vessels transiting the Chesapeake Bay entrance. The traffic analysis utilizes 2017 and 2018 vessel AIS track line data from Marine Cadastre as well as 2019 vessel AIS five-minute aggregated point data from the USCG Nationwide Automatic Identification System (NAIS). Together, the Waterborne Commerce data and USCG data characterize the baseline vessel trips in the inland and riverine portions of the action area.

Chesapeake Bay Entrance and Port of Virginia/Hampton Roads area.
The Port of Virginia is made up of over 55 public and private marine terminals. The port received over 2,300 vessel calls in 2019[30]. This does not account for Naval vessels, which are estimated at 1 to 8 transits per day or recreational boats (over 2,000 registered in the City of Portsmouth, VA) (USCG 2016). Thousands of other vessels annually transit the Chesapeake Bay entrance channels traveling to and from other ports within Chesapeake Bay, including the Port of Baltimore and ports in the James River. The USCG's 2021 Port Access Route Study for Approaches to the Chesapeake Bay, VA (USCG 2021, Enclosure 1), reports annual transits of the Chesapeake Bay entrance of 12,192 in 2017, 15,947 in 2018, and 16,811 in 2019 for an average of 14,983 annual transits through the mouth of Chesapeake Bay.

Delaware River. The Delaware River is geographically and operationally one of the most significant waterways on the East Coast of the U.S. for port operations. Collectively, the Ports of Philadelphia, South Jersey, and Wilmington, DE represent one of the largest general cargo port complexes in the nation (Altiok *et al.* 2012). Cargo and tanker vessel movements are restricted to the maintained navigation channel and only tow or tug vessels, fishing vessels, large recreational vessels, and, likely, smaller recreational vessels operate between the shoreline and the navigation channel (https://marinecadastre.gov/oceanreports and https://livingatlas.arcgis.com/vessel-traffic). The annual number of trips for all vessels (self-propelled and non-self-propelled, all drafts) in the federal navigation channel from Philadelphia to the sea ranged from 22,101 to 46,738 (median = 32,078) during the period from 2017 through 2021 (USACE Waterborne Commerce Data 2023).

Chesapeake and Delaware Canal. The 14 mile long C and D canal is a fabricated waterway first excavated in 1824 to improve navigation time between ports in the Chesapeake Bay and the Delaware River; over time, it has been expanded and is currently maintained at a depth of 35 feet and width of 450 feet. We identified a number of estimates of vessel traffic in the C and D canal including 25,000 total vessels annually[31] and a reported annual number of trips for all vessels (self-propelled and non-self-propelled, all drafts) in the federal navigation channel from the Delaware River to Pooles Island in Chesapeake Bay ranging from 3,847 to 10,225 (median = 4,538) during the period from 2017 through 2021(USACE Waterborne Commerce Data 2023). Information on sturgeon use of the C and D canal is limited to detection of tagged individuals on telemetry receivers. Welsh et al. (2002) captured and tagged 13 shortnose sturgeon in the Chesapeake Bay and 26 in the Delaware River; receivers were deployed in upper Chesapeake Bay, in the C and D Canal and in the Delaware River. Two of the shortnose sturgeon tagged in Chesapeake Bay were detected on receivers within the canal; an additional shortnose sturgeon tagged in the Bay was later detected on receivers in the Delaware River. This third individual

[30] https://hamptonroadsalliance.com/port-of-virginia/; last accessed April 10, 2024
[31] http://www.offshoreblue.com/cruising/cd-canal.php; Last accessed March 24, 2024

was assumed to swim through the canal during a three-week period when the receivers within the canal were not operational. More detailed information on use of the canal is provided in a final ESA Section 6 report prepared by the State of Delaware (Award Number NAI0NMF4720030). As part of a study to document interbasin movements through the canal, an array of five receivers was deployed from April through November in 2011, 2012, and 2013. In all three years, a small number of tagged shortnose sturgeon (0-1 shortnose annually) were documented in the canal. In all cases, the movements were characterized as exploratory behavior lasting from two hours to two weeks.

We have reports of five dead Atlantic sturgeon that were observed within the canal (one in 2013, three in 2016, and one in 2020). Three of these had injuries consistent with vessel strike (2 in 2016, 1 in 2020); the other two were too decomposed to assess injuries or any potential cause of mortality. For purposes of this consultation, we are assuming that the three sturgeon with identifiable injuries were struck and killed within the canal. We have no other information on vessel strikes in the C and D canal; however, even this limited information indicates that there is a risk of vessel strike in the C and D canal. There are no targeted surveys to monitor sturgeon in the canal or to look for dead sturgeon in this area. All reports received were opportunistic reports.

Indian River Bay and Indian River. The Indian River Inlet connects the 15 mile long Indian River Bay to the Atlantic Ocean. The inlet is predominantly navigated by recreational fishermen and boaters, though the US Coast Guard has a base just inside the inlet and a number of charter boats operate out of the Indian River Marina (Hayden 2009). There is little use of the inlet by waterborne commerce; however, there are several commercial fishing vessels which operate out of the inlet (Lanan and Dalrymple 1977). There were a total of 20 trips engaged in movement of cargo in the Indian River Inlet and Bay over the period from 2017 through 2021. All reported vessels were self-propelled with a 7-foot draft (USACE Waterborne Commerce Data 2023). These numbers represent the best available estimate of vessel traffic within the in-land portion of the action area. The estimate excludes recreational vessels, vessels not engaged in movement of cargo, and US Coast Guard vessels. Therefore, this number likely underestimates the total annual vessel traffic within the Indian River Inlet and Bay. There is significant uncertainty in estimating the total amount of non-commercial vessel traffic within the in-land portion of the action area. In general, recreational vessel traffic is expected to be seasonal with peak traffic occurring during warmer months (Lanan and Dalrymple 1977).

Dredging in Indian River Bay is a relatively regular occurrence. Maintenance dredging occurs in portions of Indian River and Indian River Bay to aid navigation, including during the 1990s, 2009, 2010, 2020, and 2022-2023. At the conclusion of the 2013 and 2020 work, dredge material was placed along the shoreline of Delaware Seashore State Park and along the Route 1 highway and bridge, respectively. Additionally, maintenance dredging in Indian River is under consideration, with the material proposed to be used to restore degraded wetlands. Dredging proposed by US Wind would be new dredging, although occurring in the vicinity of past dredging projects, and in some cases overlapping potential maintenance dredging of the Indian River federal channel if it occurs in the future in the approved federal channel.

Penobscot River. Along the Penobscot River, Bangor, Brewer, Searsport, Hampden, and Bucksport have active waterfronts with owner-operated motor boats, local tour boats, and an inter-coastal scenic cruise ship. Other than occasional asphalt and petroleum barge shipments, there is minimal commercial marine transportation north of Bucksport, ME. Large vessels bound for upriver typically take a tug to assist in making turns and docking. The head for navigation for commercial vessels in the Penobscot River is immediately downstream of the Joshua Chamberlain Bridge between Bangor and Brewer, ME. Commercial traffic going to Bangor generally consists of small coastal passenger vessels during the summer and fall. The Port of Bangor can accommodate vessels with a maximum draft of 18.7 feet (5.7 meters). Across the river in Brewer, the Cianbro Modular Manufacturing Facility features a deep water bulkhead to accommodate large ocean-going barges (Maine DoT 2011, Penobscot Bay Pilots Association 2021).

The annual number of trips for all vessels (self-propelled and non-self-propelled, all drafts) in the federal navigation channel from the mouth of the Penobscot River to Bangor ranged from 14 to 59 (median=28) during the period from 2017 through 2021. The annual number of only self-propelled vessel trips ranged from 10 to 53 (median=24) with a total of 149 trips over the period from 2017 to 2021 (USACE Waterborne Commerce Data 2023).

Vessel Traffic in the Lease Area and Surrounding Waters
In Appendix II-K1 of the COP, US Wind reports on vessel traffic in the WDA based on AIS data. Based on this data, the most common type of vessels transiting in the WDA are cargo/carrier and tanker vessels, commerce fishing, and recreational vessels. The data show that traffic is most dense in the vicinity of Cape May, Delaware Bay, and Ocean City inlets and along the traffic separation zones.

The waters around the Lease Area are utilized by a mix of commercial shipping, military, fishing, and recreational vessels (DNV 2022). The Navigational Safety Risk Assessment (NSRA; DNV 2022; Appendix II-K1 to the COP) summarized vessel traffic in the vicinity of the proposed action based on AIS data from January 1, 2019, through December 31, 2019. The data include seven vessel classes: cargo/carrier and tanker, fishing, cruise ships and ferries, passenger vessels, pleasure and recreational, tugs, and other. DNV (2022) notes that dredgers, military vessels, and pilot vessels are grouped with the “Other” vessels. A total of 49,317 vessel tracks were recorded within the study area during the timeframe of January 1, 2019 through December 31, 2019. Across the types of vessel categories, the averages for vessel lengths ranged from 15 m to 203 m, vessel beams ranged from 5 m to 31 m, and vessel draft ranged from 2 m to 11 m (DNV 2022).

Most vessels sail between 5 and 15 knots. AIS data suggest that the highest speeds are observed close to the coasts, especially around Lewes, Cape May, and the Delaware coast, primarily pleasure and passenger vessels. In the vicinity of the Lease Area, high vessel speeds are also observed in the outbound lane of the Delaware Bay Southeastern Approach TSS, north of the Lease Area and through the eastern part of the Lease Area, consisting primarily of cargo/carrier and tanker vessels, at an average speed between 12 and 15 knots. The fishing vessels transiting from Ocean City and the fishing grounds through the Lease Area have an average speed between 9 and 15 knots.

Approximately 65 percent of vessels transiting the study area were pleasure vessels (24%), fishing vessels (21%), and cargo/tankers (20%). AIS data suggest that in the immediate vicinity of the Lease Area (i.e., within 4.3 NM [8 km] of the Lease Area), and within the Lease Area itself, the largest proportion (45%) of the vessel traffic is composed of deep draft vessels. In the vicinity of the Lease Area, cargo/carrier and tanker vessel types showed greatest traffic density following the designated TSS: the Delaware Bay Eastern and Southern Approach TSS, with some traffic traversing the area proposed for WTGs. Most of these deep draft commercial vessels pass predominantly to the north of the Lease Area and the Offshore Export Cable Route. Transit information available for commercial fishing traffic shows significant traffic adjacent to the Maryland coast (west of the Lease Area) and between Ocean City inlet and fishing grounds east of the Lease Area. Fishing vessel tracks in the vicinity of the Lease Area show fan-like patterns originating at fishing ports. Relative to vessels originating from Ocean City, there are fewer vessels coming from Cape May that cross the Lease Area (DNV 2022). Pleasure and recreational vessel traffic concentrated around the coastline. The tracks for pleasure and recreational vessels also for fan-like patterns from Cape May, Indian River, and Ocean City inlets. The tracks passing through the Lease Area generally have a northeast-southwest or east-west directionality (DNV 2022). See Appendix II-K1 of the COP for a detailed description of vessel traffic patterns and statistics.

DNV (2022) analyzed vessel traffic patterns in the WDA to assess navigation safety risks using a two-step analysis. The first step relied on quantification of vessel transits through designated cross sections in proximity to the action area using AIS data for all vessel classes. The second step relied on Vessel Monitoring System (VMS) data for fishing vessels. The VMS system provides location data used by NMFS to monitor fishing activity while maintaining confidentiality.

Figure 6.4.1 below (from COP Appendix II-K1) displays AIS vessel tracks and the 22 analysis cross sections in proximity to the proposed project footprint, regional traffic corridors, and port entrances. Vessel transits through cross sections in the southern portion of the Traffic Survey Area are displayed in Figure 6.4.2. Vessel transits through cross sections in the northern portion of the Traffic Survey Area are displayed in Figure 6.4.3. Vessel classes represented by these results include deep-draft commercial vessels (i.e., cargo/tankers), tugs, cruise/ferry, fishing, passenger, pleasure vessels, and other or unspecified vessel types.

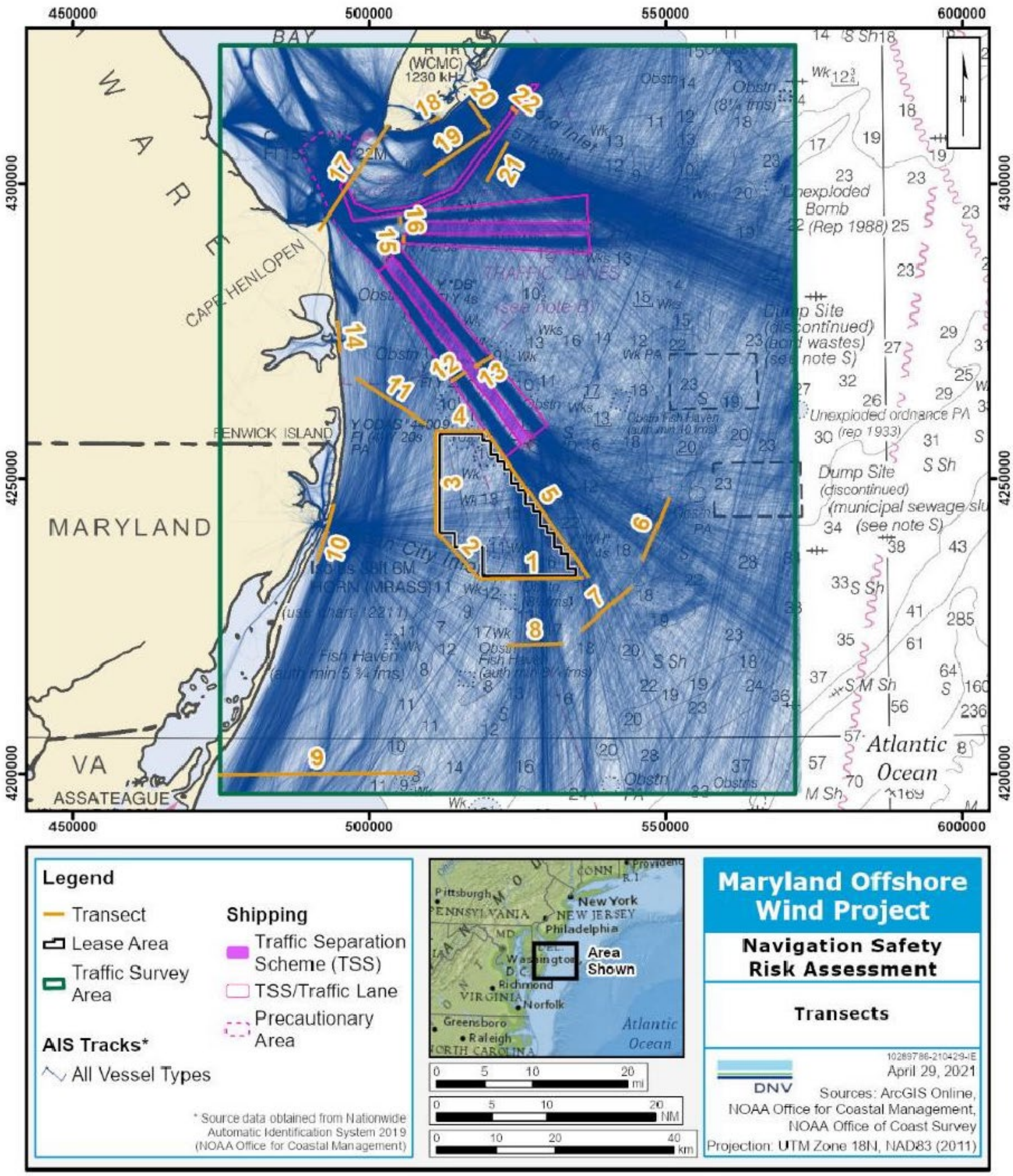
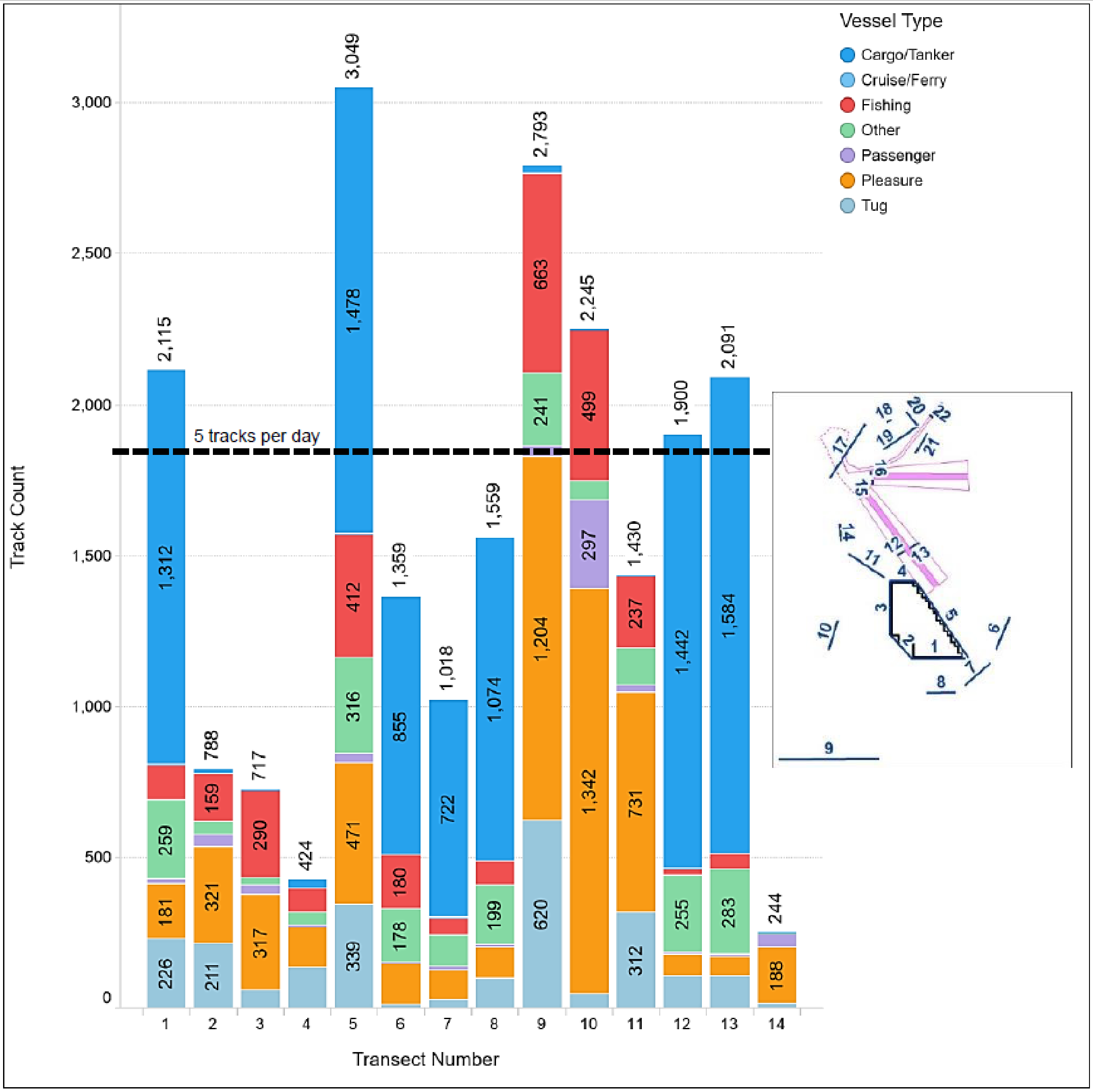


Figure 6.4.1 AIS Vessel Traffic Tracks for January 1, 2019 to December 1, 2019 and Analysis Cross Sections Used for Traffic Pattern Analysis (DNV 2022).

Figure 6.4.2 Annual Number of Vessel Tracks for the Southern Traffic Survey Area – Transects 1 to 14 (DNV 2022).



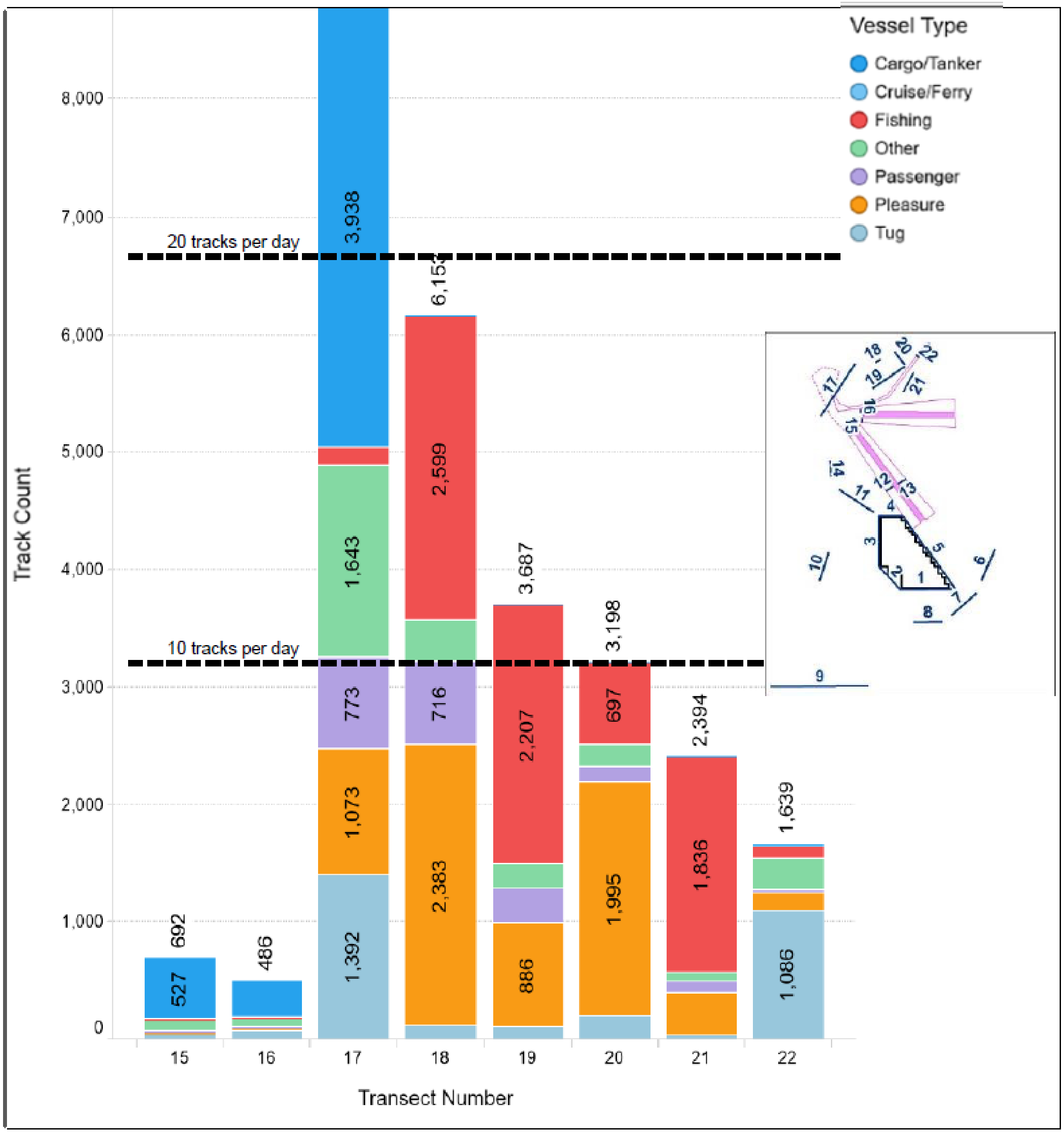


Figure 6.4.3 Annual Number of Vessel Tracks for the Northern Traffic Survey Area – Transects 15 to 22 (DNV 2022).

As shown, the Lease Area is bounded to the south by cross section 1, to the north by cross section 4, to the west by cross sections 2 and 3, and to the northeast by cross section 5. Table 6.4.1 lists the number of vessel transits through cross sections circumscribing the Lease Area in 2019. DNV (2022) notes that for a given vessel transit that crosses into the Lease Area, it will be counted in two different cross sections (i.e., one on entering the Lease Area and another on exiting the Lease Area). Vessels transiting the Lease Area were primarily cargo/tanker vessels moving in a north-south direction between cross sections 5 and 1. Vessel traffic for sections 3, 2, and 5 in the east-west direction were primarily fishing vessels.

Table 6.4.1 Track Counts – Transects Circumscribing the Lease Area (DNV 2022)

Transect Number	Cargo/Tanker	Cruise/Ferry	Fishing	Other	Passenger	Pleasure	Tug	Total
1	1,312	4	114	259	19	181	226	**2,115**
2	14	0	159	44	39	321	211	**788**
3	0	0	290	22	31	317	57	**717**
4	31	0	81	41	5	134	132	**424**
5	1,478	3	412	316	30	471	339	**3,049**

To comply with the Ship Strike Reduction Rule (50 CFR 224.105), all vessels greater than or equal to 65 ft. (19.8 m) in overall length and subject to the jurisdiction of the United States and all vessels greater than or equal to 65 ft. in overall length entering or departing a port or place subject to the jurisdiction of the United States must slow to speeds of 10 knots or less in seasonal management areas (SMA). The Philadelphia SMA, overlaps with the portion of the action area where the project will be constructed. All vessels 65 feet or longer that transit the SMA from November 1 – April 30 each year (the period when right whale abundance is greatest) must operate at 10 knots or less. Mandatory speed restrictions of 10 knots or less are required in all of the SMAs along the U.S. East Coast during times when right whales are likely to be present; a number of these SMAs overlap with the portion of the action area that may be used by project vessels. The purpose of this regulation is to reduce the likelihood of deaths and serious injuries to these endangered whales that result from collisions with ships. On August 1, 2022, NMFS published proposed amendments to the North Atlantic vessel strike reduction rule (87 FR 46921). The proposed rule would: (1) modify the spatial and temporal boundaries of current speed restriction areas referred to as Seasonal Management Areas (SMAs), (2) include most vessels greater than or equal to 35 ft. (10.7 m) and less than 65 ft. (19.8 m) in length in the size class subject to speed restriction, (3) create a Dynamic Speed Zone framework to implement mandatory speed restrictions when whales are known to be present outside active SMAs, and (4) update the speed rule's safety deviation provision. Changes to the speed regulations are proposed to reduce vessel strike risk based on a coast-wide collision mortality risk assessment and updated information on right whale distribution, vessel traffic patterns, and vessel strike mortality and serious injury events. To date, the rule has not been finalized and its potential effects have not been included in the baseline. Additional information on the risk of vessel strike to right whales is found in the materials prepared to support the proposed rule including Garrison et al. 2022 and the July 2022 Draft Environmental Assessment[32].

Restrictions are in place on how close vessels can approach right whales to reduce vessel-related impacts, including disturbance. NMFS rulemaking (62 FR 6729, February 13, 1997) restricts vessel approach to right whales to a distance of 500 yards. This rule is expected to reduce the potential for vessel collisions and other adverse vessel-related effects in the environmental baseline. The Mandatory Ship Reporting System (MSR) requires ships entering the northeast and southeast MSR boundaries to report the vessel identity, date, time, course, speed, destination,

[32] Available at: https://www.fisheries.noaa.gov/action/amendments-north-atlantic-right-whale-vessel-strike-reduction-rule

and other relevant information. In return, the vessel receives an automated reply with the most recent right whale sightings or management areas and information on precautionary measures to take while in the vicinity of right whales.

SMAs are supplemented by Dynamic Management Areas (DMAs) that are implemented for 15-day periods in areas in which right whales are sighted outside of SMA boundaries (73 FR 60173; October 10, 2008). DMAs can be designated anywhere along the U.S. eastern seaboard, including the action area, when NOAA aerial surveys or other reliable sources report aggregations of three or more right whales in a density that indicates the whales are likely to persist in the area. DMAs are put in place for two weeks in an area that encompass an area commensurate to the number of whales present. Mariners are notified of DMAs via email, the internet, Broadcast Notice to Mariners (BNM), NOAA Weather Radio, and the Mandatory Ship Reporting system (MSR). NOAA requests that mariners navigate around these zones or transit through them at 10 knots or less. In 2021, NMFS supplemented the DMA program with a new Slow Zone program, which identifies areas for recommended 10-knot speed reductions based on acoustic detection of right whales. Together, these zones are established around areas where right whales have been recently seen or heard, and the program provides maps and coordinates to vessel operators indicating areas where they have been detected. Compliance with these zones is voluntary.

Atlantic sturgeon, sea turtles, and ESA listed whales are all vulnerable to vessel strike, although the risk factors and areas of concern are different. Vessels have the potential to affect animals through strikes, sound, and disturbance by their physical presence.

As reported in Hayes et al. 2022, for the most recent 5-year period of review (2015-2019) in the North Atlantic, the minimum rate of serious injury or mortality resulting from vessel interactions is 0.40/year for fin whales, 0.2 for sei whales. As reported in Hayes et al. 2023, for the most recent 5-year period of review (2016-2020) in the North Atlantic, the minimum rate of serious injury or mortality resulting from vessel interactions is 2.4/year for right whales. No vessel strikes for sperm whales have been documented (Hayes et al. 2020). Hayes et al. (2021) reports no vessel strikes have been documented in recent years (2014–2018) for sperm whales in the Gulf of Mexico. Historically, one possible sperm whale mortality due to a vessel strike was documented for the Gulf of Mexico. The incident occurred in 1990 near Grande Isle, Louisiana. Deep cuts on the dorsal surface of the whale indicated the vessel strike was probably pre-mortem (Jensen and Silber 2004). A review of available data on serious injury and mortality determinations for sei, fin, and sperm whales for 2000-2020 and right whales for 2000-2023 (Henry et al. 2022 and 2023, UME website as cited above), includes no records of vessel struck whales that were first detected in the WDA. Hayes et al. (2021) reports three vessel struck sei whales first documented in the U.S. Northeast – all three were discovered on the bow of vessels entering port (two in the Hudson River and one in the Delaware River); no information on where the whales were hit is available. Hayes et al. (2020) reports only four recorded ship strikes of sperm whales. In May 1994, a ship-struck sperm whale was observed south of Nova Scotia (Reeves and Whitehead 1997), in May 2000, a merchant ship reported a strike in Block Canyon, and in 2001, and the U.S. Navy reported a ship strike within the EEZ (NMFS, unpublished data). In 2006, a sperm whale was found dead from ship-strike wounds off Portland, Maine. A similar rate of strike is expected to continue in the action area over the life of the project and we expect vessel strike will continue to be a source of mortality for right, sei, fin, and sperm whales in the action area. Two of the right whale mortalities recorded in the UME were detected offshore of Virginia Beach, VA (#3343, February 2023 and #1950, March 2024). As outlined above, there are a number of measures that are in place to reduce the risk of vessel strikes to large whales that apply to vessels that operate in the action area.

NMFS' Sea Turtle Stranding and Salvage Network (STSSN) database provides information on records of stranded sea turtles in the region. The STSSN database was queried for records of stranded sea turtles with evidence of vessel strike throughout the waters off of Maryland and Delaware and in the Chesapeake and Delaware Bays to overlap with the area where the majority of project vessel traffic will occur. Out of the 1,587 recovered stranded sea turtles in Maryland/Delaware waters from 2013 through 2022 (10 years), there were 306 definitely recorded sea turtle vessel strikes and 140 recorded blunt force traumas which are likely vessel strikes, and 14 recorded with both types of injury. The majority of strikes and blunt force traumas were of loggerheads with a smaller number of leatherbacks, Kemp's ridleys, and green turtles. A similar rate of strike is expected to continue in the action area over the life of the project and that vessel strike will continue to be a source of mortality for sea turtles in the action area. Due to the greater abundance of sea turtles in southern portions of the action area, particularly along the Florida coast and in the Gulf of Mexico, vessel strike occurs more frequently in this portion of the action area. Foley et al. (2019) reports that based on stranding numbers, being struck by a vessel causes up to about 30% of the mortality of loggerheads, green turtles, and leatherbacks; and up to about 25% of the mortality of Kemp's ridleys in the nearshore areas of Florida. The authors estimate that overall, strikes by motorized watercraft killed a mean of 1,326–4,334 sea turtles each year in Florida during 2000–2014.

Atlantic sturgeon are struck and killed by vessels in at least some portions of their range. There are no records of vessel strike in the Atlantic Ocean, with all records within rivers and estuaries. Atlantic sturgeon are known to be struck and killed in portions of the action area that will be transited by project vessels including Delaware Bay and the Delaware River and the lower Chesapeake Bay. Risk is thought to be highest in areas with geographies that increase the likelihood of co-occurrence between Atlantic sturgeon and vessels operating at a high rate of speed or with propellers large enough to entrain sturgeon. Shortnose sturgeon appear to be less vulnerable to vessel strike than Atlantic sturgeon. NMFS has only minimum counts of the number of Atlantic sturgeon that are struck and killed by vessels because only sturgeon that are found dead with evidence of a vessel strike are counted. New research, including a study that intentionally placed Atlantic sturgeon carcasses along the Delaware River in areas used by the public, suggests that most Atlantic sturgeon carcasses are not found and, when found, many are not reported to NMFS or to our sturgeon salvage co-investigators (Balazik et al. 2012b, Balazik, pers. comm. in ASMFC 2017; Fox et al. 2020).

Summaries of information on vessel strikes of Atlantic sturgeon in the Chesapeake Bay and the Delaware River and Bay are provided in the *Status of the Species* section of this Opinion. In addition, the effects of transits anticipated and analyzed in the 2023 Paulsboro Biological Opinion and the 2022 New Jersey Wind Port Opinion influence the environmental baseline for this action.

In the February 25, 2022, Biological Opinion issued to USACE for the construction of the NJWP, NMFS concluded that the construction and subsequent use of the New Jersey Wind Port was likely to adversely affect but not likely to jeopardize shortnose sturgeon or any DPS of Atlantic sturgeon. NMFS determined that vessel traffic to and from the NJWP during 25 years of port operations will result in the mortality of 4 shortnose sturgeon and 35 Atlantic sturgeon (23 New York Bight DPS, 5 Chesapeake Bay DPS, 5 South Atlantic DPS, 2 Gulf of Maine DPS) as a result of vessel strike. The Opinion calculated these mortalities based on 1,280 vessel trips annually during the 25-year operational life of the port. In the BA for the Maryland Wind project, BOEM included the potential use of the NJWP as an alternate port for project vessels involved in foundation fabrication, assembly of components, load out to feeder or installation vessels, and mobilization of the fall pipe vessel for scour protection. If any alternative ports are used, US Wind anticipates the number of vessel transits to remain the same such that the number of vessels and the number of transits would not differ based on the port used. In the BA, US Wind indicates that the vessels used and trips made will be spread among the ports if alternative ports are used. For this Opinion, expect the number of vessel transits to the NJWP would not exceed those expected for Baltimore (Sparrows Point), Maryland, which US Wind has identified as the primary port for foundation-related construction activities. We note that estimating sturgeon take incidental from vessel traffic to and from the NJWP based on the number of transits expected for Baltimore (Sparrows Point), Maryland will likely overestimate take because the vessels used and trips made will be spread among the alternative ports used to support construction. BOEM estimates up to 1,390 trips to the NJWP (Table 3-11 in the BA) during the construction phase and less than one trip during the O&M phase, and another 1,390 trips during decommissioning, for a total of 2,781 trips. This is approximately 9% of the total trips considered in the NJWP Biological Opinion. Based on the available information, we expect that Maryland Wind's vessels are similar to the vessels considered in the NJWP Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 9% of the total vessel strikes of Atlantic sturgeon could result from Maryland Wind vessels. Calculating 9% of 35 Atlantic sturgeon results in an estimate of 3.2 vessel struck sturgeon. As such, we anticipate that vessels using the NJWP as part of the Maryland Wind project will result in the strike of no more than four Atlantic sturgeon. Considering the apportionment of take by DPS outlined in the February 2022 Opinion, we expect that two of these would be from the New York Bight DPS with two from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS. Calculating 9% of 4 shortnose sturgeon results in an estimate of 0.36 vessel struck sturgeon. As such, we expect that vessels using the NJWP as part of the Maryland Wind project will result in the lethal strike of up to one shortnose sturgeon.

In the November 7, 2023, Biological Opinion issued to USACE for the construction and operation of the Paulsboro Marine Terminal (which replaced the July 2022 Opinion), NMFS concluded that the construction and use of the Paulsboro Marine Terminal was likely to adversely affect but not likely to jeopardize shortnose sturgeon or any DPS of Atlantic sturgeon. NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Paulsboro Marine Terminal during 10 years of port operations will result in the mortality of one shortnose sturgeon and eight Atlantic sturgeon as a result of vessel strike (4 from the New York Bight DPS, 2 from the Chesapeake Bay DPS, 1 from the South Atlantic DPS, and 1 from the Gulf of Maine DPS). The Opinion calculated this mortality based on a maximum of 880 vessel trips from 2023-2032. In the BA for the Maryland Wind project, BOEM included the potential use of Paulsboro Marine Terminal as an alternate port for project vessels involved in foundation fabrication, assembly of components, load out to feeder or installation vessels, and mobilization of the fall pipe vessel for scour protection. As stated above for the NJWP, if any alternative ports are used, vessels used and trips made will be spread among the ports and US Wind anticipates the number of vessels and vessel transits to remain the same regardless of the alternate port used. If Paulsboro Marine Terminal is selected as an alternative port, US Wind anticipates up to 92 trips (i.e., 61 trips to pick up monopiles and up to 31 trips to pick up transition pieces) during the construction phase. This is approximately 10% of the total trips considered in the Paulsboro Biological Opinion. Based on the available information, Maryland Wind vessels are similar to the vessels described in the Paulsboro Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, and considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 10% of the total vessel strikes of Atlantic sturgeon could result from Maryland Wind vessels. Calculating 10% of 8 Atlantic sturgeon results in an estimate of 0.8 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Maryland Wind project will result in the strike of no more than one Atlantic sturgeon. Based on the proportional assignment of take in the November 2023 Paulsboro Opinion, we expect that this is likely to be an Atlantic sturgeon belonging to the New York Bight DPS. Calculating 10% of 1 shortnose sturgeon results in an estimate of 0.1 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Maryland Wind project will result in the strike of up to one shortnose sturgeon.

In the November 7, 2023, Biological Opinion NMFS concluded that the construction and subsequent use of the Paulsboro Marine Terminal was not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the February 25, 2022, Biological Opinion NMFS concluded that the construction and subsequent use of the New Jersey Wind Port was likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon. As explained in that Opinion, NMFS determined that there would be temporary and permanent effects as a result of construction and mitigation activities and that the subsequent use of the NJWP channels by deep draft vessels and periodic maintenance dredging will continue to reduce the value of the habitat over the 25-year expected life-time of the NJWP operations. Based on the available information, we expect that Maryland Wind vessels are similar to the vessels considered in the NJWP Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to affect critical habitat. Due to the nature of the effects to critical habitat described in the NJWP Opinion (i.e., intermittent scouring and disturbance of river sediments), we are not able to determine the proportional effects of Maryland Wind vessel use of these port facilities on critical habitat. However, based on the available information, including consideration of vessel type and number of trips, we determined the effects of the Maryland Wind vessels are within the scope of effects considered in the NJWP Opinion. The effects of these vessel trips on critical habitat designated for the New York Bight DPS of Atlantic sturgeon are included in the *Environmental Baseline* for the Maryland Wind project.

Offshore Wind Development

The action area includes a number of areas that have been leased by BOEM for offshore wind development or that are being considered for lease issuance. As noted above, in the *Environmental Baseline* section of an Opinion, we consider the past and present impacts of all federal, state, or private activities and the anticipated impacts of all proposed federal actions that have already undergone Section 7 consultation. In the context of offshore wind development, past and present impacts in the action area include the effects of pre-construction surveys to support site characterization, site assessment, and data collection to support the development of Construction and Operations Plans (COPs), the construction of the South Fork project as well as ongoing effects of construction of the and Vineyard Wind 1, CVOW, and Revolution Wind projects.

To date, we have completed section 7 consultations to consider the effects of construction, operation, and decommissioning of multiple commercial scale offshore wind projects along the U.S. Atlantic coast (Vineyard Wind 1, South Fork Wind, Ocean Wind 1, Revolution Wind, Sunrise Wind, CVOW, Empire Wind, Atlantic Shores South, and New England Wind). To date, construction has been completed for the South Fork Wind project and is ongoing for the Vineyard Wind 1, CVOW, and Revolution Wind projects; these projects are located well outside the Maryland Wind WFA but, considering vessel transit routes, are within the overall action area. We have also completed ESA section 7 consultation on one smaller scale offshore wind project that occurs outside of the action area, the Block Island project; this project is in the operations and maintenance phase. Dominion's Coastal Virginia Offshore Wind Demonstration Project consists of two operational WTGs off the coast of Virginia; this project is within the action area. These two small scale projects are in the operations and maintenance phase. There are no offshore wind projects or associated activities (i.e. site characterization, site assessment) in the action area for which "early consultation" has been initiated or completed pursuant to 50 CFR §402.11.

The offshore wind projects that we have completed consultation on that are within the action area defined in section 3.8 of this Opinion are Vineyard Wind 1, South Fork Wind, Ocean Wind 1 (noting that status of this project is uncertain as the operational period of the lease has been paused), Revolution Wind, Sunrise Wind, CVOW, Empire Wind, Atlantic Shores South, and New England Wind. Vessels transiting between the Maryland Wind WDA and ports in New York and New Jersey would travel past the Empire Wind, Ocean Wind 1 and Atlantic Shores lease areas. Vessels transiting between the Maryland Wind WDA and Brewer, ME would travel offshore past Revolution Wind, Sunrise Wind, Vineyard Wind 1, South Fork Wind, and New England Wind. Maryland Wind's vessels transiting to/from Ingleside, TX, Houma/Harvey, LA, and Baltimore, MD are expected to transit past the CVOW lease area. Given the uncertainty in project schedules it is difficult to predict which, if any, projects will have foundation installation activities during the anticipated seasons for Maryland Wind construction. However, given the distance between projects there is not expected to be any overlap of sound fields even if construction occurred simultaneously; further, there are no projects considered in the Environmental Baseline for the Maryland Wind project that would have effects to listed species in the Maryland Wind WDA (i.e., no additive effects are expected).

Site Assessment, Site Characterization, and Surveys

A number of geotechnical and geophysical surveys to support wind farm siting have occurred and will continue to occur in the action area. Additionally, data collection buoys have been installed. Effects of these activities on ESA listed species in the action area are related to potential exposure to noise associated with survey equipment, survey vessels, and habitat impacts. NMFS GARFO completed a programmatic informal consultation with BOEM in June 2021 that considered the effects of geotechnical and geophysical surveys and buoy deployments (NMFS GAR 2021, Appendix C to this Opinion). The consultation includes a number of best management practices and project design criteria designed to minimize the potential effects of these activities on ESA listed species. In the consultation, we concluded that these activities may affect but are not likely to adversely affect any ESA listed species if implemented in accordance with applicable BMPs and PDCs. Given the characteristics of the noise associated with survey equipment and the use of best management practices to limit exposure of listed species, including protected species observers, effects of survey noise on listed species have been determined to be extremely unlikely or insignificant. There is no information that indicates that the noise sources used for these surveys has the potential to result in ESA incidental take, including harassment, injury (e.g. permanent hearing impairment or non-auditory injury), or mortality of any ESA listed species in the action area. Similarly, we have not anticipated any adverse effects to habitats or prey and do not anticipate any ESA listed species to be struck by survey vessels; risk is reduced by the slow speeds that survey vessels operate at, the use of lookouts, and incorporation of vessel strike avoidance measures.

Surveys to obtain data on fisheries resources have been undertaken in the action area to support OSW development; surveys for the Vineyard Wind 1 and South Fork projects were considered in the Biological Opinions issued for those projects. Some gear types used, including gillnet, trawl, and trap/pot, can entangle or capture ESA listed sea turtles, fish, and whales. Risk can be reduced through avoiding certain times/areas, minimizing soak and tow times, and using gear designed to limit entanglement or reduce the potential for serious injury or mortality. To date, we have records of ten Atlantic sturgeon captured in gillnet surveys (for the South Fork project) in the action area; six of the sturgeon were released alive with minor injuries while the remaining four were killed. South Fork does not anticipate further gillnet survey efforts at this time. A number of Atlantic sturgeon have also been captured in trawl surveys; however, all animals have been released alive with no serious injuries observed. Risk can be reduced through avoiding certain times/areas, minimizing soak and tow times, and using gear designed to limit entanglement or reduce the potential for serious injury or mortality. Two loggerhead sea turtles have been captured and released alive in trawl surveys being carried out by Ocean Wind. Outside of the gillnet surveys, which are no longer planned, no serious injury or mortality of any ESA listed species is exempted in any ITS issued for any of these projects.

Consideration of Construction, Operation, and Decommissioning of Other OSW Projects
We have completed ESA consultation for 11 OSW projects to date. Complete information on the assessment of effects of these projects is found in their respective Biological Opinions (South Fork Wind - NMFS 2021a, Vineyard Wind 1 - NMFS 2021b, CVOW (demonstration project)- NMFS 2016, and Block Island - NMFS 2014, Ocean Wind 1 – NMFS 2023a, CVOW – NMFS 2023b, Empire Wind – NMFS 2023c, Revolution Wind – NMFS 2023d and NMFS 2024b (reinitiation), Sunrise Wind – NMFS 2023e, Atlantic Shores South – NMFS 2023f, New England Wind – NMFS 2024). The action areas defined in each of these Opinions overlaps in part with

the action area defined in section 3.8 of this Opinion for the Maryland Wind project - primarily due to vessel transit.

The South Fork, Block Island, and CVOW Demonstration projects have been constructed and turbines are operational. Construction of the Vineyard Wind 1, Revolution Wind, and CVOW projects are ongoing. Construction of the Vineyard Wind 1 and Revolution Wind projects is expected to be complete prior to the beginning of construction of the Maryland Wind project. Given numerous project delays, it is difficult to predict which, if any, projects may be undergoing construction during the same years as the Maryland Wind project. However, given the large geographic separation between the project, no additive effects are anticipated (i.e., the sound fields would not overlap in space or time). We note that in 2024, the Ocean Wind 1 lease was suspended for a two year period. Similarly, the lessee for the Empire Wind 2 project requested the withdrawal of the project's applications. As such, it is not clear if either project will be constructed in the future. In the Biological Opinions prepared for these projects, we anticipated temporary loss of hearing sensitivity (TTS) and/or short term behavioral disturbance of ESA listed sea turtles and whales exposed to pile driving noise or UXO detonations resulting in take that meets the ESA definition of harassment and, in a few cases, anticipated permanent loss of hearing sensitivity (PTS) resulting in take that meets the definition of harm. The amount of incidental take exempted through project Biological Opinions is included below for the projects that occur in the Maryland Wind action area (Tables 6.4.2 and 6.4.3). In the Biological Opinions prepared for the offshore wind projects considered to date, we anticipated short term behavioral disturbance of ESA listed sea turtles and whales exposed to pile driving noise. In these Opinions, we concluded that effects of operational noise would be insignificant. With the exception of the gillnet interactions noted above, the only mortality anticipated is a small number of sea turtles and Atlantic sturgeon expected to be struck and injured or killed by vessels associated with the South Fork, Vineyard Wind 1, Ocean Wind 1, Empire Wind, Sunrise Wind, New England Wind, Atlantic Shores South, Revolution Wind, and CVOW Commercial projects.

Table 6.4.2 Summary of Amount and Extent of Take Identified in Offshore Wind BiOp's ITSs resulting from exposure to project noise (pile driving and/or UXO detonations). Note that not all construction periods overlap. Source: South Fork Wind - NMFS 2021a, Vineyard Wind 1 - NMFS 2021b, CVOW (demonstration project)- NMFS 2016, and Block Island - NMFS 2014, Ocean Wind – NMFS 2023a, CVOW – NMFS 2023b, Empire Wind – NMFS 2023c, Revolution Wind – NMFS 2024; Sunrise Wind – NMFS 2023e, Atlantic Shores South – NMFS 2023f, New England Wind – NMFS 2024.

Block Island - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact and Vibratory Pile Driving) from Block Island Wind Farm (BIWF) and the Block Island Transmission System (BITS)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	11
Humpback Whale	None	22
Fin whale	None	228

NA DPS green sea turtle	None	64
Kemp's ridley sea turtle	None	64
Leatherback sea turtle	None	64
NWA DPS Loggerhead sea turtle	None	576
CVOW – Demonstration Project - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact and Vibratory Pile Driving)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	1
Fin whale	None	1
Humpback Whale	None	98
NA DPS green sea turtle	None	328
Kemp's ridley sea turtle	None	1,064
Leatherback sea turtle	None	210
NWA DPS Loggerhead sea turtle	None	630
Vineyard Wind 1 - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Maximum Impact Scenario; Impact Pile Driving Only)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	20
Fin whale	5	5
Sei Whale	2	2
Sperm whale	None	None
NWA DPS Loggerhead sea turtle	None	3
NA DPS green sea turtle	None	1
Kemp's ridley sea turtle	None	1
Leatherback sea turtle	None	7
South Fork Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact and Vibratory Pile Driving)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	10
Fin whale	1	15
Sei Whale	1	2
Sperm whale	None	3
NA DPS green sea turtle	None	6
Kemp's ridley sea turtle	None	6

Leatherback sea turtle	None	8
NWA DPS Loggerhead sea turtle	None	6
Ocean Wind 1 - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Scenario 2; UXO Detonation and Impact and Vibratory Pile Driving)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	7
Fin whale	4	15
Sei Whale	1	4
Sperm whale	None	9
Blue whale	None	4
NA DPS green sea turtle	None	1
Kemp's ridley sea turtle	None	16
Leatherback sea turtle	None	7
NWA DPS Loggerhead sea turtle	None	184
Revolution Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact Pile Driving, UXO Detonation)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	34
Fin Whale	2	35
Sei Whale	3	18
Sperm whale	None	5
Blue whale	None	2
NA DPS green sea turtle	1	8
Kemp's ridley sea turtle	1	7
Leatherback sea turtle	1	7
NWA DPS Loggerhead sea turtle	1	15
Empire Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact Pile Driving Only)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**

North Atlantic right whale	None	22
Fin whale	6	190
Sei Whale	None	5
Sperm whale	None	6
NA DPS green sea turtle	None	1
Kemp's ridley sea turtle	None	9
Leatherback sea turtle	None	2
NWA DPS Loggerhead sea turtle	None	96
CVOW - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact and Vibratory Pile Driving)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	12
Fin Whale	7	202
Sei Whale	2	5
Sperm whale	None	6
NA DPS green sea turtle	46	215
Kemp's ridley sea turtle	44	203
Leatherback sea turtle	4	3
NWA DPS Loggerhead sea turtle	1,214	5,764
Sunrise Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact Pile Driving Only)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	23
Fin whale	4	55
Sei Whale	2	22
Sperm whale	None	10
Blue whale	None	2
NA DPS green sea turtle	None	1
Kemp's ridley sea turtle	None	1
Leatherback sea turtle	4	9
Atlantic Shores South - Amount and Extent of Take Identified in the BiOp's ITS due to Noise Exposure (Impact Pile Driving Only)		

Species	Harm (Auditory Injury - PTS)	Harassment (TTS/Behavior)
North Atlantic right whale	None	20
Fin whale	8	28
Sei Whale	3	15
Sperm whale	None	10
NA DPS green sea turtle	None	2
Kemp's ridley sea turtle	None	48
Leatherback sea turtle	4	25
NWA DPS Loggerhead sea turtle	None	816
New England Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Exposure to Noise (UXO Detonation and Impact Pile Driving – Schedule B)		
Species	**Harm (Auditory Injury - PTS)**	**Harassment (TTS/Behavior)**
North Atlantic right whale	None	101
Fin whale	33	368
Sei Whale	6	58
Sperm whale	None	96
Blue whale	2	100
NA DPS green sea turtle	1	1
Kemp's ridley sea turtle	None	1
Leatherback sea turtle	5	8

Table 6.4.3 Amount and Extent of Take Exempted in Offshore Wind BiOp ITSs resulting from vessel strikes. The amount of take identified is over the approximately 40-year life of each project (construction, operations, and decommissioning). Source: **South Fork Wind - NMFS 2021a, Vineyard Wind 1 - NMFS 2021b, CVOW (demonstration project)- NMFS 2016, and Block Island - NMFS 2014, Ocean Wind – NMFS 2023a, CVOW – NMFS 2023b, Empire Wind – NMFS 2023c, Revolution Wind – NMFS 2023d, Sunrise Wind – NMFS 2023e, Atlantic Shores South – NMFS 2023f, New England Wind, NMFS 2024**

CVOW Demonstration - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	None
Kemp's ridley sea turtle	None

Leatherback sea turtle	None
NWA DPS Loggerhead sea turtle	None
Block Island - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	None
Kemp's ridley sea turtle	None
Leatherback sea turtle	None
NWA DPS Loggerhead sea turtle	None
Vineyard Wind 1 - Amount and Extent of Take Identified in the BiOp's ITS Due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	2
Kemp's ridley sea turtle	2
Leatherback sea turtle	20
NWA DPS Loggerhead sea turtle	17
South Fork Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	1
Kemp's ridley sea turtle	1
Leatherback sea turtle	7
NWA DPS Loggerhead sea turtle	3
Ocean Wind 1 - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	1
Kemp's ridley sea turtle	1
Leatherback sea turtle	1
NWA DPS Loggerhead sea turtle	9
Revolution Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	

Species	**Serious Injury or Mortality**
NA DPS green sea turtle	1
Kemp's ridley sea turtle	1
Leatherback sea turtle	5
NWA DPS Loggerhead sea turtle	6
Empire Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
North Atlantic DPS green sea turtle	1
Kemp's ridley sea turtle	3
Leatherback sea turtle	4
Northwest Atlantic DPS Loggerhead sea turtle	22
CVOW Commercial - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
NA DPS green sea turtle	13
Kemp's ridley sea turtle	101
Leatherback sea turtle	5
NWA DPS Loggerhead sea turtle	249
New York Bight DPS Atlantic sturgeon	113
Chesapeake Bay DPS Atlantic sturgeon	47
South Atlantic DPS Atlantic sturgeon	25
Carolina DPS Atlantic sturgeon	11
Gulf of Maine DPS Atlantic sturgeon	5
Sunrise Wind - Amount and Extent of Take Identified in the BiOp's ITS due to Vessel Strike	
Species	**Serious Injury or Mortality**
North Atlantic DPS green sea turtle	1
Kemp's ridley sea turtle	1

Other Activities in the Action Area

Other activities that occur in the action area that may affect listed species include scientific research and geophysical and geotechnical surveys. Military operations in the action area are expected to be restricted to vessel transits, the effects of which are subsumed in the discussion of vessel strikes above.

Scientific Surveys
Numerous scientific surveys, including fisheries and ecosystem surveys carried out by NMFS operate in the action area. Regulations issued to implement section 10(a)(1)(A) of the ESA allow issuance of permits authorizing take of ESA-listed species for the purposes of scientific research. Prior to the issuance of such a permit, an ESA section 7 consultation must take place. No permit can be issued unless the proposed research is determined to be not likely to jeopardize the continued existence of any listed species. Scientific research permits are issued by NMFS for ESA listed whales and Atlantic sturgeon; the U.S. Fish and Wildlife Service is the permitting authority for ESA listed sea turtles.

Marine mammals, sea turtles, and Atlantic sturgeon have been the subject of field studies for decades. The primary objective of most of these field studies has generally been monitoring populations or gathering data for behavioral and ecological studies. Research on ESA listed whales, sea turtles, and Atlantic sturgeon has occurred in the action area in the past and is expected to continue over the life of the proposed action. Authorized research on ESA-listed whales includes close vessel and aerial approaches, photographic identification, photogrammetry, biopsy sampling, tagging, ultrasound, exposure to acoustic activities, breath sampling, behavioral observations, passive acoustic recording, and underwater observation. No lethal interactions are anticipated in association with any of the permitted research. ESA-listed sea turtle research includes approach, capture, handling, restraint, tagging, biopsy, blood or tissue sampling, lavage, ultrasound, imaging, antibiotic (tetracycline) injections, laparoscopy, and captive experiments. Most authorized take is sub-lethal with limited amounts of incidental mortality authorized in some permits (i.e., no more than one or two incidents per permit and only a few individuals overall). Authorized research for Atlantic sturgeon includes capture, collection, handling, restraint, internal and external tagging, blood or tissue sampling, gastric lavage, and collection of morphometric information. Most authorized take of Atlantic sturgeon for research activities is sub-lethal with small amounts of incidental mortality authorized; a programmatic ESA Section 7 consultation was issued in 2017 that identifies a limit on lethal take for each river population (NMFS OPR 2017); depending on the identified health of the river population, the allowable mortality limit, across all issued permits, ranges from 0.4 to 0.8%. In that Opinion, NMFS determined this was not likely to jeopardize the continued existence of any DPS.

Noise
The ESA-listed species that occur in the action area are regularly exposed to several sources of anthropogenic sounds in the action area. The major source of anthropogenic noise in the action area are vessels. Other sources are minor and temporary including short-term dredging, construction, and research activities. As described in the DEIS, the Lease Area is within the Virginia Capes (VACAPES) Range Complex, which is composed of the VACAPES Operating Area (OPAREA). This Range Complex is used for military training and subsurface, surface, and surface to air testing exercises. Military operations can be a significant source of underwater noise. Military activities are anticipated to continue to use onshore and offshore areas in the vicinity of the Project area into the future and may involve routine and non-routine activities.

ESA-listed species may be impacted by either increased levels of anthropogenic-induced background sound or high intensity, short- term anthropogenic sounds.
The Maryland Wind WDA lies within a dynamic ambient noise environment, with natural background noise contributed by natural wind and wave action, a diverse community of vocalizing cetaceans, and other organisms. Anthropogenic noise sources, including commercial shipping traffic in high-use shipping lanes in proximity to the action area, also contribute ambient sound. Bailey et al. (2018) surveyed the ambient underwater noise environment in the Maryland WEA as part of a broader study of large whale use of marine habitats in this wind energy development area.

Acoustic monitoring sensor locations in and around the Maryland WEA are depicted in Figure 3.2a of Bailey et al. (2018). As shown, eight sensors (A-1M, A-2M, A-3M, A-4M, A-5M, A-6M, A-7M, and A-8M) are within the Maryland WFA, whereas the remaining sensor locations are in a transect line with one inshore site and three sites offshore of Ocean City, MD. For the sensors within the WFA, median ambient noise from 108.1 to 116.1 dB re 1uPa SPL. The measured ambient noise levels were affected by the proximity of shipping lanes into the Philadelphia area, just north of the Project area. As depicted in Table 3-19 in the BA, ambient noise levels were increased at three sites (A-4M, A-7M, and T-2M) adjacent to or within shipping lanes, with median ambient noise ranges from 115 to 116.1 dB re 1uPa SPL.

Short term increases in noise in the action area associated with vessel traffic and other activities, including geotechnical and geophysical surveys that have taken place in the past and will continue in the future in the portions of the action area that overlap with other offshore wind lease areas and/or potential cable routes. Exposure to these noise sources can result in temporary masking or temporary behavioral disturbance; however, in all cases, these effects are expected to be temporary and short term (e.g., the seconds to minutes it takes for a vessel to pass by) and not result in any injury or mortality in the action area. Outside of the Gulf of Mexico, no acoustic surveys using seismic equipment or airguns have been proposed in the action area and none are anticipated to take place in the future, as that equipment is not necessary to support siting of future offshore wind development that is anticipated to occur in the action area. Noise associated with oil and gas exploration is addressed below noise associated with construction and operations of other offshore wind projects is addressed above.

Factors Relevant only for the Gulf of Mexico portion of the Action Area
In addition to fishing activities and vessel operations, oil and gas exploration and extraction activities occur in the Gulf of Mexico as do a number of military activities. The air space over the Gulf of Mexico is used extensively by the Department of Defense for conducting various air-to-air and air-to-surface operations. Nine military warning areas and five water test areas are located within the Gulf of Mexico. The western Gulf of Mexico has four warning areas that are used for military operations. In addition, six blocks in the western Gulf of Mexico are used by the Navy for mine warfare testing and training. The central Gulf of Mexico has five designated military warning areas that are used for military operations. Oil and gas operations on the Gulf of Mexico OCS that have been ongoing for more than 50 years involve a variety of activities that may adversely affect ESA-listed species in the action area. These activities and resulting impacts include vessels making supply deliveries, drilling operations, seismic surveys, fluid spills, oil spills and response, and oil platform removals.

Other Factors
Whales, sea turtles, and Atlantic sturgeon are exposed to a number of other stressors in the action area that are widespread and not unique to the action area which makes it difficult to determine to what extent these species may be affected by past, present, and future exposure within the action area. These stressors include water quality and marine debris. Marine debris in some form is present in nearly all parts of the world's oceans, including the action area. While the action area is not known to aggregate marine debris as occurs in some parts of the world (e.g., The Great Pacific garbage patch, also described as the Pacific trash vortex, a gyre of marine debris particles in the north central Pacific Ocean), marine debris, including plastics that can be ingested and cause health problems in whales and sea turtles is expected to occur in the action area.

Marine ecosystems are described using the Coastal and Marine Ecological Classification Standard (CMECS), a classification system based on biogeographic setting for the area of interest (FGDC 2012). CMECS provides a comprehensive framework for characterizing ocean and coastal environments and living systems using categorical descriptors for physical, biological, and chemical parameters relevant to each specific environment type (FGDC 2012). The CMECS biogeographic setting for the WDA is the Temperate Northern Atlantic Realm, Cold Temperate Northwest Atlantic Province, Virginian Ecoregion. The biotic component of CMECS classifies living organisms of the sea floor and water column based on physical habitat associations across a range of spatial scales. This component is organized into a five-level branched hierarchy: biotic setting, biotic class, biotic subclass, biotic group, and biotic community. The biotic subclass is a useful classification category for characterizing the aquatic ecosystem. Biotic component classifications in the WDA are defined by the dominance of life forms, taxa, or other classifiers observed in surveys of the site. In the case of photos, dominance is assigned to the taxa with the greatest percent cover in the photo (FGDC 2012).

The cable corridor is located in coastal marine waters where available water quality data are also limited. The EPA classified coastal water quality conditions nationally for the 2010 National Coastal Condition Assessment (EPA 2016). The 2010 National Coastal Condition Assessment used physical and chemical indicators to rate water quality, including phosphorus, nitrogen, dissolved oxygen, salinity, water clarity, pH, and chlorophyll *a*. The most recent National Coastal Condition Report rated coastal water quality from Maine to North Carolina as "good" to "fair" (EPA 2012). Broadly speaking, ambient water quality in these areas is expected to be generally representative of the regional ocean environment and subject to constant oceanic circulation that disperses, dilutes, and biodegrades anthropogenic pollutants from upland and shoreline sources (BOEM 2013).

The WDA is located in temperate waters and, therefore, subjected to highly seasonal variation in temperature, stratification, and productivity. Overall, pelagic habitat quality within the WFA and offshore components of the cable corridor is considered fair to good (USEPA 2015). Baseline conditions for water quality are further described below. Section 2.4 of the COP Volume II details oceanographic conditions in the WFA and surrounding area located on the Mid-Atlantic Shelf. Circulation patterns in the Lease Area and vicinity are dominated by a counter-clockwise gyre and the counter-clockwise circulation created by large tropical and extra-tropical storms.

That circulation creates: a) the north to south littoral currents along the coast and inner shelf and b) forms and defines the NNE-SSW-oriented sand ridges, which are the most predominate morphological features on the inner shelf. The storm discharges from the Chesapeake and Delaware Bays, as well as the flood and ebb tides into and out from the bays, disrupt the regional ocean circulation and add a significant tidal-driven element to the water circulation, currents, seafloor morphology, and sediment transport in front of the two large bays (as well as to a lesser, localized effect seaward of other, smaller bays and outlets along the coast).

Ocean waters beyond 3 miles (4.8 km) offshore typically have low concentrations of suspended particles and low turbidity. Waters along the Northeast Coast average 5.6 milligrams per liter (mg/L) of TSS, which is considered low. There are notable exceptions, including estuaries that average 27.4 mg/L (EPA 2012). While most ocean waters had TSS concentrations under 10 mg/L, which is the 90th percentile of all measured values, most estuarine waters (65.7% of the Northeast Coast area) had TSS concentrations above this level. Near-bottom TSS concentrations were similar to those near the water surface, averaging 6.9 mg/L. With the exception of the entrance to Delaware Bay, all other coastal ocean stations had near-bottom levels of TSS less than or equal to 16.3 mg/L (EPA 2012).

A study conducted by the EPA evaluated over 1,100 coastal locations in 2010, as reported in their National Coastal Condition Assessment (EPA, 2015). The EPA used a Water Quality Index (WQI) to determine the quality of various coastal areas including the northeast coast from Virginia to Maine and assigned three condition levels for a number of constituents: good, fair, and poor. A number of the sample locations overlap with the action area. Chlorophyll a concentrations, an indicator of primary productivity, levels in northeastern coastal waters were generally rated as fair (45%) to good (51%) condition, and stations in the action area were all also fair to good (EPA, 2015). Nitrogen and phosphorous levels in northeastern coastal waters generally rated as fair to good (13% fair and 82% good for nitrogen and 62% and 26% good for phosphorous); stations in the action area were all also fair to good (EPA 2015). Dissolved oxygen levels in northeastern coastal waters are generally rated as fair (14%) to good (80%) condition, with consistent results for the sampling locations in the action area. Based on the available information, water quality in the action area appears to be consistent with surrounding areas. We are not aware of any discharges to the action area that would be expected to result in adverse effects to listed species or their prey. Outside of conditions related to climate change, discussed in Section 7.10, water quality is not anticipated to negatively affect listed species that may occur in the action area.

7.0 EFFECTS OF THE ACTION

This section of the biological opinion assesses the effects of the proposed action on ESA-listed threatened or endangered species and designated critical habitat. Effects of the action are "all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action but that are not part of the action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action" (50 CFR §402.02).

The main element of the proposed action is BOEM's COP approval with conditions, the effects of which will be analyzed in this section. The effects of the issuance of other permits and authorizations that are consequences of BOEM's action are also evaluated in this section. For example, the proposed Incidental Take Regulations (ITR) and associated LOA to be issued by NMFS OPR to authorize incidental take of ESA-listed marine mammals under the MMPA and the permits/authorizations proposed by USACE and USCG are considered effects of the action as they are consequences of BOEM's proposed approval of the Maryland Wind COP with conditions. In addition, the ITR and associated LOA proposed for issuance by NMFS OPR, as well as permits issued by USACE and USCG, are also Federal actions that may affect ESA-listed species; therefore, they require Section 7 consultation in their own right. In this consultation, we have worked with NMFS OPR as the action agency authorizing marine mammal incidental takes under the MMPA, as well as with other Federal action agencies aside from BOEM that are proposing to issue permits or other approvals, and we have analyzed the effects of those actions along with the effects of BOEM's action to approve the COP with conditions. All effects of these collective actions on ESA-listed species and designated critical habitat are, therefore, comprehensively analyzed in this Opinion[33].

The purpose of the Maryland Wind project is to generate electricity. Electricity will travel from the WTGs to the OSSs and then by submarine cable to on-land cables in Delaware. All of the electricity generated will support existing uses. Even if we assume the Maryland Wind project will increase overall supply of electricity, we are not aware of any new actions demanding electricity that would not be developed but for the Maryland Wind project specifically. Because the electricity generated by Maryland Wind will be pooled with that of other sources in the power grid, we are unable to trace any particular new use of electricity to Maryland Wind's contribution to the grid and, therefore, we cannot identify any impacts, positive or negative, that would occur because of the Maryland Wind project's supply of electricity to the grid. As a result, there are no identifiable consequences of the proposed action analyzed in this Opinion that would not occur but for Maryland Wind's production of electricity and are reasonably certain to occur.

Here, we examine the activities associated with the proposed action and determine what the consequences of the action are to listed species in the action area. Effects to critical habitat were addressed in section 4 of this Opinion. A consequence is caused by the action if it would not occur but for the proposed action and it is reasonably certain to occur. In analyzing effects, we evaluate whether a source of impacts is "likely to adversely affect" listed species/critical habitat or "not likely to adversely affect" listed species/critical habitat. A "not likely to adversely affect" determination is appropriate when an effect is expected to be discountable, insignificant, or completely beneficial. As discussed in the FWS-NMFS Joint Section 7 Consultation Handbook (1998), "[b]eneficial effects are contemporaneous positive effects without any adverse effects to the species. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Discountable effects are those extremely unlikely to occur. Based on best judgment, a person would not: (1) be able to meaningfully measure, detect, or evaluate insignificant effects; or (2) expect discountable effects to occur. If an effect is beneficial, discountable, or insignificant it is not considered adverse and thus cannot cause "take" of any

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[33] The term "proposed action" or "action" may be used to refer to all action agencies' actions related to the Maryland Wind project, unless specific context reveals otherwise.

listed species. "Take" means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct" (ESA §3(19)).

7.1 Underwater Noise

In this section, we provide background information on underwater noise and how it affects listed species, establish the underwater noise that listed species are likely to be exposed to, and then establish the expected response of the individuals exposed to that noise. This analysis considers all phases of the proposed action inclusive of construction, operations, and decommissioning.

7.1.1 Background on Noise

This section contains a brief technical background on sound, the characteristics of certain sound types, and metrics used in this consultation inasmuch as the information is relevant to the specified activity and to consideration of the potential effects of the specified activity on listed species found later in this document.

Sound travels in waves, the basic components of which are frequency, wavelength, velocity, and amplitude. Frequency is the number of pressure waves that pass by a reference point per unit of time and is measured in hertz (Hz) or cycles per second. Wavelength is the distance between two peaks or corresponding points of a sound wave (length of one cycle). Higher frequency sounds have shorter wavelengths than lower frequency sounds, and typically attenuate (decrease) more rapidly, except in certain cases in shallower water. Amplitude is the height of the sound pressure wave or the "loudness" of a sound and is typically described using the relative unit of the decibel (dB). A sound pressure level (SPL) in dB is described as the ratio between a measured pressure and a reference pressure (for underwater sound, this is 1 microPascal (μPa)), and is a logarithmic unit that accounts for large variations in amplitude; therefore, a relatively small change in dB corresponds to large changes in sound pressure. The source level (SL) typically represents the SPL referenced at a distance of 1 m from the source, while the received level is the SPL at the listener's position (referenced to 1 μPa).

Root mean square (rms) is the quadratic mean sound pressure over the duration of an impulse. Root mean square is calculated by squaring all of the sound amplitudes, averaging the squares, and then taking the square root of the average (Urick, 1983). Root mean square accounts for both positive and negative values; squaring the pressures makes all values positive so that they may be accounted for in the summation of pressure levels (Hastings and Popper, 2005). This measurement is often used in the context of discussing behavioral effects, in part because behavioral effects, which often result from auditory cues, may be better expressed through averaged units than by peak pressures.

Sound exposure level (SEL; represented as dB re 1 μPa^2-s) represents the total energy in a stated frequency band over a stated time interval or event, and considers both intensity and duration of exposure. The per-pulse SEL is calculated over the time window containing the entire pulse (*i.e.*, 100 percent of the acoustic energy). SEL is a cumulative metric; it can be accumulated over a single pulse, or calculated over periods containing multiple pulses. Cumulative SEL represents the total energy accumulated by a receiver over a defined time window or during an event. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source, and is represented in the same units as the rms sound pressure.

When underwater objects vibrate or activity occurs, sound-pressure waves are created. These waves alternately compress and decompress the water as the sound wave travels. Underwater sound waves radiate in a manner similar to ripples on the surface of a pond and may be either directed in a beam or beams or may radiate in all directions (omnidirectional sources), as is the case for sound produced by the pile driving activity considered here. The compressions and decompressions associated with sound waves are detected as changes in pressure by aquatic life and man-made sound receptors such as hydrophones.

Even in the absence of sound from the specified activity, the underwater environment is typically loud due to ambient sound, which is defined as environmental background sound levels lacking a single source or point (Richardson *et al*., 1995). The sound level of a region is defined by the total acoustical energy being generated by known and unknown sources. These sources may include physical (*e.g.*, wind and waves, earthquakes, ice, atmospheric sound), biological (*e.g.*, sounds produced by marine mammals, fish, and invertebrates), and anthropogenic (*e.g.*, vessels, dredging, construction) sound. A number of sources contribute to ambient sound, including wind and waves, which are a main source of naturally occurring ambient sound for frequencies between 200 hertz (Hz) and 50 kilohertz (kHz) (Mitson, 1995). In general, ambient sound levels tend to increase with increasing wind speed and wave height. Precipitation can become an important component of total sound at frequencies above 500 Hz, and possibly down to 100 Hz during quiet times. Marine mammals can contribute significantly to ambient sound levels, as can some fish and snapping shrimp. The frequency band for biological contributions is from approximately 12 Hz to over 100 kHz. Sources of ambient sound related to human activity include transportation (surface vessels), dredging and construction, oil and gas drilling and production, geophysical surveys, sonar, and explosions. Vessel noise typically dominates the total ambient sound for frequencies between 20 and 300 Hz. In general, the frequencies of anthropogenic sounds are below 1 kHz and, if higher frequency sound levels are created, they attenuate rapidly.

The sum of the various natural and anthropogenic sound sources that comprise ambient sound at any given location and time depends not only on the source levels (as determined by current weather conditions and levels of biological and human activity) but also on the ability of sound to propagate through the environment. In turn, sound propagation is dependent on the spatially and temporally varying properties of the water column and sea floor, and is frequency-dependent. As a result of the dependence on a large number of varying factors, ambient sound levels can be expected to vary widely over both coarse and fine spatial and temporal scales. Sound levels at a given frequency and location can vary by 10-20 decibels (dB) from day to day (Richardson *et al*., 1995). The result is that, depending on the source type and its intensity, sound from the specified activity may be a negligible addition to the local environment or could form a distinctive signal that may affect a particular species. As described in the BA, the WDA lies within a dynamic ambient noise environment, with natural background noise contributed by natural wind and wave action, a diverse community of vocalizing cetaceans, and other organisms. Anthropogenic noise sources, including commercial shipping traffic in high-use shipping lanes in proximity to the WDA, also contribute ambient sound; these sources are described in the *Environmental Baseline*.

Sounds are often considered to fall into one of two general types: pulsed and non-pulsed. The distinction between these two sound types is important because they have differing potential to cause physical effects, particularly with regard to hearing (*e.g.*, Ward, 1997 in Southall *et al*., 2007). Non-impulsive sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998).

Pulsed sound sources (*e.g.*, impact pile driving) produce signals that are brief (typically considered to be less than one second), broadband, atonal transients (ANSI, 1986, 2005; Harris, 1998; NIOSH, 1998; ISO, 2003) and occur either as isolated events or repeated in some succession. Pulsed sounds are all characterized by a relatively rapid rise from ambient pressure to a maximal pressure value followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures, and generally have an increased capacity to induce physical injury as compared with sounds that lack these features.

Non-pulsed sounds can be tonal, narrowband, or broadband, brief or prolonged, and may be either continuous or intermittent (ANSI, 1995; NIOSH, 1998). Some of these non-pulsed sounds can be transient signals of short duration but without the essential properties of pulses (*e.g.*, rapid rise time). Examples of non-pulsed sounds include those produced by vessels, aircraft, drilling or dredging, and vibratory pile driving.

Specific to pile driving, the impulsive sound generated by impact hammers is characterized by rapid rise times and high peak levels. Vibratory hammers produce non-impulsive, continuous noise at levels significantly lower than those produced by impact hammers. Rise time is slower, reducing the probability and severity of injury, and sound energy is distributed over a greater amount of time (e.g., Nedwell and Edwards, 2002; Carlson et al., 2005).

7.1.2 Summary of Available Information on Sources of Increased Underwater Noise

During the construction phase of the project, sources of increased underwater noise include pile driving, vessel operations, other underwater construction activities (cable laying, placement of scour protection), and HRG surveys. During the operations and maintenance phase of the project, sources of increased underwater noise are limited to WTG operations, vessel operations, maintenance activities, and occasional HRG surveys. During decommissioning, sources of increased underwater noise include removal of project components and associated surveys, as well as vessel operations. Here, we present a summary of available information on these noise sources. More detailed information is presented in the acoustic reports produced for the project (MAI 2023 – Appendix II-H1 to the COP, and the updated MAI 2024); US Wind's Application for an ITA and update memos[34], the Proposed Rule prepared for the ITA (89 FR 504; February 5, 2024), and BOEM's BA.

Impact Pile Driving for WTG, OSS, and Met Tower Foundations

The installation of WTG, Met Tower, and OSS foundations would be limited to May 1 through November 30, given the proposed seasonal restriction on foundation impact pile driving from

[34] Available at: https://www.fisheries.noaa.gov/action/incidental-take-authorization-us-wind-inc-construction-and-operation-maryland-offshore-wind

December 1 through April 30 included in the proposed MMPA ITA. Foundation pile installation is expected to occur over three construction seasons (one for each phase of the project). During this period, up to 114 WTG foundations, 4 OSS foundations, and 1 Met Tower foundation will be installed. All WTG foundations will be monopiles (11 m diameter). The up to 4 OSSs will be installed on monopile (11 m) or jacket foundations (3m; 4 pin piles per jacket foundation). The single met tower would be installed on pin piles (1.8 m; 3 pin piles per foundation). For all construction years, one monopile, or one jacket foundation (three to four pin piles) would be installed per day; no concurrent pile driving is proposed.

Monopiles for WTG or OSS foundations would be installed using an impact pile driver to a maximum penetration depth of 40 m; conditions of the proposed MMPA ITA would limit the maximum hammer energy to 4,400 kJ (noting that hammer energy over 3,300 kJ is not proposed). Installation of each monopile will include a 20-minute soft-start where lower hammer energy is used at the beginning of each pile installation. US Wind estimates that an 11-m monopile could require up to 4,800 strikes at a rate of up to 40 blows per minute (bpm) to reach the target penetration depth. Each monopile is estimated to take approximately 2 hours to install using an impact hammer. One monopile will be installed per day.

The OSS jacket foundations would be installed with skirt piles. Skirt piles are post-piled pin piles (i.e., the jacket is placed on the seafloor and piles are subsequently driven through guides at the base of each leg). Pin piles would be installed using an impact hammer to reach a maximum penetration depth of 80 m. Each pin pile is expected to require approximately 2 hours of impact hammering (2988 strikes at a rate of up to 8.3 bpm). A piled jacket foundation is formed of a steel lattice construction (comprising tubular steel members and welded joints) secured to the seabed by means of hollow steel pin piles attached to the jacket. The piled jacket foundation will have four piles total. Conditions of the proposed MMPA ITA would limit the maximum hammer energy to 1,500 kJ. Installation of the jacket foundation would require 8 hours of pile driving total (2 hours per pile), which could involve installing 4 pin piles in a single day.

The single Met tower foundation would be a Braced Caisson design, in which one main steel pile would be supported laterally by two steel supporting (bracing) piles. The main steel pin pile would have a maximum diameter of 1.8 m and the two bracing pin piles would have a maximum diameter of 1.5 m. The main caisson and bracing piles would be installed using an impact hammer with a maximum energy of 500 kJ at a rate of approximately 2 hours per pin pile over the course of 2 days.

As described in section 3.0 of this Opinion, in addition to seasonal restrictions on impact pile driving and requirements for use of a noise attenuation system, there are a number of other measures included as part of the proposed action that are designed to avoid or minimize exposure of ESA listed species to underwater noise. These measures are discussed in detail in the effects analysis below but generally include requirements for clearance and shutdown zones and ensuring adequate visibility for monitoring.

US Wind is currently planning on only carrying out pile driving during the day; however, to maintain operational flexibility, US Wind has indicated they may prepare a night time monitoring plan (required by the proposed MMPA ITA and described in the BA as a proposed condition of COP approval). To date, US Wind has not submitted a plan containing the information necessary, including evidence, that their proposed systems are capable of detecting marine mammals, particularly large whales, at night and at distances necessary to ensure mitigation measures are effective. We also note that BOEM will require submission of a monitoring plan for sea turtles; no such plan has been provided to date. As noted in the proposed MMPA ITA, the available information on traditional night vision technologies demonstrates that there is a high degree of uncertainty in reliably detecting marine mammals at night at the distances necessary for this project (Smultea *et al.,* 2021). It is also not clear that the technologies that may improve detectability for marine mammals at night (i.e., IR cameras, PAM) would improve detectability of sea turtles. In the proposed MMPA ITA, NMFS OPR proposes to only allow US Wind to initiate pile driving during daylight hours and prohibit US Wind from initiating pile driving earlier than one hour after civil sunrise or later than 1.5 hours before civil sunset. NMFS OPR is proposing to condition the LOA such that nighttime pile driving would only be allowed if US Wind submits a Nighttime Monitoring Plan (as part of the Pile Driving and Marine Mammal Monitoring Plan) to NMFS for approval that proves the efficacy of their night vision devices (*e.g.,* mounted thermal/IR camera systems, hand-held or wearable night vision devices (NVDs), infrared (IR) spotlights) in detecting protected marine mammals prior to making a determination in the final rule. The plan must include a full description of the proposed technology, monitoring methodology, and supporting data demonstrating the reliability and effectiveness of the proposed technology in detecting marine mammal(s) within the clearance and shutdown zones for foundation piles before and during impact pile driving. The Plan will need to identify the efficacy of the technology at detecting marine mammals in the clearance and shutdowns under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting. As noted above, BOEM is requiring a complementary plan for their review, and review and approval by NMFS GARFO that will also require consideration of sea turtles. Given this, our effects analysis for this Opinion assumes that pile driving at night will only occur if the agencies have determined that the monitoring that will occur for pile driving initiated after dark will allow PSOs to effectively and reliably monitor the full extent of the identified clearance and shutdown zones for marine mammals and sea turtles. Night time pile driving in accordance with approved plans described above that are effective in providing for monitoring and detecting marine mammals and sea turtles in clearance and shut down zones is thus considered a part of the proposed action for this consultation.

US Wind would employ a noise attenuation system during all impact pile driving of monopile and jacket foundations. Noise attenuation systems, such as bubble curtains, are used to decrease the sound levels radiated from a source in an effort to reduce ranges to acoustic thresholds and minimize any acoustic impacts resulting from pile driving. US Wind is proposing, and BOEM proposes to require through conditions of COP approval, the use of a noise attenuation system designed to minimize the sound radiated from piles by 10 dB. This requirement is also a condition of the proposed MMPA ITA. This requirement will be in place for all foundation piles to be installed. As such, US Wind, BOEM, and NMFS OPR anticipate that the noise attenuation system ultimately chosen will be capable of reliably reducing source levels by 10 dB; therefore, modeling results assuming 10 dB attenuation were carried forward in the modeling of sound exposure for impact pile driving for foundation installation.

Consistent with the requirements of the proposed MMPA ITA, the noise attenuation system would be at least a big double bubble curtain and may be a double big bubble curtain paired with another noise abatement device such as a hydro-sound damper (HSD), or an AdBm Helmholz resonator. A single bubble curtain, even paired with an additional system, would not be permissible under the conditions of the proposed ITA. The noise attenuation system ultimately selected for the Project would be tailored to and optimized for site-specific conditions and reflect the requirements of the proposed MMPA ITA. As described in the proposed ITA, the noise attenuation system used would be required to attenuate pile driving noise such that measured ranges to isopleth distances corresponding to relevant marine mammal harassment thresholds are consistent with those modeled based on 10 dB attenuation, determined via sound field verification. Sound field verification (SFV) will be required through BOEM's conditions of COP approval and NMFS OPR's proposed MMPA ITA. SFV involves monitoring underwater noise levels during pile driving to determine the actual distances to isopleths of concern (e.g., the distances to the noise levels equated to Level A and Level B harassment for marine mammals and injury and behavioral disturbance of sea turtles and Atlantic sturgeon). Requirements will be in place through the MMPA ITA and BOEM's conditions of COP approval to implement adjustments to pile driving and/or additional or alternative sound attenuation measures for subsequent piles if any distances to any thresholds are exceeded. The goal of the SFV and associated requirements is to ensure that the actual distances to isopleths of concern do not exceed those modeled assuming 10 dB of sound attenuation as those are the noise levels/distances that are the foundation of the effects analysis carried out in this Opinion for all ESA listed species and the exposure analysis and take estimates in the proposed MMPA ITA for listed marine mammals. Failure to demonstrate that distances to these thresholds of concern as modeled can be met through SFV and prescribed sound attenuation adjustment could lead to the need for reinitiation of consultation.

Bubbles create a local impedance change that acts as a barrier to sound transmission. The size of the bubbles determines their effective frequency band, with larger bubbles needed for lower frequencies. There are a variety of bubble curtain systems, confined or unconfined bubbles, and some with encapsulated bubbles or panels. Attenuation levels also vary by type of system, frequency band, and location. As described in the proposed ITA, US Wind would be required to maintain the following operational parameters for bubble curtains (single or double): The bubble curtain(s) must distribute air bubbles using a target air flow rate of at least 0.5 m^3 /(min*m), and must distribute bubbles around 100 percent of the piling perimeter for the full depth of the water column. The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact; no parts of the ring or other objects should prevent full seafloor contact. US Wind must require that construction contractors train personnel in the proper balancing of airflow to the bubble ring, and must require that construction contractors submit an inspection/performance report following the performance test. Corrections to the attenuation device to meet the performance standards must occur prior to impact driving of monopiles. If US Wind uses a noise mitigation device in addition to a BBC, similar quality control measures will be required.

As described in the BA, BOEM considers an attenuation level of 10 dB achievable using a joint mitigation approach of a bubble curtain and another noise abatement system or a double bubble curtain. NMFS OPR is requiring at least a double bubble curtain, as described in the proposed

MMPA ITA. Based on our independent review of the available information, we agree that the required NAS will provide the required noise attenuation (10 dB) and note that this presumption will be verified through the required SFV. Bellmann et al. (2020) found three noise abatement systems to have proven effectiveness and be offshore suitable: 1) the near-to-pile noise abatement systems - noise mitigation screen (IHC-NMS); 2) the near-to-pile hydro sound damper (HSD); and 3) for a far-from-pile noise abatement system, the single and double big bubble curtain (BBC and dBBC). With the IHC-NMS or the BBC, noise reductions of approximately 15 to 17 dB in depths of 82 to 131 feet (25 to 40 meters) could be achieved. The HSD system, independent of the water depth, demonstrated noise reductions of 10 dB with an optimum system design. The achieved broadband noise reduction with a BBC or dBBC was dependent on the technical-constructive system configuration. *In situ* measurements during installation of large monopiles (approximately 8 m) for more than 150 WTGs in comparable water depths (greater than 25 m) and conditions in Europe indicate that attenuation levels of 10 dB are readily achieved (Bellmann, 2019; Bellmann *et al.*, 2020) using single BBCs as a noise abatement system. The Coastal Virginia Offshore Wind (CVOW) pilot project systematically measured noise resulting from the impact driven installation of two 7.8 m monopiles, one with a noise abatement system (double big bubble curtain (dBBC)) and one without (CVOW, unpublished data). Although many factors contributed to variability in received levels throughout the installation of the piles (*e.g.*, hammer energy, technical challenges during operation of the dBBC), reduction in broadband SEL using the dBBC (comparing measurements derived from the mitigated and the unmitigated monopiles) ranged from approximately 9 to 15 dB. The effectiveness of the dBBC as a noise mitigation measure was found to be frequency dependent, reaching a maximum around 1 kHz; this finding is consistent with other studies (*e.g.*, Bellman, 2014; Bellman *et al.*, 2020).

As of the writing of this Opinion, we have received the final sound field verification report for monopiles installed for the South Fork project; these results indicate that the required sound attenuation systems are capable of reducing noise levels to the distances predicted by modeling assuming 10 dB attenuation. We note that South Fork deployed a double bubble curtain and a near field noise attenuation device. We have also received the final SFV report for the first 12 monopiles and the jacket foundation for the Vineyard Wind project; these results also indicate that a double bubble curtain and near field sound attenuation device are capable of reducing noise levels to the distances predicted by modeling (note that the Vineyard Wind modeling assumed 6 dB attenuation). Results from both projects have indicated that actual noise is inconsistent between piles installed with similar methodology and location, and the importance of proper deployment and maintenance of the bubble curtains in obtaining expected sound attenuation results. These results also suggest that it may not be reasonable to expect that sound field verification results from a small subset of piles will be truly representative of noise produced during all subsequent piles due to differences in noise source and attenuation, at least in part related to functionality of the noise attenuation system. We are in the process of reviewing interim SFV reports for the ongoing CVOW and Revolution Wind projects; these results support the conclusions that the noise attenuation systems that will be required for the Maryland Wind project will likely be effective at reducing sound to modeled levels when properly maintained and deployed. We note that, to date, all SFV results for impact pile driving carried out for the CVOW project have demonstrated actual distances to thresholds of concern that are less than those predicted by modeling, inclusive of the 150 dB threshold for fish. For

Revolution Wind, when the noise attenuation system has been properly functioning, we have seen similar results.

US Wind carried out acoustic modeling to estimate sound fields produced during pile driving, to estimate distances to thresholds of concern for marine mammals, sea turtles, and fish, and to estimate exposures of marine mammals and sea turtles to noise above identified thresholds (MAI, 2023). A full summary of modeling, including source and sound propagation is provided in MAI 2023 and summarized in the proposed MMPA ITA. Additional information for sea turtles is present in the updated modeling report, MAI 2024.

Key modeling assumptions for the monopiles and pin piles are listed in Table 9 of the Underwater Acoustic Modeling Assessment (MAI 2023, Table 7.1.1 below). Hammer energy schedules for monopiles (11-m), skirt piles (3-m), and pin piles (1.8-m) are provided in Table 10 of the Underwater Acoustic Modeling Assessment (Table 7.1.1 below, also Table 3 in the proposed MMPA ITA). Due to seasonal changes in the water column, sound propagation is likely to differ at different times of the year. As described in MAI 2023, given the May - November pile driving window, the propagation modeling used sound velocity profiles from May as these were considered to represent the maximum propagation environment for the proposed construction period (May – September). While MAI 2023 also includes an analysis of vibratory piling for the Met Tower, this is no longer considered as part of the proposed action and will not be evaluated here; vibratory pile driving was not considered in the proposed MMPA ITA or BOEM's BA and the effects of vibratory pile driving are thus not evaluated in this Opinion.

Table 7.1.1 US Wind's planned hammer strike energy progression and installation duration for the impact pile driving modeling scenarios

Pile Type	Max Hammer Energy (kJ)[1]	Number of Hammer Blows	Piling Time Duration per Pile (min)	Total Duration for Pile Install per Day (min)	Number piles/day
WTG: 11-m Monopile	1,100	600	120	120	1
	2,200	2,400			
	3,300	1,800[2]			
OSS: 3-m pin pile jacket foundations	1,500	19,200	120	480	4
Met Tower: 1.8-m Steel Bracing Caisson Pile/Steel Bracing Pile [3]	500	2,988	120	360	3

[1] Assumes MHU 4400 hammer.[2] US Wind has proposed a hammer strike energy progression for impact pile driving of monopiles, beginning at a hammer energy of 1,100 kJ to an energy of 3,300 kJ, although the maximum hammer energy possible (4,400 kJ) was used and scaled in the modeling. [3] A bracing caisson design has one main pile supported laterally by two bracing piles. The bracing caisson pile and bracing piles for the Met tower are pin piles.

Source: Table 3, 89 FR 504

After calculating source levels, MAI used the Navy Standard Parabolic Equation (NSPE) propagation model to estimate distances to thresholds identified by NMFS (i.e., the MMPA Level A and Level B harassment thresholds for marine mammals, and injury and behavioral disturbance thresholds for sea turtles and fish). This approach combined the outputs of the source model with the spatial and temporal environmental context (e.g., location, oceanographic conditions, and seabed type) to estimate sound fields. A single representative location of intermediate water depth (27 m) was selected for the underwater acoustic propagation modeling analysis as this was determined to provide conservative, yet representative modeling results. The model generated the predicted noise during impact pile driving scenarios for the 11-m monopiles, 3-m pin piles, and 1.8-m pin piles. As noted above, the May sound velocity profile was selected to be representative of the proposed pile driving construction period as this profile represented the largest acoustic propagation ranges (see appendix A of the ITA application). See Appendix II- H1 in US Wind's COP (MAI 2023 and 2024) and the proposed MMPA ITA for more detailed descriptions of MAI's propagation models.

Animal Movement Modeling
MAI integrated the results from acoustic source and propagation modeling into an animal movement model to calculate acoustic ranges for marine mammals, sea turtles, and fish. The acoustic ranges represent distances to identified thresholds (e.g., the MMPA Level A harassment threshold) independent of movement of a receiver. To estimate the number of whales and sea turtles that may be exposed to noise levels above the identified thresholds during foundation installation, US Wind used animat modeling to integrate the predicted received sound level fields of the impact pile driving resulting from the acoustic modeling of the impact pile driving sources (acoustic ranges) with the four-dimensional movements of the identified species. Marine Acoustic, Inc.'s Acoustic Integration Model (AIM) was used to integrate the sound fields generated from the source and propagation models described above with species-typical behavioral parameters (*e.g.,* dive patterns). Sound exposure models such as AIM use simulated animals (animats) to sample the predicted 3-D sound fields with movement rules derived from animal observations. Animats that exceed NMFS' acoustic thresholds (summarized below) are identified and the range for the exceedances determined. The output of the simulation is the exposure history for each animat within the simulation, and the combined history of all animats gives a probability density function of exposure during the project. The number of animals expected to exceed the identified thresholds is determined by scaling the probability of exposure by the species-specific density of animals in the area. By programming animats to behave like marine species that may be present near the lease area, the sound fields are sampled in a manner similar to that expected for real animals. The parameters used for forecasting realistic behaviors (*e.g.,* diving, foraging, and surface times) were determined and interpreted from marine species studies (*e.g.,* tagging studies) where available, or reasonably extrapolated from related species (MAI, 2023). Given the lack of density data, estimates of the number of Atlantic sturgeon or

Giant manta rays that may be exposed to pile driving noise above the identified thresholds were not calculated.

As described in the proposed MMPA ITA, NMFS OPR carefully considered all information and analysis presented by US Wind, as well as all other applicable information and, based on the best available science, concurred that the estimates of the types and amounts of take for each species are reasonable but can be considered conservative as the estimates do not reflect the implementation of clearance and shutdown zones for any marine mammal species. Based on our own independent evaluation of the information presented by BOEM and NMFS OPR to support initiation of ESA consultation, we agree that the analysis developed to consider the effects of project noise on ESA listed species is based on the best available scientific information.

Results of the modeling for ESA listed whales, sea turtles, and fish are included in the species group analyses below where we describe anticipated pile driving noise in more detail and assess the effects on those species.

Pile Driving - O&M Facility

As explained in section 3, as part of the Connected Action, an existing timber pier and the existing bulkhead/quay wall will be replaced. The pier is anticipated to be up to 625 feet (191 meters) long and 28 feet wide (8.5 meters). The existing bulkhead/quay wall would be replaced from the end of the pier to 175 feet (53 meters) west. Up to 170 steel pipe pier piles (12-18 inch diameter, 100 to 125 feet in length) would be driven by impact hammer. A 2-foot- (0.6 meter) wide timber fender system along the north side of the pier and along the steel sheet pile bulkhead will be installed. Also, a 2-foot-(0.6 meter) wide timber fender system and wave screen on the south side of the pier would be installed. Up to 240 timber fender system piles 12-to-18-inch (30.5 to 45.7 centimeters) diameter, 40 to 45 feet (12.2 to 13.7 meter) in length would be driven by impact hammer. The piling for the steel pipe pier piles and timber fender system piles would occur over a period of up to 6-months. The sheet pile bulkhead would include up to 120 sheets that would be driven by impact hammer over a period of up 3 months. At this time, no time of year restrictions have been identified for this work. This work is expected to occur during daylight. Assessments of exposure by these species to the noise sources is addressed in the species group sections below.

Vessel Noise

Vessel noise is considered a continuous noise source that will occur intermittently. Vessels transmit noise through water primarily through propeller cavitation, although other ancillary noises may be produced. The intensity of noise from vessels is roughly related to ship size and speed. Large ships tend to be noisier than small ones, and ships underway with a full load (or towing or pushing a load) produce more noise than unladen vessels. Radiated noise from ships varies depending on the nature, size, and speed of the ship. McKenna et al. (2012) determined that container ships produced broadband source levels around 177 to 188 dB re 1 µPa and a typical fishing vessel radiates noise at a source level of about 158 dB re 1 µPa (Mintz and Filadelfo 2011; Richardson et al. 1995; Urick 1983). Noise levels generated by larger construction and installation and O&M would have an approximate *L*rms source level of 170 dB re 1 µPa-m (Denes et al. 2020). Smaller construction and installation and O&M vessels, such as CTVs, are expected to have source levels of approximately 160 dB re 1 µPa-m, based on observed noise levels generated by working commercial vessels of similar size and class (Kipple and Gabriele 2003; Takahashi et al. 2019).

Typical large vessel ship-radiated noise is dominated by tonals related to blade and shaft sources at frequencies below about 50 Hz and by broadband components related to cavitation and flow noise at higher frequencies (approximately around the one-third octave band centered at 100 Hz) (Mintz and Filadelfo 2011; Richardson et al. 1995; Urick 1983). The acoustic signature produced by a vessel varies based on the type of vessel (e.g., tanker, bulk carrier, tug, container ship) and vessel characteristics (e.g., engine specifications, propeller dimensions and number, length, draft, hull shape, gross tonnage, speed). Bulk carrier noise is predominantly near 100 Hz while container ship and tanker noise is predominantly below 40 Hz (McKenna et al. 2012). Small craft types will emit higher-frequency noise (between 1 kHz and 50 kHz) than larger ships (below 1 kHz). Large shipping vessels and tankers produce lower frequency noise with a primary energy near 40 Hz and underwater SLs for these commercial vessels generally range from 177 to 188 decibels referenced to 1 micropascal at 1 meter (dB re 1 μPa m) (McKenna et al., 2012). Smaller vessels typically produce higher frequency sound (1,000 to 5,000 Hz) at SLs of 150 to 180 dB re 1 μPa m (Kipple and Gabriele, 2003; Kipple and Gabriele, 2004).

As part of various construction related activities, including cable laying and construction material delivery, dynamic positioning thrusters may be utilized to hold vessels in position or move slowly. Sound produced through use of dynamic positioning thrusters is similar to that produced by transiting vessels, and dynamic positioning thrusters are typically operated either in a similarly predictable manner or used for short durations around stationary activities.

Dynamically positioned (DP) vessels use thrusters to maneuver and maintain station, and generate substantial underwater noise with apparent SLs ranging from SPL 150 to 180 dB re 1 μPa depending on operations and thruster use (BOEM 2014, McPherson et al., 2016). Acoustic propagation modeling calculations for DP vessel operations were completed by JASCO Applied Sciences, Inc. for two representative locations for pile foundation construction at the South Fork Wind Farm based on a 107 m DP vessel equipped with six thrusters (Denes et al., 2021). Unweighted root-mean square sound pressure levels (SPLrms) ranged from 166 dB re one μPa at 50 m from the vessel (CSA 2021). Noise from vessels used for the Maryland Wind project are expected to be similar in frequency and source level.

Cable Installation

Noise produced during cable laying includes dynamic positioning (DP) thruster use. Nedwell et al. (2003) reports a sound source level for cable trenching operations in the marine environment of 178 dB re 1μPa at a distance of 1m from the source. Hale (2018) reports on unpublished information for cable jetting operations indicating a comparable sound source level, concentrated in the frequency range of 1 kHz to 15 kHz and notes that the sounds of cable burial were attributed to cavitation bubbles as the water jets passed through the leading edge of the burial plow.

WTG Operations

As described in BOEM's BA, once operational, offshore wind turbines produce continuous, non-impulsive underwater noise, primarily in the lower-frequency bands (below 1 kHz; Thomsen et al. 2006); vibrations from the WTG drivetrain and power generator would be transmitted into the steel monopile foundation generating underwater noise. Most of the currently available information on operational noise from turbines is based on monitoring of existing windfarms in Europe. Although useful for characterizing the general range of WTG operational noise effects, this information is drawn from studies of older generation WTGs that operate with gearboxes and is not necessarily representative of current generation direct-drive systems (Elliot et al. 2019; Tougaard et al. 2020). Studies indicate that the typical noise levels produced by older-generation WTGs with gearboxes range from 110 to 130 dB RMS with 1/3-octave bands in the 12.5- to 500-Hz range, sometimes louder under extreme operating conditions such as higher wind conditions (Betke et al. 2004; Jansen and de Jong 2016; Madsen et al. 2006; Marmo et al. 2013; Nedwell and Howell 2004; Tougaard et al. 2009). Recent publications have provided more information on operational noise including from larger, direct drive turbines (HDR 2023, Bellman et al. 2023, Holme et al. 2023). Operational noise increases concurrently with ambient noise (from wind and waves), meaning that noise levels usually remain indistinguishable from background within a short distance from the source under typical operating conditions.

Tougaard et al. (2020) concluded that operational noise from multiple WTGs could elevate noise levels within a few kilometers of large windfarm operations under very low ambient noise conditions. Tougaard et al. (2020) caution that their analysis is based on monitoring data for older generation WTG designs that are not necessarily representative of the noise levels produced by modern direct-drive systems, which are considerably quieter. However, even with these louder systems, Tougaard further stated that the operational noise produced from WTGs is static in nature and is lower than noise produced from passing ships; operational noise levels are likely lower than those ambient levels already present in active shipping lanes, meaning that any operational noise levels would likely only be detected at a very close proximity to the WTG (Thomsen et al., 2006; Tougaard et al., 2020).

Stober and Thomsen (2021) summarized data on operational noise from offshore wind farms with 0.45 – 6.15 MW turbines based on published measurements and simulations from gray literature then used modeling to predict underwater operational noise levels associated with a theoretical 10 MW turbine. Using generic transmission loss calculations, they then predicted distances to various noise levels including 120 dB re 1uPa RMS. The authors note that there is unresolved uncertainty in their methods because the measurements were carried out at different water depths and using different methods that might have an effect on the recorded sound levels. Given this uncertainty, it is questionable how reliably this model predicts actual underwater noise levels for any operating wind turbines. The authors did not do any in-field measurements to validate their predictions. Additionally, the authors noted that all impact ranges (i.e., the predicted distance to thresholds) come with very high uncertainties. Using this methodology, they used the sound levels reported for the Block Island Wind Farm turbines in Elliot et al. 2019 and estimated the noise that would be produced by a theoretical 10 MW direct-drive WTG would be above the 120 dB re 1uPa RMS at a distance of up to 1.4 km from the turbine. However, it is important to note that this desktop calculation, using values reported from different windfarms under different conditions, is not based on in situ evaluation of underwater noise of a 10 MW direct-drive turbine. Further, we note that context is critical to the reported noise levels evaluated in this study as well as for any resulting predictions. Without information on soundscape, water depth, sediment type, wind speed, and other factors, it is not possible to determine the reliability of any predictions from the Stober and Thomsen paper to the Maryland Wind project. Further, as noted by Tougaard et al. (2020), as the turbines also become higher with larger capacity, the distance from the noise source in the nacelle to the water becomes larger too, and with the mechanical resonances of the tower and foundation likely to change with size as well, it is not straightforward to predict changes to the noise with increasing sizes of the turbines. Therefore, for the reasons provided above, Stober and Thomsen (2021) is not considered the best available scientific information. We also note that Tougaard et al. (2020) and Stober and Thomsen (2021) both note that operational noise is less than shipping noise; this suggests that in areas with consistent vessel traffic, such as the US Wind lease area, operational noise may not be detectable above ambient noise.

Elliot et al. (2019)[35] summarized findings from hydroacoustic monitoring of operational noise from the Block Island Wind Farm (BIWF). The BIWF is composed of five GE Haliade 150 6-MW direct-drive WTGs on jacketed foundations located approximately 425 km northeast of the proposed US Wind WFA. We note that Tougaard (2020) reported that in situ assessments have not revealed any systematic differences between noise from turbines with different foundation types (Madsen et al., 2006); this is consistent with findings reported in Bellman et al. 2023. However, we note that HDR 2023 (see below) found differences in operational noise from the BIWF and CVOW turbines that could be related to differences in foundation types. Thus, the extent to which foundation types may influence of underwater noise from operations is at least partially unresolved. However, we note that, across foundation types, underwater operational noise levels are largely consistent and that most studies have not found meaningful differences in underwater operational noise across foundation types.

For the BIWF, underwater noise monitoring took place from December 20, 2016 – January 7, 2017 and July 15 – November 3, 2017. Elliot et al. (2019) also presents measurements comparing underwater noise associated with operations of the direct-drive turbines at the BIWF to underwater noise reported at wind farms in Europe using older WTGs with gearboxes and conclude that absent the noise from the gears, the direct-drive models are quieter. Elliot et al. (2019) presented a representative high operational noise scenario at an observed wind speed of 15 m/s (approximately 54 km/h, which is 1.5 to three times the average annual wind speed in the Maryland Wind WFA (COP section 4.2.4.1), which is summarized in Table 7.1.2 below. As shown, the BIWF WTGs produced frequency weighted instantaneous noise levels of 103 and 79 dB SEL for the LFC and MFC marine mammal hearing groups in the 10-Hz to 8-kHz frequency band, respectively. Frequency weighted noise levels for the LFC and MFC hearing groups were higher for the 10-Hz to 20-kHz frequency band at 122.5- and 123.3-dB SEL, respectively.

Table 7.1.2. Frequency weighted underwater noise levels, based on NMFS 2018, at 50 m from an operational 6-MW WTG at the Block Island Wind Farm.

[35] Also cited elsewhere as HDR 2019 or BOEM OCS Study 2019-028. Available online at: https://espis.boem.gov/final%20reports/BOEM_2019-028.pdf

Species Hearing Group	Instantaneous dB SEL*		Cumulative dB SEL†	
	10 Hz to 8 kHz	10 Hz to 20 kHz	10 Hz to 8 kHz	10 Hz to 20 kHz
Unweighted	121.2	127.1	170.6	176.5
LFC (North Atlantic right whale, fin whale, sei whale)	103.0	122.5	152.4	171.9
MFC (sperm whale)	79.0	123.3	128.4	172.7

Source: Elliot et al. (2019)
* 1-second SEL re 1 µPaS2 at 15 m/s (33 mph) wind speed. 1sec SEL = RMS
† Cumulative SEL re 1 µPaS2 assuming continuous 24 exposure at 50 m from WTG foundation operating at 15 m/s.

Elliot et al. (2019) also summarizes sound levels sampled over the full survey duration. These averages used data sampled between 10 PM and 10 AM each day to reduce the risk of sound contamination from passing vessels. The loudest noise recorded was 126 dB re 1uPa at 50 m from the turbine when wind speeds exceeded 56 km/h; at wind speeds of 43.2 km/h and less, measured noise did not exceed 120 dB re 1uPa at 50 m from the turbine. As summarized in the COP, average wind speeds in the lease area are between 17.5 and 35 km/h and exceed 54 km/h less than 5% of the time.

Table 7.1.3. Summary of unweighted SPL RMS average sound levels (10 Hz to 8 kHz) measured at 50 m (164 ft.) from WTG 5.

Wind speed (Km/h)	Overall average sound level, dB re 1 µPa
7.2	112.2
14.4	113.1
21.6	114
28.8	115.1
36	116.7
43.2	119.5
46.8	120.6
Average over survey duration	119
Background sound levels in calm conditions	107.4 [30 km from turbine]
	110.2 [50 m from turbine]

Reproduced from Elliot et al. (2019); wind speeds reported as m/s converted to km/h for ease of reference

Underwater acoustic monitoring was conducted under BOEM's Real-Time Opportunity for Development Environmental Observations (RODEO) Program after CVOW's two turbines became operational off the coast of Virginia (HDR 2023). As described in the report, the objective of the monitoring was to measure and analyze underwater sound levels within the water column and seafloor sediment vibrations generated by the operating monopile turbines. The two operating WTGs are Siemens Gamesa's 6 MW SWT-6.0-154 direct drive turbines with 154 m rotors installed on 7.8 m diameter monopile foundations. Underwater noise data were collected using one Geosled and two Ocean Bottom Seismometers; one RBRconcerto conductivity, temperature, and depth logger was also deployed approximately 1.3 km from Turbine A01 and 352 meters (m) from Turbine A02. The unattended systems collected data over approximately 40 days from December 13, 2021 to January 24, 2022 (HDR 2023). Analyses of operational phase underwater acoustic monitoring data indicated that noise levels recorded during turbine operations ranged from 120 to 130 dB re 1 µPa except during storms, when the received levels increased to 145 dB re 1 µPa. Recorded particle acceleration levels were compared to published behavioral audiograms of selected fish species and were found to be below the respective hearing thresholds for these species. Additionally, all recorded measurements were below the NMFS criteria for TTS and PTS for marine mammals. Results also indicated that operational phase sound levels recorded at CVOW were higher (10 to 30 dB) than those previously recorded at the BIWF at frequencies below approximately 120 Hz. At frequencies above 120 Hz, CVOW operational phase monitoring results were broadly consistent with operational phase acoustic monitoring previously conducted at BIWF and wind farms in Europe. The report indicates that these differences may be attributable to the differences in foundation types and the vibrations in the monopile structures but that this requires further investigation (monopiles at CVOW, lattice jacket at BIWF); we also note that while the WTGs at both projects are 6 MW direct drive turbines they have different manufacturers. (HDR 2023).

Holme et al. 2023 examined underwater noise measurements recorded within and outside operating offshore wind farms consisting of 6.3 MW (direct-drive) and 8.3 MW (planetary gear) turbines, considering data collected over a 5 week period from multiple hydrophones located between 70 m and 5 km from operating WTGs. All three wind projects (Gode Wind 1 and 2, Borkum Riffgrund 2, all in the North Sea, Germany) monitored have depths of approximately 30 m. Data were collected to facilitate a statistical examination of how the magnitude of underwater noise changes with turbine activity (power production data) and natural fluctuations (e.g., tides and wind). Additionally, the authors compared recorded noise levels to simulated noise levels from a published empirical model (Tougaard et al. 2020, Stober and Thomsen 2021, both described above), showing that the model's extrapolated noise levels greatly exceeded that of the in-situ recordings. The data reported by Holme et al. showed no noticeable differences on the broadband SPL between the two foundation types assessed in the study (monopiles and suction bucket jackets). The authors found no changes to the ambient broadband SPL from either 6.3 or 8.3 MW operating wind turbines. While this partly was attributed to the high ambient noise levels of the German Bight, the authors concluded that natural effects (e.g., wind speed and tidal changes) were the dominating forces behind changes to the ambient noise levels.

Bellman et al. 2023 evaluated data from all German offshore wind farms included in the MarinEARS database (MarinEARS - Marine Explorer and Registry of Sound; specialist information system for underwater noise and national noise registry for noise events (continuous and impulsive noise) in the German EEZ of the North- and Baltic Sea to the EU in accordance with the MSFD (https://marinears.bsh.de). This database includes data for 27 operational and 12 background noise measurements in 24 wind farms with 16 different WTG-types from seven different manufacturers and nominal power between 2.3 and 8.0 MW, installed on five different foundation structures; there were three measurement positions per wind farm, each with three defined operating states of the turbines. The authors concluded that the evaluation of noise conditions during the operation of offshore wind farms inside and outside wind farms is extremely complex, as noise input from wind turbines in operation and from wind farm-related service traffic do not differ significantly in time or space from background noise already present in the surroundings. Specific findings include: Noise input from operating offshore wind turbines is basically characterized by low frequencies; these low-frequency noise inputs into the water are only dominating the broadband Sound Pressure Level in the immediate vicinity of the turbines (~ 100 m) and when the turbines are operating close to their nominal power. The mean (broadband) total Sound Pressure Level (SPL50 or L50) at nominal power of the turbines varies between 112 and 131 dB (median and mean value 120 dB). The mean Sound Pressure Level (L50) from the 1/3-octave-band with the dominant component of the natural frequency of the system varies between 102 and 126 dB (median and mean value 114 dB); no evaluation-relevant differences based on water depths (20 to 40 m); The natural frequencies of the turbines tend to be lower-frequency (≤ 80 Hz) for direct-drive resp. gearless turbines and are also "quieter" than turbines with gearboxes; and, a significant correlation between the noise and foundation structure could not be determined.

Importantly, the authors concluded that a strong correlation between the noise inputs and the nominal power of the turbines (between 2.3 and 8.0 MW) could not be found. They noted turbines with a higher nominal power to be slightly quieter than turbines with a lower nominal power (on average ≤ 5 MW 122.8 dB, > 5 MW 120.0 dB); however, they note that this may also be due to larger, newer turbines mostly being direct drive rather than gearbox. The tonal, low-frequency components of the turbines in operation can usually still be measured outside the wind farms up to distances of a few kilometers, but with increasing distance, they mix with the general background noise level, so that the emitted noise is no longer dominating the broadband Sound Pressure Level (signal-to noise-ratio < 6 dB). The authors conclude that low-frequency noise input from the wind turbine is no longer audible to individual marine mammals at distances of 100 m from the turbine. The background noise level outside the wind farms is mostly dominated by non-wind farm-related shipping traffic outside the wind farms and varies strongly in different directions to a wind farm. (Bellman et al. 2023).

Like Holme et al. (2023), Bellman et al. (2023) evaluated in-situ measurements in comparison to the predictions made by modeling approaches (Tougaard et al. 2020, Stober and Thomsen 2021). Consistent with the findings of Holme et al. 2023, the authors concluded that these modeled predictions lead to considerable overestimations of the actually measured operational noise of turbines of up to 8 dB and that other modeling components could not be validated.

The WTGs proposed for Maryland Wind will use the newer, direct-drive technology. The results from the available in-situ operational noise measurements (Elliot et al. 2019, HDR 2023, Holme 2023, Bellman et al. 2023) all have consistent findings across a range of turbine sizes, geographic areas, water depths, and foundation types. As such, and given the issues with modeled predictions outlined above including the findings of Bellman et al. 2023 and Holme 2023 that the modeled predictions significantly overestimate underwater noise from operational turbines, we consider the published in-situ measurements cited herein to represent the best available data on operational noise that can be expected from the operation of the Maryland Wind turbines. We acknowledge that as the Maryland Wind turbines will have a greater capacity (up to 12 MW) than the turbines reported in these papers there is some uncertainty in operational noise levels. However, we note that Bellman et al. (2023) did not identify a strong correlation between noise and the nominal power of the turbines (between 2.3 and 8.0 MW) and that even the papers that predict greater operational noise note that operational noise is less than shipping noise. In consideration of the literature cited here, we expect that operational noise will typically be 130 dB or less and be detectable above ambient by any listed species at only short distances from any foundation (less than 100 dB).

High-Resolution Geophysical Surveys
As part of the proposed action for consultation in this opinion described in Section 3, US Wind plans to conduct HRG surveys in the WDA, including along the export cable routes to landfall locations in Delaware intermittently through the construction and operation periods. US Wind plans on conducting HRG surveys to identify any seabed debris or unexploded ordnance (UXO), confirm previously surveyed site conditions prior to cable installation, meet BOEM or other agency requirements for additional surveys, and to refine or (microsite) locations of construction footprints, WTG and OSS foundations, and cables. Equipment planned for use includes multibeam echosounders, side scan sonars, shallow penetration sub-bottom profilers (SBPs), medium penetration sub-bottom profilers (*e.g.,* sparkers), and ultra-short baseline positioning equipment.

As noted in Section 3, BOEM has completed a programmatic informal ESA consultation with NMFS for HRG surveys and other types of survey and monitoring activities supporting offshore wind energy development (NMFS 2021a; Appendix C to this Opinion). The equipment proposed for the US Wind HRG surveys is consistent with the survey equipment considered in that programmatic consultation. A number of measures to minimize effects to ESA listed species during HRG operations are proposed to be required by BOEM as conditions of COP approval and by NMFS OPR as conditions of the proposed MMPA ITA (see section 3.0 and Appendix A and B). As described in the BA, BOEM will require US Wind to comply with all relevant programmatic survey and monitoring PDCs and BMPs included in the 2021 programmatic ESA consultation; these measures are detailed in Appendix B of the programmatic consultation. HRG surveys related to the approval of the US Wind COP are considered part of the proposed action evaluated in this Opinion and the applicable survey, including the PDCs and BMPs included in the 2021 informal programmatic ESA. The PDCs and BMPs included in the 2021 informal programmatic ESA and required by BOEM as described in the BA are thus also considered components of the proposed action evaluated in this Opinion.

All noise producing survey equipment is secured to the survey vessel or towed behind a survey vessel and is only turned on when the vessel is traveling along survey transects; thus, the area ensonified is constantly moving, making survey noise transient and intermittent. The maximum anticipated distances from the HRG sound sources to noise thresholds of concern are presented in the tables below. The information on these noise sources is consistent with the information and effects analysis contained in the above referenced 2021 programmatic consultation.

Consistent with conclusions made by BOEM, and by NMFS OPR in the Notice of Proposed ITA, operation of some survey equipment types is not reasonably expected to result in any effects to ESA listed species in the area. Parametric sub-bottom profilers (SBP), also called sediment echosounders, generate short, very narrow-beam (1° to 3.5°) signals at high frequencies (generally around 85-100 kHz). The narrow beamwidth significantly reduces the potential that an individual animal could be exposed to the signal, while the high frequency of operation means that the signal is rapidly attenuated in seawater. Ultra-Short Baseline (USBL) positioning systems produce extremely small acoustic propagation distances in their typical operating configuration. The single beam and Multibeam Echosounders (MBES), side-scan sonar, and the magnetometer/gradiometer that may be used in these surveys all have operating frequencies >180 kilohertz (kHz) and are therefore outside the general hearing range of ESA listed species that may occur in the survey area. This is consistent with the conclusions made in the above referenced 2021 programmatic consultation. The only survey equipment planned for use that have operating frequencies within the relevant species hearing thresholds are the medium penetration sub-bottom profilers (boomers and sparkers) that will be used for the micro-siting surveys. Table 4 of the proposed MMPA ITA identifies representative survey equipment that is planned for use (see Table 7.1.4 below). US Wind estimates 14 days of micro-siting survey activities would occur in two of the three construction years.

Table 7.1.4 Operating Parameters of Micro-siting HRG Survey Equipment

HRG System	Survey Equipment	Operating Frequencies (kHz)	Peak Source Level (dB_{peak})	RMS Source Level (dB_{RMS})	Pulse Duration (ms)	Repetition Rate (Hz)	Beamwidth (degrees)
Medium-penetration SBP	Applied Acoustics S Boomer (AA252)	0.1 - 5	211	205	0.6	3	80
	Geo-spark 2000 (2 x 400 tip)	0.3 - 4	222	219	4	2	100

Source: Table 4 in 89 FR 504

The boomer and sparker operate at a frequency that is detectable by the ESA listed whales, sea turtles, and fish in the action area. Assessments of exposure by these species to the noise sources is addressed in the species group sections below.

7.1.3 Effects of Project Noise on ESA-Listed Whales

Background Information – Acoustics and Whales

The *Federal Register* notice prepared for the Proposed ITA (89 FR 504; February 5, 2024) presents extensive information on the potential effects of underwater sound on marine mammals. Rather than repeat that information, that information is incorporated by reference here. As explained in detail in the *Federal Register* notice, anthropogenic sounds cover a broad range of frequencies and sound levels and can have a range of highly variable impacts on marine life, from none or minor to potentially severe behavioral responses, depending on received levels, duration of exposure, behavioral context, and various other factors. Underwater sound from active acoustic sources can have one or more of the following effects: temporary or permanent hearing impairment, non-auditory physical or physiological effects (including injury), behavioral disturbance, stress, and masking (Richardson et al., 1995; Gordon et al., 2004; Nowacek et al., 2007; Southall et al., 2007; Götz et al., 2009). The degree of effect is intrinsically related to the signal characteristics, received level, distance from the source, and duration of the sound exposure. In general, sudden, high level sounds can cause hearing loss, as can longer exposures to lower level sounds. Temporary or permanent loss of hearing (i.e. temporary (TTS) or permanent threshold shift (PTS) respectively) will occur almost exclusively for noise within an animal's hearing range.

Richardson et al. (1995) described zones of increasing intensity of effect that might be expected to occur, in relation to distance from a source and assuming that the signal is within an animal's hearing range. First is the area within which the acoustic signal would be audible (potentially perceived) to the animal but not strong enough to elicit any overt behavioral or physiological response. The next zone corresponds with the area where the signal is audible to the animal and of sufficient intensity to elicit behavioral or physiological responsiveness. Third is a zone within which, for signals of high intensity, the received level is sufficient to potentially cause discomfort or tissue damage to auditory or other systems. Overlaying these zones to a certain extent is the area within which masking may occur. Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity, and may occur whether the sound is natural (e.g., snapping shrimp, wind, waves, precipitation) or anthropogenic (e.g., shipping, sonar, seismic exploration) in origin. Masking is when a sound interferes with or masks the ability of an animal to detect a signal of interest that is above the absolute hearing threshold. The masking zone may be highly variable in size. Masking can lead to behavioral changes in an attempt to compensate for noise levels or because sounds that would typically have triggered a behavior were not detected.

In general, the expected responses to pile driving noise may include threshold shift, behavioral effects, stress response, and auditory masking. Threshold shift is the loss of hearing sensitivity at certain frequency ranges (Finneran 2015). It can be permanent (PTS), in which case the loss of hearing sensitivity is not fully recoverable, or temporary (TTS), in which case the animal's hearing threshold would recover over time (Southall et al., 2007). PTS is an auditory injury, which may vary in degree from minor to significant. Behavioral disturbance may include a variety of effects, including subtle changes in behavior (e.g., minor or brief avoidance of an area or changes in vocalizations), more conspicuous changes in similar behavioral activities, and more sustained and/or potentially severe reactions, such as displacement from or abandonment of high-quality habitat. Not all behavioral disturbance would have meaningful consequences to an individual. The duration of the disturbance and the activity that is impacted are considered when evaluating the potential for a behavioral disturbance to significantly disrupt normal behavioral patterns. An animal's perception of a threat may be sufficient to trigger stress responses consisting of some combination of behavioral responses, autonomic nervous system responses, neuroendocrine responses, or immune responses (e.g., Seyle, 1950; Moberg, 2000). In many cases, an animal's first and sometimes most economical response in terms of energetic costs is behavioral avoidance of the potential stressor. Autonomic nervous system responses to stress typically involve changes in heart rate, blood pressure, and gastrointestinal activity. These responses have a relatively short duration and may or may not have a significant long-term effect on an animal's fitness.

Criteria Used for Assessing Effects of Noise Exposure to Fin, Right, Sei, and Sperm Whales

NMFS *Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing* compiles, interprets, and synthesizes scientific literature to produce updated acoustic thresholds to assess how anthropogenic, or human-caused, sound affects the hearing of all marine mammals under NMFS jurisdiction (NMFS 2018[36]). Specifically, it identifies the received levels, or thresholds, at which individual marine mammals are predicted to experience temporary or permanent changes in their hearing sensitivity for acute, incidental exposure to underwater anthropogenic sound sources. As explained in the document, these thresholds represent the best available scientific information. These acoustic thresholds cover the onset of both temporary (TTS) and permanent hearing threshold shifts (PTS). We consider the NMFS technical guidance the best scientific information available for assessing the effects of anthropogenic noise on marine mammals.

Table 7.1.5. Impulsive acoustic thresholds identifying the onset of permanent threshold shift and temporary threshold shift for the marine mammal species groups considered in this opinion (NMFS 2018)

Hearing Group	Generalized Hearing Range[37]	Permanent Threshold Shift Onset[38]	Temporary Threshold Shift Onset
Low-Frequency Cetaceans (LF: baleen whales –fin, right, sei)	7 Hz to 35 kHz	*L*pk,flat: 219 dB *L*E,LF,24h: 183 dB	*L*pk,flat: 213 dB *L*E,LF,24h: 168 dB
Mid-Frequency Cetaceans (MF: sperm whales)	150 Hz to 160 kHz	*L*pk,flat: 230 dB *L*E,MF,24h: 185 dB	*L*pk,flat: 224 dB *L*E,MF,24h: 170 dB

Note: Peak sound pressure level (Lp,0-pk) has a reference value of 1 µPa, and weighted cumulative sound exposure level (LE,p) has a reference value of 1µPa2 s. In this Table, thresholds are abbreviated to be more reflective of International Organization for Standardization standards (ISO 2017). The subscript “flat” is being included to indicate peak sound pressure are flat weighted or

[36] See www.nmfs.noaa.gov/pr/acoustics/guidelines.htm for more information.

[37] Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species’ hearing ranges are typically not as broad. Generalized hearing range chosen based on approximately 65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007).

[38] *L*pk,flat: unweighted ($_{flat}$) peak sound pressure level (L_{pk}) with a reference value of 1 µPa; *L*E,$_{XF,24h}$: weighted (by species group; $_{LF}$: Low Frequency, or $_{MF}$: Mid-Frequency) cumulative sound exposure level (L_E) with a reference value of 1 µPa^2-s and a recommended accumulation period of 24 hours ($_{24h}$)

unweighted within the generalized hearing range of marine mammals (i.e., 7 Hz to 160 kHz). The subscript associated with cumulative sound exposure level thresholds indicates the designated marine mammal auditory weighting function (LF, MF, and HF cetaceans) and that the recommended accumulation period is 24 hours. The weighted cumulative sound exposure level thresholds could be exceeded in a multitude of ways (i.e., varying exposure levels and durations, duty cycle).

These thresholds are a dual metric for impulsive sounds, with one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the duration of exposure, and another based on cumulative sound exposure level (SEL_{cum}) that does incorporate exposure duration. Cumulative SEL represents the total energy accumulated by a receiver over a defined time window or during an event. Peak sound pressure (also referred to as zero-to-peak sound pressure or 0-pk) is the maximum instantaneous sound pressure measurable in the water at a specified distance from the source. The cumulative sound exposure criteria incorporate auditory weighting functions, which estimate a species group's hearing sensitivity, and thus susceptibility to TTS and PTS, over the exposed frequency range, whereas peak sound exposure level criteria do not incorporate any frequency dependent auditory weighting functions.

In using these thresholds to estimate the number of individuals that may experience auditory effects in the context of the MMPA, NMFS classifies any exposure equal to or above the threshold for the onset of PTS as auditory injury (and thus MMPA Level A harassment). As defined under the MMPA, Level A harassment means any act of pursuit, torment, or annoyance that has the potential to injure a marine mammal or marine mammal stock in the wild. NMFS considers exposure to impulsive noise greater than 160 dB re 1uPa rms to result in MMPA Level B harassment. As defined under the MMPA, Level B harassment refers to acts that have the potential to disturb (but not injure) a marine mammal or marine mammal stock in the wild by disrupting behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering. As defined in the MMPA, Level B harassment does not include an act that has the potential to injure a marine mammal or marine mammal stock in the wild. Among Level B exposures, NMFS OPR does not distinguish between those individuals that are expected to experience TTS and those that would only exhibit a behavioral response. The 160 dB re 1uPa rms threshold is based on observations of behavioral responses of mysticetes (Malme et al. 1983; Malme et al. 1984; Richardson et al. 1986; Richardson et al. 1990), but is used for all marine mammal species.

As explained below, given the differences in the definitions of "harassment" under the MMPA and ESA, it is possible that some activities could result in harassment, as defined under the MMPA, but not meet the definition of harassment used by NMFS to determine whether ESA harassment is likely to occur. Under the ESA, take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." Harm is defined by regulation (50 C.F.R. §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding, or sheltering." NMFS does not have a regulatory definition of "harass." However, on December 21, 2016, NMFS issued interim guidance[39] on the term "harass," under the ESA, defining it as to "create the likelihood of injury

[39] NMFS Policy Directive 02-110-19; available at *https://media.fisheries.noaa.gov/dam-migration/02-110-19.pdf*; last accessed June 1, 2024.

to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." The NMFS interim ESA definition of "harass" is not equivalent to MMPA Level B harassment. Due to the differences in the definition of "harass" under the MMPA and ESA, there may be activities that result in effects to a marine mammal that would meet the threshold for harassment under both the MMPA and the ESA, while other activities may result in effects that would meet the threshold for harassment under the MMPA but not under the ESA. This issue is addressed further in the sections that follow.

For this consultation, we considered NMFS' interim guidance on the term "harass" under the ESA when evaluating whether the proposed activities are likely to harass ESA-listed species, and we considered the available scientific evidence to determine the likely nature of the behavioral responses and their potential fitness consequences.

7.1.3.1 Effects of Project Noise on ESA-Listed Whales

Fin, sei, and right whales occur in the area where increased underwater noise from a variety of sources during construction, operation, and/or decommissioning of the Maryland Wind project would be experienced; sperm whales are expected to be rare in the area. As explained in section 3, NMFS OPR is proposing to authorize MMPA Level B harassment take of a number of fin, sei, and right whales as a result of exposure to noise from foundation pile driving and HRG surveys and to authorize MMPA Level A take of a small number of fin and sei whales as a result of exposure to noise from monopile foundation pile driving. US Wind did not request authorization for MMPA take of ESA listed species for any other noise sources, and OPR is not proposing to authorize MMPA take of any ESA listed whale species for any noise sources other than pile driving and HRG surveys. No serious injury or mortality is expected to result from exposure to any project noise sources and none is proposed to be authorized through the MMPA ITA. As described below, NMFS GARFO has carried out our own independent analysis of these noise sources in the context of the ESA definition of take.

Here, we consider the effects of exposure and response to underwater noise during construction, operations, and decommissioning in the context of the ESA. Information on the relevant acoustic thresholds and a summary of the best available information on likely responses of whales to underwater noise is presented above.

Pile Driving for WTG, OSS, and Met Tower Foundations

In their ITA application and supplemental information, US Wind estimated exposure of marine mammals (including ESA listed fin, right, sei, and sperm whales) known to occur in the lease area and along the cable corridors to a number of noise sources above the MMPA Level A and Level B harassment thresholds. As part of the response to the MMPA ITA application, OPR conducted their own review of the model reports and determined they were based on the best available information. OPR relied on the model results to develop the proposed ITA.

For the purposes of this ESA section 7 consultation, we evaluated the applicants' and OPR's exposure estimates of the number of ESA-listed marine mammals that would be "taken" relative to the definition of MMPA Level A and Level B harassment and considered this expected MMPA take in light of the ESA definition of take including the NMFS definition of harm (64 FR

60727; November 8, 1999) and NMFS interim guidance on the definition of harass (see NMFS policy directive 02-110-19). We have independently evaluated and adopted OPR's analysis of the number of fin, right, sei, and sperm whales expected to be exposed to pile driving noise because, after our independent review we determined it utilized the best available scientific information and methods to evaluate exposure of these whale species to such noise. BOEM's BA is consistent with the analysis and exposure estimates presented in the Notice of Proposed ITA. Below we describe US Wind and NMFS OPR's exposure analyses for these species.

Acoustic Modeling
The Notice of Proposed ITA and BOEM's BA provide extensive information on the acoustic modeling prepared for the project (MAI, 2023). That information is summarized here. As addressed above, BOEM and NMFS OPR will require use of a noise abatement system to achieve 10 dB noise attenuation; thus, modeling and exposure estimates incorporated 10 dB noise attenuation. Effectively achieving 10 dB noise attenuation is thus a critical element of modeling and this Opinion's effects analysis predicting exposure and the resultant number and type of take for each listed whale species.

The anticipated pile driving schedule for the full buildout of the Maryland Wind project (114 WTGs) is presented in Table 1 of the proposed MMPA ITA (Table 7.1.6 below). For the take analysis in the MMPA ITA, it was assumed that Campaign 1 would have a maximum of 21 WTGs and 1 OSS, Campaign 2 would have a maximum of 55 WTGs, 1 Met Tower and 2 OSSs, and Campaign 3 would have a maximum of 38 WTGs and 1 OSS. Between these scenarios, we note that US Wind has analyzed the construction of 119 permanent foundation structures, including up to 114 WTGs, one Met Tower, and 4 OSSs.

Table 7.1.6 Estimated Piling Schedule by Year for the Three Construction Campaigns

Campaign	Construction Year	Number of 11-m monopiles for WTGs	Number of 3-m pin piles for OSS foundations	Number of 1.8-m pin piles for Met Tower
MarWin	1 (2025)	21	4 (1 jacket)	0
Momentum	2 (2026)	55	8 (2 jackets)	3 (1 foundation)
Future Development	3 (2027)	38	4 (1 jacket)	0

source: Table 1 in 89 FR 504

As noted above, the updated acoustic thresholds for impulsive sounds (such as impact pile driving) contained in the Technical Guidance (NMFS, 2018) are dual metric acoustic thresholds using both SEL_{cum} and peak sound pressure level metrics (Table 7.1.5). As dual metrics, NMFS considers onset of PTS (MMPA Level A harassment) to have occurred when either one of the two metrics is exceeded. The SEL_{cum} metric considers both level and duration of exposure, as well as auditory weighting functions by marine mammal hearing group. For example, the distance from the source to the peak Level A threshold marks the outer bound of the area within which an animal needs to be located in order to be exposed to enough noise to experience Level A harassment from a single pile strike. Considering acoustic range, the distance from the source to the cumulative Level A threshold marks the outer bound of the area within which an animal needs to stay for the entire duration of the activity considered (e.g., the 2 hours of pile driving to install a monopile).

As explained above, to estimate exposure of animals to sound above the MMPA Level A and Level B harassment thresholds during foundation installation, Marine Acoustics, Inc.'s Acoustic Integration Model (AIM) was used (MAI 2023). Note that animal aversion was not incorporated into the AIM model runs that were the basis for the take estimate for any species; that is, the models do not incorporate any animal movements or avoidance behavior that would be expected to result from exposure to underwater noise. The modeling also does not incorporate the clearance or shutdown requirements.

US Wind calculated acoustic ranges which represent the distance to an identified threshold based on sound propagation through the environment (*i.e.*, independent of any receiver). Acoustic ranges ($R_{95\%}$) to the Level A harassment SELcum metric thresholds are considered conservative but reasonable as the accumulation of acoustic energy does not account for animal movement and behavior and therefore assumes that animals are essentially stationary at that distance for the entire duration of the pile installation, a scenario that does not reflect realistic animal behavior.

In the proposed MMPA ITA, NMFS OPR considers the modeled acoustic ranges to Level A harassment (SEL), Level A peak, and Level B harassment thresholds, densities, exposure estimates and the amount of take requested and proposed to be authorized incidental to foundation installation in consideration of the parameters outlined here. The proposed MMPA ITA analyzes a construction schedule that includes three discreet construction campaigns over three years (May through November, annually) including WTGs, OSSs, and Met Tower foundations. US Wind's take request, and NMFS OPR's proposed ITA, is based on all OSSs being installed on jacket foundations (rather than monopiles), as they determined it has the potential to result in exposure of a greater number of animals to noise above the thresholds of concern compared to an all monopile scenario. With these considerations, we consider for the purposes of this Opinion, that the resulting estimates of exposure of ESA listed marine mammals to noise above the Level A and Level B harassment thresholds represents a reasonable upper limit of exposure during the project that is unlikely to be exceeded, absent any consideration of the potential for the proposed minimization measures (e.g.., clearance and shutdown requirements) to reduce actual exposure (which is addressed below).

Acoustic ranges (ER95%) for impact pile driving of a 11-m monopile, 3-m skirt pile, and 1.8-m pin pile and (pre- and post-piled) jacket foundations, assuming 10 dB of sound attenuation to the PTS (SEL) thresholds are presented in the tables below. Presented below are the distances to the PTS (SELcum and peak) thresholds for low frequency cetaceans (fin, sei, right whales) during impact pile driving and the Level B harassment (SPL) thresholds for all impact pile driving during WTG, OSS, and Met Tower foundation installation. The distances to the PTS (SELcum and peak) thresholds for mid frequency cetaceans (sperm whales) are predicted to be less than 50 m. No sperm whales are expected to be exposed to noise above the PTS threshold and PTS is extremely unlikely to occur.

Table 7.1.7 Acoustic Ranges (95th Percentile) in Meters (m) to Marine Mammal Level A Harassment Thresholds (SEL and Peak) and Level B Harassment Threshold During Impact Pile Driving 11- m Monopiles, 3- m Pin Piles, and 1.8- m Pin Piles, Assuming 10 dB Sound Attenuation.

			Distance to Threshold (m)					
Pile Type	**Maximum hammer energy (kJ)**	**Duration (minutes)**	**LFC**			**MFC**		
			Level A peak	Level A cSEL	Level B	Level A peak	Level A cSEL	Level B
11 m monopile	3,300	120	<50	2,900	5,250	<50	0	5,250
3 m pin	1,500	480	<50	1,400	500	<50	0	500
1.8 m pin	500	240	<50	50	100	<50	0	100

source: Table 14 and 15 in 89 FR 504

As explained in the proposed MMPA ITA, to obtain acoustic exposure estimates for each species per pile, the numbers of modeled animat sound exposures were multiplied by the ratio of the modeled animat density to the real-world marine mammal density estimate for the buffered Lease Area (Roberts et al., 2023). The animat exposure estimates per pile are the product of the number of modeled exposures multiplied by the ratio of real-world density per month (Roberts et al., 2023, Table 7.1.8) to model density. The daily exposures were then multiplied by the planned number of piles driven each month and then summed for the year for each of the three when pile driving would take place. US Wind plans to install only one monopile per day, four 3-m pin piles per day, and three 1.8-m pin piles per day (for Met tower). Requested take for pile driving activities was adjusted according to average group size (Table 7.1.9) and rounded to the nearest whole number.

As explained in the proposed MMPA ITA, for monopile and jacket foundation installation, mean (or annual) monthly densities for all species were calculated by first selecting density data from 5 x 5 km (3.1 x 3.1 mile) grid cells (Roberts et al., 2016; Roberts et al. 2023) both within the Lease Area and outside the lease area to include a buffer based on upon the largest range to Level B harassment threshold, which was 5.25 km for impact pile driving of 11-m monopiles at a maximum hammer energy of 4,400 kJ. This resulted in density estimates considering all grid cells within the lease area plus a 5.25 km buffer around the lease.

Table 7.1.8. Monthly mean densities (animals per 100km^2) of ESA-listed marine mammals in the Lease Area used in the exposure modeling (May-November)

Species	May	June	July	August	September	October	November
NARW	0.008	0.003	0.001	0.001	0.002	0.004	0.011
Fin whale	0.094	0.111	0.041	0.028	0.040	0.037	0.045
Sei whale	0.020	0.005	0.001	0.000	0.001	0.006	0.017

(Source: Table 12 in 89 FR 504)

Table 7.1.9 Group size estimates for marine mammal species used in the Proposed MMPA ITA

Marine Mammal Hearing Group	Marine Mammal Species	Mean Group Size	Source
Low Frequency Cetaceans (LFC)	Fin Whale	1.64	RPS, 2023
	North Atlantic right whale	2.00	RPS, 2023

(Source: Table 13 in 89 FR 504)

The total exposure estimates, by species, for each of the construction seasons, and the proposed amount of take (which considers the group size adjustments, and for level A take of right whales only, consideration of proposed mitigation measures) is presented in Table 7.1.10-7.1.12 below. The total amount of proposed take for impact pile driving of foundations is summarized in Table 7.1.13. Modeling did not predict the exposure of any sperm whales to noise above the Level A or Level B thresholds; US Wind did not request authorization for take of any sperm whales and NMFS OPR is not proposing to authorize any. We agree that exposure of sperm whales to noise above either threshold is extremely unlikely to occur; therefore, effects to sperm whales from foundation pile driving noise are discountable.

Table 7.1.10 Modeled Level A (cSEL) Harassment and Level B Harassment Exposures Assuming 10- d B Sound Attenuation During Impact Pile Driving of 11- m Monopile Foundations Over 3 Years and Amount of Incidental Take Proposed for MMPA Authorization

Species	Year 1 (MarWind)				Year 2 (Momentum Wind)				Year 3 (Future Development)			
	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed
fin	0.39	2	3.94	4	1.16	2	11.57	12	0.68	2	6.83	7
NARW	0.01	0	0.06	2	0.05	0	0.24	2	0.02	0	0.08	2
sei	0.01	1	0.11	1	0.12	1	0.83	1	0.02	1	0.17	1

(Source: Table 17 in 89 FR 504)

Table 7.1.11 Modeled Level B Harassment Exposures (Assuming 10- d B Sound Attenuation) Due To Impact Pile Driving of 3- m Pin Piles for OSS Foundations Over 3 Years and Amount of Take Proposed for Authorization through the MMPA ITA

Species	Year 1 (MarWind)				Year 2 (Momentum Wind)				Year 3 (Future Development)			
	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed
fin	0	0	0.03	2	0	0	0.06	2	0	0	0.03	2
NARW	0	0	0	0	0	0	0	0	0	0	0	0
sei	0	0	0	0	0	0	0	0	0	0	0	0

(Source: Table 18 in 89 FR 504)

Species	Year 1 (MarWind)				Year 2 (Momentum Wind)				Year 3 (Future Development)			
	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed	Level A Exposure Estimates	Level A Proposed	Level B Exposure Estimates	Level B Proposed
fin	N/A	N/A	N/A	N/A	0	0	0.01	2	N/A	N/A	N/A	N/A
NARW	N/A	N/A	N/A	N/A	0	0	0	0	N/A	N/A	N/A	N/A
sei	N/A	N/A	N/A	N/A	0	0	0	0	N/A	N/A	N/A	N/A

(Source: Table 19 in 89 FR 504)

NMFS OPR proposes to authorize the following numbers for the harassment of marine mammals incidental to foundation installation activities of WTGs, OSSs, and the Met Tower by Level A harassment and Level B harassment in Table 7.1.13. We note that US Wind did not request, nor is NMFS proposing to authorize, serious injury and/or mortality of marine mammals. No Level A harassment of North Atlantic right whales has been proposed for authorization by NMFS OPR due to enhanced mitigation measures that US Wind would be required to implement for this species.

Table 7.1.13 Total Amount of Incidental Take Proposed for Authorization through the MMPA ITA for all Impact Pile Driving

Species	Level A Harassment	Level B Harassment
NARW	0	6
Fin	6*	31
Sei	3	3

*Amount of Level A take (PTS) proposed for authorization is based on the modeled exposures, adjusted based on group size and rounded to whole number
(Source: Table 20 in 89 FR 504)

We note that US Wind requested and NMFS proposes to authorize, the full amount of Level A take of fin and sei whales predicted by the exposure modeling (rounded up to whole animals and adjusted by group size). However, due to the enhanced mitigation measures for North Atlantic right whales, no Level A harassment takes were requested for this species nor is NMFS OPR proposing to authorize any. Our consideration of this assessment is presented below.

7.1.3.1 Consideration of Proposed Measures to Minimize Exposure of ESA Listed Whales to Pile Driving Noise

Here, we consider the measures that are part of the overall proposed action, either because they are proposed by US Wind in the COP, by BOEM as described in the BA regarding potential COP approval conditions, or by NMFS OPR as requirements of the proposed ITA. We also consider how those measures may serve to minimize exposure of ESA listed whales to pile driving noise. Details of these proposed measures are included in section 3 above.

Seasonal Restriction on Impact Pile Driving of Foundations

No impact pile driving activities would occur between December 1 and April 30 to avoid the time of year with the highest densities of right whales in the WDA. This seasonal restriction is factored into the acoustic modeling that supported the development of the amount of take proposed in the ITA. That is, the modeling does not consider any impact pile driving in the December 1 – April 30 period. Thus, the take estimates do not need to be adjusted to account for this seasonal restriction.

Sound Attenuation Devices and Sound Field Verification

For all impact pile driving, US Wind would implement sound attenuation technology that would achieve at least a 10 dB reduction in pile driving noise; BOEM is requiring that the noise mitigation device(s) perform such that measured ranges to the Level A and Level B harassment thresholds are consistent with (i.e., no larger than) those modeled assuming 10 dB attenuation, determined via sound source verification (see Table 7.1.7;). This requirement is also proposed in the MMPA ITA. Together, the purpose of the requirements to utilize sound attenuation devices (also referred to as noise or sound mitigation measures) and sound field verification (i.e., in situ noise monitoring during pile driving) are to ensure that US Wind does not exceed the modeled distances to the Level A and Level B harassment thresholds for ESA listed marine mammals (modeled assuming 10 dB attenuation). The sound field verification related measures are based on the expectation that US Wind's initial pile driving methodology and sound attenuation measures will result in noise levels that do not exceed the identified distances (as modeled assuming 10 dB attenuation) but, if that is not the case, provide a step-wise approach for modifying or adding sound attenuation measures that can reasonably be expected to achieve those metrics prior to the next pile being driven.

The 10 dB attenuation was incorporated into the take estimate calculations presented above. Thus, the take estimates do not need to be adjusted to account for the use of sound attenuation. If a reduction greater than 10 dB is achieved, the actual amount or extent of take could be lower as a result of resulting smaller distances to thresholds of concern. In section 7.1.2, we provided an explanation for why it is reasonable to expect that 10 dB of sound attenuation for impact pile driving can be achieved assuming proper deployment and maintenance of devices, with the most recent information indicating that proper deployment and continuous maintenance of a dBBC plus a nearfield attenuation device provides the highest likelihood of consistent success (i.e. SFV reports for the South Fork and Vineyard Wind 1 projects).

Through conditions of the proposed ITA and conditions of the proposed COP approval, US Wind will conduct sound field verification for at least the first three monopiles and the first three full jacket foundations (inclusive of all pin piles for each foundation). US Wind is also required to conduct sound field verification of any additional piles in locations that are not represented by the previous locations where sound field verification was carried out or where pile specifications are different (e.g., type of piles, higher hammer energy, greater number of strikes). As required by the proposed MMPA ITA, SFV measurements must continue until at least three consecutive monopiles and three entire jacket foundations demonstrate noise levels are at or below those modeled, assuming 10 dB of attenuation. Additional details of the required sound field verification are included in the proposed MMPA ITA.

The required sound field verification will provide information necessary to confirm that the sound source characteristics predicted by the modeling are reflective of actual sound source characteristics in the field. As described in the proposed MMPA ITA, if sound field verification measurements on any of the first three piles indicate that the ranges to Level A harassment or Level B harassment isopleths are larger than those modeled, assuming 10-dB attenuation, US Wind must modify and/or apply additional noise attenuation measures (e.g., improve efficiency of bubble curtain(s), modify the piling schedule to reduce the source sound, install an additional noise attenuation device) before the next pile is installed. Until sound field verification confirms the ranges to Level A harassment and Level B harassment isopleths are less than or equal to those modeled, assuming 10-dB attenuation, the shutdown and clearance zones must be expanded to match the ranges to the Level A harassment and Level B harassment isopleths based on the sound field verification measurements. If the application/use of additional and/or modified noise attenuation measures still does not achieve ranges less than or equal to those modeled, assuming 10-dB attenuation, and no other actions can further reduce sound levels, US Wind must expand the clearance and shutdown zones according to those identified through sound field verification, in coordination with NMFS OPR. In the event that noise attenuation measures and/or adjustments to pile driving cannot reduce the distances to less than or equal to those modeled, this may indicate that the amount or extent of taking specified in the incidental take statement has been exceeded or be considered new information that reveals effects of the action that may affect listed species in a manner or to an extent not previously considered and reinitiation of this consultation is expected to be necessary, see requirements at 50 CFR 402.16.

Clearance and Shutdown Zones

As described in Section 3, US Wind proposed as part of the COP and BOEM and NMFS OPR are proposing to require monitoring of clearance and shutdown zones before and during impact pile driving (also, Tables 7.1.14). In addition to the clearance and shutdown zones, OPR will include a requirement for a minimum visibility distance before foundation pile driving can begin. For monopile foundation installation, the minimum visibility zone, defined as the area over which PSOs must be able to visually detect marine mammals, would extend 2,900 m; it is 1,400 m for 3-m pin pile installation, and 200 m for 1.8-m pin pile installation (Table 26 in the proposed MMPA ITA). This is the distance from the observation platform that the visual observers must be able to effectively monitor for marine mammals; that is, lighting, weather (e.g., rain, fog, etc.), and sea state must be sufficient for the observer to be able to detect a marine mammal within that distance from the observation platform. The identified minimum visibility zone is the same size as the shutdown zone for large whales (other than right whales) and is smaller than the clearance zone; however, when considering that there will be PSOs at the pile driving platform and on at least one dedicated PSO vessel and that the minimum visibility must be achieved at all platforms, it is reasonable to expect that the full extent of the clearance zone will be able to be visually monitored. For example, for monopile foundations, considering the 2,900 m minimum visibility distance and considering that there will be observers at the pile driving platform and then at a vessel located at a distance from the pile that would maximize detections of animals in the clearance and shutdown zones, we would expect visual monitoring extending from the pile out to at least 5.8 km (i.e., 2,900 m from the pile driving platform plus an additional 2,900 m from a vessel located approximately 2 km from the pile); this is larger than the 2.9 km clearance zone.

Table 7.1.14 Minimum visibility, clearance, and shutdown zones incorporated into the proposed action

Species	Clearance Zone (m)	Shutdown Zone (m)
Monopile Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving platform and at least one PSO vessel): 2,900 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10 km zone monitored by PAM	At any distance (Minimum visibility zone plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10 km zone monitored by PAM
Other large whales (visual and PAM monitoring)	5,250 m	2,900 m
3-m pin Pile Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving platform and at least one PSO vessel): 1,400 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10 km zone monitored by PAM	At any distance (Minimum visibility zone plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10 km zone monitored by PAM

Other large whales (visual and PAM monitoring)	1,400 m	200 m
1.8-m pin Pile Foundation Installation – visual PSOs and PAM		
Minimum visibility zone from each PSO platform (pile driving platform and at least one PSO vessel): 200 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10 km zone monitored by PAM	At any distance (Minimum visibility zone plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10 km zone monitored by PAM
Other large whales (visual and PAM monitoring)	100 m	100 m

The clearance zone is the area around the pile that must be declared "clear" of marine mammals (and sea turtles) prior to the activity commencing. The size of the zone is measured as the radius with the impact activity (i.e., pile) at the center. For marine mammals, both visual observers and passive acoustic monitoring (PAM, which detects the sound of vocalizing marine mammals) will be used; the area is determined to be "cleared" when visual observers have determined there have been no sightings of marine mammals in the identified area for a prescribed amount of time and, for North Atlantic right whales in particular, if no right whales have been visually observed in any area beyond the minimum visibility zone that the visual observers can see. For example, if a right whale is observed at a distance of 6 km from the pile, pile driving would be delayed. Further, the PAM operator will declare an area "clear" if they do not detect the sound of vocalizing whales within the identified PAM clearance zone for the identified amount of time. The PAM monitoring system will be designed to detect vocalizing marine mammals located within 10 km of the pile. Pile driving cannot commence until all of these clearances are made. The clearance zone for each pile type is larger (by 2.3 km) than the modeled distances to the Level A cumulative threshold for monopiles, equivalent to the modeled distance the Level A cumulative threshold for 3-m pin piles (both 1,400 m), and 4 times larger (200 m vs. 50 m) for the 1.8 m piles. We note that OPR may make additional modifications to these zone sizes in the MMPA final rule.

Once pile driving begins, the shutdown zone applies. If a marine mammal is observed by a visual PSO entering or within the respective shutdown zones after pile driving has commenced, an immediate shutdown of pile driving will be implemented unless US Wind and/or its contractor determines shutdown is not feasible due to an imminent risk of injury or loss of life to an individual; or risk of damage to a vessel that creates risk of injury or loss of life for individuals (see section 3.0 for more information). Similarly, detection of a vocalizing whale within the identified shutdown zone by the PAM operator would trigger a call for a shutdown. For right whales, shutdown is also triggered by: the visual PSO observing a right whale at any distance (i.e., even if it is outside the shutdown zone identified for other whale species), or a detection by the PAM operator of a vocalizing right whale at any distance within the 10 km distance from the pile that will be monitored by PAM. For monopiles, the shutdown zone (2,900 m) for large whales (other than right whales, which is "any distance") is equivalent to the modeled distances to the Level A cumulative threshold. We note that OPR may make additional modifications to these zone sizes in the MMPA final rule.

Clearance zones will be monitored by at least three PSOs at the pile driving platform and at least three PSOs actively observing on at least one dedicated PSO vessels. All distances to the edge of clearance zones are the radius from the center of the pile. As noted above, the proposed clearance and shutdown zone is larger than the acoustic range to the Level A peak cumulative threshold (which is less than 50 m for each pile type) and equal to the acoustic range to the Level A cumulative threshold for monopiles for all ESA listed whales (for right whales, this is the case even considering only the minimum visibility zone and not any further distance that a PSO may be able to see right whales). The PSO vessels will be located at a distance from the pile that maximizes the opportunity for effective visual observation of the clearance and shutdown zone, likely approximately 2,000 m from the pile. The PSOs would be required to maintain watch at all times when impact pile driving of foundation piles is underway. Concurrently, at least one PAM operator would be actively monitoring for marine mammals before, during, and after pile driving (more information on PAM is provided below). PSOs would visually monitor for marine mammals for a minimum of 60 minutes while PAM operators would review data from at least 24 hours prior to pile driving and actively monitor hydrophones for 60 minutes prior to pile driving. Prior to initiating soft-start procedures, the PSO must confirm that the relevant clearance zones have been free of marine mammals for at least the 30 minutes immediately prior to starting a soft-start of pile driving. For fin, sei, and sperm whales, this means that the PSOs have not seen any individuals within the relevant clearance zone (dependent on pile type and daily construction schedule) and the PAM operator must not have detected any vocalizations from those species within the relevant clearance zone. For right whales, this means that the PSOs have not seen any right whales in the relevant minimum visibility zone plus any additional distance that they can see beyond that minimum visibility zone. Similarly, the PAM operator must confirm that there have been no detections of vocalizing right whales in the PAM clearance zone (10 km from the pile) for the preceding 60 minutes. If a visual PSO observes a marine mammal entering or within the relevant clearance zone, or the PAM operator detects a right whale within the PAM clearance zone prior to the initiation of impact pile driving activities, pile driving must be delayed and will not begin until either the marine mammal(s) has voluntarily left the clearance zone and has been visually or acoustically confirmed beyond that clearance zone, or, when 30 minutes have elapsed with no further sightings or acoustic detections. Pile driving must only commence when lighting, weather (e.g., rain, fog, etc.), and sea state have been sufficient for the observer to be able to detect a marine mammal within the identified clearance zones for at least 30 minutes (i.e., clearance zone is fully visible for at least 30 minutes). As required by the proposed MMPA ITA, any large whale sighted by a PSO or acoustically detected by a PAM operator that cannot be identified as a species other than a North Atlantic right whale must be treated as if it were a North Atlantic right whale.

The requirement for the minimum visibility zones for foundation pile driving and the requirement that PSOs be working from at least two platforms (3 PSOs at the pile driving platform, 3 on at least one vessel at a distance from the pile), make it reasonable to expect that the full extent of the clearance zones will be effectively monitored and that large whales within this area will be detected by at least one of the PSOs. The clearance zones may only be declared clear, and pile driving started, when the full extent of all clearance zones are visible (*i.e.*, when not obscured by dark, rain, fog, etc.) for a full 30 minutes prior to pile driving and the PAM operator has made the required clearances based on detection of vocalizing whales. To ensure adequate visibility for PSOs, impact pile driving may commence only during daylight hours and no earlier than one hour after civil sunrise. Impact pile driving may not be initiated any later than 1.5 hours before civil sunset and may continue after dark only when the installation of that pile began during daylight hours, and must proceed for human safety or installation feasibility reasons (i.e., stopping would result in pile refusal or pile instability that would risk human life). Pile driving may continue after dark only when the driving of the same pile began during the day when clearance zones were fully visible and it was anticipated that pile installation could be completed before sundown; in this case, monitoring must be carried out consistent with an approved monitoring plan for low visibility conditions. Given that the time to install the pile is expected to be predictable, we expect these instances of pile driving taking longer than anticipated to be very rare. As described above, unless a monitoring plan is approved by BOEM, NMFS OPR, and NMFS GARFO and that plan demonstrates that PSOs working at night can observe the clearance and shutdown zones in a way that would allow for effective implementation of the clearance and shutdown zones (i.e., such that effects of pile driving would be the same at night as they were during the day), pile driving would not be initiated at night, or, when conditions prevent visual observation of the full extent of all relevant clearance zones to be confirmed to be clear of marine mammals, as determined by the lead PSO on duty.

For impact pile driving of foundations, monitoring of the clearance zones by PSOs at the stationary platform and two PSO vessels will be supplemented by real-time passive acoustic monitoring (PAM). PAM systems are designed to detect the vocalizations of marine mammals, allowing for detection of the presence of whales underwater or outside of the range where a visual observer may be able to detect the animals. Monitoring with PAM not only allows for potential documentation of any whales exposed to noise above thresholds of concern that were not detected by the visual PSOs but also allows for greater awareness of the presence of whales in the project area as a larger area can be monitored (in this case, extending 10 km from the pile being driven). As with the monitoring data collected by the visual PSOs, this information can be used to plan the pile driving schedule to minimize pile driving at times when whales are nearby and may be at risk of exposure to pile driving noise. The PAM system will be designed and established such that calls can be localized within 10 km from the pile driving location and to ensure that the PAM operator is able to review acoustic detections within 15 minutes of the original detection. If the PAM operator has confidence that a vocalization originated from a right whale located within the PAM clearance or shutdown zone , the appropriate associated clearance or shutdown procedures must be implemented (i.e., delay or stop pile driving). More details on PAM operator training and PAM protocols are included in the Notice of Proposed ITA (89 FR 504).

If an ESA listed whale is observed entering or within the identified shutdown zone (see Tables 7.1.14) after pile driving has begun, a shutdown must be implemented (with limited exceptions for safety). The purpose of a shutdown is to prevent exposure of individuals to noise above the cumulative Level A by halting the activity before such an exposure could occur. Additionally, pile driving must be halted upon visual observation of a North Atlantic right whale by PSOs or PAM detection of a vocalizing right whale at any distance from the pile. If a marine mammal is observed entering or within the respective shutdown zone after impact pile driving has begun, the PSO will request a temporary cessation of impact pile driving; similar requirements will be in place for PAM detections. In situations when shutdown is called for but US Wind determines shutdown is not feasible due to imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk of injury or loss of life for individuals, reduced hammer energy must be implemented. As described in section 3.3, in rare instances, shutdown may not be feasible, as shutdown would result in a risk to human life. Specifically, pile refusal or pile instability could result in not being able to shut down pile driving immediately. Pile refusal occurs when the pile driving sensors indicate the pile is approaching refusal (i.e., the limits of installation), and a shutdown would lead to a stuck pile which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals. Pile instability occurs when the pile is unstable and unable to stay standing if the piling vessel were to "let go." During these periods of instability, the lead engineer may determine a shut-down is not feasible because the shut-down combined with impending weather conditions may require the piling vessel to "let go," which then poses an imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals as it means the pile would be released while unstable and could fall over. As explained above, the likelihood of shutdown being called for and not implemented is considered very low.

After shutdown, impact pile driving may be restarted once all clearance zones are clear of marine mammals for the minimum species-specific periods, or, if required to maintain pile stability, at which time the lowest hammer energy must be used to maintain stability. If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale is no longer observed or 30 minutes has elapsed since the last detection. Upon re-starting pile driving, soft start protocols must be followed.

Consideration of the Effectiveness of Clearance and Shutdown Zones
Noise above the Level A peak harassment threshold is expected to extend no further than 50 m from a pile being installed (Table 7.1.7). This distance is expected to be within the bubble curtain. We consider it extremely unlikely that a whale would be that close to the pile (within the bubble curtain) and not be detected prior to the start of pile driving or that a whale could get that close to the pile during active pile driving. As such, we do not anticipate any exposure of any ESA listed whales to noise that could result in PTS due to a single pile strike.

For monopiles, the proposed clearance zone (5,250 m) is larger than the distance to the Level A cumulative threshold. For 3 m pin piles, the proposed clearance zone (1.4 km) is equivalent to the distances to the Level A cumulative threshold. The clearance zone for 1.8 m pin piles (200 m) is four times larger than the distance to the Level A cumulative threshold. Pile driving cannot begin if a whale is detected by the visual PSOs within the clearance zone. As explained above, considering the minimum visibility requirements and placement of visual PSOs at the pile driving platform and on at least one vessel approximately 2 km from the pile being driven, we expect that the full extent of the clearance zone will be able to be monitored by the visual PSOs. Given the visibility requirements and the ability of the PSOs to monitor the entirety of the clearance zone, and the additional detection ability provided by the PAM system, it is unlikely that any pile driving would begin with a whale within the clearance zone.

For each pile type, the shutdown zone is equivalent to the distance to the Level A cumulative threshold (e.g., for the 11 m monopiles, both distances are 2.9 km). Because the distances to thresholds are acoustic ranges, they represent the distance within which an individual would need to remain for the entirety of the pile driving event to accumulate enough noise exposure to experience PTS. Shutdown would be triggered by detection of a large whale within 2.9 km of an 11 m monopile, 1.4 km of a 3 m pin pile, and 200 m of a 1.8 m pin pile. In order to experience PTS, a whale would need to be within those distances for the entire duration of the pile driving event; for a monopile that would be 2 hours and for the pin piles 6 hours (for all 3 m pin piles installed in a day) or 4 hours (for all 1.8 m pin piles installed in a day). It is extremely unlikely that a large whale would remain in such close proximity to a pile being installed for such a long period and even less likely that it would go unnoticed (considering there would be at least 6 PSOs on duty and they'd only need to detect in at a maximum of 2.9 km from the pile), and even less likely that a shutdown would not be called and pile driving stopped. Given this, we expect that the clearance and shutdown requirements will prevent all exposures of right, fin, and sei whales to noise above the cumulative Level A harassment thresholds.

Modeling predicted the exposure of a small number of right (0.08), sei (0.15), and fin (2.23) whales to noise above the cumulative Level A harassment threshold during installation of the 11m monopile foundations (Table 7.1.10). Exposure modeling did not predict exposure of any right, sei, or fin whales to noise above the Level A thresholds during installation of the pin piles (3m or 1.8 m, Tables 7.1.11 and 7.1.12). As explained above, in order for this modeled exposure to occur, a whale would need to remain within the area where noise is above the Level A cumulative threshold (2.9 km) for the entirety of the pile duration (2 hours). As explained above, the exposure modeling does not incorporate any aversion behaviors or the clearance or shutdown zones.

For right whales, the minimum clearance and shutdown zone (considering only the 5,250 clearance zone from the pile driving platform) exceed the modeled distances to the cumulative Level A harassment threshold by over 2 km; given the distances that we expect the visual PSOs to be able to monitor (at least 5.8 km considering the 2.9 km minimum visibility distance and having PSOs at the pile driving platform and on PSO vessels), the area that would be visually monitored is about double the distance from the pile that modeling suggests would indicate a right whale had accumulated enough noise exposure to experience PTS. Visual monitoring will be supplemented by PAM, which has the potential to detect vocalizing right whales that are too far away to be seen by the visual observer or that are submerged. The area monitored by PAM and where a detection would trigger delay or shutdown is even larger (extending 10 km from the pile), and pile driving will be delayed or stopped if a right whale is detected by a visual PSO at any distance from the pile or vocalizations are detected anywhere within 10 km of the pile. Given this, we consider it extremely unlikely that a right whale would be close enough to a pile to experience PTS without a PSO detecting it and calling for a shutdown. In the event that shutdown cannot occur (i.e., to prevent imminent risk of injury or loss of life to an individual, or risk of damage to a vessel that creates risk for individuals), the energy that the pile driver operates at will be reduced. The lower energy results in less noise and shorter distances to thresholds. As such, even if shutdown cannot occur, we do not expect that a right whale would remain close enough to the pile being driven for a long enough period to be exposed to noise above the Level A cumulative harassment threshold. We expect that these measures in combination with the requirements for monitoring North Atlantic right whale sightings reports for surrounding areas daily, which increases awareness of potential North Atlantic right whales in the WDA, and the low density of right whales in the WDA when pile driving could occur make it extremely unlikely that any of the modeled exposure to noise above the Level A threshold, which already was small (0.08 individuals over a three year period), will occur. As a result of these mitigation measures, and in light of our independent review, we agree with BOEM's and NMFS OPR's determinations that the already small potential for North Atlantic right whales to be exposed to project-related sound above the Level A harassment threshold is extremely unlikely to occur. As such, as stated above, it is extremely unlikely that any right whales will experience permanent threshold shift or any other injury.

Similarly, given our consideration of the ability of the PSOs to effectively monitor the clearance (5.25 km) and shutdown (2.9 km) zones for fin and sei whales, and the supplementation with PAM monitoring, we consider that a fin or sei whale remaining within 2.9 km of a pile being installed for the entirety of the 2 hour installation period to be extremely unlikely to occur. Thus, we also do not expect that any fin or sei whales will be exposed to noise above the Level A cumulative threshold and do not expect any PTS to occur. Note that we expect that the 6 fin and 3 sei whales predicted by modeling to be exposed to noise above the Level A (cumulative) threshold would be exposed only to noise above the Level B threshold (but below the Level A threshold).

For the 11 m monopiles, given that the size of the area with noise above the Level B harassment threshold (5.25 km for monopiles) is larger than the shutdown zone (2.9 km), the clearance and shutdown procedures may limit the duration of exposure of fin, right, and sei whales to noise above the Level B harassment thresholds; however, they are not expected to eliminate the potential for exposure to noise above the Level B harassment threshold. Therefore, we cannot reduce or refine the take estimates based on the Level B harassment thresholds in consideration of the effectiveness of the clearance or shutdown zone. We anticipate that, as modeled and proposed by NMFS OPR and BA, up to 31 fin, 6 right, and 3 sei whales may be exposed to noise above the Level B threshold during the installation of foundation piles. Additionally, we have added the number of fin and sei whales that modeling predicted would be exposed to noise above the Level A threshold to these estimates (see additional explanation above); thus, we expect no more than 37 fin, 6 right, and 6 sei whales will be exposed to noise above the Level B threshold during the installation of foundation piles.

Soft Start

As described in the Notice of Proposed ITA, the use of a soft start procedure is believed to provide additional protection to marine mammals by warning marine mammals or providing them with a chance to leave the area prior to the hammer operating at full capacity, and typically involves a requirement to initiate sound from the hammer at reduced energy followed by a waiting period. US Wind will utilize soft start techniques for impact pile driving including by performing 4-6 strikes per minute at 10 to 20 percent of the maximum hammer energy (i.e., 330 to 660 KJ for monopiles, 150 to 300 kJ for jackets), for a minimum of 20 minutes. Soft start, which we consider part of the proposed action, would be required at the beginning of each day's impact pile driving work and at any time following a cessation of impact pile driving of thirty minutes or longer. Without soft start procedures, pile driving would begin with full hammer energy, which would present a greater risk of more severe impacts to more animals. In this context, soft start is a minimization measure designed to reduce the amount and severity of effects incidental to pile driving.

Use of a soft start can reduce the cumulative sound exposure if animals respond to a stationary sound source by swimming away from the source quickly (Ainslie et al. 2020). The result of the soft start will be an increase in underwater noise in an area radiating from the pile that is expected to exceed the Level B harassment threshold and, therefore, is expected to cause any whales exposed to the noise to swim away from the source. The use of the soft start gives whales near enough to the piles to be exposed to the soft start noise a "head start" on avoidance behavior by causing them to swim away from the source. Through use of soft start, marine mammals are expected to move away from a sound source that is annoying, thereby avoiding exposure resulting in a serious injury and avoiding sound sources at levels that would cause hearing loss (Southall et al. 2007, Southall et al. 2016). It is possible that some whales may swim out of the noisy area before full force pile driving begins; in this case, the risk of whales being exposed to noise that exceeds the cumulative Level A harassment threshold would be reduced. It is likely that by eliciting avoidance behavior prior to full power pile driving, the soft start will reduce the duration of exposure to noise that could result in Level A or Level B harassment. However, we are not able to predict the extent to which the soft start will reduce the number of whales exposed to pile driving noise or the extent to which it will reduce the duration of exposure. Therefore, while the soft start is expected to reduce the duration of exposure of pile driving noise, the level of reduction is uncertain, and we are not able to modify the estimated take numbers to account for any benefit provided by the soft start.

Summary of Noise Exposure Anticipated as a Result of Foundation Pile Driving

In summary, we expect that no ESA listed whales will be exposed to noise above the peak or cumulative Level A harassment threshold and 37 fin, 6 right, and 6 sei whales will be exposed to noise above the Level B threshold but below the Level A harassment threshold. No sperm whales are expected to be exposed to noise above the Level A (peak or cumulative) or Level B harassment threshold. Below, we consider the effects of these noise exposures.

7.1.3.2 Effects to ESA-Listed Whales from Exposure to Pile Driving Noise

As explained above, we anticipate that during impact pile driving for foundations, up to 37 fin, 6 right, and 6 sei whales will be exposed to noise above the Level B threshold but below the Level A harassment threshold. Below, following consideration of other noise sources, we consider the effects of these noise exposures.

Effects of Exposure to Noise above the Level B Harassment Threshold but Below the Level A Harassment Threshold

Potential impacts associated with exposure above the Level B harassment threshold would include only temporary behavioral modifications, most likely in the form of avoidance behavior and/or potential alteration of vocalizations, as well as potential Temporary Threshold Shift (TTS). The 37 fin, 6 right, and 6 sei whales exposed to noise above the Level B harassment threshold but below the Level A harassment threshold are expected to experience TTS.

An extensive discussion of TTS is presented in the proposed MMPA ITA and is summarized here, with additional information presented in Southall et al. (2019) and NMFS 2018. TTS represents primarily tissue fatigue and is reversible (Henderson et al. 2008). In addition, investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.,* Ward, 1997; Southall *et al.,* 2019). Therefore, NMFS does not consider TTS to constitute auditory injury.

While experiencing TTS, the hearing threshold rises, and a sound must be at a higher level in order to be heard; that is, the animal experiences a temporary loss of hearing sensitivity. TTS, thus, is a temporary hearing impairment and can last from a few minutes to days, be of varying degree, and occur across different frequency bandwidths. All of these factors determine the severity of the impacts on the affected individual, which can range from minor to more severe. In many cases, hearing sensitivity recovers rapidly after exposure to the sound ends. Observations of captive odontocetes suggest that wild animals may have a mechanism to self-mitigate the impacts of noise exposure by dampening their hearing during prolonged exposures to loud sound, or if conditioned to anticipate intense sounds (Finneran, 2018, Nachtigall *et al.,* 2018).

Impact pile driving generates sounds in the lower frequency ranges (with most of the energy below 1-2 kHz but with a small amount energy ranging up to 20 kHz); therefore, in general and all else being equal, we would anticipate the potential for TTS as more likely to occur in frequency bands in which the animals communicate. However, we would not expect the TTS to span the entire communication or hearing range of any species, given the frequencies produced by pile driving do not span entire hearing ranges for any particular species. Additionally, though the frequency range of TTS that marine mammals might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from US Wind's pile driving activities is not expected to span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species.

Generally, both the degree of TTS and the duration of TTS would be greater if the marine mammal is exposed to a higher level of energy (which would occur when the peak dB level is higher or the duration is longer). Source level alone is not a predictor of TTS. An animal would have to approach closer to the source or remain in the vicinity of the sound source appreciably longer to increase the received SEL, which is not likely to occur considering the proposed mitigation and the anticipated movement of the animal relative to the stationary sources such as impact pile driving. The recovery time of TTS is also of importance when considering the potential impacts from TTS. In TTS laboratory studies--some using exposures of almost an hour in duration or up to 217 SEL--almost all individuals recovered within 1 day or less, often in minutes. For nearly all pile driving days, pile driving will occur for only two hours (the estimated duration for pile driving for the 11m monopiles). For the four days that OSS foundations are installed, pile driving would occur for up to 8 non-continuous hours in a day; for the one day that the Met Tower foundation is installed, pile driving would occur for up to 4 non-continuous hours. It is extremely unlikely that ESA listed whales would stay in the close proximity to the source long enough to incur more severe TTS (see additional explanation below regarding anticipated duration of exposure). Overall, given that we do not expect an individual to experience TTS from pile driving on more than one day, the low degree of TTS and the short anticipated duration (less than a day), and that it is extremely unlikely that any TTS overlapped the entirety of a critical hearing range, we expect that, consistent with the literature cited above, the effects of TTS and any behavioral response resulting from this TTS will be limited to no more than 24 hours from the time of exposure. Effects of TTS resulting from exposure to Maryland Wind project noise are addressed more fully below.

In order to evaluate whether or not individual behavioral responses, in combination with other stressors, impact animal populations, scientists have developed theoretical frameworks that can then be applied to particular case studies when the supporting data are available. One such framework is the population consequences of disturbance model (PCoD), which attempts to assess the combined effects of individual animal exposures to stressors at the population level (NAS 2017). Nearly all PCoD studies and experts agree that infrequent exposures of a single day or less are unlikely to impact individual fitness, let alone lead to population level effects (Booth et al. 2016; Booth et al. 2017; Christiansen and Lusseau 2015; Farmer et al. 2018; Harris et al. 2017; Harwood and Booth 2016; King et al. 2015; McHuron et al. 2018; NAS 2017; New et al. 2014; Pirotta et al. 2018; Southall et al. 2007; Villegas-Amtmann et al. 2015).

Since we expect that any exposures to disturbing levels of noise would be limited to significantly less time than an entire day (limited only to the time it takes to swim out of the area with noise above the Level B threshold, but never more than 2 hours (the time it would take to install a single monopile or pin pile), and repeat exposures to the same individuals in a given construction season are unlikely (based on abundance, distribution and sightings data including that whales in the WDA are transient and not remaining in the area for extended periods), any behavioral responses that would occur due to animals being exposed to pile driving are expected to be temporary, with behavior returning to a baseline state shortly after the acoustic stimuli ceases (i.e., pile driving stops or the animal swims far enough away from the source to no longer be exposed to disturbing levels of noise). Given this, and our evaluation of the available PCoD studies, this infrequent, time-limited exposure of individuals to pile driving noise is unlikely to impact the overall, long-term fitness of any individual; that is, the anticipated disturbance is not expected to impact individual animals' health or have effects on individual animals' survival or reproduction. Specific effects to the different species are considered below.

North Atlantic Right Whales
We expect that up to 6 North Atlantic right whales may experience TTS and/or behavioral disturbance from exposure to pile driving noise. These exposures are only predicted to occur during installation of the monopiles. We expect that this will be up to 6 different individuals each experiencing exposure to pile driving noise above the Level B harassment threshold on a single day. We do not expect repeat exposures in the same construction season (i.e., the same individual exposed to multiple pile driving events) due to the short duration and intermittent natures of the pile driving noise and the limited residence time and transient nature of right

whales in the area. That is, because right whales are not expected to stay in the WDA for any extended period of time (regardless of pile driving activity) we do not expect an individual to be present in the WDA for multiple days such that it could be exposed to multiple pile driving events. While right whales may be present throughout the year, right whales predominantly use the WDA as they migrate north in March and April and south in November and December. While opportunistic foraging may occur in the WDA if prey is available in suitable densities to trigger foraging behavior, the WDA is not an area where right whales are known to aggregate for foraging, and it is not known to support regular or sustained foraging. Additionally, neither mating nor calving are known or expected to occur in the WDA.

When in the action area surrounding and including the WDA, where noise exposure would occur, the primary activity North Atlantic right whales are expected to be engaged in is migration. However, we also expect the animals to perform other behaviors, including opportunistic foraging and resting. If North Atlantic right whales exhibited a behavioral response to the pile driving noise, the activity that the animal was carrying out would be disrupted, and it may pose some energetic cost; these effects are addressed below. Because use of this area is limited to transient individuals, we do not expect that animals displaced from a particular portion of the area due to exposure to pile driving noise would return to the area, rather, they would continue their normal behaviors from the location they moved to; these effects are addressed below. As noted previously, behavioral responses to pile driving noise are anticipated to be short-term and limited to no more than the duration of pile driving noise in a day (two hours for monopiles). Given the small distance to the Level B harassment threshold for the pin piles, no right whales are expected to be exposed to noise above the Level B harassment threshold during installation of the pin piles for the OSS and Met Tower foundations.

Right whales are considerably slower than the other whale species in the action area, with maximum speeds of about 9 kilometers per hour (kph). Hatin et al. (2013) report median swim speeds of singles, non mother-calf pairs, and mother-calf pairs in the southeastern United States recorded at 1.3 kph, with examples that suggest swim speeds differ between within-habitat movement and migration-mode travel (Hatin et al. 2013). Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the Level B harassment threshold would take a direct path to get outside of the noisy area. During impact pile driving of foundations, the area with noise above the Level B harassment threshold extends up to up to 5.25 km for monopiles. As such, for foundation piles, considering a right whale that was at the edge of the minimum visibility zone (2.9 km) when pile driving starts, we would expect that right whale swimming at maximum speed (9 kph) would swim out of the area with noise above 160 dBre 1uPa (extending 5.25 km from the pile) in less than 20 minutes, but at the median speed observed in Hatin et al. (1.3 kph, 2013), it would take the animal nearly two hours to move out of the noisy area.

Based on best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013; Melcon et al. 2012), we anticipate that exposed animals will be able to return to normal behavioral patterns (i.e., socializing, foraging, resting, migrating) after the exposure ends. If an animal exhibits an avoidance response, it would experience a cost in terms of the energy associated with traveling away from the acoustic source. That said, migration is not considered a particularly costly activity in terms of energetics (Villegas-Amtmann et al. 2015). The up to 6 right whales exposed to pile driving noise may experience one-time, temporary, disruptions to foraging activity; this would be the case if a right whale was foraging while pile driving started and it stopped foraging to move away from the noise or if it was actively avoiding the noisy area and did not forage during that period. However, given the rarity of foraging in the WDA we consider this to be a very low probability of occurrence. As explained above, given that the duration of pile driving is short (2 hours for a single pile, with exposure expected to be less than that period), and we expect an individual to only be exposed to noise from a single pile driving event, we expect the potential for disruption of foraging to occur for a short period of time on a single day. Goldbogen et al. (2013) hypothesized that if the temporary behavioral responses due to acoustic exposure interrupted feeding behavior, this could have impacts on individual fitness and eventually, population health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location once it swims away from the noisy area, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this is the case, particularly since unconsumed prey would likely still be available in the environment following the cessation of acoustic exposure (i.e., the pile driving is not expected to disrupt copepod prey). There would likely be an energetic cost associated with any temporary displacement to find alternative locations for foraging, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (Southall et al. 2007). Disruption of resting and socializing may also result in short term stress. Efforts have been made to try to quantify the potential consequences of responses to behavioral disturbance, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017; King et al. 2015; NAS 2017; New et al. 2014; Southall et al. 2007; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for North Atlantic right whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Maryland Wind project.

Based on best available information that indicates whales resume normal behavior quickly in their new location after the cessation of sound exposure (e.g., Goldbogen et al. 2013; Melcon et al. 2012), we anticipate that the 6 individuals exposed to noise above the Level B harassment threshold will resume normal behavioral patterns (primarily migrating, but also resting, socialization, and potential limited, opportunistic foraging) after the exposure ends. If an animal exhibits an avoidance response, it would experience a cost in terms of the energy associated with traveling away from the acoustic source. That said, migration is not considered a particularly costly activity in terms of energetics (Villegas-Amtmann et al. 2015). An animal that was migrating through the area and was exposed to pile driving noise would make minor alterations to their route, taking them about 5.25 km out of their way depending on which pile driving noise they were avoiding. This is far less than the distance normally traveled over the course of a day (they have been tracked moving more than 80 km in a day in the Gulf of St. Lawrence) and we expect that even for stressed individuals or mother-calf pairs, this alteration in course would result in only a small energetic impact that would not have consequences for the animals health or fitness.

We have also considered the possibility that a resting animal could be exposed to pile driving noise and its rest disturbed. Resting would be disrupted until the animal moved outside of the area with increased pile driving noise. As explained above, we expect this disruption would likely last less than 20 minutes but could last up to 2 hours. Given that disruptions to resting will be a one-time event that likely lasts only a few minutes and at most a few hours, we expect that any exposed individuals would be able to make up that lost rest without consequences to their overall energy budget, health, or fitness.

Stress responses are also anticipated in the 6 right whales experiencing temporary behavioral disruption. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase in stress that could result in physiological consequences to the animal; this is true for all potentially exposed animals, including mother-calf pairs. The stress response is expected to fully resolve when the animal has moved away from the disturbing levels of noise; as such, the stress response is limited to the 20 minutes to up to 2 hours the individual right whales are expected to be exposed to disturbing levels of noise during impact pile driving. These short-term stress responses are not equivalent to stress responses and associated elevated stress hormone levels that have been observed in North Atlantic right whales that are chronically entangled in fishing gear (Rolland et al. 2017). This is also in contrast to stress level changes observed in North Atlantic right whales due to fluctuations in chronic ocean noise. Rolland et al. (2012) documented that stress hormones in North Atlantic right whales significantly decreased following the events of September 11, 2001 when shipping was significantly restricted. This was thought to be due to the resulting decline in ocean background noise level because of the decrease in shipping traffic. As noted in Southall et al. (2007), substantive behavioral reactions to noise exposure (such as disruption of critical life functions, displacement, or avoidance of important habitat) are considered more likely to be significant if they last more than 24 hours, or recur on subsequent days; this is not the case here as the behavioral response and associated effects will in all cases last less than 2 hours (if a right whale was exposed to noise from all four pin piles installed in a day) and will not recur on subsequent days in a single construction season. Because we expect these 6 individuals to only be exposed to a single pile driving event in a season, we do not expect chronic exposure to pile driving noise. In summary, we do not anticipate long duration exposures to occur, and we do not anticipate that behavioral disturbance and associated stress response as a result of exposure to pile driving noise will affect the health of any individual and therefore, there would be no consequences on body condition or other factor that would affect health, survival, reproductive or calving success.

As noted above, TTS represents primarily tissue fatigue and is reversible (Southall et al., 2007). Temporary hearing loss is not considered physical injury but will cause auditory impairment to animals over the short period in which the TTS lasts. The TTS experienced by up to 6 right whales exposed to noise above the Level B threshold during monopile installation is expected to be a minor degradation of hearing capabilities within regions of hearing that align most completely with the energy produced by pile driving (i.e. the low-frequency region below 2 kHz), not severe hearing impairment. If hearing impairment occurs, it is most likely that the affected animal would lose a few decibels in its hearing sensitivity, which, given the limited impact to hearing sensitivity, is not likely to meaningfully affect its ability to forage and communicate with conspecifics, including communication between mothers and calves. We anticipate that any instances of TTS will be of minimum severity and short duration. This conclusion is based on literature indicating that even following relatively prolonged periods of sound exposure resulting in TTS, recovery occurs quickly (Finneran 2015). TTS is expected to resolve within a day and in all cases would resolve within a week of exposure (that is, hearing sensitivity will return to normal) and is not expected to affect the health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

Masking occurs when the receipt of a sound is interfered with by another coincident sound at similar frequencies and at similar or higher intensity. Pile driving noise may mask right whale calls and could have effects on mother-calf communication and behavior. If such effects were severe enough to prevent mothers and calves from reuniting or initiating nursing, they may result in missed feeding opportunities for calves, which could lead to reduced growth, starvation, and even death. Any mother-calf pairs in the action area would have left the southern calving grounds and be making northward migrations to northern foraging areas. The available data suggests that North Atlantic right whale mother-calf pairs rarely use vocal communication on the calving grounds and so the two maintain visual contact until calves are approximately three to four months of age (Parks and Clark 2007; Parks and Van Parijs 2015; Root-Gutteridge et al. 2018; Trygonis et al. 2013). Such findings are consistent with data on southern right and humpback whales, which appear to rely more on mechanical stimulation to initiate nursing rather than vocal communication (Thomas and Taber 1984; Videsen et al. 2017). When mother-calf pairs leave the calving grounds and begin to migrate to the northern feeding grounds, if they begin to rely on acoustic communication more, then any masking could interfere with mother-calf reunions. For example, even though humpback whales do not appear to use vocal communication for nursing, they do produce low-level vocalizations when moving that have been suggested to function as cohesive calls (Videsen et al. 2017). However, when calves leave the foraging grounds at around four months of age, they are expected to be more robust and less susceptible to a missed or delayed nursing opportunity. Any masking would only last for the duration of the exposure to pile driving noise, which in all cases would be no more than 2 hours. As such, even if masking were to interfere with mother-calf communication in the action area, we do not anticipate that such effects would result in fitness or health consequences given their short-term nature. We also note that given the time of year restriction on impact pile driving and that mother-calf pairs are most likely to swim through the WDA in March and April (LaBreque et al. 2015) and are less likely to be present when impact pile driving occurs between May and November.

Quantifying the fitness consequences of sub-lethal impacts from acoustic stressors is exceedingly difficult for marine mammals, and we do not currently have data to conduct a quantitative analysis on the likely consequences of such sub-lethal impacts. While we are unable to conduct a quantitative analysis on how sub-lethal behavioral effects and temporary hearing impacts (i.e., masking and TTS) may impact animal vital rates (and therefore fitness), based on the best available information, we expect an increased likelihood of consequential effects when exposures and associated effects are long-term and repeated, occur in locations where the animals are conducting critical activities, and when the animal affected is in a compromised state. While we acknowledge that the 6 right whales exposed to pile driving noise may be in a compromised state, individual exposures will be short term (in most cases less than an hour but potentially for up to 2 hours) and none are expected to be repeated. The effects of this temporary exposure and associated behavioral response will not affect the health or fitness of any individual right whale.

Harris et al. (2017) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017; King et al. 2015; NAS 2017; New et al. 2014; Southall et al. 2007; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for North Atlantic right whales exposed to pile driving noise even for animals that may already be in a stressed or compromised state due to factors unrelated to the Maryland Wind project. We do not anticipate that instances of behavioral response and any associated energy expenditure or stress will impact an individual's overall energy budget or result in any health or fitness consequences to any individual North Atlantic right whales.

We have also considered whether TTS, masking, or avoidance behaviors would be likely to increase the risk of vessel strike or entanglement in fishing gear. As explained above, we would not expect the TTS to span the entire communication or hearing range of right whales given the frequencies produced by pile driving do not span entire hearing ranges for right whales. Additionally, though the frequency range of TTS that right whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from US Wind's pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues. Masking may also make it more difficult for the individual to hear other animals or to detect auditory cues; however, masking resolves as soon as the animal moves sufficiently far from the source. As such, while TTS and masking may temporarily affect the ability of a right whale to communicate with other right whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats, we do not expect these effects to be so severe that they would prevent the affected individual from communicating or limit their response to acoustic cues such that it would prevent them from responding to a threat. For example, to the extent that a right whale relies on acoustic cues to detect and move away from nearby vessels, which is largely unknown, TTS and/or masking could slow the animal's response time. However, these risks are lowered by the limited scope of the TTS and lowered further by the short duration of TTS (less than a week) and masking (limited only to the time that the whale is exposed to the pile driving noise, so less than 2 hours). As such, while TTS and masking may increase the likelihood of injury by temporarily affecting the ability of an individual to use acoustic cues to respond to threats or stressors, the effects are not expected to be so severe to actually increase the risk that a right whale will be exposed to a threat such as being hit by a vessel or become entangled in fishing gear.

While we do expect pile driving noise to cause avoidance and temporary localized displacement as discussed above, we do not expect that avoidance of pile driving noise would result in right whales moving to areas with higher risk of vessel strike or entanglement in fishing gear. Information available in the Navigational Safety Risk Assessment describes vessel traffic and fishing activity within and outside the WFA where pile driving will occur; additional mapping products are viewable at northeastoceandata.org (e.g., all VMS vessels 2015-2019 and Annual vessel transit counts). Based on the available information, we do not expect avoidance of pile driving noise to result in an increased risk of vessel strike or entanglement in fishing gear. This determination is based on the relatively small size of the area with noise that an individual whale is expected to avoid (no more than 5.25 km from the pile being installed), the short term nature of any disturbance, the limited number of whales impacted, and the lack of any significant differences in vessel traffic or fishing activity in that 5.25 km area that would put an individual whale at greater risk of vessel strike or entanglement/capture.

The ESA's definition of take includes harassment of a listed species. NMFS Interim Guidance on the ESA Term "Harass" (PD 02-110-19; December 21, 2016[40] provides for a four-step process to determine if a response meets the definition of harassment. The Interim Guidance defines harassment as to "[c]reate the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." The guidance states that NMFS will consider the following steps in an assessment of whether proposed activities are likely to harass: 1) Whether an animal is likely to be exposed to a stressor or disturbance (i.e., an annoyance); and 2) The nature of that exposure in terms of magnitude, frequency, duration, etc. Included in this may be type and scale as well as considerations of the geographic area of exposure (e.g., is the annoyance within a biologically important location for the species, such as a foraging area, spawning/breeding area, or nursery area?); 3) The expected response of the exposed animal to a stressor or disturbance (e.g., startle, flight, alteration [including abandonment] of important behaviors); and 4) Whether the nature and duration or intensity of that response is a significant disruption of those behavior patterns which include, but are not limited to, breeding, feeding, or sheltering, resting or migrating.

Here, we carry out that four-step assessment to determine if the effects to the 6 individuals expected to be exposed to noise above the Level B harassment threshold meet the definition of harassment. We have established that up to 6 individual right whales will be exposed to levels of noise above the threshold at which we expect TTS and behavioral response to occur, we also expect exposure to noise will result in masking (step 1). For an individual, the nature of this exposure is expected to be limited to a one-time exposure to pile driving noise and will last for as long as it takes the individual to swim away from the disturbing noise or, at maximum, the duration of the pile event (up to 2 hours), with TTS lasting for as long as a week; this disruption will occur in areas where individuals are expected to primarily be migrating but also could be

[40] Available at: https://www.fisheries.noaa.gov/national/laws-and-policies/protected-resources-policy-directives

foraging, resting, or socializing (step 2). Animals that are exposed to this noise are expected to abandon their activity and move far enough away from the pile being driven to be outside the area where noise is above the Level B harassment threshold (traveling up to 5.25km). As explained above, these individuals are expected to experience TTS (temporary hearing impairment), masking, stress disruptions to behaviors including foraging, resting, socializing, and migrating, and, energetic consequences of moving away from the pile driving noise (step 3). As explained above, breeding and calving do not occur in the action area or do not occur at the time of year when exposure to pile driving could occur. Together, these effects will significantly disrupt a right whale's normal behavior for the period that the exposure occurs, additionally TTS is expected to affect the animal's behavior, including limited impacts on its ability to communicate and use acoustic cues to detect and respond to threats for the period before TTS resolves (up to a week); that is, the nature and duration/intensity of these responses are a significant disruption of normal behavioral patterns that creates the likelihood of injury (step 4). Therefore, based on this four-step analysis, we find that the 6 right whales exposed to pile driving noise louder than 160 dB re 1uPa rms threshold are likely to be adversely affected and that effect amounts to ESA take by harassment. As such, we expect the take by harassment of 6 right whales as a result of pile driving noise.

NMFS defines "harm" in the ESA's definition of "take" as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR §222.102). No right whales will be injured or killed due to exposure to pile driving noise. Further, while exposure to pile driving noise will significantly disrupt normal behaviors of individual right whales on the day that the whale is exposed to the pile driving noise as well as for the period before TTS resolves (i.e., when hearing sensitivity returns to normal) creating the likelihood of injury, it will not actually kill or injure any right whales by significantly impairing any essential behavioral patterns. This is because behavioral disturbance, displacement, potential loss of foraging opportunities, and expending additional injury, will be limited to that single day and are expected to be fully recoverable, there will not be an effect on the animal's overall energy budget in a way that would compromise its ability to successfully obtain enough food to maintain its health, or impact the ability of any individual to make seasonal migrations or participate successfully in nursing, breeding, or calving. TTS will resolve within no more than a week of exposure and while it may temporarily affect the individual's ability to communicate and/or use acoustic cues to respond to threats, it is not expected to affect the health of any whale, result in actual injury, or affect its ability to migrate, forage, breed, calve, or raise its young. We also expect that stress responses will be limited to the single day that exposure to pile driving noise occurs and there will not be such an increase in stress that there would be physiological consequences to the individual that could affect its health or ability to socialize, migrate, forage, breed, calve, or raise its young. Thus, as no injury or mortality will actually occur, the response of right whales to pile driving noise does not meet the definition of "harm."

Fin and Sei Whales
Behavioral responses may impact health through a variety of different mechanisms, but most Population Consequences of Disturbance models focus on how such responses affect an animal's energy budget (Costa et al. 2016; Farmer et al. 2018; King et al. 2015; NAS 2017; New et al.

2014; Villegas-Amtmann et al. 2017). Responses that relate to foraging behavior, such as those that may indicate reduced foraging efficiency (Miller et al. 2009) or involve the complete cessation of foraging, may result in an energetic loss to animals. Other behavioral responses, such as avoidance, may have energetic costs associated with traveling (NAS 2017). When considering whether energetic losses due to reduced foraging or increased traveling will affect an individual's fitness, it is important to consider the duration of exposure and associated response. Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget and that long duration and repetitive disruptions would be necessary to result in consequential impacts on an animal (Farmer et al. 2018; Harris et al. 2017; King et al. 2015; NAS 2017; New et al. 2014; Southall et al. 2007; Villegas-Amtmann et al. 2015). As explained below, individuals exposed to pile driving noise will experience only a singular, temporary behavioral disruption that will not last for more than a few hours and will not be repeated. As such, the factors necessary for behavioral disruption to have long-term consequential impacts on an animal are not present in this case. We also recognize that aside from affecting health via an energetic cost, a behavioral response could result in more indirect impacts to health and/or fitness. For example, if a whale hears the pile driving noise and avoids the area, this may cause it to travel to an area with other threats such as vessel traffic or fishing gear. However, as explained below, this is extremely unlikely to occur.

Quantifying the fitness consequences of sub-lethal impacts from acoustic stressors is exceedingly difficult for marine mammals and we do not currently have data to conduct a quantitative analysis on the likely consequences of such sub-lethal impacts. While we are unable to conduct a quantitative analysis on how sub-lethal behavioral effects and temporary hearing impacts (i.e., masking) may impact animal vital rates (and therefore fitness), based on the best available information, we expect an increased likelihood of consequential effects when exposures and associated effects are long-term and repeated, occur in locations where the animals are conducting normal or essential behavioral activities, and when the animal affected is in a compromised state.

We do not have information to suggest that affected sei or fin whales are likely to be in a compromised state at the time of exposure. During exposure, affected animals may be engaged in migration, foraging, or resting. If fin or sei whales exhibited a behavioral response to pile driving noise, these activities would be disrupted, and the disruption may pose some energetic cost. However, as noted previously, responses to pile driving noise are anticipated to be singular and short term (up to three hours depending on pile type); that is, the identified number of individuals are each expected to be exposed to a single pile driving event that will result in the individual altering their behavior to avoid the disturbing level of noise. Based on the estimated abundance of fin and sei whales in the action area, anticipated residency time in the lease area, and the number of instances of behavioral disruption expected, multiple exposures of the same animal are not anticipated in a given construction season. Fin whales cruise at approximately 10 kph while feeding and have a maximum swim speed of up to 35 kph. Sei whales swim at speeds of up to 55 kph. During impact pile driving, the area with noise above the Level B harassment threshold extends up to approximately 5.25 km from the pile being driven. Assuming that a whale exposed to noise above the Level B harassment threshold takes a direct path to get outside of the noisy area, a fin or sei whale that was at the edge of the clearance zone (2.9 km from the pile) when pile driving starts, would swim out of the area with noise above 160 dB re 1uPa the noise in less than an hour, even at a slow speed of 5 kph; actual time spent swimming away from the noise is likely to be significantly less.

Considering the density and distribution of fin and sei whales in the WDA and their known prey, disruptions of foraging activity are most likely for individual fin whales. Goldbogen et al. (2013) suggested that if the documented temporary behavioral responses interrupted feeding behavior, this could have impacts on individual fitness and eventually, population health. However, for this to be true, we would have to assume that an individual whale could not compensate for this lost feeding opportunity by either immediately feeding at another location, by feeding shortly after cessation of acoustic exposure, or by feeding at a later time. There is no indication this will occur, particularly since unconsumed prey would still be available in the environment following the cessation of acoustic exposure (i.e., the pile driving is not expected to result in a reduction in prey). There would likely be an energetic cost associated with any temporary habitat displacement to find alternative locations for foraging, but unless disruptions occur over long durations or over subsequent days, we do not anticipate this movement to be consequential to the animal over the long-term (Southall et al 2007). Based on the estimated abundance of fin and sei whales in the action area, anticipated residency time in the lease area, and the number of instances of behavioral disruption expected, multiple exposures of the same animal are not anticipated. Therefore, we do not anticipate repeat exposures, and based on the available literature that indicates infrequent exposures are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017; King et al. 2015; NAS 2017; New et al. 2014; Southall et al. 2007; Villegas-Amtmann et al. 2015), we do not expect this level of exposure to impact the fitness of exposed animals.

For fin and sei whales, little information exists on where they give birth as well as on mother-calf vocalizations. As such, it is difficult to assess whether masking could significantly interfere with mother-calf communication in a way that could result in fitness consequences. In our judgment it is reasonable to assume here that it is likely that some of the sei or fin whales exposed to pile driving noise are mother-calf pairs. Absent data on mother-calf communication for these species within the action area, we rely on our analysis of the effects of masking to North Atlantic right whales, which given their current status, are considered more vulnerable than any of these whale species. Based on this analysis, we expect that any effects of TTS and/or masking on communication or nursing by fin or sei whale mother-calf pairs will be extremely unlikely to occur or will be so small that they cannot be meaningfully measured, evaluated, or detected; therefore, all effects of TTS and/or masking on mother-calf fitness will be insignificant or discountable.

We have also considered whether TTS, masking, or avoidance behaviors would be likely to increase the risk of vessel strike or entanglement in fishing gear. As explained above, we would not expect the TTS to span the entire communication or hearing range of fin or sei whales given the frequencies produced by pile driving do not span entire hearing ranges for any whales. Additionally, though the frequency range of TTS that fin or sei whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from Maryland Wind pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. Masking may also make it more difficult for the individual to hear other animals or to detect auditory cues; however, masking resolves as soon as the animal moves sufficiently far from the source. As such, while TTS and masking may temporarily affect the ability of a whale to communicate with other whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats, we do not expect these effects to be so severe that they would prevent the affected individual from communicating or limit their response to acoustic cues such that it would prevent them from responding to a threat. For example, to the extent that an individual whale relies on acoustic cues to detect and move away from nearby vessels, which is largely unknown, TTS and/or masking could slow the animal's response time. However, these risks are lowered by the limited scope of the TTS and lowered further by the short duration of TTS (less than a week) and masking (limited only to the time that the whale is exposed to the pile driving noise, so less than 2 hours). As such, while TTS and masking may increase the likelihood of injury by temporarily affecting the ability of an individual to use acoustic cues to respond to threats or stressors, the effects are not expected to be so severe to actually increase the risk that a right whale will be exposed to a threat such as being hit by a vessel or become entangled in fishing gear.

While we do expect pile driving noise to cause avoidance and temporary localized displacement as discussed above, we do not expect that avoidance of pile driving noise would result in right, fin or sei whales moving to areas with higher risk of vessel strike or entanglement in fishing gear. Information available in the Navigational Safety Risk Assessment describes vessel traffic and fishing activity within and outside the WFA where pile driving will occur; additional mapping products are viewable at northeastoceandata.org (e.g., all VMS vessels 2015-2019 and Annual vessel transit counts). Based on the available information, we do not expect avoidance of pile driving noise to result in an increased risk of vessel strike or entanglement in fishing gear. This determination is based on the relatively small size of the area with noise that an individual whale is expected to avoid (no more than 5.25 km from the pile being installed), the short term nature of any disturbance, the limited number of whales impacted, and the lack of any significant differences in vessel traffic or fishing activity in that 5.25 km area that would put an individual whale at greater risk of vessel strike or entanglement/capture.

We set forth the NMFS interim guidance definition of ESA take by harassment above and the four-step analysis to evaluate whether harassment is likely to occur. Here, we carry out that four-step assessment to determine if the effects to the up to 37 fin and 6 sei whales expected to be exposed to noise above the Level B harassment threshold, but below the Level A harassment threshold, meet the ESA definition of harassment. We have established that up to 37 fin and 6 sei whales will be exposed to levels of noise above the threshold at which we expect TTS and behavioral response to occur, we also expect exposure to noise will result in masking (step 1). For an individual, the nature of this exposure is expected to be limited to a one-time exposure to pile driving noise and will last for as long as it takes the individual to swim away from the disturbing noise or, at maximum, the duration of the pile driving in a single day (with exposure for more than 2 hours unexpected), with TTS lasting for as long as a week; this disruption will occur in areas where individuals are expected to primarily be migrating but also could be foraging, resting, or socializing (step 2). Animals that are exposed to this noise are expected to abandon their activity and move far enough away from the pile being driven to be outside the area where noise is above the Level B harassment threshold (traveling up to 5.25 km). As explained above, these individuals are expected to experience TTS (temporary hearing impairment), masking, stress disruptions to behaviors including foraging, resting, socializing, and migrating, and, energetic consequences of moving away from the pile driving noise (step 3). As explained above, breeding and calving do not occur in the action area or do not occur at the time of year when exposure to pile driving could occur. Together, these effects will significantly disrupt a right whale's normal behavior for the period that the exposure occurs. Additionally TTS is expected to affect the animal's behavior, including limited impacts on its ability to communicate and use acoustic cues to detect and respond to threats for the period before TTS resolves (up to a week); that is, the nature and duration/intensity of these responses are a significant disruption of normal behavioral patterns that creates the likelihood of injury (step 4). Therefore, based on this four-step analysis, we find that the 37 fin and 6 sei whales exposed to pile driving noise louder than 160 dB re 1uPa rms threshold are likely to be adversely affected and that effect amounts to ESA take by harassment. As such, we expect the ESA take by harassment of up to 37 fin and 6 sei whales as a result of exposure to pile driving noise above the Level B harassment threshold but below the Level A harassment threshold.

As noted, NMFS defines "harm" for ESA take purposes as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering." No fin or sei whales will be injured or killed due to exposure to pile driving noise above the Level B harassment threshold but below the Level A harassment threshold. Further, while exposure to pile driving noise will significantly disrupt normal behaviors of individual whales on the day that the whale is exposed to the pile driving noise as well as for the period before TTS resolves (i.e., when hearing sensitivity returns to normal) creating the likelihood of injury, it will not actually kill or injure any individuals by significantly impairing any essential behavioral patterns. This is because the effects will be limited to that single day and are expected to be fully recoverable, there will not be an effect on the animal's overall energy budget in a way that would compromise its ability to successfully obtain enough food to maintain its health, or impact the ability of any individual to make seasonal migrations or participate successfully in nursing, breeding, or calving. TTS will resolve within no more than a week of exposure and while it may temporarily affect the individual's ability to communicate and/or use acoustic cues to respond to threats, and is not expected to affect the health of any whale or its ability to migrate, forage, breed, calve, or raise its young. We also expect that stress responses will be limited to the single day that exposure to pile driving noise occurs and there will not be such an increase in stress that there would be physiological consequences to the individual that could affect its health or ability to socialize, migrate, forage, breed, calve, or raise its young. Thus, as no injury or mortality will actually occur, the response of fin or sei whales to pile driving noise above the Level B harassment threshold but below the Level A harassment threshold does not meet the ESA definition of "harm."

Effects of Exposure to Other Project Noise Sources

Pile Driving for O&M Facilities

Impact pile driving activities will occur inshore during construction to support the development of the proposed O&M Facility. This will include pile driving of up to 170, 12-to-18-inch diameter steel pipe piles installed over an approximate 6-month period; up to 240, 12-to-18-inch diameter timber fender system piles installed over an approximate 6-month period; and up to 120 sheet piles installed for the bulkhead over an approximate 3-month period. As described in the BA, the NMFS Multi-Species Pile Driving Calculator Tool was used to estimate ranges to the thresholds for marine mammals. Summary pages of both the inputs and results of the calculator tool are provided in Appendix D of BOEM's BA.

Results from the calculator tool indicate the distances to injury criteria (PTS) are limited to an area within less than 70 meters (considering all pile types and the peak and cumulative thresholds) and that noise would exceed the 160 dB re 1 μPa behavioral disturbance threshold within 46 m, depending on pile type. Given the location of these activities and the extremely small areas where noise would be above the injury or behavioral disturbance thresholds, exposure of any ESA listed whales to pile driving noise that could result in injury or behavioral disturbance is extremely unlikely to occur. As such, effects are extremely unlikely to occur and discountable.

Vessel Noise and Cable Installation
The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with the generalized hearing range for sei, fin, and right whales (7 Hz to 35 kHz) and sperm whales (150 Hz to 160 kHz) and would therefore be audible. As described in the BA, vessels without ducted propeller thrusters would produce levels of noise of 150 to 170 dB re 1 μPa-1 meter at frequencies below 1,000 Hz, while the expected sound-source level for vessels with ducted propeller thrusters level is 177 dB (RMS) at 1 meter. For ROVs, source levels may be as high as 160 dB. Given that the noise associated with the operation of project vessels is below the thresholds that could result in injury, no injury is expected. Noise produced during cable installation is dominated by the vessel noise; therefore, we consider these together.

Marine mammals may experience masking due to vessel noises. For example, right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al. 2007) as well as increasing the amplitude (intensity) of their calls (Parks et al. 2011; Parks et al. 2009). Right whales also had their communication space reduced by up to 84 percent in the presence of vessels (Clark et al. 2009). Although humpback whales did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected, potentially indicating some signal masking (Dunlop 2016).

Vessel noise can potentially mask vocalizations and other biologically important sounds (e.g., sounds of prey or predators) that marine mammals may rely on. Potential masking can vary depending on the ambient noise level within the environment, the received level and frequency of the vessel noise, and the received level and frequency of the sound of biological interest. In the open ocean, ambient noise levels are between about 60 and 80 dB re 1 μPa in the band between 10 Hz and 10 kHz due to a combination of natural (e.g., wind) and anthropogenic sources (Urick 1983), while inshore noise levels, especially around busy ports, can exceed 120 dB re 1 μPa. When the noise level is above the sound of interest, and in a similar frequency band, masking could occur. This analysis reasonably assumes that any sound that is above ambient noise levels and within an animal's hearing range may potentially cause masking.

However, the degree of masking increases with increasing noise levels; a noise that is just detectable over ambient levels is unlikely to cause any substantial masking.

Vessel noise has the potential to disturb marine mammals and elicit an alerting, avoidance, or other behavioral reaction. These reactions are anticipated to be short-term, likely lasting the amount of time the vessel and the whale are in close proximity (e.g., Magalhaes et al. 2002; Richardson et al. 1995; Watkins 1981), and not consequential to the animals. We also note that we do not anticipate any project vessels to occur within close proximity of any ESA listed whales; regulations prohibit vessels from approaching right whales closer than 500m and the vessel strike avoidance measures identified in Section 3 (inclusive of Appendix A and B) are expected to ensure no project vessels operate in close proximity to any whales in the action area. Additionally, short-term masking could occur. Masking by passing ships or other sound sources transiting the action area would be short term and intermittent, and therefore unlikely to result in any substantial costs or consequences to individual animals or populations. Areas with increased levels of ambient noise from anthropogenic noise sources such as areas around busy shipping lanes and near harbors and ports may cause sustained levels of masking for marine mammals, which could reduce an animal's ability to find prey, find mates, socialize, avoid predators, or navigate.

Based on the best available information, ESA-listed marine mammals are either not likely to respond to vessel noise or are not likely to measurably respond in ways that would significantly disrupt normal or essential behavior patterns that include, but are not limited to, breeding, feeding or sheltering. Therefore, the effects of vessel noise on ESA-listed marine mammals are insignificant (i.e. so minor that the effect cannot be meaningfully evaluated or detected).

Operation of WTGs

In considering the potential effects of operational noise on ESA listed whales we consider the expected noise levels from the operational turbines and the ambient noise (i.e., background noise that exists without the operating turbines) in the WDA. Ambient noise is a relevant factor because if the operational noise is not louder than ambient noise we would not expect an animal to react to it.

Ambient noise includes the combination of biological, environmental, and anthropogenic sounds occurring within a particular region. In temperate marine environments including the WDA, major contributors to the overall acoustic ambient noise environment include the combination of surface wave action (generated by wind), weather events such as rain, lightning, marine organisms, and anthropogenic sound sources such as ships. In temperate marine environments including the WDA, major contributors to the overall acoustic ambient noise environment include the combination of surface wave action (generated by wind), weather events such as rain, lightning, marine organisms, and anthropogenic sound sources such as ships. The coastal waters of the Mid-Atlantic have relatively high levels of ambient noise, attributed to nearby shipping noise (Rice et al. 2014). Kraus et al. (2016) surveyed the ambient underwater noise environment in RI/MA. Depending on location, ambient underwater sound levels within the RI/MA waters varied from 96 to 103 dB in the 70.8- to 224-Hz frequency band at least 50% of the recording time, with peak ambient noise levels reaching as high as 125 dB in proximity to the Narraganset Bay and Buzzards Bay shipping lanes (Kraus et al. 2016). Van Parijs et al. (2023) used PAM to document ambient noise near the southern New England wind lease areas; median broadband SPLs of all available data at each site ranged from 105 to 112 dB (re 1 μPa) with some variability among sites and years. Daily median broadband SPLs were variable within and among sites, ranging from 96 to 129 dB (re 1 μPa). Salisbury et al. 2018 monitored ambient noise off the coast of Virginia in consideration of the hearing frequencies of a number of marine mammal species. In the right whale frequency band (71-224 Hz), ambient noise exceeded 110 dB 50% of the time and 115 dB 14% of the time. Noise levels in the fin whale frequency band (18-28 Hz) were lower than the other whale species, with noise levels exceeding 100 dB 50% of the time. Salisbury et al. 2018 monitored ambient noise off the coast of Virginia in consideration of the hearing frequencies of a number of marine mammal species. In the right whale frequency band (71-224 Hz), ambient noise exceeded 110 dB 50% of the time and 115 dB 14% of the time. Noise levels in the fin whale frequency band (18-28 Hz) were lower than the other whale species, with noise levels exceeding 100 dB 50% of the time.

As described above, many of the published measurements of underwater noise levels produced by operating WTGs range from older geared WTGs and are not expected to be representative of newer direct-drive WTGs, like those that will be installed for the Maryland Wind project. Elliott et al. (2019) notes that the direct-drive turbines measured at BIWF generated operational noise above background sound levels at the measurement location of 50 m (164 ft.) from the foundation. The authors also conclude that even in quiet conditions (i.e., minimal wind or weather noise, no transiting vessels nearby), operational noise at any frequency would be below background levels within 1 km (0.6 mi) of the foundation. This information suggests that in quiet conditions, a whale located within 1 km of the foundation may be able to detect operational noise above ambient noise conditions. However, given the typical ambient noise in the WDA, we expect these instances of quiet to be rare. Regardless, detection of the noise does not mean that there would be any effect to the individual.

Elliot et al. (2019) conclude that based on monitoring of underwater noise at the Block Island site, under most intense condition likely to occur, no risk of temporary or permanent hearing damage (PTS or TTS) could be projected even if an animal remained in the water at 50 m (164 ft.) from the turbine for a full 24-hour period. As such, we do not expect any PTS, TTS, or other potential injury to result from even extended exposure to the operating WTGs. The loudest noise recorded by Elliot et al. (2019) was 126 dB re 1uPa at 50 m from the turbine when wind speeds exceeded 56 km/h; at wind speeds of 43.2 km/h and less, measured noise did not exceed 120 dB re 1uPa at 50 m from the turbine (Eliot et al. 2019). As noted above, based on wind speed records within the WDA (US Wind COP) and the nearby NDBC station 44009 buoy, instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, occurring less than 1% of the time across a year. In a review of data from 27 operational wind farms in the North Sea (turbines between 2.3 and 8 MW), the mean (broadband) total SPL (SPL50 or L50) at nominal power of the turbines varied between 112 and 131 dB (median and mean value 120 dB) (Bellman et al. 2023). Bellman et al. (2023) also found that the low-frequency noise input from the wind turbine is no longer audible to individual marine mammals at distances of 100 m from the turbine. HDR 2023 found that noise levels recorded during the 6 MW CVOW turbine operations ranged from 120 to 130 dB re 1 μPa except during storms, when the received levels increased to 145 dB re 1 μPa. All recorded measurements were below the NMFS criteria for TTS and PTS for marine mammals. As described above these recent publications (Elliott et al.

2019, HDR 2023, Holme et al. 2023, and Bellman et al. 2023) are the best available data for estimating operational noise of the Maryland Wind turbines.

Given the conditions necessary to result in noise above 120 dB re 1uPa are expected to be rare (less than 3% of the time on an annual basis), and that in such windy conditions ambient noise is also increased, we do not anticipate the underwater noise associated with the operations noise of the direct-drive WTGs to result in avoidance of an area any larger than 50-100m from the WTG foundation. As such, even if ESA-listed marine mammals avoided the area with noise above ambient, any effects would be so small that they could not be meaningfully measured, detected, or evaluated, and are therefore insignificant.

We recognize that the data from Elliot et al. (2019) represents WTGs that are of a smaller capacity than those proposed for use at Maryland Wind. We also recognize the literature that has predicted larger sound fields for larger turbines. However, we note that Bellman et al. (2023) did not identify a strong correlation between noise and the nominal power of the turbines (between 2.3 and 8.0 MW) and that even the papers that predict greater operational noise (Tougaard et al. (2020) and Stober and Thomsen (2021)) note that operational noise is less than shipping noise; this suggests that in areas with consistent vessel traffic, such as the Maryland Wind WDA, operational noise is not expected to be detectable above ambient noise at a distance more than 50 -100 m from the foundation. Additionally, while there are no studies documenting distribution of large whales in an area before and after construction of a wind farm, data from other marine mammals (harbor porpoise) indicates that any reduction in abundance in the wind farm area that occurred during the construction period resolves and that harbor porpoise are as abundant in the wind farm area during project operations as they were before (Tougaard et al. 2006, Teilmann and Carstensen 2012, Thompson et al. 2010, Scheidat et al. 2011). This supports our determination that effects of operational noise are likely to be insignificant.

HRG Surveys

As explained above, HRG surveys are planned within the lease area and cable routes and are elements of the proposed action under consultation in this opinion. A number of minimization measures for HRG surveys are also included as part of the proposed action. This includes maintenance of a 500 m clearance and shutdown zone for North Atlantic right whales and 100 m clearance and shutdown zone for other ESA listed marine mammals during the operations of equipment that operates within the hearing frequency of these species (i.e., less than 180 kHz).

In their ITA application, US Wind requested Level B harassment take associated with HRG surveys during the 5-year effective period of the ITA. NMFS OPR has determined that the only survey activities that will produce noise that has the potential to result in exposure of marine mammals to noise above the Level B harassment threshold are the boomers and sparkers that will be used for a limited period (14 days) in each of two construction years to support micrositing. As described in the proposed MMPA ITA, the isopleth distances corresponding to the Level B harassment threshold for each type of HRG equipment with the potential to result in harassment of marine mammals were calculated per NMFS' Interim Recommendation for Sound Source Level and Propagation Analysis for HRG Sources. The distances to the 160 dB RMS re 1 μPa isopleth for Level B harassment are presented in Table 7.1.15 (see also Table 21 in the proposed MMPA ITA). The LOA application contains a full description of the methodology and formulas used to calculate distances to the Level B harassment threshold. NMFS OPR determined that the only proposed equipment with the potential to result in exposure of whales to noise above the Level B threshold are the boomer and sparkers.

Table 7.1.15 Horizontal Distances to Level B Harassment Threshold (160 dB_{rms} re 1 µPa)

HRG System	Representative Survey Equipment	Distance to Threshold (m)
Medium-penetration SBP	Applied Acoustics S Boomer	35.2
	AA Dura Spark 400 tip	200

Source: Table 21 in 89 FR 504

The basis for the MMPA take estimate is the number of marine mammals that would be exposed to sound levels in excess of the Level B harassment threshold (160 dB) calculated in consideration of the 200 m distance to the threshold (based on the sparker), distance covered by the survey vessel in each of the 14 days, and density of marine mammals in that area. More information on the density estimates and calculations used are presented in the Notice of Proposed ITA. Modeling predicts the exposure of 0.5 right whales, 1.3 fin whales, and 0.4 sei whales in each of the two years that micro-siting surveys will take place (see Table 22, proposed MMPA ITA). US Wind requested authorization for the take of 2 right whales and 2 fin whales for each of the two survey years, based on rounding up the annual exposure estimates to group size; NMFS OPR is proposing to authorize this take. US Wind did not request, and NMFS OPR is not proposing to authorize, any take of any sei or sperm whales due to exposure to HRG surveys.

As explained above, given the difference in the definitions between MMPA harassment and NMFS guidance defining take by harassment under the ESA, it is reasonable for NMFS OPR to find, in certain instances, that noise is likely to result in MMPA Level B harassment (i.e. potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns), while we determine that the intensity of those impacts is not severe enough to cause take by harassment under the ESA (i.e. create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns). As described below, we do not expect that exposure of any ESA listed whales to noise resulting from HRG surveys will result in any take as defined by the ESA. That is, we have determined that exposure of any ESA listed whales to noise above ESA behavioral harassment thresholds or at levels anticipated to cause take by harassment is extremely unlikely to occur. Further, if any exposure to noise resulting from HRG surveys were to occur, we expect the effects to be of very brief duration and marginal intensity causing only minor behavioral reactions and not TTS (i.e. so minor that they could not be detected, measured or evaluated: insignificant). We do not expect any effects to any ESA-listed whale's hearing to result from exposure to HRG noise sources. Based on these considerations, we have determined that all effects of exposure to HRG survey noise to be either insignificant or discountable. The basis for this conclusion is set forth below.

Extensive information on HRG survey noise and potential effects of exposure to ESA listed whales is provided in NMFS June 29, 2021 programmatic ESA consultation on certain geophysical and geotechnical survey activities (NMFS GAR 2021, inclusive of BOEM's 2021 BA) which we consider the best available science and information on these effects. We summarize the relevant conclusions here.

Based on the characteristics of the noise sources planned, no ESA listed whales are anticipated to be exposed to noise above the Level A harassment thresholds (peak or cumulative). The peak noise threshold is not exceeded at any distance; the cumulative noise threshold is less than 1m. It is extremely unlikely that a whale would be close enough to the sound source to experience any exposure at all, and even less likely that it would experience sustained exposure. This is due to both the very small distance from the source that noise above the threshold extends (less than 1 m) and because the sound source is being towed behind a vessel and therefore is moving. Considering the sources that would be used for the surveys, the distance to the Level B harassment threshold extends out to approximately 200 m from the source. Given the very small area ensonified and considering the source is moving, any exposure of ESA listed whales to noise above the Level B harassment threshold is extremely unlikely to occur. The use of PSOs to monitor a clearance and shutdown zone (500 m for right whales and 100 m for other ESA listed whales) makes exposure even less likely to occur.

In the unlikely event that a whale did get within 200 m of the source (the maximum distance from the source where noise is above the Level B harassment threshold), we expect that the result of this exposure would be, at worst, temporary avoidance of the area with underwater noise louder than this threshold, which is a reaction that is considered to be of low severity and with no lasting biological consequences (e.g., Southall et al. 2007). The noise source itself will be moving. This means that any co-occurrence between a whale, even if stationary, and the noise source will be brief and temporary. Given that exposure will be short (no more than a few seconds, given that the noise signals themselves are short and intermittent and because the vessel towing the noise source is moving) and that the reaction to exposure is expected to be limited to changing course and swimming away from the noise source only far/long enough to get out of the ensonified area (200 m or less), the effect of this exposure and resulting response will be so small that it will not be able to be meaningfully detected, measured or evaluated and, therefore, is insignificant. Further, the potential for substantial disruption to activities such as feeding (including nursing), resting, and migrating is extremely unlikely given the very brief exposure to any noise (given that the source is traveling and the area ensonified at any given moment is so small). Any brief interruptions of these behaviors are not anticipated to have any lasting effects. Additionally, given the extremely short duration of any measurable behavioral disruption and the very small distance any animal would have to swim to avoid the noise it is extremely unlikely that the behavioral response would increase the risk of exposure to other threats including vessel strike or entanglement in fisheries gear. Thus, while we anticipate effects to be discountable as explained above, even in the extremely unlikely event that such effects were to occur, we anticipate the effects of these temporary behavioral changes to be so minor as to be insignificant. Insignificant and discountable effects are not adverse effects and thus cannot result in ESA take by harassment or otherwise.

In the Notice of Proposed ITA, NMFS OPR concluded that marine mammal communications would not likely be masked by the sub-bottom HRG survey equipment types planned for use for the types of surveys considered here and the brief period when an individual mammal is likely to be within its beam. Because effects of masking, if any, will be so small that they cannot be meaningfully measured, evaluated, or detected, any effects of masking on ESA-listed whales will be insignificant.

7.1.4 Effects of Project Noise on Sea Turtles

Background Information – Sea Turtles and Noise
Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol and Ketten 2006, Bartol et al. 1999, Lenhardt 1994, Lenhardt 2002, Ridgway et al. 1969). Below, we summarize the available information on expected responses of sea turtles to noise.

Stress caused by acoustic exposure has not been studied for sea turtles. As described for marine mammals, a stress response is a suite of physiological changes that are meant to help an organism mitigate the impact of a stressor. If the magnitude and duration of the stress response is too great or too long, it can have negative consequences to the animal such as low reproductive rates, decreased immune function, diminished foraging capacity, etc. Physiological stress is typically analyzed by measuring stress hormones (such as cortisol), other biochemical markers, and vital signs. To our knowledge, there is no direct evidence indicating that sea turtles will experience a stress response if exposed to acoustic stressors such as sounds from pile driving. However, physiological stress has been measured for sea turtles during nesting, capture and handling (Flower et al. 2015; Gregory and Schmid 2001; Jessop et al. 2003; Lance et al. 2004), and when caught in entangling nets and trawls (Hoopes et al. 2000; Snoddy et al. 2009). Therefore, based on their response to these other anthropogenic stressors, and including what is known about cetacean stress responses, we assume that some sea turtles will exhibit a stress response if exposed to a detectable sound stressor.

Marine animals often respond to anthropogenic stressors in a manner that resembles a predator response (Beale and Monaghan 2004b; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). As predators generally induce a stress response in their prey (Dwyer 2004; Lopez and Martin 2001; Mateo 2007), we assume that sea turtles may experience a stress response if exposed to acoustic stressors, especially loud sounds. We expect breeding adult females may experience a lower stress response, as studies on loggerhead, hawksbill, and green turtles have demonstrated that females appear to have a physiological mechanism to reduce or eliminate hormonal response to stress (predator attack, high temperature, and capture) in order to maintain reproductive capacity at least during their breeding season; a mechanism apparently not shared with males (Jessop 2001; Jessop et al. 2000; Jessop et al. 2004). We note that the only portion of the action area where breeding females may occur is the portion of vessel transit routes between Charleston, SC and the WDA that travel south of Virginia and that presence is limited seasonally.

Based on the limited information about acoustically induced stress responses in sea turtles, it is reasonable to assume that physiological stress responses would occur concurrently with any other response such as hearing impairment or behavioral disruptions. However, we expect such responses to be brief, with animals returning to a baseline state once exposure to the acoustic source ceases. As with cetaceans, such a short, low-level stress response may in fact be adaptive and, in part, beneficial as it may result in sea turtles exhibiting avoidance behavior, thereby minimizing their exposure duration and risk from more deleterious, high sound levels.

Effects to Hearing
Interference, or masking, occurs when a sound is a similar frequency and similar to or louder than the sound an animal is trying to hear (Clark et al. 2009; Erbe et al. 2016). Masking can interfere with an individual's ability to gather acoustic information about its environment, such as predators, prey, conspecifics, and other environmental cues (Richardson 1995). This can result in loss of environmental cues of predatory risk, mating opportunity, or foraging options. Compared to other marine animals, such as marine mammals, which are highly adapted to use sound in the marine environment, sea turtle hearing is limited to lower frequencies and is less sensitive. Because sea turtles likely use their hearing to detect broadband low-frequency sounds in their environment, the potential for masking would be limited to certain sound exposures. Only continuous anthropogenic sounds that have a significant low-frequency component, are not of brief duration, and are of sufficient received level could create a meaningful masking situation (e.g., long-duration vibratory pile extraction or long term exposure to vessel noise affecting natural background and ambient sounds); this type of noise exposure is not anticipated based on the characteristics of the sound sources considered here.

There is evidence that sea turtles may rely primarily on senses other than hearing for interacting with their environment, such as vision (Narazaki et al. 2013), magnetic orientation (Avens and Lohmann 2003; Putman et al. 2015), and scent (Shine et al. 2004). Thus, any effect of masking on sea turtles would likely be mediated by their normal reliance on other environmental cues.

Behavioral Responses
To date, very little research has been done regarding sea turtle behavioral responses relative to underwater noise. Hawkins and Popper (2014) describes relative risk (high, moderate, low) for sea turtles exposed to pile driving noise and concludes that risk of a behavioral response decreases with distance from the pile being driven. O'Hara and Wilcox (1990) and McCauley et al. (2000b), who experimentally examined behavioral responses of sea turtles in response to seismic airguns. O'Hara and Wilcox (1990) found that loggerhead turtles exhibited avoidance behavior at estimated sound levels of 175 to 176 dB re: 1 µPa (rms) (or slightly less) in a shallow canal. Mccauley et al. (2000a) experimentally examined behavioral responses of sea turtles in response to seismic air guns. The authors found that loggerhead turtles exhibited avoidance behavior at estimated sound levels of 175 to 176 dB rms (re: 1 µPa), or slightly less, in a shallow canal. Mccauley et al. (2000a) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dB rms (re: 1 µPa). At 175 dB rms (re: one µPa), both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior (Mccauley et al. 2000a). Based on these data, NMFS GARFO finds that sea turtles would exhibit a behavioral response in a manner that constitutes take by harassment, as defined for ESA take purposes above in this opinion, when exposed to received levels of 175 dB rms (re: 1 µPa) for a period long enough such that the behavioral response significantly disrupts normal behavioral patterns. This is the level at which sea turtles are expected to begin to exhibit avoidance behavior based on experimental observations of sea turtles exposed to multiple firings of nearby or approaching air guns.

7.1.4.1 Thresholds Used to Evaluate Effects of Project Noise on Sea Turtles
In order to evaluate the effects of exposure to noise by sea turtles that could result in physical effects, NMFS relies on the available literature related to the noise levels that would be expected to result in sound-induced hearing loss (i.e., TTS or PTS); we relied on acoustic thresholds for PTS and TTS for impulsive sounds developed by the U.S. Navy for Phase III of their programmatic approach to evaluating the environmental effects of their military readiness activities (U.S. Navy 2017). At the time of this consultation, we consider these the best available data since they rely on all available information on sea turtle hearing and employ the same methodology to derive thresholds as in NMFS recently issued technical guidance for auditory injury of marine mammals (NMFS 2018). Below we briefly detail these thresholds and their derivation. More information can be found in the U.S. Navy's Technical report on the subject (U.S. Navy 2017).

To estimate received levels from airguns and other impulsive sources expected to produce TTS in sea turtles, the U.S. Navy compiled all sea turtle audiograms available in the literature in an effort to create a composite audiogram for sea turtles as a hearing group. Since these data were insufficient to successfully model a composite audiogram via a fitted curve as was done for marine mammals, median audiogram values were used in forming the hearing group's composite audiogram. Based on this composite audiogram and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to TTS. Data from fishes were used since there are currently no data on TTS for sea turtles and fishes are considered to have hearing range more similar to sea turtles than do marine mammals (Hawkins and Popper 2014). Assuming a similar relationship between TTS onset and PTS onset as has been described for humans and the available data on marine mammals, an extrapolation to PTS susceptibility of sea turtles was made based on the methods proposed by Navy 2017. From these data and analyses, dual metric thresholds were established similar to those for marine mammals: one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the auditory weighting function nor the duration of exposure, and another based on cumulative sound exposure level (SELcum) that incorporates both the auditory weighting function and the exposure duration (Table 7.1.16). The cumulative metric accumulates all sound exposure within a 24-hour period and is therefore different from a peak, or single exposure, metric.

Table 7.1.16 Acoustic thresholds identifying the onset of permanent threshold shift and Temporary threshold shift for sea turtles exposed to impulsive sounds (U.S. Navy 2017)

Hearing Group	Generalized Hearing Range	Permanent Threshold Shift Onset	Temporary Threshold Shift Onset
Sea Turtles	30 Hz to 2 kHz	204 dB re: 1 $Pa^2 \cdot s$ SEL_{cum} 232 dB re: 1 μPa SPL (0-pk)	189 dB re: 1 $\mu Pa^2 \cdot s$ SEL_{cum} 226 dB re: 1 μPa SPL (0-pk)

Criteria for Considering Behavioral Effects
For assessing behavioral effects, in the BA BOEM used the 175 dB re 1uPa RMS criteria based on McCauley et al. (2000b), consistent with NMFS recommendations. This level is based upon work by Mccauley et al. (2000a), who experimentally examined behavioral responses of sea turtles in response to seismic air guns. The authors found that loggerhead turtles exhibited

avoidance behavior at estimated sound levels of 175 to 176 dB rms (re: 1 µPa), or slightly less, in a shallow canal. Mccauley et al. (2000a) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dB rms (re: 1 µPa). At 175 dB rms (re: 1 µPa), both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior (Mccauley et al. 2000a). Based on these data, NMFS assumes that sea turtles would exhibit a significant behavioral response when exposed to received levels of 175 dB rms (re: 1 µPa). This is the level at which sea turtles are expected to begin to exhibit avoidance behavior based on experimental observations of sea turtles exposed to multiple firings of nearby or approaching air guns. Because data on sea turtle behavioral responses to pile driving is limited, the air gun data set is used to inform potential risk.

7.1.4.2 Effects of Project Noise on Sea Turtles

Here, we consider the effects of the noise producing activities of the Maryland Wind project in the context of the noise thresholds presented above.

Impact Pile Driving for WTG, OSS, and Met Tower Foundation Installation

Modeling was carried out to determine distances to the onset of injury and behavioral disruption thresholds for sea turtles exposed to pile driving sound for the different foundation types (11-m monopile, four 3-m skirt piles, and three 1.8-m post-piled pin piles) (MAI, 2024). Similar to the results presented for marine mammals, the acoustic ranges for sea turtles were modeled assuming 10 dB broadband attenuation and a summer acoustic propagation environment (MAI, 2024). For the sound exposure level (SEL, cumulative exposure) criteria, acoustic energy was accumulated for all pile driving strikes in a 24 hour period.

Acoustic range estimates for the modeled piles and pile locations for sea turtles are included in MAI, 2023. Based on these results, noise is not expected to exceed the peak injury criteria (232 dB) beyond 50 m during any pile driving for the Maryland Wind project. Acoustic ranges for the modeled piles and pile locations for sea turtles are included in MAI, 2024; the tables include the distances to the cumulative injury (PTS), TTS, and behavioral disturbance thresholds. The modeling results are presented in table 7.1.17 below.

Table 7.1.17 Acoustic ranges (m) (95th percentile) to PTS, TTS, and behavioral threshold levels for sea turtles (DoN 2017) modeled for May with 10 dB attenuation for the three pile types.

	Range to Threshold (m)				
Pile Type	**PTS peak**	**PTS SEL24 hr**	**TTS peak**	**TTS SEL24 hr**	**Behavioral**
11 m monopile	<50	250	<50	2,750	850
3 m pin	<50	50	<50	1,000	0
1.8 m pin	<50	0	<50	50	0

(Source: Tables 6-24 to 6-26 in BOEM's BA, original source MAI 2024)

Modeling was carried out to determine the numbers of individual sea turtles predicted to receive sound levels above the cumulative injury and behavioral disturbance criteria using animal movement modeling (MAI, 2023). MAI (2023) used the AIM model to predict the exposure of animats (virtual sea turtles) to sound arising from sound sources. An individual animat's modeled sound exposure levels are summed over the total simulation duration, to determine its total received energy, and then compared to the assumed threshold criteria. The tables below include results assuming broadband attenuation of 10 dB for impact pile driving with maximum seasonal densities for each species (as described below). No aversion behaviors (e.g., avoidance) or mitigation measures (e.g., shutdown zones) other than the 10 dB attenuation for impact pile driving were incorporated into the modeling to generate the number of sea turtles of each species that are expected to be exposed to the noise.

As described in MAI (2023) and in BOEM's BA, there are limited density estimates for sea turtles in the WDA. Few at-sea density data are available for sea turtles. For the Project area, two sources of sea turtle densities represent the best available at-sea density data for sea turtles: DoN (2007) and Barco et al. (2018). The DoN (2007) density estimates were prepared for the Navy's U.S. Atlantic operating areas; the Project area lies within one of the Navy's operating areas. However, densities of sea turtles are available only by season and not by month from the DoN (2007) data. The DoN (2007) densities are based on grid cells for the U.S. Atlantic. Only DoN (2007) grid cells that fell within the buffered lease area were included in the seasonal density estimates for each potentially occurring turtle species.

More recent loggerhead turtle density estimates for the Project area are available in Barco et al. (2018). These more recent loggerhead densities presented in Barco et al. (2018) are much higher than the older DoN (2007) estimates for the loggerhead turtle. Additionally, Barco et al. (2018) included a seasonal availability correction factor. Instead of selecting one of these loggerhead density estimates for the calculation of acoustic exposure to loggerheads, both the DoN (2007) and Barco et al. (2018) loggerhead turtle density estimates are included in the BA; the exposure estimates based on Barco et al. 2018 are considered here as they present a reasonable estimate of the maximum anticipated number of loggerheads exposed to pile driving noise.

Although green turtles occur seasonally in the WDA, no at-sea density estimates are available. Since available occurrence data for the green turtle were included in the "Hardshelled Guild" in the DoN (2007) density dataset, the seasonal density estimate from this guild was used as a surrogate density for the green turtle. The U.S. Navy set the precedent for using the hard-shelled guild's density estimates to represent the green turtle (DoN 2017a).

Table 7.1.18 Sea turtle seasonal densities (DoN 2007, Barco et al. 2018) in the lease area plus a 5.25 km buffer. The modeling group indicates that all sea turtles were modeled as a group instead of as an individual species

Turtle Species	**Densities (animals per km^2)**			
	Spring (March to	**Summer (June to**	**Fall (September**	**Winter (December**

	May)	August)	to November)	to February)
Green turtle (Hardshelled guild)	0.03802	0.05041	0.03802	0.03802
Kemp's ridley turtle	0.00220	0.00226	0.00220	0.00220
Leatherback turtle	0.02040	0.02706	0.02040	0.02040
Loggerhead turtle (DoN 2007)	0.05858	0.07848	0.05712	0.05843
Loggerhead turtle (Barco et al. 2018)	3.319	1.385	1.488	

(Source: Table 6 in MAI 2024, also BOEM's BA)

As explained in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, due to seasonal water temperature patterns, sea turtles are most likely to occur in the WDA in the summer and fall, with turtles absent in the winter months (January – April).

We considered whether sufficient information was available on detection rates from aerial surveys from which we could further adjust the exposure estimates. We reviewed the underlying reports that informed the density estimates and note that they do not appear to make any adjustments to sea turtle sightings based on detectability from the survey platform. Describing an aerial survey in the MA/RI Wind Energy Area, Kraus et al. (2016) notes that the number of sea turtle sightings was substantially increased by detections in the vertical camera (mounted under the plane) compared to the number observed by observers using binoculars during the aerial survey but does not provide any information on overall sea turtle detectability nor does it adjust observations to account for availability bias.

Some studies have concurrently conducted tagging studies to account for availability bias. We reviewed the literature for similar studies conducted in the lease area, however no studies were found. NEFSC 2011 estimated regional abundance of loggerhead turtles in Northwestern Atlantic Ocean continental shelf waters using aerial surveys and accounted for availability bias using satellite tags. However, as determining availability bias depends on the species and is influenced by habitat, season, sea surface temperature, time of day, and other factors, we determined that while we may be able to identify studies that identified availability bias (such as NEFSC 2011) it would not be reasonable to apply those post-hoc to the density estimates given differences in the study designs, location, habitat, sea surface temperature, etc.

We also considered whether it would be reasonable to adjust the density estimates to account for the percent of time that sea turtles are likely to be at the surface while in the WDA and therefore would be available to be detected for such a survey. However, after consulting with subject matter experts we determined it was not reasonable to adjust the density estimates with general observations about the amount of time sea turtles may be spending at the surface. Therefore, we have determined that there is no information available for us to use that could result in a different estimate of the amount of exposure that is reasonably certain to occur and have not made any further adjustments to the exposure estimates. As such, the density estimates provided in MAI, 2024 as derived from the cited data sources are considered the best available scientific information.

As explained above, modeling was carried out for the anticipated pile driving scenarios (i.e., one 11-m monopiles per day, four 3-m skirt piles per day, and three 1.8-m post-piled pin piles per day). Considering all scenarios, no sea turtles are expected to be exposed to noise above the peak injury (PTS) threshold; this is because noise during pile driving is not expected to exceed the peak injury (PTS) threshold beyond a distance of 50 m from any pile, which is expected to be well within the bubble curtains. The tables below contain the modeled number of sea turtles predicted to be exposed to noise above the injury and behavioral thresholds. These estimates do not account for any aversion behavior (i.e., avoidance of pile driving noise) and they do not incorporate the clearance or shutdown zones.

Table 7.1.19 Predicted maximum annual PTS, TTS, and behavioral exposures of ESA-listed sea turtles during impact pile driving of 36.1-ft (11-m) monopiles during the 3 years of construction planned for the Proposed Action with 10 dB noise attenuation as Presented in the BA

Species	Construction Year	PTS	TTS	Behavior
Green sea turtle	Year 1	0	25.13	3.59
	Year 2	0	72.08	10.30
	Year 3	0	53.64	7.66
	Total	**0**	**150.85**	**21.55**
Kemp's ridley sea turtle	Year 1	0	1.31	0.19
	Year 2	0	3.45	0.49
	Year 3	0	2.40	0.34
	Total	**0**	**7.16**	**1.02**
Leatherback sea turtle	Year 1	0	13.49	1.93
	Year 2	0	38.69	5.53
	Year 3	0	28.79	4.11
	Total	**0**	**149.28**	**11.57**
Loggerhead sea turtle	Year 1	0	344.65	49.24
	Year 2	0	1,406.33	200.90
	Year 3	0	866.54	123.79
	Total	**0**	**2,617.52**	**373.93**

(Source: Table 6-27 in BOEM's BA).

Table 7.1.20 Predicted maximum annual PTS, TTS, and behavioral exposures[a] of ESA-listed sea turtles during impact pile driving of 9.8-foot (3-meter) OSS skirt piles during the 3 years of construction planned for the Proposed Action with 10 dB noise attenuation as Presented in the BA

Species	Construction Year	PTS	TTS	Behavior
Green sea turtle	Year 1	0	0.20	0
	Year 2	0	0.40	0
	Year 3	0	0.20	0
	Total	**0**	**0.80**	**0**
Kemp's ridley sea turtle	Year 1	0	0.01	0
	Year 2	0	0.02	0
	Year 3	0	0.01	0
	Total	**0**	**0.03**	**0**
Leatherback sea turtle	Year 1	0	0.11	0
	Year 2	0	0.22	0
	Year 3	0	0.11	0
	Total	**0**	**0.44**	**0**
Loggerhead sea turtle	Year 1	0	2.42	0
	Year 2	0	4.85	0
	Year 3	0	2.42	0
	Total	**0**	**9.69**	**0**

(Source: Table 6-28 in BOEM's BA)

Table 7.1.21 Predicted maximum annual PTS, TTS, and behavioral exposures of ESA-listed sea turtles during impact pile driving of 5.9-foot (1.8-meter) Met Tower pin piles during the second year of construction for the second construction campaign planned for the Proposed Action with 10 dB noise attenuation as presented in BOEM's BA

Species	PTS	TTS	Behavior
Green sea turtle	0	0	0
Kemp's ridley sea turtle	0	0	0
Leatherback sea turtle	0	0	0
Loggerhead sea turtle[a]	0	0	0

(Source: Table 6-29 in BOEM's BA)

Considering all scenarios, a sea turtle would need to be within 50 m of the pile being driven to be exposed to noise that could result in TTS (temporary loss of hearing sensitivity) as a result of a single pile strike. We do not expect any sea turtles to be exposed to noise above the peak TTS threshold; this is because noise during pile driving is not expected to exceed this threshold beyond a distance of 50 m from any pile, which is expected to be well within the bubble curtains. Considering the cumulative TTS threshold, in order for a sea turtle to experience TTS, the individual would need to remain in the area around the pile where noise is above the cumulative TTS threshold for the entire duration of pile driving in a 24 hour period. This means a sea turtle would need to stay within an area less than 3 km from the pile for the entire duration of monopile installation (2 hours), within 1 km for the 8 hour duration of 3 m pin piles for a jacket foundation, and within 50 m for the 4 hour duration of 1.8 m pin piles for a jacket foundation: This is extremely unlikely to occur given the expected aversion/avoidance behavior. The pre-construction clearance procedures and the shutdown procedures further reduce this already extremely unlikely possibility. As such, while modeling predicts exposure of sea turtles that would experience TTS we consider this extremely unlikely to occur; therefore, effects of TTS are discountable and we do not expect any sea turtles to experience any permanent or temporary losses of hearing sensitivity as a result of exposure to pile driving noise.

Proposed Measures to Minimize Exposure of Sea Turtles to Pile Driving Noise
Here, we consider the measures that are part of the proposed action, because they are proposed by US Wind or BOEM and are reflected in the proposed action as described to us by BOEM in the BA, or they are proposed to be required through the ITA (recognizing that those measures are required for marine mammals but may provide benefit to sea turtles). Specifically, we consider if and how those measures will serve to minimize exposure of ESA listed sea turtles to pile driving noise. Details of these proposed measures are included in the Description of the Action section above. We do not consider the use of PAM here; because sea turtles do not vocalize, PAM cannot be used to monitor sea turtle presence.

Seasonal Restriction on Pile Driving
No impact pile driving activities for monopiles would occur between December 1 and April 30 to avoid the time of year with the highest densities of right whales in the project area. The December 1 – April 30 period overlaps with the period when we do not expect sea turtles to occur in the action area due to cold water temperatures. This seasonal restriction is factored into the acoustic modeling that supported the development of the amount of exposure estimates above. That is, the modeling does not consider any pile driving in the December 1 – April 30 period. Thus, the exposure estimates do not need to be adjusted to account for this seasonal restriction.

Sound Attenuation Devices and Sound Field Verification
US Wind will implement sound attenuation measures that are designed and projected to achieve at least a 10 dB reduction in pile driving noise, as described above. The attainment of a 10 dB reduction in pile driving noise was incorporated into the exposure estimate calculations presented above. Thus, the exposure estimates do not need to be adjusted to account for the use of sound attenuation. If a reduction greater than 10 dB is achieved, the number of sea turtles exposed to pile driving noise could be lower as a result of smaller distances to thresholds of concern.

As described above, US Wind will conduct hydroacoustic monitoring (sound field verification) for a subset of impact-driven piles. The required sound field verification will provide information necessary to confirm that the sound source characteristics predicted by the modeling are reflective of actual sound source characteristics in the field. If noise levels are higher than predicted by the modeling described here (i.e., measured distances exceed the distances to the peak and/or cumulative injury and/or behavioral disturbance thresholds identified in table 7.1.23), additional or alternative noise attenuation measures will be implemented to reduce noise and avoid exceeding the modeled distances to the injury and behavioral disturbance thresholds that were analyzed here. In the event that noise attenuation measures and/or adjustments to pile driving cannot reduce the distances to less than those modeled (assuming 10 dB attenuation), this would indicate the amount or extent of taking specified in the incidental take statement might be exceeded and/or constitute new information that reveals effects of the action that may affect listed species in a manner or to an extent not previously considered and reinitiation of this consultation is expected such that reinitiation of consultation would be necessary consistent with 50 CFR 402.16.

Clearance and Shutdown Zone

BOEM will require US Wind to use PSOs to establish clearance zones of 250 m around the pile being driven to ensure the area is clear of sea turtles prior to the start of pile driving. PSOs will be located at an elevated location on the pile driving platform and on at least one additional vessel at a distance from the pile driving platform determined to ensure maximum detection probability of animals in the clearance and shutdown zones. Prior to the start of pile driving activity, the 250m clearance zone will be monitored for 60 minutes for protected species including sea turtles. If a sea turtle is observed approaching or entering the clearance zone prior to the start of pile driving operations, pile driving activity will be delayed until either the sea turtle has voluntarily left the respective clearance zone and been visually confirmed beyond that clearance zone, or, 30 minutes have elapsed without re-detection of the animal. Sea turtles observed within a clearance zone will be allowed to remain in the clearance zone (*i.e.*, must leave of their own volition), and their behavior will be monitored and documented. The clearance zones may only be declared clear, and pile driving started, when the entire clearance zone is visible (*i.e.*, when not obscured by dark, rain, fog, etc.) for a full 30 minutes prior to pile driving. If a sea turtle is observed entering or within the 250 m clearance zone after pile driving has begun, the PSO will request a temporary cessation of pile driving as explained for marine mammals above. As explained above, even without the clearance and shutdown zones, we consider that exposure to pile driving noise that would result in PTS or TTS to be extremely unlikely to occur.

As required by the MMPA ITA, there will be at least three PSOs stationed at an elevated position on the pile driving platform and at least three PSOs on at least one dedicated PSO vessel stationed or transiting to allow effective monitoring of the entirety of the minimum visibility (2,900 m for monopiles, 1,400 m for 3- m pin piles, 200 m for 1.8 m pin piles), clearance, and shutdown zones identified in the proposed MMPA ITA. Conditions of COP approval require adequate PSO coverage to ensure effective monitoring of the clearance and shutdown zones. Given that PSOs at an elevated position are expected to reasonably be able to detect sea turtles at a distance of 500 m from their station, we expect that the PSOs from the pile driving platform will be able to effectively monitor the 250 m clearance zone and that the PSOs on the PSO vessels will provide additional information on sea turtles detected outside the clearance zone. While visibility of sea turtles in the clearance zone is limited to only sea turtles at or very near the surface, we expect that the monitoring the clearance zone and not starting pile driving until no sea turtles have been detected for 60 minutes will reduce the number of times that pile driving begins with a sea turtle closer than 250 m to the pile being driven. The single strike PTS and TTS (peak) thresholds will only be exceeded in very close proximity to any pile (less than 50 m, so within the bubble curtains); it is extremely unlikely that a sea turtle would be that close to a pile and not observed during the clearance period. As explained above, it is extremely unlikely that a sea turtle would remain close enough to any pile being installed for the full duration of a day's pile driving to be exposed to noise that would meet the cumulative PTS or TTS threshold. The clearance and shutdown procedures further reduce this potential. Noise during the pin pile installation does not exceed the behavioral disturbance threshold.

Soft Start
As described above, before full energy pile driving begins, the hammer will operate at 10-20% energy for 20 minutes (330 – 660 kJ for WTG monopiles, 150-300 kJ for pin piles). At these hammer energies, underwater noise would not exceed the peak threshold for considering PTS for sea turtles; noise above the 175 dB re 1uPa threshold would extend a few hundred meters from the pile during the soft start period for monopiles. The use of the soft start gives sea turtles near enough to the piles to be exposed to the soft start noise a "head start" on escape or avoidance behavior by causing them to swim away from the source. This means that sea turtles within the clearance zone that had not been detected by the PSOs would be expected to begin to swim away from the noise before full force pile driving begins; this further reduces the potential for a sea turtle remaining close enough to any pile being actively driven to experience PTS or TTS. It is likely that by eliciting avoidance behavior prior to full power pile driving, the soft start will reduce the duration of exposure to noise that could result in behavioral disturbance. In this context, soft start is a minimization measure designed to reduce the amount and severity of effects incidental to pile driving. However, we are not able to predict the extent to which the soft start will reduce the number of sea turtles exposed to pile driving noise or the extent to which it will reduce the duration of exposure. Therefore, we are not able to modify the estimated exposures to noise above the behavioral disturbance threshold to account for any benefit provided by the soft start.

7.1.4.1 Effects to Sea Turtles Exposed to Impact Pile Driving Noise for Foundation Installation
As explained above, we have determined that exposure to noise above the peak or cumulative PTS or TTS threshold is extremely unlikely to occur. As such, we do not expect any sea turtles to experience permanent acoustic injury, any other type of injury or temporary hearing impairment, or due to exposure to pile driving noise.

The exposure analysis predicts exposure of sea turtles to noise expected to result in a behavioral response (i.e., above the 175 dB re 1uPa threshold). In the table below we present the modeled exposures above the 175 dB re 1uPa behavioral threshold as whole numbers. We have rounded up fractions to whole animals with the exception that fractions 0.1 or less have been rounded down to zero as we consider modeled exposures at that level extremely unlikely to occur. Note that exposure above this threshold is only expected to occur during impact pile driving for monopiles.

Table 7.1.22 Total Number of Sea Turtles Predicted to be Exposed to Noise above the Behavioral Harassment Threshold During Impact Pile Driving for Monopiles (with 10 dB attenuation) - all 3 years total.

Species	Number of Individuals
Green turtle	22
Kemp's ridley turtle	1
Leatherback turtle	12
Loggerhead turtle	374

(Source: Table 6-27 in BOEM's BA)

As described in the table above, we expect up to 22 green, 1 Kemp's ridley, 12 leatherback, and 374 loggerheads will be exposed to noise above the behavioral disturbance threshold over the 3 years of foundation installation.

Masking

Sea turtle hearing abilities and known use of sound to detect environmental cues is discussed above. Sea turtles are thought capable of detecting nearby broadband sounds, such as would be produced by pile driving. Thus, environmental sounds, such as the sounds of waves crashing along coastal beaches or other important cues for sea turtles, could possibly be masked for a short duration during pile driving. However, any masking would not persist beyond the period a sea turtle is exposed to the pile driving noise (likely minutes but in no case more than the approximately 2 hours it takes to drive a single monopile). As addressed in Hazel et al. (2004), sea turtle reaction to vessels is thought to be based on visual cues and not sound; thus, we do not expect that any masking would increase the risk of vessel strike as sea turtles are not expected to rely on the noise of vessels to avoid vessels.

Behavioral Response and Stress

Based on prior observations of sea turtle reactions to sound, if a behavioral reaction were to occur, the responses could include increases in swim speed, change of position in the water column, or avoidance of the sound. The area where pile driving will occur is not known to be a breeding area and is over 200 km north of the nearest beach where sea turtle nesting has been documented (Virginia Beach, VA). Therefore, breeding adults and hatchlings are not expected in the area. The expected behavioral reactions would temporarily disrupt migration, feeding, or resting. However, that disruption will last for no longer than it takes the sea turtle to swim away from the noisy area (less than 1 km) and displacement from a particular areas would last, at the longest, the duration of pile driving (up to 2 hours for a monopile). There is no evidence to suggest that any behavioral response would persist beyond the duration of the sound exposure, which in this case is the time it takes the turtle to swim less than 1 km or the time to drive a pile, approximately 2 hours. For migrating sea turtles, it is unlikely that this temporary disturbance, which would result in a change in swimming direction, would have any long-term or significant consequence to the animal. Resting sea turtles are expected to resume resting once they swim away from the noise. Foraging sea turtles would resume foraging once suitable forage is located outside the noisy area.

While in some instances, temporary displacement from an area may have significant consequences to individuals or populations this is not the case here. For example, if individual turtles were prevented from accessing nesting beaches and missed a nesting cue or were precluded from a foraging area for an extensive period, there could be impacts to reproduction and the health of individuals, respectively. However, the area where noise may be at disturbing levels at any one time is an extremely small portion of the coastal area used for north-south and south-north migrations and is only a fraction of the WDA used by foraging sea turtles. We have no information to indicate that any particular portion of the WDA is more valuable to sea turtles than another and no information to indicate that resting, foraging and migrating cannot take place in any portion of the WDA or that any area is better suited for these activities than any other area. A disruption in migration, feeding, or resting for no more than the period the animal is exposed to pile driving noise (up to 2 hours and likely even less given the short distance a sea turtle would need to swim to avoid the noise), is not expected to result in any reduction in the health or fitness of any sea turtle. Additionally, significant behavioral responses that result in disruption of important life functions are more likely to occur from multiple exposures within a longer period of time; while we expect that some individuals could be exposed to noise from more than one pile installation, the noise exposure would be limited to noise that could result in behavioral disturbance only.

Concurrent with the above responses, sea turtles are also expected to experience physiological stress responses. Stress is an adaptive response and does not normally place an animal at risk. Distress involves a chronic stress response resulting in a negative biological consequence to the individual. While all ESA-listed sea turtles that experience behavioral responses are also expected to experience a stress response, such responses are expected to be short-term in nature given the duration of pile driving (no more than 2 hours at a time) and, if there is exposure of a single individual to more than one pile driving event, there would be recovery in between. As such, we do not anticipate stress responses would be chronic, involve distress, or have negative long-term impacts on any individual sea turtle's fitness.

All behavioral responses to a disturbance, such as those described above, will have an energetic or metabolic consequence to the individual reacting to the disturbance (e.g., adjustments in migratory movements or disruption/delays in foraging or resting). Short-term interruptions of normal behavior are likely to have little effect on the overall health, reproduction, and energy balance of an individual or population (Richardson *et al.* 1995). As the disturbance will occur for a portion of each day for a period of up to approximately 22 days in year 1 of foundation pile driving, 58 days in year 2, and up to 39 days in year 3, with exposure to noise that could result in a behavioral response experienced for no more than 2 hours per day, this exposure and displacement will be temporary and not chronic (although it may be repetitive). Therefore, any interruptions in behavior and associated metabolic or energetic consequences will similarly be temporary. Thus, we do not anticipate any impairment of the overall health, survivability, or reproduction of any individual sea turtle due to avoidance or displacement resulting from exposure to pile driving noise.

As explained above, we do not expect masking to increase the risk of vessel strike as sea turtles are expected to rely on visual, rather than acoustic, cues when attempting to avoid vessels. We have considered if the avoidance of pile driving noise is likely to result in an increased risk of vessel strike or entanglement in fishing gear. This could theoretically occur if displacement from an area ensonified by pile driving noise resulted in individuals moving into areas where vessel traffic was higher or where fishing gear was more abundant. Information available in the Navigational Safety Risk Assessment describes vessel traffic and fishing activity within and outside the WFA where pile driving will occur; additional mapping products are viewable at northeastoceandata.org (e.g., all VMS vessels 2015-2019 and Annual vessel transit counts). Based on the available information, we do not expect avoidance of pile driving noise to result in an increased risk of vessel strike or entanglement in fishing gear. This determination is based on the relatively small size of the area with noise that a sea turtle is expected to avoid (no more than 850 m from the pile being installed), the short term nature of any disturbance, the limited number of sea turtles impacted, and the lack of any significant differences in vessel traffic or fishing activity in that 850 m area that would put a sea turtle at greater risk of vessel strike or entanglement/capture.

We evaluate the potential for noise produced by the proposed action to cause ESA take by harassment. As explained above, the NMFS Interim Guidance on the ESA Term "Harass" (NMFS PD-02-110-19) provides for a four-step process to determine if a response meets the definition of harassment. Here, we carry out that four-step assessment to determine if the effects to the up to 1 Kemp's ridley, 12 leatherback, 374 loggerhead, and 22 green sea turtles expected to be exposed to noise above the 175 dB threshold but below the injury threshold meet the definition of harassment. We have established that these individual sea turtles will be exposed to disturbing levels of noise (step 1). For an individual, the nature of this exposure is expected to be limited to exposure to pile driving noise that is expected to result in behavioral disturbance/aversion behavior but not affect hearing (i.e., no PTS or TTS is expected) and will last for as long as it takes the individual to swim away from the disturbing noise or, at maximum, the duration of the monopile driving event (up to 2 hours); this disruption will occur in areas where individuals may be migrating, foraging, or resting (step 2). Animals that are exposed to this noise are expected to abandon their activity and move far enough away from the pile being driven to be outside the area where noise is above the 175 dB threshold (traveling up to 850 m). As explained above, these individuals are not expected to experience TTS (temporary hearing impairment), but may experience temporary masking (which would affect their ability to detect certain environmental cues which may include predators and other threats), stress, disruptions to foraging, resting, or migrating and energetic consequences of moving away from the pile driving noise and potentially needing to seek out alternative prey resources (step 3). For an individual sea turtle, this may occur on more than one day during a construction season and it is possible that it could occur in multiple years. Together, these effects will significantly disrupt a sea turtle's normal behavior at a level that creates the likelihood of injury for the duration of exposure to pile driving noise; that is, the nature and duration/intensity of these responses are a significant disruption of normal behavioral patterns that creates the likelihood of injury (step 4). Therefore, based on this four-step analysis, we find that the up to 1 Kemp's ridley, 12 leatherback, 374 loggerhead, and 22 green sea turtles exposed to pile driving noise louder than 175 dB re 1uPa rms are likely to be adversely affected and that effect amounts to harassment. As such, we expect the harassment of up to 1 Kemp's ridley, 12 leatherback, 374 loggerhead, and 22 green sea turtles as a result of exposure to foundation pile driving noise.

NMFS defines "harm" in the definition of ESA "take" as "an act which actually kills or injures fish or wildlife (50 CFR 222.102). Such an act may include significant habitat modification or degradation where it actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding or sheltering" (50 CFR §222.102). Here, we consider if the sea turtles that will experience masking and behavioral disruption that met the definition of harassment will also be harmed. No sea turtles will be injured or killed due to this exposure to pile driving noise. Further, while exposure to pile driving noise will significantly disrupt normal behaviors of individual sea turtles on the day that the turtle is exposed to the pile driving noise creating the likelihood of injury, it will not actually kill or injure any sea turtles directly or by significantly impairing any essential behavioral patterns. This is because the effects will be limited to that single day and are expected to be fully recoverable, there will not be an effect on the animal's overall energy budget in a way that would compromise its ability to successfully obtain enough food to maintain its health, or impact the ability of any individual to make seasonal migrations or participate successfully in breeding or nesting. We also expect that stress responses will be limited to the single day that exposure to pile driving noise occurs and there will not be such an increase in stress that there would be physiological consequences to the individual that could affect its health or ability to migrate, forage, breed, or nest. Thus, as no injury or mortality will actually occur, the response of individual sea turtles to pile driving noise does not meet the definition of "harm."

Pile Driving for O&M Facilities
Impact pile driving will occur during construction to support the development of the proposed O&M Facility. This will include pile driving of up to 170, 12-to-18-inch diameter steel pipe piles installed over an approximate 6-month period; up to 240, 12-to-18-inch diameter timber fender system piles installed over an approximate 6-month period; and up to 120 sheet piles installed for the bulkhead over an approximate 3-month period. As described in the BA, the NMFS Multi-Species Pile Driving Calculator Tool was used to estimate ranges to the thresholds for fish ≥2 g. Summary pages of both the inputs and results of the calculator tool are provided in Appendix D of BOEM's BA.

Results from the calculator tool indicate the distances to injury criteria are limited to an area within less than 5 meters (considering all pile types and the peak and cumulative thresholds) and that noise would exceed the 175 dB re 1 μPa behavioral disturbance threshold within 5 m, depending on pile type. Given the location of these activities and the extremely small areas where noise would be above the injury or behavioral disturbance thresholds, exposure of any sea turtles to pile driving noise that could result in injury or behavioral disturbance is extremely unlikely to occur. As such, effects resulting in take by injury (i.e. harm) or harassment are extremely unlikely to occur and are thus discountable.

Vessel Noise and Cable Installation
The vessels used for the proposed project will produce low-frequency, broadband underwater sound below 1 kHz (for larger vessels), and higher-frequency sound between 1 kHz to 50 kHz (for smaller vessels), although the exact level of sound produced varies by vessel type. Noise produced during cable installation is dominated by the vessel noise; therefore, we consider these together.

ESA-listed turtles could be exposed to a range of vessel noises within their hearing abilities. Depending on the context of exposure, potential responses of green, Kemp's ridley, leatherback, and loggerhead sea turtles to vessel noise disturbance, would include startle responses, avoidance, or other behavioral reactions, and physiological stress responses. Very little research exists on sea turtle responses to vessel noise disturbance. Currently, there is nothing in the available literature specifically aimed at studying and quantifying sea turtle response to vessel noise. However, a study examining vessel strike risk to green sea turtles suggested that sea turtles may habituate to vessel sound and may be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in prompting reactions (Hazel et al. 2007). Regardless of the specific stressor associated with vessels to which turtles are responding, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel et al. 2007).

Therefore, the noise from vessels is not likely to affect sea turtles from further distances, and disturbance may only occur if a sea turtle hears a vessel nearby or sees it as it approaches. These responses appear limited to non-injurious, minor changes in behavior based on the limited information available on sea turtle response to vessel noise.

For these reasons, vessel noise is expected to cause minimal disturbance to sea turtles. If a sea turtle detects a vessel and avoids it or has a stress response from the noise disturbance, these responses are expected to be temporary and only endure while the vessel transits through the area where the sea turtle encountered it. Therefore, sea turtle responses to vessel noise disturbance are considered insignificant (i.e., so minor that the effect cannot be meaningfully evaluated), and a sea turtle would be expected to return to normal behaviors and stress levels shortly after the vessel passes by.

Operation of WTGs
As described above, many of the published measurements of underwater noise levels produced by operating WTGs are from older geared WTGs and may not be representative of newer direct-drive WTGs, like those that will be installed for the Maryland Wind project. Elliot et al. (2019) reports underwater noise monitoring at the Block Island Wind Farm, which has direct-drive GE Haliade turbines; as explained in section 7.1.2, this is the best available data for estimating operational noise of the US Wind turbines. The loudest noise recorded was 126 dB re 1uPa at a distance of 50 m from the turbine when wind speeds exceeded 56 kmh. As noted above, based on wind speed records within the WDA (US Wind COP) and the nearby NDBC station 44009 buoy, instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, occurring less than 1% of the time across a year.

Elliot et al. (2019) conclude that based on monitoring of underwater noise at the Block Island site, under maximum potential impact scenarios, no risk of temporary or permanent hearing damage (PTS or TTS) for sea turtles could be projected even if an animal remained in the water at 50 m (164 ft.) from the turbine for a full 24-hour period. Similarly, in a review of data from 27 operational wind farms in the North Sea (turbines between 2.3 and 8 MW), the mean (broadband) total SPL (SPL50 or L50) at nominal power of the turbines varied between 112 and 131 dB (median and mean value 120 dB). HDR 2023 found that noise levels recorded during the 6 MW CVOW turbine operations ranged from 120 to 130 dB re 1 µPa except during storms, when the received levels increased to 145 dB re 1 µPa. Together, these publications are the best available data for estimating operational noise of the Maryland Wind turbines. As underwater noise associated with the operation of the WTGs is below the thresholds for considering behavioral disturbance, and considering that there is no potential for exposure to noise above the peak or cumulative PTS or TTS thresholds, effects to sea turtles exposed to noise associated with the operating turbines are extremely unlikely to occur. No take of sea turtles from exposure to operational noise is expected.

HRG Surveys
Some of the equipment that is proposed for use for HRG surveys produces underwater noise that can be perceived by sea turtles; for the equipment described by US Wind this is limited to boomers and sparkers. Extensive information on HRG survey noise and potential effects of

exposure to sea turtles is provided in NMFS June 29, 2021 programmatic ESA consultation on certain geophysical and geotechnical survey activities (NMFS GAR 2021). We summarize the relevant conclusions here. For the equipment proposed for use by US Wind, the maximum distance to the 175 dB re 1uPa behavioral disturbance threshold is 90 meters; the TTS and PTS thresholds are not exceeded at any distance (see table 7.1.23).

Table 7.1.23 Largest PTS Exposure Distances from mobile HRG Sources at Speeds of 4.5 knots –Sea Turtles

HRG Source	Highest Source Levels (dB re 1uPa)	Distance to Onset of Injury Threshold (Peak)	Distance to Onset of Injury Threshold (cSEL)	Distance to Behavioral Threshold (175 dB re 1uPa RMS)
Boomer	176 dB SEL 207 dB RMS 216 PEAK	0	0	40 m
Sparker	188 dB SEL 214 dB RMS 225 PEAK	0	0	90 m

Sea turtle PTS distances were calculated for 203 cSEL and 230 dB peak criteria from Navy (2017).

None of the equipment being operated for these surveys that overlaps with the hearing range (30 Hz to 2 kHz) for sea turtles has source levels loud enough to result in PTS or TTS based on the peak or cumulative exposure criteria. Therefore, physical effects are extremely unlikely to occur.

As explained above, we find that sea turtles would exhibit a behavioral response when exposed to received levels of 175 dB re: 1 µPa (rms) and are within their hearing range (below 2 kHz). The distance to this threshold is 90 m for sparkers, 40 m for boomers (Table 7.1.23). Thus, a sea turtle would need to be within 90 m of the source to be exposed to potentially disturbing levels of noise. We expect that sea turtles would react to this exposure by swimming away from the sound source; this would limit exposure to a short time period, just the few seconds it would take an individual to swim away to avoid the noise. As the noise source is moving, this further limits the potential for exposure that would result in sustained behavioral disturbance and we expect exposure to be limited to only seconds to minutes. BOEM calculated that for a survey with equipment being towed at 3 knots, exposure of a turtle that was within 90 m of the source would last for less than two minutes.

The risk of exposure to potentially disturbing levels of noise is reduced by the use of PSOs to monitor for sea turtles. A clearance zone (500 m in all directions) for ESA-listed species must be monitored around all vessels operating equipment at a frequency of less than 180 kHz. At the start of a survey, equipment cannot be turned on until the Clearance Zone is clear for at least 30 minutes. This condition is expected to reduce the potential for sea turtles to be exposed to noise that may be disturbing. However, even in the event that a sea turtle is submerged and not seen by the PSO, in the worst case, we expect that sea turtles would avoid the area ensonified by the survey equipment that they can perceive. Because the area where increased underwater noise will be experienced is transient and increased underwater noise will only be experienced in a particular area for less than two minutes, we expect any effects to behavior to be minor and limited to a temporary disruption of normal behaviors, temporary avoidance of the ensonified area and minor additional energy expenditure spent while swimming away from the noisy area. If foraging or migrations are disrupted, we expect that they will quickly resume once the survey vessel has left the area. No sea turtles will be displaced from a particular area for more than a few minutes. While the movements of individual sea turtles will be affected by the sound associated with the survey, these effects will be temporary (no more than two minutes) and localized (avoiding an area no larger than 90 m) and there will be only a minor and temporary impact on foraging, migrating, or resting sea turtles. For example, BOEM calculated that for a survey with equipment being towed at 3 knots, exposure of a sea turtle that was within 90 m of the source would last for less than two minutes.

Given the intermittent and short duration of exposure to any potentially disturbing noise from HRG equipment, effects to individual sea turtles from brief exposure to potentially disturbing levels of noise are expected to be minor and limited to a brief startle, short increase in swimming speed and/or short displacement from an area not exceeding 90 m in diameter, and will be so small that they cannot be meaningfully measured, detected, or evaluated; therefore, effects are insignificant, and take is not anticipated to occur.

7.1.5. Effects of Project Noise on ESA Listed Marine Fish

Background Information – Fish and Noise
Impulsive sounds such as those produced by impact pile driving can affect fish in a variety of ways, and in certain circumstances, can cause mortality, auditory injury, barotrauma, and behavioral changes. Impulsive sound sources produce brief, broadband signals that are atonal transients (e.g., high amplitude, short-duration sound at the beginning of a waveform; not a continuous waveform). They are generally characterized by a rapid rise from ambient sound pressures to a maximal pressure followed by a rapid decay period that may include a period of diminishing, oscillating maximal and minimal pressures. For these reasons, they generally have an increased capacity to induce physical injuries in fishes, especially those with swim bladders (Casper et al. 2013; Halvorsen et al. 2012; Hawkins and Popper 2014). These types of sound pressures cause the swim bladder in a fish to rapidly and repeatedly expand and contract, and pound against the internal organs. This pneumatic pounding may result in hemorrhage and rupture of blood vessels and internal organs, including the swim bladder, spleen, liver, and kidneys. External damage has also been documented, evident with loss of scales, hematomas in the eyes, base of fins, etc. (e.g., Casper et al. 2012; Gisiner 1998; Halvorsen et al. 2012; Wiley et al. 1981; Yelverton et al. 1975). Fish can survive and recover from some injuries, but in other cases, death can be instantaneous, occur within minutes after exposure, or occur several days later.

Hearing impairment
Research is limited on the effects of impulsive noise on the hearing of fishes, however some research on seismic air gun exposure has demonstrated mortality and potential damage to the

lateral line cells in fish larvae, fry, and embryos after exposure to single shots from a seismic air gun near the source (0.01 to 6 m; Booman et al. 1996; Cox et al. 2012). Popper et al. (2005) examined the effects of a seismic air gun array on a fish with hearing specializations, the lake chub (*Couesius plumbeus*), and two species that lack notable hearing specializations, the northern pike (*Esox lucius*) and the broad whitefish (*Coregonus nasus*), a salmonid species. In this study, the average received exposure levels were a mean peak pressure level of 207 dB re 1 μPa; sound pressure level of 197 dB re 1 μPa; and single-shot sound exposure level of 177 dB re 1 μPa^2-s. The results showed temporary hearing loss for both lake chub and northern pike to both 5 and 20 air gun shots, but not for the broad whitefish. Hearing loss was approximately 20 to 25 dB at some frequencies for both the northern pike and lake chub, and full recovery of hearing took place within 18-24 hours after sound exposure. Examination of the sensory surfaces showed no damage to sensory hair cells in any of the fish from these exposures (Song et al. 2008). Popper et al. (2006) also indicated exposure of adult fish to a single shot from an air gun array (consisting of four air guns) within close range (six meters) did not result in any signs of mortality, seven days post-exposure. Although non-lethal injuries were observed, the researchers could not attribute them to air gun exposure as similar injuries were observed in controlled fishes. Other studies conducted on fishes with swim bladders did not show any mortality or evidence of other injury (Hastings et al. 2008; McCauley and Kent 2012; Hawkins and Popper 2014; Popper et al. 2007; Popper et al. 2005).

McCauley et al. (2003) showed loss of a small percent of sensory hair cells in the inner ear of the pink snapper (*Pagrus auratus*) exposed to a moving air gun array for 1.5 hours. Maximum received levels exceeded 180 dB re 1 μPa^2-s for a few shots. The loss of sensory hair cells continued to increase for up to at least 58 days post-exposure to 2.7 percent of the total cells. It is not known if this hair cell loss would result in hearing loss since TTS was not examined. Therefore, it remains unclear why McCauley et al. (2003) found damage to sensory hair cells while Popper et al. (2005) did not. However, there are many differences between the studies, including species, precise sound source, and spectrum of the sound that make it difficult speculate what the caused hair cell damage in one study and not the other.

Hastings et al. (2008) exposed the pinecone soldierfish (*Myripristis murdjan*), a fish with anatomical specializations to enhance their hearing and three species without notable specializations: the blue green damselfish (*Chromis viridis*), the saber squirrelfish (*Sargocentron spiniferum*), and the bluestripe seaperch (*Lutjanus kasmira*) to an air gun array. Fish in cages in 16 ft. (4.9 m) of water were exposed to multiple air gun shots with a cumulative sound exposure level of 190 dB re 1 μPa^2-s. The authors found no hearing loss in any fish following exposures. Based on the tests to date that indicated TTS in fishes from exposure to impulsive sound sources (air guns and pile driving) the recommended threshold for the onset of TTS in fishes is 186 dB SEL_{cum} re 1 μPa^2-s, as described in the 2014 *ANSI Guidelines*.

Physiological Stress

Physiological effects to fishes from exposure to anthropogenic sound are increases in stress hormones or changes to other biochemical stress indicators (e.g., Santulli et al. 1999; Sverdrup et al. 1994; Wysocki et al. 2006). Fishes may have physiological stress reactions to sounds that they can detect. For example, a sudden increase in sound pressure level or an increase in overall background noise levels can increase hormone levels and alter other metabolic rates indicative of a stress response. Studies have demonstrated elevated hormones such as cortisol, or increased ventilation and oxygen consumption (Hastings and C. 2009; Pickering 1981; Simpson et al. 2015; Simpson et al. 2016; Smith et al. 2004a; Smith et al. 2004b). Although results from these studies have varied, it has been shown that chronic or long-term (days or weeks) exposures of continuous anthropogenic sounds can lead to a reduction in embryo viability (Sierra-Flores et al. 2015) and decreased growth rates (Nedelec et al. 2015).

Generally, stress responses are more likely to occur in the presence of potentially threatening sound sources such as predator vocalizations or the sudden onset of loud and impulsive sound signals. Stress responses are typically considered brief (a few seconds to minutes) if the exposure is short or if fishes habituate or have previous experience with the sound**.** However, exposure to chronic noise sources may lead to more severe effects leading to fitness consequences such as reduced growth rates, decreased survival rates, reduced foraging success, etc. Although physiological stress responses may not be detectable on fishes during sound exposures, NMFS assumes a stress response occurs when other physiological impacts such as injury or hearing loss occur.

Some studies have been conducted that measure changes in cortisol levels in response to sound sources. Cortisol levels have been measured in fishes exposed to vessel noises, predator vocalizations, or other tones during playback experiments**.** Nichols et al. (2015) exposed giant kelpfish (*Heterostichus rostratus*) to vessel playback sounds, and fish increased levels of cortisol were found with increased sound levels and intermittency of the playbacks. Sierra-Flores et al. (2015) demonstrated increased cortisol levels in fishes exposed to a short duration upsweep (a tone that sweeps upward across multiple frequencies) across 100 to 1,000 Hz. The levels returned to normal within one hour post-exposure, which supports the general assumption that spikes in stress hormones generally return to normal once the sound of concern ceases**.** Gulf toadfish (*Opsanus beta*) were found to have elevated cortisol levels when exposed to low-frequency dolphin vocalization playbacks (Remage-Healey et al. 2006). Interestingly, the researchers observed none of these effects in toadfish exposed to low frequency snapping shrimp "pops," indicating what sound the fish may detect and perceive as threats. Not all research has indicated stress responses resulting in increased hormone levels. Goldfish exposed to continuous (0.1 to 10 kHz) sound at a pressure level of 170 dB re 1 μPa for one month showed no increase in stress hormones (Smith et al. 2004b). Similarly, Wysocki et al. (2007) exposed rainbow trout to continuous band-limited noise with a sound pressure level of about 150 dB re 1 μPa for nine months with no observed stress effects. Additionally, the researchers found no significant changes to growth rates or immune systems compared to control animals held at a sound pressure level of 110 dB re 1 μPa.

Masking

As described previously in this biological opinion, masking generally results from a sound impeding an animal's ability to hear other sounds of interest. The frequency of the received level and duration of the sound exposure determine the potential degree of auditory masking. Similar to hearing loss, the greater the degree of masking, the smaller the area becomes within which an animal can detect biologically relevant sounds such as those required to attract mates, avoid predators or find prey (Slabbekoorn et al. 2010). Because the ability to detect and process sound may be important for fish survival, anything that may significantly prevent or affect the ability of fish to detect, process or otherwise recognize a biologically or ecologically relevant sound could decrease chances of survival. For example, some studies on anthropogenic sound effects on fishes have shown that the temporal pattern of fish vocalizations (e.g., sciaenids and gobies) may be altered when fish are exposed to sound-masking (Parsons et al. 2009). This may indicate fish are able to react to noisy environments by exploiting "quiet windows" (e.g., Lugli and Fine 2003) or moving from affected areas and congregating in areas less disturbed by nuisance sound sources. In some cases, vocal compensations occur, such as increases in the number of individuals vocalizing in the area, or increases in the pulse/sound rates produced (Picciulin et al. 2012). Fish vocal compensations could have an energetic cost to the individual, which may lead to a fitness consequence such as affecting their reproductive success or increase detection by predators (Amorin et al. 2002; Bonacito et al. 2001).

Behavioral Responses

In general, NMFS assumes that most fish species would respond in similar manner to both air guns and impact pile driving. As with explosives, these reactions could include startle or alarm responses, quick bursts in swimming speeds, diving, or changes in swimming orientation. In other responses, fish may move from the area or stay and try to hide if they perceive the sound as a potential threat. Other potential changes include reduced predator awareness and reduced feeding effort. The potential for adverse behavioral effects will depend on a number of factors, including the sensitivity to sound, the type and duration of the sound, as well as life stages of fish that are present in the areas affected.

Fish that detect an impulsive sound may respond in "alarm" detected by Fewtrell (2003), or other startle responses may also be exhibited. The startle response in fishes is a quick burst of swimming that may be involved in avoidance of predators. A fish that exhibits a startle response may not necessarily be injured, but it is exhibiting behavior that suggests it perceives a stimulus indicating potential danger in its immediate environment. However, fish do not exhibit a startle response every time they experience a strong hydroacoustic stimulus. A study in Puget Sound, Washington suggests that pile driving operations disrupt juvenile salmon behavior (Feist et al. 1992). Though no underwater sound measurements are available from that study, comparisons between juvenile salmon schooling behavior in areas subjected to pile driving/construction and other areas where there was no pile driving/construction indicate that there were fewer schools of fish in the pile-driving areas than in the non-pile driving areas. The results are not conclusive but there is a suggestion that pile-driving operations may result in a disruption in the normal migratory behavior of the salmon in that study, though the mechanisms salmon may use for avoiding the area are not understood at this time.

Because of the inherent difficulties with conducting fish behavioral studies in the wild, data on behavioral responses for fishes is largely limited to caged or confined fish studies, mostly limited to studies using caged fishes and the use of seismic air guns (Lokkeborg et al. 2012). In an effort to assess potential fish responses to anthropogenic sound, NMFS has historically applied an interim criteria for onset injury of fish from impact pile driving which was agreed to in 2008 by a coalition of federal and non-federal agencies along the West Coast (FHWG 2008). These criteria were also discussed in Stadler and Woodbury (2009), wherein the onset of physical injury for fishes would be expected if either the peak sound pressure level exceeds 206 dB (re 1 μPa), or the SEL_{cum}, (re 1 μPa^2-s) accumulated over all pile strikes occurring within a single day, exceeds

187 dB SEL_{cum} (re 1 μPa^2-s) for fish two grams or larger, or 183 dB re 1 μPa^2-s for fishes less than two grams. The more recent recommendations from the studies conducted by Halvorsen et al. (2011), Halvorsen et al. (2012), and Casper et al. (2012), and summarized in the 2014 *ANSI Guidelines* are similar to these levels, but also establishes levels based upon fish hearing abilities, the presence of a swim bladder as well as severity of effects ranging from mortality, recoverable injury to TTS. The interim criteria developed in 2008 were developed primarily from air gun and explosive effects on fishes (and some pile driving) because limited information regarding impact pile driving effects on fishes was available at the time.

7.1.5.1. Criteria Used for Assessing Effects of Noise Exposure to Marine Fish

The three ESA-listed fish species under NMFS jurisdiction in the action area are the Atlantic sturgeon, shortnose sturgeon, and giant manta ray. The Atlantic sturgeon and shortnose sturgeon have a swim bladder and can detect the sound pressure component of noise, but the swim bladder is not directly connected to hearing like species of carp or herring and therefore sturgeon are less sensitive to underwater sound pressure. Given the distribution of shortnose sturgeon in the action area, they will not be exposed to noise sources from pile driving or HRG surveys. Giant manta rays are elasmobranchs that do not have a swim bladder; hearing capabilities are limited to particle motion detection at frequencies well below 2 kHz (Gardiner et al. 2012).

There is no available information on the hearing capabilities of Atlantic sturgeon specifically, although the hearing of two other species of sturgeon have been studied. While sturgeon have swim bladders, they are not known to be used for hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon (*Acipenser sturio*) using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon (*Acipenser fulvescens*) and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for oscar (*Astronotus ocellatus*) and goldfish (*Carassius auratus*) and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (that can hear up to 5 kHz) than to the oscar (that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002). Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish (*Polyodon spathula*) and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of all Atlantic sturgeon DPSs.

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, USFWS, FHWA, USACE, and the California, Washington and Oregon DOTs, supported by national experts on underwater sound producing activities that affect fish and wildlife species of concern. In June 2008, the agencies signed an MOA documenting criteria for assessing physiological effects of impact pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted that these criteria are for the onset of physiological effects (Stadler and Woodbury, 2009), not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all fish species, including listed green sturgeon, which are biologically similar to shortnose and Atlantic sturgeon and for these purposes can be considered a surrogate. Note that NMFS' acoustic thresholds for fishes are for all species of fish and do not distinguish between fishes of different groups (e.g., elasmobranchs or teleosts). The interim criteria are:

- Peak SPL: 206 dB re 1 μPa
- SELcum: 187 dB re 1μPa^2-s for fishes 2 grams or larger (0.07 ounces).
- SELcum: 183 dB re 1μPa^2-s for fishes less than 2 grams (0.07 ounces).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to sturgeon are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness to significant injuries that will lead to death. The severity of injury is related to the distance from the pile being installed and the duration of exposure. The closer to the source and the greater the duration of the exposure, the higher likelihood of significant injury.

Hawkins and Popper (2014) presents a series of proposed thresholds for onset of mortality and potential injury, recoverable injury, and temporary threshold shift for fish species exposed to pile driving noise. This assessment incorporates information from lake sturgeon and includes a category for fish that have a swim bladder that is not involved in hearing (such as Atlantic sturgeon). The criteria included in Hawkins and Popper (2014) are:

- Mortality and potential mortal injury: 210 dB SELcum or >207 dB peak
- Recoverable injury: 203 dB SELcum or >207 dB peak
- TTS: >186 dB SELcum.

While these criteria are not exactly the same as the FHWG criteria, they are very similar. Based on the available information, for the purposes of this Opinion, we consider the potential for physiological effects upon exposure to 206 dB re 1 μPa peak and 187 dB re 1 μPa^2-s cSEL. Use of the 183 dB re 1 μPa^2-s cSEL threshold is not appropriate for this consultation because all sturgeon in the action area will be larger than 2 grams. Physiological effects could range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality, or result in death.

We use 150 dB re: 1 μPa RMS as a threshold for examining the potential for behavioral responses by individual listed fish to noise with frequency less than 1 kHz. This is supported by information provided in a number of studies described above (Andersson et al. 2007, Purser and Radford 2011, Wysocki et al. 2007). Responses to temporary exposure of noise of this level is expected to be a range of responses indicating that a fish detects the sound, these can be brief startle responses or, in the worst case, we expect that listed fish would completely avoid the area ensonified above 150 dB re: 1 uPa rms. Hawkins and Popper (2014) does not identify a behavioral threshold but notes that the potential for behavioral disturbance decreases with the distance from the source.

7.1.5.2 Effects to Marine Fish Exposed to Project Noise

Impact Pile Driving for WTG, OSS, and Met Tower Foundations
Distances to potential injury and behavioral disruption thresholds for fish exposed to pile driving sound for the different foundations (11-m monopile, four 3-m skirt pile, and three 1.8-m post-piled pin pile for jacket foundation) were modeled (MAI, 2023). The acoustic ranges ($R_{95\%}$) to fish impact criteria thresholds (i.e., onset of injury and behavioral disturbance) were calculated by determining the isopleth at which thresholds could be exceeded considering 0, 10, and 20 dB attenuation; as requirements for achieving 10 dB attenuation are part of the proposed action, those results are presented here and form the basis for our effects analysis. For the sound exposure level (SEL, cumulative exposure) criteria, acoustic energy was accumulated for all pile driving strikes in a 24 hour period. Acoustic range estimates for the modeled piles and pile locations for fish are included in MAI, 2023. The distances to the identified criteria for the different pile types is summarized in the table below.

Table 7.1.24 Acoustic ranges (m) (95th percentile) to threshold levels for fish modeled for May for the three pile types, assuming 10 dB attenuation

			Distance to Threshold (m)		
Pile Type	**Maximum hammer energy (kJ)**	**Duration (minutes)**	**Injury (peak; 206 dB)**	**Injury (cSEL; 187 dB)**	**Behavioral Disturbance (150 dB re 1uPa RMS)**
11 m monopile	3,300	120	150	4,000	13,650
3 m pin	1,500	480	<50	1,500	2,650
1.8 m pin	500	240	<50	50	750

No density estimates for Atlantic sturgeon or Giant manta rays are available for the action area or for any area that could be used to estimate density in the action area. Therefore, it was not possible to conduct an exposure analysis to predict the number of Atlantic sturgeon or Giant manta rays likely to be exposed to any of the thresholds identified here.

Consideration of Mitigation Measures
Here, we consider the measures that are part of the proposed action, either because they are proposed by US Wind or by BOEM and reflected in the proposed action as described to us by BOEM in the BA, or are proposed to be required through the MMPA ITA. Specifically, we consider how those measures may minimize exposure of Atlantic sturgeon to pile driving noise. Details of these proposed measures are included in the Description of the Action section above.

Atlantic sturgeon are not visible to PSOs because they occur near the bottom and depths in the areas where pile driving is planned would preclude visual observation of fish near the bottom. While Giant manta rays may sometimes be at the surface, they are pelagic species and are often at depth. Therefore, monitoring of clearance zones or areas beyond the clearance zones will not minimize exposure of Atlantic sturgeon or Giant manta rays to pile driving noise. Because Atlantic sturgeon and Giant manta rays do not vocalize, PAM cannot be used to monitor the presence of ESA listed fish; therefore, the use of PAM will not reduce exposure of these species to pile driving noise.

No impact pile driving activities for monopiles would occur between December 1 and April 30 to avoid the time of year with the highest densities of right whales in the project area. Giant manta rays are present in the WDA during the warmer months, primarily summer and early fall; thus, the time of year restriction would not reduce potential exposure of Giant manta rays to pile driving noise. Information from Secor et al. (2020) and Rothermel et al. (2020) indicates that abundance of Atlantic sturgeon in the Maryland WEA is highest from early spring to early summer and early fall to early winter as Atlantic sturgeon move north and south during seasonal migrations. Very few sturgeon are expected in the late winter. Given this, the seasonal restriction preventing pile driving in April would reduce the number of Atlantic sturgeon that would otherwise have been exposed to foundation pile driving noise; however, we are not able to produce any quantitative estimates of the extent of the reduction.

For all impact pile driving, US Wind would implement sound attenuation technology that would target at least a 10 dB reduction in noise, and that must achieve in-field measurements no greater than those modeled and presented in the BA and summarized in Table 7.1.30 above. The attainment of a 10 dB reduction in impact pile driving was incorporated into the estimates of the area where injury or behavioral disruption may occur as presented above. If a reduction greater than 10 dB is achieved, the size of the area of impact would be smaller which would likely result in a smaller number of Atlantic sturgeon exposed to pile driving noise.

Soft start procedures can provide a warning to animals or provide them with a chance to leave the area prior to the hammer operating at full capacity. As described above, for impact pile driving before full energy pile driving begins, pile driving will occur at 4-6 strikes per minute at 10 to 20 percent of the maximum hammer energy (i.e., 330 to 660 kJ for monopiles and 150 to 300 kJ for jackets), for a minimum of 20 minutes. During installation of any piles, at this hammer intensity, a sturgeon or manta ray would need to be between the pile and the bubble curtains to be exposed to be exposed to noise above the 206 dB re 1uPa threshold (see Tables 1in MAI, 2023). Given the dispersed nature of Atlantic sturgeon and Giant manta rays in the lease area and the presence of the bubble curtains at approximately 100-150 m from the pile, this co-occurrence is extremely unlikely to occur. We expect that any ESA listed fish close enough to the pile to be exposed to noise above 150 dB re 1uPa rms would experience behavioral disturbance as a result of exposure to the pile driving noise during the soft start and that these sturgeon would exhibit evasive behaviors and swim away from the noise source. During the soft start period, noise will be above 150 dB at a distance of several hundred meters to over a km from the pile being driven. The use of the soft start is expected to give Atlantic sturgeon or Giant manta rays near enough to the piles to be exposed to the soft start noise a “head start” on escape or avoidance behavior by causing them to swim away from the source. It is possible that some listed fish would swim out of the noisy area before full force pile driving begins; in this case, the number of fish exposed to noise that may result in injury would be reduced. It is likely that by eliciting avoidance behavior prior to full power pile driving, the soft start will reduce the duration of exposure to noise that could result in behavioral disturbance. However, we are not able to predict the extent to which the soft start will reduce the extent of exposure above the 150 dB re 1uPa threshold for considering behavioral impacts.

As described above, US Wind will also conduct hydroacoustic monitoring (SFV) for a subset of impact-driven piles. The required sound source verification will provide information necessary to confirm that the sound source characteristics predicted by the modeling are reflective of actual sound source characteristics in the field. If noise levels are higher than predicted by the modeling described here, additional noise attenuation measures will be implemented to reduce distances to the injury and behavioral disturbance thresholds. In the event that noise attenuation measures and/or adjustments to pile driving cannot reduce the distances to less than those modeled, this may be considered new information that reveals effects of the action that may affect listed species in a manner or to an extent not previously considered and reinitiation of this consultation may be necessary.

Exposure to Noise above the Onset of Injury Threshold during Impact Pile Driving for Foundations

Acoustic range modeling (Table 7.1.24) indicates that in order to be exposed to pile driving noise that could result in injury, an Atlantic sturgeon or Giant manta ray would need to be within 150 m of a monopile and within 50 m of a pin pile for a single pile strike (based on the 206 dB peak threshold). Given the dispersed distribution and transient nature of Atlantic sturgeon and Giant manta rays in and near the WDA, the potential for co-occurrence in time and space is extremely unlikely given the small area where exposure to peak noise could occur (extending less than 150 m from the pile). We also expect that the bubble curtain(s) deployed as part of the noise attenuation system will extend further than 150 m from the pile, this is likely to further deter Atlantic sturgeon or Giant manta rays from being closer than that to the pile. The soft-start, which we expect would result in a behavioral reaction and movement outside the area with the potential for exposure to the peak injury threshold, reduces this risk even further. As described above, during the soft start, an ESA listed fish would need to be closer than 100 meters of the pile being driven to be exposed to peak noise that could result in physiological effects. Given these considerations, we do not anticipate any Atlantic sturgeon or Giant manta ray to be exposed to noise above the peak injury threshold during monopile installation.

Considering the 186 dB SELcum threshold (see Table 7.1.24), an Atlantic sturgeon or Giant manta ray would need to remain within approximately 4.5km of a single monopile for the duration of the pile driving event (2 hours) or stay within approximately 50 m of all pin piles installed in a single day (4 - 8 hours) to be exposed to pile driving noise that could result in injury. Considering the anticipated behavioral reaction of sturgeon to avoid pile driving noise above 150 dB re 1 uPa RMS and the swimming abilities of Atlantic sturgeon, this is extremely unlikely to occur. Downie and Kieffer (2017) reviewed available information on maximum sustained swimming ability for a number of sturgeon species. No information was presented on Atlantic sturgeon. Kieffer and May (2020) report that swimming speed of sturgeons is consistent at approximately 2 body lengths/second. Considering that the smallest Atlantic sturgeon in the ocean environment where piles will be driven will be migratory subadults (at least 75 cm length), we can assume a minimum swim speed of 150 cm/second (equivalent to 5.4 km/hour) for Atlantic sturgeon in the WDA. Assuming a straight line avoidance and the slowest anticipated swim speed (5.4 km/h), even a sturgeon that was close by the pile at the start of pile driving would be able to swim away from the noisy area well before being exposed to the noise for a long enough period to meet the 187 dB SELcum threshold. The distance we would expect a sturgeon to cover in the approximately 2 hours it would take to install a monopile or pin pile is at least 10.8 km; these distances are at least double the distance a sturgeon would need to swim to avoid the noise above the cumulative injury (187 dB cSEL) threshold. We expect that the soft-start will mean that the closest a sturgeon is to the pile being driven at the start of full power driving is several hundred meters away which further reduces the duration of exposure to noise that could accumulate to exceed the 187 dB SELcum threshold. Given these considerations, we expect any Atlantic sturgeon that are exposed to pile driving noise will be able to avoid exposure to noise above the levels that could result in exposure to the cumulative injury threshold. Based on this analysis and consideration of the peak and cumulative noise thresholds for injury, it is extremely unlikely that any Atlantic sturgeon will be exposed to noise that will result in injury. Therefore, no take by harm (i.e. injury) of any Atlantic sturgeon is expected to occur.

Fish et al. (2018) reports swim speeds for manta rays. During migration, swim speeds are reported at 0.97 m/s (approximately 3.5 km/h) when measured from satellite tags but notes that this likely underestimates actual swim speeds. Other sources included in Fish et al. report swim speeds of up to 4.43 m/s (approximately 16 km/h). Given this information, a manta ray is expected to be able to cover a distance of at least 7 km in the approximately 2 hours it would take to install a single monopile or pin pile; these distances are at least double the distance a ray would need to swim to avoid the noise above the cumulative injury (187 dB cSEL) threshold. We expect that the soft-start will mean that the closest a fish is to the pile being driven at the start of full power driving is several hundred meters away which further reduces the duration of exposure to noise that could accumulate to exceed the 187 dB SELcum threshold. Given these considerations, we expect any Giant manta rays that are exposed to pile driving noise will be able to avoid exposure to noise above the levels that could result in exposure to the cumulative injury threshold. Based on this analysis and consideration of the peak and cumulative noise thresholds for injury, it is extremely unlikely that any Giant manta rays will be exposed to noise that will result in injury. Therefore, no take by harm (i.e. injury) of any Giant manta rays is expected to occur.

Effects of Noise Exposure above 150 dB re 1uPa rms but below the injury threshold
We expect Atlantic sturgeon and Giant manta rays to exhibit a behavioral response upon exposure to noise that is louder than 150 dB re 1uPa RMS. This response could range from a startle with immediate resumption of normal behaviors to complete avoidance of the area with noise above this threshold. The area where pile driving will occur is used for migration of these species, with opportunistic foraging expected to occur where suitable benthic resources are present. The area is not an aggregation area and sustained foraging by either species is not known to occur in this area.

During the 2 hour periods where impact pile driving occurs for monopile foundations, the area that will have underwater noise above the 150 dB re 1uPa RMS threshold will extend approximately 13.7 km from the pile being installed; for the three hour period that each 3m pin pile is being driven that area will extend up to approximately 3.7 km from the pile being installed (and less than 1 km for the 1.8 m pin piles). We expect that Atlantic sturgeon and Giant manta rays exposed to noise above 150 dB re 1uPa RMS would exhibit a behavioral response that ranges from a brief startle response with resumption of normal behaviors to temporary avoidance of the entire area where noise is louder than 150 dB re 1uPa RMS for the period of time that a pile is being installed. The consequences for an individual fish would be limited to temporary alteration of movements to avoid the noise and potential temporary cessation of opportunistic foraging. Considering the minimum swimming speeds noted above, we expect a sturgeon or manta ray actively avoiding this area could swim out of it in 1 to 2 hours.

While in some instances temporary displacement from an area may have significant consequences to individuals or populations, this is not the case here. For example, if individual Atlantic sturgeon were prevented or delayed from accessing spawning habitat or were precluded from a foraging area for an extensive period, there could be impacts to reproduction and the health of individuals, respectively. However, as explained above, the area where noise may be at disturbing levels is used only for movement between other more highly used portions of the coastal Atlantic Ocean and is used only for opportunistic, occasional foraging; avoidance of any area ensonified during impact pile driving for the foundations would not block or delay movement to spawning, foraging, or other important habitats. This is the case for Giant manta rays and Atlantic sturgeon.

All behavioral responses to a disturbance, such as those described above, will have an energetic or metabolic consequence to the individual reacting to the disturbance (e.g., adjustments in migratory movements or disruption in opportunistic foraging). Short-term interruptions of normal behavior are likely to have little effect on the overall health, reproduction, and energy balance of an individual or population (Richardson *et al.* 1995). As the disturbance will occur for a portion of each day for a period of up to approximately 22 days in year 1 of foundation pile driving, 58 days in year 2, and up to 39 days in year 3, this exposure and displacement will be temporary and not chronic. Therefore, any interruptions in behavior and associated metabolic or energetic consequences will similarly be temporary. Thus, we do not anticipate any impairment of the health, survivability, or reproduction of any individual Atlantic sturgeon or Giant manta rays.

As explained above, NMFS Interim Guidance defines harassment as to "[c]reate the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering." Here, we consider whether the effects to Atlantic sturgeon and Giant manta rays resulting from exposure to pile driving noise meet the ESA definition of harassment. We have established that some Atlantic sturgeon and Giant manta rays are likely to be exposed to the stressor or disturbance (in this case, pile driving noise above 150 dB re 1uPa rms). This disturbance is expected to be intermittent and limited in time and space as it will only occur when active pile driving is occurring and only in the geographic area where noise is above the potential behavioral disturbance threshold. As explained above, the expected response of any ESA listed fish exposed to potentially disturbing levels of noise, is expected to range from startle responses with a quick return to normal behaviors to alterations to their movements and swimming away from the source of the noise (i.e., aversion/avoidance). For any fish that exhibit an avoidance response, they will need to alter their migration route; any foraging that was occurring would also be disrupted during this period. This will result in minor, temporary energetic costs that are expected to be fully recoverable. The nature, duration, and intensity of the response will not be a significant disruption of any behavior patterns. This is because any alterations of the movements of an individual sturgeon to avoid pile driving noise will be a minor disruption of migration, potentially taking it off of its normal migratory path for a short period of time (less than two hours) as it avoids the noisy area but not disrupting its overall migration (e.g., it will not result in delays or other impacts that would have a consequence to the individual). For example, we do not expect that a sturgeon or ray that is exposed to pile driving noise would delay or abandon its normal seasonal migrations. Similarly, any disruption of foraging will be temporary and limited to the hour or two that the fish is moving away from the noise. Use of the WDA by Atlantic sturgeon and Giant manta rays is limited to transient individuals; as such, the potential for behavioral disruption to have significant impacts is limited. As the area where these impacts will occur is an area where only occasional, opportunistic foraging will occur, any aversion or avoidance of any particular area that does occur would not be a significant disruption to foraging behavior. We do not expect any avoidance behavior to affect an individual's health, fitness, energy budget, or increase its vulnerability to any other stressor or threat; as such, we do not find that the potential short-term disruption of an individual's activities would create the likelihood of injury. Based on this analysis, the nature and duration of the response to exposure to pile driving noise above the behavioral disturbance threshold, which is limited to, at most, avoidance of the area extending approximately 14 km from the pile being installed for a period of 1 to 2 hours, is not a significant disruption of behavior patterns that creates the likelihood of injury; therefore, no take by harassment is anticipated. We also note that the 150 dB re 1uPa rms threshold is based on the noise level that any response to noise may occur and its use may overestimate the area where actual aversion/avoidance behavior will occur and that effects experienced by some sturgeon or Giant manta rays may be even less than considered here. Based on this analysis we have similarly determined that it is extremely unlikely that any Atlantic sturgeon or Giant manta rays will be exposed to noise which actually kills or injures any individual; thus no take by harm is anticipated.

We have also considered if the avoidance of the area where pile driving noise will be experienced would increase the risk of vessel strike or entanglement in fishing gear. As explained above, a sturgeon or Giant manta ray would need to travel no more than 14 km to swim outside the area where noise is above the threshold where behavioral disturbance is expected; this distance would result from a sturgeon being very near the source when pile driving started, it is more likely that the distance traveled would be smaller. As we do not expect vessel strike to occur in the open ocean, regardless of traffic levels, we do not expect any increase in risk of vessel strike even if a sturgeon or ray was displaced into an area with higher vessel traffic. Information available in the Navigational Safety Risk Assessment describes fishing activity within and outside the WFA where pile driving will occur; additional mapping products are viewable at northeastoceandata.org (e.g., all VMS vessels 2015-2019 and Annual vessel transit counts). Based on the available information, we do not expect avoidance of pile driving noise to result in an increased risk entanglement or capture in fishing gear. Based on the available information on the distribution of fishing activities that may interact with sturgeon and manta rays (i.e., gillnets, trawl), it is extremely unlikely that a sturgeon or ray avoiding pile driving noise would be more at risk of entanglement or capture than had it not been exposed to the noise source. This is because the distance that a sturgeon would need to move to avoid potentially disturbing level of noise (up to approximately 14 km) would not put the individual in areas with higher levels of trawl or gillnet fishing than in the WDA.

Based on this analysis, all effects to Atlantic sturgeon from exposure to impact pile driving noise are expected to be extremely unlikely, or so small that they cannot be meaningfully measured, detected, or evaluated and are, therefore, discountable or insignificant. Take of Atlantic sturgeon and Giant manta rays is not anticipated as a result of exposure to noise from driving of WTG, OSS, or Met Tower foundations.

Pile Driving for O&M Facilities
Impact pile driving will occur to support the development of the proposed O&M Facility. This will include pile driving of up to 170, 12-to-18-inch diameter steel pipe piles installed over an approximate 6-month period; up to 240, 12-to-18-inch diameter timber fender system piles installed over an approximate 6-month period; and up to 120 sheet piles installed for the bulkhead over an approximate 3-month period. As described in the BA, the NMFS Multi-Species Pile Driving Calculator Tool was used to estimate ranges to the thresholds for fish ≥2 g. Summary pages of both the inputs and results of the calculator tool are provided in Appendix D of BOEM's BA.

Results from the calculator tool indicate the distances to injury criteria are limited to an area within less than 50 meters (considering all pile types and the peak and cumulative thresholds) and that noise would exceed the 150 dB re 1 μPa behavioral disturbance threshold within 25 - 215 m, depending on pile type. Given the location of these activities, neither Atlantic sturgeon or Giant manta rays are expected to occur in areas where they could be exposed to pile driving noise. As such, effects are extremely unlikely to occur and discountable.

Vessel Noise and Cable Installation
The vessels used for the proposed project will produce low-frequency, broadband underwater sound below 1 kHz (for larger vessels), and higher-frequency sound between 1 kHz to 50 kHz (for smaller vessels), although the exact level of sound produced varies by vessel type. Noise produced during cable installation is dominated by the vessel noise; therefore, we consider these together. Vessels operating with dynamic positioning thrusters produce peak noise of 171 dB SEL peak at a distance of 1 m, with noise attenuating to below 150 dB rms at a distance of 135 m (BOEM 2021, see table 23).

In general, information regarding the effects of vessel noise on fish hearing and behaviors is limited. Some TTS has been observed in fishes exposed to elevated background noise and other white noise, a continuous sound source similar to noise produced from vessels. Caged studies on sound pressure sensitive fishes show some TTS after several days or weeks of exposure to increased background sounds, although the hearing loss appeared to recover (e.g., Scholik and Yan 2002; Smith et al. 2006; Smith et al. 2004b). Smith et al. (2004b) and Smith et al. (2006) exposed goldfish (a fish with hearing specializations, unlike any of the ESA-listed species considered in this opinion) to noise with a sound pressure level of 170 dB re 1 μPa and found a clear relationship between the amount of TTS and duration of exposure, until maximum hearing loss occurred at about 24 hours of exposure. A short duration (e.g., 10-minute) exposure resulted in 5 dB of TTS, whereas a three-week exposure resulted in a 28 dB TTS that took over two weeks to return to pre-exposure baseline levels (Smith et al. 2004b). Recovery times were not measured by researchers for shorter exposure durations, so recovery time for lower levels of TTS was not documented.

Vessel noise may also affect fish behavior by causing them to startle, swim away from an occupied area, change swimming direction and speed, or alter schooling behavior (Engas et al. 1998; Engas et al. 1995; Mitson and Knudsen 2003). Physiological responses have also been documented for fish exposed to increased boat noise. Nichols et al. (2015) demonstrated physiological effects of increased noise (playback of boat noise) on coastal giant kelpfish. The fish exhibited acute stress responses when exposed to intermittent noise, but not to continuous noise. These results indicate variability in the acoustic environment may be more important than the period of noise exposure for inducing stress in fishes. However, other studies have also shown exposure to continuous or chronic vessel noise may elicit stress responses indicated by increased cortisol levels (Scholik and Yan 2001; Wysocki et al. 2006). These experiments demonstrate physiological and behavioral responses to various boat noises that have the potential to affect species' fitness and survival, but may also be influenced by the context and duration of exposure. It is important to note that most of these exposures were continuous, not intermittent, and the fish were unable to avoid the sound source for the duration of the experiment because this was a controlled study. In contrast, wild fish are not hindered from movement away from an irritating sound source, if detected, so are less likely to be subjected to accumulation periods that lead to the onset of hearing damage as indicated in these studies. In other cases, fish may eventually become habituated to the changes in their soundscape and adjust to the ambient and background noises.

All fish species can detect vessel noise due to its low-frequency content and their hearing capabilities. Because of the characteristics of vessel noise, sound produced from vessels is unlikely to result in direct injury, hearing impairment, or other trauma to Atlantic sturgeon. In addition, in the near field, fish are able to detect water motion as well as visually locate an oncoming vessel. In these cases, most fishes located in close proximity that detect the vessel either visually, via sound and motion in the water would be capable of avoiding the vessel or move away from the area affected by vessel sound. Thus, fish are more likely to react to vessel noise at close range than to vessel noise emanating from a greater distance away. These reactions may include physiological stress responses, or avoidance behaviors. Auditory masking due to vessel noise can potentially mask biologically important sounds that fish may rely on. However, impacts from vessel noise would be intermittent, temporary, and localized, and such responses would not be expected to compromise the general health or condition of individual fish from continuous exposures. Instead, the only impacts expected from exposure to project vessel noise for Atlantic sturgeon and Giant manta rays may include temporary auditory masking, physiological stress, or minor changes in behavior.

Therefore, similar to marine mammals and sea turtles, exposure to vessel noise for fishes could result in short-term behavioral or physiological responses (e.g., avoidance, stress). Vessel noise would only result in brief periods of exposure for fishes and would not be expected to accumulate to the levels that would lead to any injury, hearing impairment or long-term masking of biologically relevant cues. For these reasons, exposure to vessel noise is not expected to significantly disrupt normal behavior patterns (i.e., cause harassment) of Atlantic sturgeon in the action area or harm the species. Based on this analysis we have similarly determined that it is extremely unlikely that any Atlantic sturgeon will experience significant impairment of essential behavioral patterns. Thus, no take by harassment is anticipated. The effects are also so minor that they cannot be meaningfully measured, detected, or evaluated. Therefore, the effects of vessel noise on Atlantic sturgeon and Giant manta rays are considered insignificant and discountable.

Operation of WTGs

As described above, many of the published measurements of underwater noise levels produced by operating WTGs are from older geared WTGs and are not expected to be representative of newer direct-drive WTGs, like those that will be installed for the Maryland Wind project. Elliot et al. (2019) reports underwater noise monitoring at the Block Island Wind Farm, which has direct-drive GE Haliade turbines; as explained in section 7.1.2, this is the best available data for estimating operational noise of the US Wind turbines. The loudest noise recorded was 126 dB re 1uPa at a distance of 50 m when wind speeds exceeded 56 kmh. As noted above, based on wind speed records within the WDA (US Wind COP) and the nearby NBDC station 44009 buoy, instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, occurring less than 1% of the time across a year. Elliot et al. note that based on monitoring of underwater noise at the Block Island site, the noise levels identified in the vicinity of the turbine are far below any numerical criteria for adverse effects on fish. Similarly, in a review of data from 27 operational wind farms in the North Sea (turbines between 2.3 and 8 MW), the mean (broadband) total SPL (SPL50 or L50) at nominal power of the turbines varied between 112 and 131 dB (median and mean value 120 dB). HDR 2023 found that noise levels recorded during the 6 MW CVOW turbine operations ranged from 120 to 130 dB re 1 μPa except during storms, when the received levels increased to 145 dB re 1 μPa. Recorded particle acceleration levels were compared to published behavioral audiograms of selected fish species and were found to be below the respective hearing thresholds for these species. Together, these publications are the best available data for estimating operational noise of the US Wind turbines. As underwater noise associated with the operation of the WTGs is expected to be below the thresholds for injury or behavioral disturbance for Atlantic sturgeon and Giant manta rays, we do not expect any impacts to any individual due to noise associated with the operating turbines. Additionally, we note that many studies of fish resources within operating wind farms, including the Block Island Wind Farm, and wind farms in Europe with the older, louder geared turbines report localized increases in fish abundance during operations (due to the reef effect; e.g., Stenburg et al. 2015, Methartta and Dardick 2019, Wilber et al. 2022). This data supports the conclusion that operational noise is extremely unlikely to result in the displacement or disturbance of any Atlantic sturgeon or Giant manta rays. Based on these considerations, effects of operational noise on Atlantic sturgeon and Giant manta rays are extremely unlikely to occur and are discountable.

HRG Surveys

Some of the equipment that is described by BOEM for use for surveys produces underwater noise that can be perceived by Atlantic sturgeon. Of the equipment that is proposed by US Wind, this is limited to boomers and sparkers. Extensive information on HRG survey noise and potential effects of exposure to Atlantic sturgeon is provided in NMFS June 29, 2021 programmatic ESA consultation on certain geophysical and geotechnical survey activities (NMFS GAR 2021). We summarize the relevant conclusions here. For the equipment proposed for use, the maximum distance to the injury threshold (peak) is 9 m and the maximum distance to the 150 dB re 1uPa behavioral disturbance threshold is 1.9 km for the loudest equipment (sparker).

Table 7.1.25 Largest PTS Exposure Distances from mobile HRG Sources at Speeds of 4.5 knots – Fish

HRG Source	Highest Source Level (dB re 1 µPa)	Distance to Fish Thresholds in m (FHWG 2008)		
		Peak	*SEL*	*Behavior (150 dB re 1uPa rms)*
Boomers	176 dB SEL 207 dB RMS 216 PEAK	3.2	0	708
Sparkers	188 dB SEL 214 dB RMS 225 PEAK	9	0	1,996[a]

a – the calculated distance to the 150 dB rms threshold for the Applied Acoustics Dura-Spark is 1,996m; however, the distances for other equipment in this category is significantly smaller
NA = not applicable due to the sound source being out of the hearing range for the group.

As explained above, the available information suggests that for noise exposure to result in physiological impacts to the fish species considered here, received levels need to be at least 206 dB re: 1uPa peak sound pressure level (SPLpeak) or at least 187 dB re: u1Pa cumulative. The peak thresholds are exceeded only very close to the noise source (<9 m for the sparkers, 3.2 m for boomers; the cumulative threshold is not exceeded at any distance). As such, in order to be exposed to peak sound pressure levels of 206 dB re: 1uPa from any of these sources, an individual fish would need to be within 9 m of the source. This is extremely unlikely to occur given the dispersed nature of the distribution of ESA-listed Atlantic sturgeon and Giant manta rays in the action area, the use of a ramp up procedure, the moving and intermittent/pulsed characteristic of the noise source, and the expectation that ESA-listed fish will swim away, rather than towards the noise source. Based on this, no physical effects to any Atlantic sturgeon or Giant manta rays, including injury or mortality, are expected to result from exposure to noise from the geophysical surveys. We consider the potential for effects on behavior below.

The calculated distances to the 150 dB re: 1 uPa rms threshold for the boomers is 708m and for

Because the area where increased underwater noise will be experienced is transient (because the survey vessel towing the equipment is moving), increased underwater noise will only be experienced in a particular area for a short period of time. Given the transient and temporary nature of the increased noise, we expect any effects to behavior to be minor and limited to a temporary disruption of normal behaviors, potential temporary avoidance of the ensonified area and minor additional energy expenditure spent while swimming away from the noisy area. If foraging, resting, or migrations are disrupted, we expect that these behaviors will quickly resume once the survey vessel has left the area (i.e., in seconds to minutes, given its traveling speed of 3 – 4.5 knots). Therefore, no fish will be displaced from a particular area for more than a few minutes. While the movements of individual fish will be affected by the sound associated with the survey, these effects will be temporary and localized. These fish are not expected to be excluded from any particular area, and there will be only a minimal impact on foraging, migrating, or resting behaviors. Sustained shifts in habitat use, distribution, or foraging success are not expected. Effects to individual fish from brief exposure to potentially disturbing levels of noise are expected to be limited to a brief startle or short displacement and will be so small that they cannot be meaningfully measured, detected, or evaluated; therefore, effects of exposure to survey noise are insignificant. Take of Atlantic sturgeon or Giant manta rays is not anticipated to occur.

7.1.6 Effects of Noise on Prey

The ESA listed species in the WDA forage in varying frequencies and intensities on a wide variety of prey. With the exception of fish, little information is available on the effects of underwater noise on many prey species, such as most benthic invertebrates and zooplankton, including copepods and krill. Effects to schooling fish that are preyed upon by some whale species are likely to be similar to the effects described for Atlantic sturgeon; that is, effects are expected to be limited to temporary behavioral disturbance with no injury or mortality anticipated. However, like Atlantic sturgeon, we expect these disturbances and changes in distribution to be temporary and not represent any reduction in biomass or reduction in the availability of prey. Most benthic invertebrates have limited mobility or move relatively slowly compared to the other species considered in this analysis. As such, there may be some small reductions in prey for sea turtles and Atlantic sturgeon as a result of exposure of benthic prey species to pile driving noise. However, these reductions are expected to be small and limited to the areas immediately surrounding the piles being installed. We expect that the effects to Atlantic sturgeon and loggerhead and Kemp’s ridley sea turtles from any small and temporary reduction in benthic invertebrates due to exposure to pile driving noise to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant. No take is anticipated as a consequence of disturbance to prey.

We are not aware of any information on the effects of pile driving noise exposure to krill, copepods, or other zooplankton. McCauley et al. (2017) documented mortality of juvenile krill exposed to seismic airguns. No airguns are proposed as part of the Maryland Wind project. We are not aware of any evidence that pile driving noise, HRG surveys, or the other noise sources considered here are likely to result in the mortality of zooplankton. Effects to marine mammals and giant manta rays due to disturbance of prey are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant. No take is anticipated to occur.

Similarly, we expect that any effects of operational noise on the prey of ESA listed species to be extremely unlikely or so small that they cannot be meaningfully measured, detected, or evaluated. As described above, many of the published measurements of underwater noise levels produced by operating WTGs are from older geared WTGs and are not expected to be representative of newer direct-drive WTGs, like those that will be installed for the Maryland Wind project. Elliot et al. (2019) reports underwater noise monitoring at the Block Island Wind Farm, which has direct-drive GE Haliade turbines; as explained in section 7.1.2, this is the best available data for estimating operational noise of the US Wind turbines. The loudest noise recorded was 126 dB re 1uPa at a distance of 50 m when wind speeds exceeded 56 kmh. As noted above, based on wind speed records within the WDA (US Wind COP) and the nearby NBDC station 44009 buoy, instances of wind speeds exceeding 56 km/h in the lease area are expected to be rare, occurring less than 1% of the time across a year. Elliot et al. note that based on monitoring of underwater noise at the Block Island site, the noise levels identified in the vicinity of the turbine are far below any numerical criteria for adverse effects on fish. Similarly, in a review of data from 27 operational wind farms in the North Sea (turbines between 2.3 and 8 MW), the mean (broadband) total SPL (SPL50 or L50) at nominal power of the turbines varied between 112 and 131 dB (median and mean value 120 dB). HDR 2023 found that noise levels recorded during the 6 MW CVOW turbine operations ranged from 120 to 130 dB re 1 µPa except during storms, when the received levels increased to 145 dB re 1 µPa. Recorded particle acceleration levels were compared to published behavioral audiograms of selected fish species and were found to be below the respective hearing thresholds for these species. Together, these publications are the best available data for estimating operational noise of the US Wind turbines. As underwater noise associated with the operation of the WTGs is expected to be below the thresholds for injury or behavioral disturbance for fish species, we do not expect any impacts to any fish species due to noise associated with the operating turbines. There is no information to indicate that operational noise will affect krill, copepods, or other zooplankton. Additionally, we note that many studies of fish and benthic resources within operating wind farms, including the Block Island Wind Farm, and wind farms in Europe with the older, louder geared turbines report localized increases in fish and benthic invertebrate abundance during operations (due to the reef effect; e.g., Stenburg et al. 2015, Methartta and Dardick 2019, Wilber et al. 2022). This data supports the conclusion that operational noise is not likely to result in the displacement or disturbance of prey species. As effects to prey from operational noise on prey are extremely unlikely, effects to ESA listed species resulting from impacts to prey are also extremely unlikely and therefore, discountable.

7.2 Effects of Project Vessels

In this section we consider the effects of the operation of project vessels on listed species in the action area by describing the existing vessel traffic in the action area (i.e., as previously summarized in the *Environmental Baseline*, Section 6 of this Opinion), estimating the anticipated increase in vessel traffic associated with construction, operations, and decommissioning of the project (based on the information provided in BOEM's BA), and then analyzing risk and determining likely effects to listed whales, sea turtles, and marine fishes. We also consider impacts to air quality from vessel emissions and whether those impacts may cause effects to listed species. In section 3 of this Opinion we described proposed vessel use over all phases of the project as informed by BOEM's BA: that information is summarized here. Effects of project noise, including from vessels, were considered in Section 7.1, and are not repeated here. As considered here, project vessel trips are vessel transits that would not occur but for the proposed action and are reasonably certain to occur: that is, these are vessels that are operated by US Wind, or under contract to US Wind, or otherwise engaged in activities that are described in the COP or other project permits, authorizations, or approvals. A number of measures to reduce the risk of vessel strike are included in the proposed action (see section 3, inclusive of Appendix A and B).

Project vessels will operate in distinct areas within the action area over the life of the project. According to the information presented in the BA, the majority of vessel transits during the construction period will occur between the WDA and ports in Baltimore (Sparrows Point), Maryland and Ocean City, Maryland. Vessels transiting between the WDA and Baltimore may utilize routes through Chesapeake Bay or Delaware Bay via the C and D canal (Figure 7.2.1). There will also be transits between the WDA and ports in the Gulf of Mexico as well as transits to the Cianbro Modular Manufacturing Facility in the Penobscot River. Depending on contracts, port capacity, and other factors, those ports may not accommodate all transits; in that case, some vessel transits may occur between the WDA and ports located in the lower Chesapeake Bay (e.g., Hampton Roads area, Virginia; Cape Charles, Virginia) and the Delaware River and Bay (e.g., Paulsboro, New Jersey; Hope Creek, New Jersey (NJWP); Port Norris, New Jersey; Wilmington, Delaware; Lewes, Delaware). There may also be transits between the WDA and Charleston, South Carolina and from ports in Europe.

During the O&M phase, maintenance activities for WTGs, OSSs, and routine inspections using CTVs will operate out of the O&M facility in Ocean City, Maryland and Lewes, Delaware. Major maintenance activities requiring deep draft or jack-up vessels may travel to the project site from Baltimore (Sparrows Point), Maryland; Hampton Roads area, Virginia; Hope Creek, New Jersey (New Jersey Wind Port); or the Port of New York/New Jersey. As described in the BA, the locations of ports used for decommissioning are unknown at this time; however, we know that vessels supporting decommissioning would operate in and around the WDA. Thus, we have considered an increase in traffic during the decommissioning period in the general area in and around the WDA, including between the WDA and ports identified for use during the O&M phase.

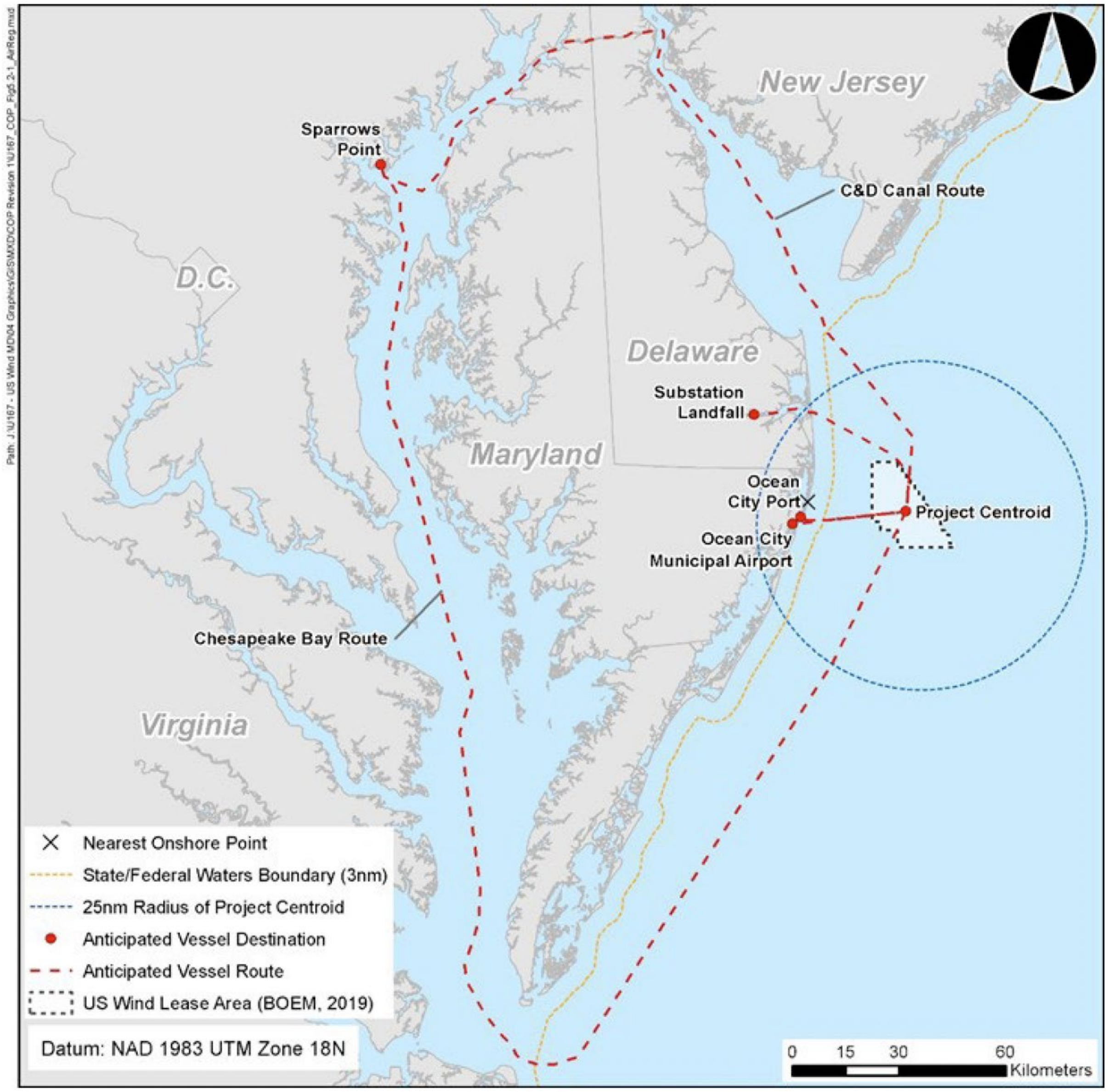


Figure 7.2.1. Vessel transit routes from Baltimore (Sparrows Point), Maryland
Source: COP, Volume II, Section 5.2, Figure 5-1 (US Wind 2023)

7.2.1 Project Vessel Descriptions and Increase in Vessel Traffic from Proposed Project

Descriptions of project vessel use and traffic are described in Section 3 of this Opinion and summarized here for reference. Vessel traffic will occur in the WDA and between the WDA and the ports used to support US Wind's construction, operations and maintenance, and decommissioning activities; these ports were identified in BOEM's BA. As explained in Section 3, vessels of various classes will be used during the construction and installation phase with a total of 2,355 round trips between various ports and the Maryland Wind WDA, with an average of 2.1 round trips per day over the 3-year construction period. US Wind anticipates an average of approximately 6.2 daily vessel round trips could occur during the most active month of construction. Up to 6 round trips of heavy transport vessels may occur between ports in Europe and the WDA during the construction phase. In this section, we consider the effects of the portion of those vessel transits that are within the US Atlantic EEZ (see explanation in Section 3 of this Opinion). During the O&M period, approximately 822 vessel round trips annually are anticipated, with an average of 2.3 round trips per day. US Wind anticipates a maximum of 4.5 vessel round trips per day for the months of highest activity during O&M.

As described in Section 3 (Table 3.6), during the construction phase a variety of vessels will be used including installation and transport vessels that may transit between 1-25 knots (when not subject to a speed restriction), these vessels range from 10 to 225 meters in length (COP Volume I, Table 4-1). The larger installation vessels, such as the floating/jack-up crane, dredging vessels, and cable-laying vessel, will generally travel to and from the construction area in the WDA at the beginning and end of the wind turbine and cable construction/installation and will not make transits to port on a regular basis. Tugs and barges transporting construction equipment and materials will make more frequent trips (e.g., weekly) from ports to the project site while smaller support vessels carrying supplies and crew may travel to the WDA more frequently. However, we note that construction crews assembling the WTGs may hotel onboard installation vessels at sea thus limiting the number of crew vessel transits expected during wind farm installation. Within the WDA, many vessels will be stationary or moving 8 knots or less. Construction of the offshore and inshore export cables will utilize various vessel types including a cable-laying vessel, tugs, barges, and work and transport vessels from numerous different ports.

During the O&M phase, approximately 822 round trips per year to the WDA will occur to carry out inspections and maintenance for the WTGs, OSSs, cables, and the Met Tower; this is for the complete Maryland Wind project (i.e., all three phases). The majority of vessel trips over the 30-year O&M period would originate from the O&M facility in Ocean City, MD. Jack-up vessels, cable-lay/cable burial vessels, crew transport vessels, and support barges may be used on an as-needed basis for major repairs. Typical drafts and operational speeds for O&M vessel types are expected to be similar to those for equivalent vessels used during construction.

As described in the BA, the number and type of vessels required for project decommissioning would be similar to those used during project construction, with the exception that impact pile driving would not be required. As such, while the same class of vessel used for foundation installation may be used for decommissioning, that vessel would not be equipped with an impact hammer. At this time, no information is available on the ports that may be used for decommissioning; however, based on information presented for other wind projects we expect that trips will occur primarily between the WDA and the ports used for the O&M or within the general vicinity of the O&M ports.

Total estimated vessel trips during the 3-year construction period are 2,355; these trips will be between the US Wind WDA and the ports identified above. During the decommissioning period, the number and types of vessels required would be similar to those described for the construction and installation period (2,355). As explained in Section 6, the best available information indicates there are at least approximately 49,317 vessel transits annually in the area that US Wind vessel transits will overlap. Table 7.2.1 below describes the calculated increase in traffic in this area attributable to Maryland Wind project vessels during each project phase.

Table 7.2.1 Percent Increase above Baseline Vessel Traffic in the Project Area Due to Maryland Wind Project Vessels

Phase	Annual Project-Related Vessel Transits	Phase Duration	% Increase in Annual Vessel Transits in the WDA and Surrounding Area
Construction	785[a]	3 years	1.59%
O&M	822[b]	30 years	1.67%
Decommissioning	1,178[c]	2 years	2.39%

[a] Source: BOEM 2024 BA (2,355 total trips divided by 3 years of construction)
[b] Source: BOEM 2024 BA (822 maximum trips per year during all construction campaigns)
[c] Source: BOEM 2024 BA (2,355 total trip divided by 2 years of decommissioning)
[d] Source: Baseline vessel traffic in the US Wind WDA and surrounding area where the majority of project vessels will operate is based on 49,317 transits per year (DNV 2022)

7.2.2 Minimization and Monitoring Measures for Vessel Operations

There are a number of measures that US Wind is proposing to take and/or BOEM is proposing to require as conditions of COP approval that are designed to avoid, minimize, or monitor effects of the action on ESA listed species during construction, operation, and decommissioning of the project. The proposed MMPA ITA also contains requirements for vessel strike avoidance measures for marine mammals; these measures will be implemented over the 5 year effective period of the ITA. The measures incorporated into the proposed action or otherwise required by regulation fall into the following general categories: speed reductions, monitoring for animals in the vessel's path, separation distances between vessels and animals, actions to be taken when an animal is sighted, and increased situational awareness. The complete list of measures that are part of the proposed action is provided in Appendices A, B, and C of this Opinion. The measures described below are all considered part of the proposed action or are otherwise required by regulation (62 FR 6729, February 13, 1997), (66 FR 58066, November 20, 2001), (73 FR 60173, October 10, 2008).

Speed Restrictions

As described in the BA and Notice of Proposed ITA, the following speed restrictions will be in place during all phases of the project:

- Year round, all vessels, regardless of size, will comply with 10 knot speed restrictions in any seasonal management area (SMA), dynamic management area (DMA), or slow zone.
- Outside of areas where other speed restrictions are in place (e.g., SMA, DMA, Slow Zone), for all vessels, in order for a vessel to travel at greater than 10 knots, a vessel must be within a "transit corridor" being monitored by real time PAM. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all vessels must travel at 10 knots or less for the following 24 hours. Each subsequent detection will trigger a 24-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection of North Atlantic right whales in the transit corridor in the past 24 hours. (Mitigation Requirement (b)(8) in 89 FR 504).

- After the MMPA ITA expires, BOEM will require continued implementation of an approved Vessel Strike Avoidance Plan that is determined by NMFS and BOEM to provide risk reduction equivalent to a 10 knot speed restriction.
- All vessels, regardless of size, will reduce vessel speed to 10 knots or less when mother/calf pairs, pods, or larger assemblages of whales are observed near an underway vessel.

We note that exceptions to the speed limits may also be made in emergencies when traveling over 10 knots is necessary to ensure the health and safety of vessel crew. As explained in the Notice of Proposed ITA, US Wind must comply with the vessel strike avoidance measures, unless a situation presents a threat to the health, safety, or life of a person or when a vessel, actively engaged in emergency rescue or response duties, including vessel-in-distress or environmental crisis response, requires speeds in excess of 10 kn to fulfill those responsibilities.

To minimize risk to sea turtles, if a sea turtle is sighted within 100 meters or less of the operating vessel's forward path, the vessel operator is required to slow down to 4 knots (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots or less until there is a separation distance of at least 100 meters at which time the vessel may resume normal operations. Additionally, vessel captains/operators must avoid transiting through areas of visible jellyfish aggregations or floating sargassum lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots while transiting through such areas.

Monitoring and Look Outs

Monitoring and lookouts are required for all project vessels operating in the action area.

- All underway vessels operating at any speed must have a dedicated visual observer on duty at all times to monitor for protected species within a 180-degree direction of the forward path of the vessel (90 degrees port to 90 degrees starboard). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.

- For vessels operating at speeds greater than 10 knots, that observer/lookout must have no other duties during the period the vessel is traveling at speeds greater than 10 knots.

- Alternative monitoring technology, such as night vision and thermal cameras, must be available and used to ensure effective watch at night and in any other low visibility conditions (e.g., rain, fog).

- Detection of a marine mammal will trigger appropriate vessel speed reductions and changes in course to avoid close approaches of animals.

Monitoring measures also include the integration of sighting communication tools such as Mysticetus, Whale Alert, and WhaleMap to establish a situational awareness network for marine mammal and sea turtle detections.

As outlined above, vessels in some areas may be exempted from the 10 knot speed restriction otherwise imposed by conditions of COP approval or the MMPA ITA if they are operating in an area that is being monitored by real time PAM and/or visual surveys. As required by BOEM and NMFS OPR, if US Wind plans to implement this, they would need to prepare a vessel strike avoidance plan that contained a complete description of their PAM protocols. Details for implementation of the Vessel Strike Avoidance plan were not included in the proposed MMPA ITA or the BA but based on other recent offshore wind projects where PAM monitoring of transit corridors was addressed, we expect the following requirements:

- Localized detections of any right whale in an action zone would trigger a slow-down to 10 knots or less in the respective zone for the following 24 hours. Each subsequent detection would trigger a 24-hour reset. A slow-down zone expires when there has been no further visual or acoustic detection in the past 24 hours within the triggered zone; and

- The detection action zone's size will be defined based on the efficacy of PAM equipment deployed and subject to NMFS approval as part of the NARW Vessel Strike Avoidance Plan.

We note that any PAM monitoring plan will be subject to review and approval by BOEM and NMFS prior to implementation and that unless and, consistent with the proposed action described in the Notice of Proposed MMPA ITA, until it is approved, all project vessels, with exceptions only for emergencies as noted above, are required to travel at speeds of 10 knots or less.

7.2.3 Assessment of Risk of Vessel Strike – Construction, Operations and Maintenance, and Decommissioning

Here, we consider the risk of vessel strike to ESA listed species. This assessment incorporates the vessel strike avoidance measures identified in Section 3.0, because they are considered part of the proposed action or are otherwise required by regulation. This analysis is organized by species group (i.e., Atlantic sturgeon, shortnose sturgeon, giant manta ray, whales, and sea turtles) because the risk factors and effectiveness of strike avoidance measures are different for the different species groups. Within the species groups, the effects analysis is organized around the different geographic areas where project related vessel traffic would be experienced.

As noted in section 2 of this Opinion and further addressed below, the effects of some vessel transits have been addressed in other Biological Opinions. Specifically, some Maryland Wind project vessels will utilize the Paulsboro Marine Terminal in Paulsboro, NJ, the New Jersey Wind Port in Hope Creek, NJ, and the Nexans Cable Plant in Charleston, SC, which were constructed pursuant to USACE permits. The Biological Opinions prepared by NMFS for the Paulsboro Marine Terminal (November 7, 2023, "2023 Paulsboro Opinion") and New Jersey Wind Port (February 25, 2022, "2022 NJWP Opinion") considered effects of vessels transiting to/from these ports on shortnose sturgeon, Atlantic sturgeon, and critical habitat designated for the New York Bight DPS of Atlantic sturgeon. The Biological Opinion prepared by NMFS' SERO for the Nexans Plant (May 4, 2020, "2020 Nexans Opinion") considered effects of vessels transiting to/from the facility on shortnose sturgeon, Atlantic sturgeon, and critical habitat designated for the Carolina DPS of Atlantic sturgeon.

Each of these three Biological Opinions analyzed an overall amount of vessel transits, of which Maryland Wind would contribute a small part. The effects analyzed in the three completed port

Opinions have been considered as part of the *Environmental Baseline* of this Opinion, given the definition of that term at 50 CFR §402.02. The effects specific to Maryland Wind's vessel use of those ports will be discussed here in this *Effects of the Action* section by referencing the analysis in the three port Opinions and determining whether the effects of Maryland Wind's vessels transiting to and from those ports are consistent with those analyses or anticipated to cause additional effects. As previously explained, by using this methodology, this Opinion ensures that all of the effects of Maryland Wind's vessel transits to and from the ports analyzed in other Biological Opinions will be considered in the *Integration and Synthesis* section and reflected in this Opinion's final determination under ESA 7(a)(2). This methodology also ensures this Opinion does not "double-count" effects of Maryland Wind's vessel transits to and from the ports–once in the Environmental Baseline and once here in this Opinion's *Effects of the Action* section. This approach is being taken because BOEM was not a party to the three port Biological Opinions' consultation process, yet Maryland Wind's vessel transits would not occur but for BOEM's proposed COP approval with conditions; additionally, the three port Opinions do not identify specific users of the ports.

7.2.3.1 Atlantic Sturgeon

The distribution of Atlantic sturgeon does not overlap with the entirety of the action area. The marine range of Atlantic sturgeon extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida with distribution largely from shore to the 50m depth contour (ASMFC 2006; Stein et al. 2004). Considering the area where project vessels will operate, Atlantic sturgeon may be present in nearshore waters along the U.S. Atlantic coast (depths less than 50 m), including the WDA, and in some rivers and bays that may be transited by Project vessels (i.e., Delaware Bay and Delaware River (Paulsboro Marine Terminal, New Jersey Wind Port, Wilmington, DE, Lewes, DE, and Port Norris, NJ), the Chesapeake Bay (Baltimore (Sparrow's Point), MD, Cape Charles, VA, Hampton Roads area, VA), New York Harbor (Port of New York/New Jersey), Charleston Harbor and the Cooper River (Port of Charleston), and the Penobscot River (Cianbro Modular Manufacturing Facility). Atlantic sturgeon do not occur in the Gulf of Mexico.

Effects of Vessel Transits in the Lease Area, along the offshore Cable Corridor, and to/from Coastal Ports in MD, VA, DE, NY and NJ

While Atlantic sturgeon are known to be struck and killed by vessels in rivers and in estuaries adjacent to spawning rivers (i.e., Delaware Bay), we have no reports of vessel strikes in the marine environment. We have considered whether Atlantic sturgeon are likely to be struck by project vessels or if the increase in vessel traffic is likely to otherwise increase the risk of strike for Atlantic sturgeon in the lease area, along the cable corridor, during transits to and from the O&M Facility in Ocean City, MD. As established elsewhere in this Opinion, Atlantic sturgeon use of the WDA (i.e., the lease area and cable corridors) is intermittent and dispersed; there are no aggregation areas in the area in the WDA, the cable corridors or along the vessel transit route to Ocean City. The dispersed and transient nature of Atlantic sturgeon in this area means that the potential for co-occurrence between a project vessel and an Atlantic sturgeon in time and space in this portion of the action area is extremely low.

In order to be struck by a vessel, an Atlantic sturgeon needs to co-occur with the vessel hull or propeller in the water column. Given the depths in the vast majority of this area (with the exception of nearshore areas where vessels will dock at the port in Ocean City and the 3R's

Beach landfall as well as the nearshore waters of the lower Chesapeake and Delaware Bays where vessels will dock at Cape Charles Harbor, VA, Port Norris Marina, NJ, and Lewes Harbor, DE) and that sturgeon typically occur at or near the bottom while in the marine environment, the potential for co-occurrence of a vessel and a sturgeon in the water column is extremely low even if a sturgeon and vessel co-occurred generally. The areas to be transited by the project vessels are free flowing with no obstructions; therefore, even in the event that a sturgeon was up in the water column such that it could be vulnerable to strike there is ample room for a sturgeon to swim deeper to avoid a vessel or to swim away from it which further reduces the potential for strike. The nearshore port area in Ocean City where vessels will enter shallower water and dock are not known to be used by Atlantic sturgeon; as such, co-occurrence between any Atlantic sturgeon and any project vessels in areas with shallow water or constricted waterways where the risk of vessel strike is theoretically higher, is extremely unlikely to occur. Considering this analysis, it is extremely unlikely that any project vessels operating in the Maryland Wind lease area, along the cable corridor, or between these areas and the O&M facility in Ocean City will strike an Atlantic sturgeon during any phase of the proposed project.

Project vessels transiting between the WDA and the Port of New York/New Jersey will enter the Lower New York Bay and then travel through the Upper New York Bay. From 2013 to 2020, NYSDEC reported 13 Atlantic sturgeon carcasses in New York Bay that had some evidence of a possible vessel strike. These carcasses were not examined and we do not have an estimate of the total number of vessel strikes in this area annually. While we are not able to use these reports to estimate the total number of Atlantic sturgeon struck in this year, the number of carcasses reported and detected in an area that has high volumes of vessel traffic, accessible and well populated shorelines and waterways, and an established reporting system (through the NYSDEC), indicates that risk of vessel strike in this area may be considerably lower than in other geographic areas (e.g., the Delaware River). This may be due to the deep depths of the waterways in this area, the transient nature of Atlantic sturgeon in the New York Harbor/New York Bay area (i.e., sturgeon use of this area is limited to individuals migrating in and out of the Hudson River), and the lack of constrictions that would increase the potential for co-occurrence of deep draft vessels and individual sturgeon.

The best available information indicates there are approximately 85,092 vessel transits annually in the Upper New York Bay, Bay Ridge and Red Hook Channels, and New York Harbor Lower Entrance Channels (i.e., the general area that the majority of Maryland Wind vessels will transit to/from the Port of New York/New Jersey). In the BA, BOEM included the potential use of the Port of New York/New Jersey as an alternate port for project vessels involved in WTG delivery, storage, and pre-assembly; foundation fabrication, assembly, and load out to feeder or installation vessels; mobilization of the fall pipe vessel for scour protection; cable storage and load out to installation vessels; and support. If any alternative ports are used, US Wind anticipates the number of vessel transits to remain the same such that the number of vessels and the number of transits would not differ based on the port used. In the BA, US Wind indicates that the vessels used and trips made will be spread among the ports if alternative ports are used. For this Opinion, we consider, based on the information provided in the BA, that the number of vessel transits to the Port of New York/New Jersey would not exceed the number of trips expected for Baltimore (Sparrows Point), Maryland. Considering the trips identified in the BA, Maryland Wind trips (up to 668 vessel trips for year 2, the year with the highest anticipated vessel activity during construction) will represent approximately 0.8% of vessel transits in this area annually. Given the anticipated low risk of vessel strike in this area, and this very small increase in vessel traffic, it is extremely unlikely that a Maryland Wind vessel transiting to/from the Port of New York/New Jersey will increase the risk of vessel strike of Atlantic sturgeon in this area or result in the strike of an Atlantic sturgeon. As such, effects to Atlantic sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits along the Inshore Export Cable Route
We have considered whether vessels operating along the Inshore Export Cable Route could potentially encounter Atlantic sturgeon. US Wind assumes all construction within Indian River Bay, including any vessel transits, would occur within a October to March window. The cable installation barge will be moved along the cable route using a six-point anchor system, assisted by an anchor handling tug, in combination with spud piles. Cable laying operations proceed at speeds of <1 knot. At these speeds, any sturgeon is expected to be able to avoid any interactions with vessels associated with the cable laying operation.

As noted above, in the *Environmental Baseline* section, Atlantic sturgeon may occur within Indian River Bay from October to December prior to migrating further offshore to deeper waters. However, Atlantic sturgeon have not been documented in trawl surveys conducted by Delaware Division of Fish and Wildlife from April through October within the Indian River, Indian River Bay, and the Rehoboth Bay since 1986 (USACE 2017). Given the rarity of observations in Indian River Bay and the dispersed nature of Atlantic sturgeon in this portion of the action area, the risk of any Atlantic sturgeon being struck by vessels in Indian River Bay is considered low. Additionally, considering the slow speeds of vessels included as part of the inshore cable installation spread, vessel strikes are extremely unlikely even if migrating individuals occur along the vessel transit routes within Indian River Bay. As such, effects to Atlantic sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits to Ports in the Chesapeake Bay
<u>Baltimore (Sparrows Point), MD</u>
In the BA, BOEM indicates that up to 270 roundtrips are anticipated between Baltimore (Sparrows Point), Maryland and the Lease Area during year 1; 668 roundtrips during year 2; 451 roundtrips during year 3; less than one annual round trip is anticipated during O&M; and another 1,390 trips during decommissioning, for a total of 2,780 vessel transits between Sparrows Point, MD, and the WDA. Sparrows Point is located near the mouth of the Patapsco River at the Port of Baltimore. Vessels traveling to/from this port will travel within the Federal navigation channels within Chesapeake Bay. Subadult and adult Atlantic sturgeon are seasonally present in portions of the Chesapeake Bay as they migrate between riverine habitats and the Atlantic Ocean. Little information is available on the risk of vessel strike in the Bay. Atlantic sturgeon are not known to occur in the Patapsco River itself.

The Port of Baltimore typically has over 100 vessel arrivals and departures per day[41] and had approximately 3,000 inbound and 3,000 outbound commerce-carrying vessel trips in 2021 (ACOE 2021). The maximum 668 vessel trips for year 2 (i.e., the year with the highest anticipated vessel activity during construction) represents approximately 22% of the annual commerce-carrying vessel traffic traveling through the Chesapeake Bay to the Port of Baltimore and a smaller percentage of the total vessel traffic in the Bay and at the Port. While the potential vessel transits represent a significant increase in traffic to Sparrows Point and the Port of Baltimore during the construction period, the dispersed nature of Atlantic sturgeon in the upper Chesapeake Bay, the lack of known sturgeon use of the Patapsco River, the absence of spawning populations in the upper Bay, and the geography of the upper Bay, which does not restrict Atlantic sturgeon distribution in the way that narrow or constricted river reaches may, reduce many of the factors that are considered to increase risk of vessel strike of Atlantic sturgeon. Based on this, effects to Atlantic sturgeon from project vessels operating at Sparrows Point/Port of Baltimore or in the upper Chesapeake Bay are extremely unlikely to occur and are discountable. We consider vessel strike risk in the Chesapeake Bay entrance channels and the lower Bay below.

Port of Virginia/Hampton Roads
Vessels traveling to or from the port facilities in the Hampton Roads area would travel from the lower Chesapeake Bay to the Port of Virginia/Hampton Roads along the Elizabeth River. Vessels are expected to travel within the Federal navigation channels from the confluence of the Chesapeake Bay with the Atlantic Ocean to the Port. Large vessels, such as the Maryland Wind project vessels, that enter the Elizabeth River are typically assisted by tug boats and travel at speeds of less than 1 knot with their propeller idling. The Port of Virginia is made up of over 55 public and private marine terminals. The port received over 2,300 vessel calls in 2019[42]. This does not account for Naval vessels, which are estimated at 1 to 8 transits per day or recreational boats (over 2,000 registered in the City of Portsmouth, VA) (USCG 2016). Thousands of other vessels annually transit the Chesapeake Bay entrance channels traveling to and from other ports within Chesapeake Bay, including the Port of Baltimore and ports in the James River. The USCG's 2021 Port Access Route Study for Approaches to the Chesapeake Bay, VA (USCG 2021, Enclosure 1), reports annual transits of the Chesapeake Bay entrance of 12,192 in 2017, 15,947 in 2018, and 16,811 in 2019 for an average of 14,983 annual transits through the mouth of Chesapeake Bay.

In the BA, BOEM included the potential use of facilities in the Hampton Roads area as alternate ports for project vessels involved in WTG delivery, storage, and pre-assembly; foundation fabrication, assembly, and load out to feeder or installation vessels; mobilization of the fall pipe vessel for scour protection; and support. If any alternative ports are used, US Wind anticipates the number of vessel transits to remain the same such that the number of vessels and the number of transits would not differ based on the port used. In the BA, US Wind indicates that the vessels used and trips made will be spread among the ports if alternative ports are used. For this Opinion, we consider, based on the information presented in the BA, the number of vessel transits to the Hampton Roads area would not exceed those expected for Baltimore (Sparrows

[41] https://www.marinetraffic.com/en/ais/details/ports/95?name=BALTIMORE&country=USA#Statistics; last accessed June 4, 2024
[42] https://hamptonroadsalliance.com/port-of-virginia/; last accessed April 10, 2024

Point), Maryland, which US Wind has identified as the primary port for WTG and foundation-related construction activities (note that Hampton Roads is only identified as an alternate port for construction). The maximum 668 vessel trips for year 2 (i.e., the year with the highest anticipated vessel activity during construction) represents approximately 29% of the annual commerce-carrying vessel traffic to the Port of Virginia. We also note that as the vessels will be using existing port facilities, this may not represent an actual increase in vessel traffic in the area (i.e., while these particular trips would not occur but for the Maryland Wind project, other vessels would transit to/from Portsmouth if these trips did not occur).

Through the Sturgeon Salvage Program, we keep records of Atlantic sturgeon carcasses that are reported by researchers and the public. From June 2013 through December 2020, 89 carcasses were reported in the Virginia waters of the Chesapeake Bay with approximately 70 of those records having injuries consistent with vessel strike; from September 2021 – May 2023, 32 carcasses were reported from that area (NMFS unpublished data). Of these 121 reports, 1 carcass was observed in the Elizabeth River. We do not expect that all vessel struck sturgeon are observed and reported; thus, the salvage data represents a minimum estimate of total vessel strikes. However, based on the available information, vessel strike within the Elizabeth River appears to be rare (one carcass in 10 years); this is likely due to the rarity of Atlantic sturgeon in the Elizabeth River and the slow movement of vessels in this area (as described above). We also note that we do not know if the reported carcass was actually struck in the Elizabeth River or if it floated in from the James River. The available carcass recovery information suggests that Atlantic sturgeon are struck in the lower James River and also likely struck near the confluence of the James River with the Chesapeake Bay (as we only have information on carcass recovery location, we do not typically know where a strike actually occurred). While Maryland Wind vessels will transit through areas where Atlantic sturgeon vessel strikes are expected to occur, these vessels will make up an extremely small percentage of the traffic in this area (less than 4.5%). As such, assuming a proportional risk to Atlantic sturgeon, any risk of these vessels striking an Atlantic sturgeon is extremely small and approaching zero (4.5% of 0.1 sturgeon/annually is 0.0045). Therefore, we have determined that a vessel strike of an Atlantic sturgeon from a Maryland Wind vessel transiting within the Hampton Roads area, VA is extremely unlikely to occur and effects are discountable.

<u>Chesapeake Bay Entrance</u>

As noted above, the USCG's 2021 Port Access Route Study for Approaches to the Chesapeake Bay, VA (USCG 2021, Enclosure 1), reports annual transits of the Chesapeake Bay entrance of 12,192 in 2017, 15,947 in 2018, and 16,811 in 2019 for an average of 14,983 annual transits through the mouth of Chesapeake Bay. As described in the BA, the maximum annual transits of Maryland Wind project vessels through the Chesapeake Bay entrance channels is 668 (during year 2 of construction). Vessel trips through the Chesapeake Bay entrance channels are only anticipated during the three year construction period. During this period, Maryland Wind trips will represent up to 4.5% of vessel traffic in this area. Atlantic sturgeon do not occur in this portion of the action area year round; Kahn et al. (2023) reports that both spawning and non-spawning fish regularly utilized the Chesapeake Bay (the Bay itself, not tributary rivers) starting as the water begins to warm in the spring and ending as it cools in the fall. Pre-spawn females were recorded in the bay generally from late February to early October, with males present from early March to early September. Kahn et al (2023) recommends that vessel operations avoid the

April - August and October 15 - December 1 period to best avoid overlap with Atlantic sturgeon. We expect Maryland Wind project vessels to transit year round, thus not all trips will occur when Atlantic sturgeon are present; assuming even distribution of trips year round, we would expect approximately 50% of the trips to occur when Atlantic sturgeon are expected to be present in the Bay.
As noted above, from June 2013 through December 2020, 89 carcasses were reported in the Virginia waters of the Chesapeake Bay with approximately 70 of those records having injuries consistent with vessel strike; from September 2021 – May 2023, 32 carcasses were reported from that area (NMFS unpublished data) for a total of 102 carcass reports; this is approximately 10 carcass reports per year. We note that the number of carcasses reported likely represents only a portion of the total vessel strikes in a given area as it requires a carcass to be observed and for that observation to be reported to NMFS. Fox et al. reports an estimated annual reporting rate of 4.76% for Atlantic sturgeon carcasses in the Delaware River over a two year study period (2018 and 2019). A similar study has not been carried out for the Chesapeake Bay. Using the Fox et al. average annual reporting data would result in a predicted number of total vessel strikes of approximately 187 vessel strikes in this area annually. We have considered using the Fox et al. carcass recovery estimate for this area but determined it was not a reasonable estimate because of differences in location/geography (which influence if and where carcasses land, which affects the availability of carcasses for human detection), and reporting mechanisms and public awareness (which influence the potential for reporting).

Given the increase in vessel traffic in an area where we know Atlantic sturgeon are vulnerable to vessel strike and that the risk reduction measures implemented for other species (lookouts, reduced speeds) are less likely to reduce risk for Atlantic sturgeon, we are not able to conclude that the risk of vessel strike in the Chesapeake Bay entrance is extremely unlikely to occur. However, given the expected number of vessel transits, that not all will occur when Atlantic sturgeon are present in the area, and that these trips will only occur for three years, we expect the number of strikes to be small. Therefore, we expect that a Maryland Wind project vessel will strike and kill no more than one Atlantic sturgeon per year for each of the three construction seasons. Given the location of these anticipated strikes, we use the stock composition data for the "MID Offshore" area described in Kazyak et al. 2021. Using that data, we expect that Atlantic sturgeon struck by Maryland Wind project vessels in the Chesapeake Bay entrance area will occur originate from the five DPSs at the following frequencies: New York Bight (55.3%), Chesapeake (22.9%), South Atlantic (13.6%), Carolina (5.8%), and Gulf of Maine (1.6%) DPSs This represents the best available information on the likely genetic makeup of individuals occurring in this area. Using this data, we predict that of the three Atlantic sturgeon predicted to be struck and killed by Maryland Wind project vessels, 2 will be from the New York Bight and 1 from the Chesapeake Bay DPS.

<u>Chesapeake and Delaware Canal</u>
We have considered whether the increase in vessel traffic that will result from the use of the C&D canal would increase vessel strikes of Atlantic sturgeon. As described in Section 6.0, we identified a number of estimates of vessel traffic in the C&D canal including 25,000 total vessels annually and a reported annual number of trips for all vessels (self-propelled and non-self-propelled, all drafts) in the federal navigation channel from the Delaware River to Pooles Island in Chesapeake Bay ranging from 3,847 to 10,225 (median = 4,538) during the period from 2017

through 2021(USACE Waterborne Commerce Data 2023). Given the high amount of vessel traffic in the waterbody, and even just considering the median number of commercial one way trips, an increase of a maximum of 668 trips (i.e., number of trips for the year with highest anticipated vessel activity) would result in an approximately 15% increase in vessel traffic. The actual percent increase in vessel traffic is likely even less considering that commercial traffic is only a portion of the vessel traffic in the canal (e.g., if the 25,000 vessel estimate is used the increase in traffic would represent a 3% increase). The highest number of sturgeon mortalities observed in the canal in a single year is the two in 2016. As noted above, in the *Environmental Baseline* (Section 6 of this Opinion), in 2016 two dead Atlantic sturgeon were observed in the canal with injuries consistent with vessel strike. If we assume that the increase in vessel traffic will result in a corresponding increase in risk of vessel strike and number of sturgeon struck, we would expect an additional 0.06 Atlantic sturgeon struck in the canal. Given this very small increase in traffic and the similar very small potential increase in risk of strike and a calculated potential increase in the number of strikes that is very close to zero (despite likely being an overestimate), we have determined that vessel strike of an Atlantic sturgeon from a Maryland Wind vessel transiting the C&D Canal is extremely unlikely to occur and effects are discountable.

Effects of Vessel Transits to Ports in the Delaware Bay and Delaware River
<u>New Jersey Wind Port (NJWP)</u>
In the February 25, 2022, Biological Opinion issued to USACE for the construction and operation of the NJWP, NMFS concluded that the construction and use of the New Jersey Wind Port was likely to adversely affect but not likely to jeopardize any DPS of Atlantic sturgeon. NMFS determined that vessel traffic to and from the NJWP during 25 years of port operations will result in the mortality of 35 Atlantic sturgeon (23 New York Bight DPS, 5 Chesapeake Bay DPS, 5 South Atlantic DPS, 2 Gulf of Maine DPS) as a result of vessel strike. The Opinion calculated these mortalities based on 1,280 vessel trips annually during the 25-year operational life of the port (approximately 32,000 total trips). In the BA for the Maryland Wind project, BOEM included the potential use of the NJWP as an alternate port for project vessels involved in foundation fabrication, assembly of components, load out to feeder or installation vessels, and mobilization of the fall pipe vessel for scour protection. If any alternative ports are used, US Wind anticipates the number of vessel transits to remain the same such that the number of vessels and the number of transits would not differ based on the port used. In the BA, US Wind indicates that the vessels used and trips made will be spread among the ports if alternative ports are used. For this Opinion, we consider based on the information provided in the BA the number of vessel transits to the NJWP would not exceed those expected for Baltimore (Sparrows Point), Maryland, which US Wind has identified as the primary port for foundation-related construction activities. We note that estimating sturgeon take incidental from vessel traffic to and from the NJWP based on the number of transits expected for Baltimore (Sparrows Point), Maryland will likely overestimate take because the vessels used and trips made will be spread among the alternative ports used to support construction. If selected as an alternative port, we assume up to 1,390 trips to the NJWP (Table 3-11 in the BA) could occur during the construction phase and less than one trip during the O&M phase, and another 1,390 trips during decommissioning, for a total of 2,780 trips. This is approximately 9% of the total trips considered in the NJWP Biological Opinion. Based on the available information, we expect that Maryland Wind vessels are similar to the vessels considered in this Opinion; we have not identified any features of the

vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 9% of the total vessel strikes of Atlantic sturgeon could result from Maryland Wind vessels. Calculating 9% of 35 Atlantic sturgeon results in an estimate of 3.2 vessel struck sturgeon. As such, we anticipate that vessels using the NJWP as part of the Maryland Wind project will result in the strike of no more than four Atlantic sturgeon. Considering the apportionment of take by DPS outlined in the February 2022 Opinion, we expect that two of these would be from the New York Bight DPS with two from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS.

Paulsboro Marine Terminal

As explained in Section 2.0 and Section 6.0 of this Opinion, NMFS has completed ESA Section 7 consultation on the construction and use of the Paulsboro Marine Terminal. In the November 7, 2023, Biological Opinion issued to USACE for the construction and operation of the Paulsboro Marine Terminal, NMFS concluded that the construction and use of the Paulsboro Marine Terminal was likely to adversely affect but not likely to jeopardize any DPS of Atlantic sturgeon. In that Opinion, NMFS determined that vessel traffic transiting between the mouth of Delaware Bay to and from the Paulsboro Marine Terminal during 10 years of port operations will result in the mortality of eight Atlantic sturgeon as a result of vessel strike (4 from the New York Bight DPS, 2 from the Chesapeake Bay DPS, 1 from the South Atlantic DPS, and 1 from the Gulf of Maine DPS).

The Paulsboro Opinion calculated this mortality based on a maximum of 880 vessel trips during the 10-year operational life of the port. In the BA for the Maryland Wind project, BOEM included the potential use of Paulsboro Marine Terminal as an alternate port for project vessels involved in foundation fabrication, assembly of components, load out to feeder or installation vessels, and mobilization of the fall pipe vessel for scour protection. US Wind anticipates up to 92 trips to the Paulsboro Marine Terminal if selected as an alternative port. This is approximately 10% of the total trips considered in the Paulsboro Biological Opinion. Based on the available information, we expect that Maryland Wind vessels are similar to the vessels considered in this Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike an Atlantic sturgeon. As such, and considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that up to 10% of the total vessel strikes of Atlantic sturgeon could result from Maryland Wind vessels. Calculating 10% of 8 Atlantic sturgeon results in an estimate of 0.8 vessel struck sturgeon. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Maryland Wind project will result in the strike of no more than one Atlantic sturgeon. Based on the proportional assignment of take in the November 2023 Paulsboro Opinion, we expect that this would be no more than one Atlantic sturgeon belonging to the New York Bight DPS.

Effects of Vessel Transits to Cianbro Modular Manufacturing Facility (Brewer, ME)

Vessels traveling along the Atlantic coast and through the Gulf of Maine between the lease area and the Cianbro Modular Manufacturing Facility (Brewer, Maine) in the Penobscot River will transit past a number of Atlantic sturgeon aggregation areas or “hot spots”; however, these vessels will be transiting in deeper, more offshore waters and not actually pass through any of these areas. As such, the risk to Atlantic sturgeon from the oceanic portions of these trips is the same as identified for the marine environment above; that is, it is extremely unlikely that any Atlantic sturgeon will be struck by project vessels operating in the Atlantic Ocean or Gulf of Maine on the way to/from the Cianbro facility.

US Wind anticipates up to four vessel trips to the Cianbro Modular Manufacturing Facility. Vessels traveling to or from Brewer, Maine would travel from the Penobscot River Bay to the Cianbro facility along the Penobscot River. Vessels are expected to travel within the Federal navigation channels from the confluence of the Penobscot River Bay with the Gulf of Maine to the Cianbro facility. Large vessels, such as the Maryland Wind vessels, that enter the Penobscot River are typically assisted by tug boats and travel at speeds of less than 1 knot with their propeller idling.

As described in Section 6.0, Atlantic sturgeon within the Penobscot River system typically occur in a discrete 1.5-km reach (at rkm 23.0-24.5) of the middle estuary during the summer. The aggregation area for Atlantic sturgeon using this area is significantly deeper (>15m deep at mean low water) than any other part of the estuary upstream of rkm 8 (Haefner 1967, Fernandes et al. 2010). Even if migrating Atlantic sturgeon occurred along the routes of vessels transiting between the Maryland WDA and Brewer, Maine, we do not expect project related vessels to increase the risk of a vessel strike as a result of the proposed project. Vessel strikes were not identified as a primary threat in the listing determination (77 FR 5880) or the most recent 5-year review (NMFS 2022) to the Gulf of Maine DPS of Atlantic sturgeon because the risk appears to be less than that of the New York Bight and Chesapeake Bay DPSs based on the limited number of known vessel struck carcasses in Gulf of Maine rivers and given differences in vessel presence, particularly of large vessels, in the DPS's natal river.

The USACE reports the annual number of trips for all commercial cargo vessels (self-propelled and non-self-propelled, all drafts) in the federal navigation channel from the mouth of the Penobscot River to Bangor/Brewer ranged from 14 to 59 (median=28) during the period from 2017 through 2021 (ACOE 2021). The port of Searsport, located further downstream in Penobscot Bay, receives multiple commercial vessel calls per day. In addition, there are numerous other sources of vessel traffic including commercial fishing vessels, recreational vessels, and military vessels. The four Maryland Wind vessel trips in the Penobscot River portion of the action area over a three-year period (1-2 trips per year over the three year construction period) will represent an extremely small portion of the total vessel traffic traveling up and down the Penobscot River respectively and an even smaller percentage of the total vessel traffic in the Gulf of Maine portion of the action area. Given this very small increase in vessel traffic and the similar very small potential increase in risk of strike, we have determined that vessel strike of an Atlantic sturgeon from a Maryland Wind vessel along transit routes to the Cianbro Modular Manufacturing Facility (Brewer, Maine) is extremely unlikely to occur and effects are discountable.

Effects of Vessel Transits to the Nexans Facility at the Port of Charleston (SC)
Vessels traveling along the Atlantic coast between the lease area and the Nexans cable facility in the lower portions of the Cooper River will transit past a number of Atlantic sturgeon aggregation areas or "hot spots"; however, these vessels will be transiting in deeper, more

offshore waters and not actually pass through any of these areas. As such, the risk to Atlantic sturgeon from the oceanic portions of these trips is the same as identified for the marine environment above; that is, it is extremely unlikely that any Atlantic sturgeon will be struck by project vessels operating in the Atlantic Ocean on the way to/from the Nexans facility.
As explained in Section 2.0 of this Opinion and above, NMFS completed an ESA section 7 consultation on the construction and use of Nexans Facility in Charleston. In the May 4, 2020, Biological Opinion issued to USACE for the construction and operations of the Nexans Cable Facility, NMFS concluded that the construction and use of the Nexans Facility was likely to adversely affect but not likely to jeopardize the Carolina DPS of Atlantic sturgeon. However, the only adverse effects to Atlantic sturgeon were dredging and riprap installation. In the Opinion, NMFS concluded that vessel strikes between vessels using the facility to transport cable were extremely unlikely to occur based on the frequency of vessel operations, type of vessel, and low transit speed and that vessels using the facility were not likely to adversely affect any DPS of Atlantic sturgeon. As the effects of this vessel traffic were already considered in the April 2020 Biological Opinion issued for the Nexans Facility, and no take of Atlantic sturgeon by vessel strike was anticipated, and we do not anticipate any difference in the type or level of effects from vessel traffic from those considered in that opinion, US Wind's use of the Nexans Facility is also extremely unlikely to result in vessel strikes, no take is anticipated: the effects of vessel strike are thus discountable.

Summary of Effects of Vessel Operations on Atlantic Sturgeon
In summary, considering all vessel traffic over the life of the project, we anticipate vessel traffic related to the Maryland Wind project to cause the mortality of no more than 8 Atlantic sturgeon (5 from the New York Bight DPS and 3 from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS). A portion of this take and its effects have been evaluated in the above referenced Biological Opinions issued by NMFS to the USACE for the NJWP and Paulsboro Marine Terminal; the only take beyond that considered in the Environmental Baseline is the anticipated serious injury or mortality of up to three Atlantic sturgeon (two NY Bight DPS, one Chesapeake Bay DPS) resulting from US Wind vessels transiting in the Chesapeake Bay entrance channels/lower Chesapeake Bay area during the construction period.

Critical Habitat Designated for the New York Bight DPS of Atlantic sturgeon
The action area overlaps with a portion of the Delaware River critical habitat unit designated for the New York Bight DPS. The only project activity that may affect this critical habitat is the transit of project vessels to or from the Paulsboro Marine Terminal in Paulsboro, NJ (approximately RKM 139) and the New Jersey Wind Port in Hope Creek, NJ (approximately RKM 84).

The Biological Opinions prepared by NMFS for the Paulsboro and New Jersey Wind Ports considered effects of construction of these port facilities and the effects of all vessels transiting between the mouth of Delaware Bay and these ports on critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the November 7, 2023, Biological Opinion NMFS concluded that the construction and use of the Paulsboro Marine Terminal was not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the February 25, 2022, Biological Opinion NMFS concluded that the construction and use of the New Jersey Wind Port was likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon. As explained in that Opinion, NMFS determined that there would be temporary and permanent effects as a result of construction and mitigation activities and that use of the NJWP channels by deep draft vessels and periodic maintenance dredging will continue to reduce the value of the habitat over the 25-year expected life-time of the NJWP operations. Based on the available information, we expect that Maryland Wind vessels are similar to the vessels considered in the NJWP Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to affect critical habitat at the NJWP.

While we are not able to determine the proportional effects of Maryland Wind vessel use of the NJWP on critical habitat we have determined that because the number of trips and vessel types are consistent with the activities described in the NJWP Opinion, effects to critical habitat are also within the scope of effects considered in that Opinion. The effects of these vessel trips on critical habitat designated for the New York Bight DPS of Atlantic sturgeon are included in the Environmental Baseline for the Maryland Wind project. We have not identified any effects of the Maryland Wind project on critical habitat designated for the New York Bight DPS of Atlantic sturgeon that are beyond what was considered in the Paulsboro and New Jersey Wind Port consultations.

7.2.3.2 Shortnose sturgeon

The only portion of the action area that overlaps with the distribution of shortnose sturgeon is the estuarine/riverine portions of the vessel transit routes used by vessels transiting Delaware Bay and Delaware River, the upper Chesapeake Bay, the Penobscot River, the Cooper River, and the New York Harbor. Shortnose sturgeon are not expected to occur in the Chesapeake Bay entrance channels or in the port of Norfolk/Elizabeth River; as such, they will not be exposed to vessel traffic in these portions of the action area. As we do not expect shortnose sturgeon to occur in the Gulf of Mexico or marine waters transited by project vessels, they will not be exposed to vessel traffic in these portions of the action area.

Effects of Vessel Transits to Ports in Chesapeake Bay

Baltimore (Sparrows Point), MD

Transient individual shortnose sturgeon are at least occasionally present in upper Chesapeake Bay; the best available information indicates that these are individuals that travel to the Bay from the C&D Canal (which connects the upper Bay to the Delaware River). Shortnose sturgeon are rare, infrequent visitors to the lower Chesapeake Bay. Shortnose sturgeon are not known to occur in the Patapsco River or at the Port of Baltimore. We have no reports of vessel strikes of shortnose sturgeon in this portion of the action area.

As noted above, the 668 Maryland Wind vessel trips represent approximately 22% of the annual commerce-carrying vessel traffic traveling through the Chesapeake Bay to the Port of Baltimore and an even smaller percentage of the total vessel traffic in the Bay and at the Port. As the vessels will be using existing port facilities, we do not expect there to be an increase in vessel traffic or an increase in the risk of vessel strike. Given this, and the lack of evidence of shortnose sturgeon being struck in this area, it is extremely unlikely that a Maryland Wind vessel transiting to/from the Baltimore (Sparrows Point), Maryland will strike a shortnose sturgeon. As such, effects to shortnose sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits through the Chesapeake and Delaware Canal
We have considered whether the increase in vessel traffic that will result from the use of the C&D canal would increase vessel strikes of shortnose sturgeon. Given the high amount of vessel traffic in the waterbody, and even just considering the median number of commercial one way trips, an increase of a maximum of 668 trips (i.e., number of trips for the year with highest anticipated vessel activity) would result in an approximately 15% increase in vessel traffic. The actual percent increase in vessel traffic is likely even less considering that commercial traffic is only a portion of the vessel traffic in the canal (e.g., if the 25,000 vessel estimate is used the increase in traffic would represent a 3% increase). The highest number of sturgeon mortalities observed in the canal in a single year is the two in 2016. As noted above, in 2016 two dead Atlantic sturgeon were observed in the canal with injuries consistent with vessel strike. If we assume that the increase in vessel traffic will result in a corresponding increase in risk of vessel strike and number of sturgeon struck, and that the risk to shortnose sturgeon is no greater than Atlantic sturgeon we would expect an additional 0.06 shortnose sturgeon struck in the canal. Given this very small increase in traffic and the similar very small potential increase in risk of strike and a calculated potential increase in the number of strikes that is very close to zero (despite likely being an overestimate), we have determined that vessel strike of an shortnose sturgeon from a Maryland Wind vessel transiting the C&D Canal is extremely unlikely to occur and effects are discountable.

Effects of Vessel Transits to Ports in Delaware River/Bay
New Jersey Wind Port (NJWP)
In the 2022 NJWP Biological Opinion[43] NMFS concluded that the construction and subsequent use of the New Jersey Wind Port by visiting vessels was likely to adversely affect but not likely to jeopardize shortnose sturgeon. NMFS determined that vessel traffic to and from the NJWP during 25 years of port operations will result in the mortality of four shortnose sturgeon as a result of vessel strike. The Opinion calculated these mortalities based on 1,280 annual vessel trips during the 25-year operational life of the port (32,000 total trips). If selected as an alternative port, we assume up to 1,390 trips to the NJWP (Table 3-11 in the BA) could occur during the construction phase and less than one trip during the O&M phase, and another 1,390 trips during decommissioning, for a total of 2,780 trips. This is approximately 9% of the total trips considered in the NJWP Biological Opinion. Based on the available information, we expect that Maryland Wind vessels are similar to the vessels considered in this Opinion; we have not identified any features of the vessels or their operations that would make them more or less likely to strike a shortnose sturgeon. As such, considering that we have no information to indicate that any particular vessels visiting the port are any more or less likely to strike a sturgeon, we would expect that 9% of the total vessel strikes of shortnose sturgeon could result from Maryland Wind vessels. Calculating 9% of 4 shortnose sturgeon results in an estimate of 0.36 vessel struck

[43] The USACE has requested reinitiation of the 2022 NJWP Opinion. However, NMFS has requested that the USACE provide additional information necessary for the analysis and reinitiation of the consultation may not commence until NMFS receives that information. Until a new biological opinion is produced, the 2022 NJWP Opinion remains the best analysis of effects on listed species and critical habitat due to NJWP construction and use.

sturgeon. As such, we anticipate that vessels using the NJWP as part of the Maryland Wind project will result in the lethal strike of up to one shortnose sturgeon.

Paulsboro Marine Terminal

Shortnose sturgeon occur in the portion of the Delaware River that would be transited by vessels moving to or from the Paulsboro Marine Terminal in Paulsboro, NJ (approximately river kilometer 139). The 2023 Paulsboro Opinion considered effects of vessels transiting between the mouth of Delaware Bay and Paulsboro on shortnose sturgeon. The 2023 Paulsboro Opinion analyzed an overall amount of vessel transits, of which Maryland Wind would contribute a small part. In the November 7, 2023, Biological Opinion NMFS concluded that the construction and subsequent use of the Paulsboro Marine Terminal by any vessels was likely to adversely affect but not likely to jeopardize shortnose sturgeon. NMFS determined that vessel traffic to and from the Paulsboro Marine Terminal during 10 years of port operations will result in the mortality of one shortnose sturgeon as a result of vessel strike. The Opinion calculated this mortality based on a maximum of 880 vessel trips during the 10-year operational life of the port. As noted above, the Maryland Wind project would result in up to 100 trips to the Paulsboro Marine Terminal. This is approximately 11.4% of the total trips considered in the Paulsboro Biological Opinion. Consistent with the analysis in the Paulsboro Marine Terminal, we consider that all vessels using the port are equally likely to strike a shortnose sturgeon. Calculating 11.4% of 1 shortnose sturgeon results in an estimate of 0.11 vessel struck sturgeon. It is not possible to determine which of the 880 trips to Paulsboro over the 10 year period considered in the Opinion would result in a vessel strike, as such, consistent with the analysis in the Paulsboro Opinion, we consider it equally likely that one of the 100 Maryland Wind vessel trips will strike and kill a shortnose sturgeon as any of the other vessels transiting to/from the port. As such, we anticipate that vessels using the Paulsboro Marine Terminal as part of the Maryland Wind project will result in the strike of no more than one shortnose sturgeon.

Effects of Vessel Transits to Cianbro Modular Manufacturing Facility (Brewer, ME)

During the three-year construction phase, US Wind anticipates up to four vessel trips between the WDA and the Cianbro Modular Manufacturing Facility (Brewer, Maine) in the Penobscot River. These vessels would include heavy lift vessels assisted by tug boats. Vessels are expected to travel within the Federal navigation channels from the confluence of the Penobscot River Bay with the Gulf of Maine to the Cianbro facility.

As described in Section 6.0, shortnose sturgeon are present year round in the Penobscot River estuary and Penobscot Bay. Shortnose sturgeon overwinter from fall (mid-October) to spring (mid-April) in a small area of the upper estuary (rkm 36.5 near Bangor/Brewer, Maine) and individuals move downstream to the middle estuary in early spring. Tracking data indicate that many of the coastal movements of shortnose sturgeon tagged in the Penobscot River resulted in detections in the adjacent Kennebec River (Fernandes et al. 2010). Even if migrating shortnose sturgeon occurred along the routes of vessels transiting the Penobscot River estuary and Penobscot Bay, we do not expect project related vessels to increase the risk of a vessel strike as a result of the Maryland Wind project. This is because project vessels will represent a small portion (1-2 trips per year for three years) of the vessel traffic traveling in the Penobscot River portion of the action area. The USACE reports the annual number of trips for all commercial cargo vessels (self-propelled and non-self-propelled, all drafts) in the federal navigation channel from the mouth of the Penobscot River to Bangor/Brewer ranged from 14 to 59 (median=28) during the period from 2017 through 2021 (ACOE 2021). The port of Searsport, located further downstream in Penobscot Bay, receives multiple commercial vessel calls per day. In addition, there are numerous other sources of vessel traffic including commercial fishing vessels, recreational vessels, and military vessels. The four Maryland Wind vessel trips in the Penobscot River will represent an extremely small portion of the total vessel traffic traveling up and down the Penobscot River respectively and an even smaller percentage of the total vessel traffic in the Gulf of Maine portion of the action area. Given this very small increase in vessel traffic and the similar very small potential increase in risk of strike, we have determined that vessel strike of a shortnose sturgeon from a Maryland Wind vessel along transit routes to the Cianbro Modular Manufacturing Facility (Brewer, Maine) is extremely unlikely to occur and effects are discountable.

Effects of Vessel Transits to Port of New York/New Jersey
Adult shortnose sturgeon have occasionally been captured in trawl surveys in Upper New York Bay. From 1998-2011, six shortnose sturgeon total were identified in the Harbor Deepening Project (HDP) Aquatic Biological Survey (ABS) program (USACE 2021); from 2003-2017, 19 shortnose sturgeon were collected in the Hudson River Utilities winter trawl survey (unpublished data). The best available information indicates that only rare transient adult shortnose sturgeon are likely to occur in the area transited by vessels traveling to/from the Port of New York/New Jersey. We have no evidence of any vessel strikes of shortnose sturgeon in this area. In the BA, BOEM included the potential use of the Port of New York/New Jersey as an alternate port for project vessels during the 3-year construction phase. For this Opinion, we conservatively assume the number of vessel transits to the Port of New York/New Jersey would be the same as those expected for Baltimore (Sparrows Point), Maryland. Considering the trips identified in the BA, Maryland Wind trips (up to 668 vessel trips for year 2, the year with the highest anticipated vessel activity during construction) will represent approximately 0.8% of the annual commerce-carrying vessel traffic traveling through New York Bay and an even smaller percentage of the total vessel traffic in the area. As the vessels will be using existing port facilities, we do not expect there to be an increase in vessel traffic or an increase in the risk of vessel strike. Given this, and the lack of evidence of shortnose sturgeon being struck in this area, it is extremely unlikely that a Maryland Wind vessel transiting to/from the Port of New York/New Jersey will strike a shortnose sturgeon. As such, effects to shortnose sturgeon from project vessels operating in this portion of the action area are extremely unlikely to occur and are discountable.

Effects of Vessel Transits to the Nexans Facility at the Port of Charleston (SC)
In the May 4, 2020, Biological Opinion NMFS concluded that the construction and subsequent use of the Nexans Facility by any vessels was likely to adversely affect but not likely to jeopardize shortnose sturgeon. However, the only adverse effects to shortnose sturgeon were from dredging and riprap installation. In the Opinion, NMFS concluded that vessel strikes of shortnose sturgeon by vessels using the facility to transport cable were extremely unlikely to occur based on the frequency of vessel operations, type of vessel, and low transit speeds. In the Opinion, NMFS concluded that vessel use of the Nexans Facility was not likely to adversely affect shortnose sturgeon and, therefore, not likely to jeopardize the continued existence of shortnose sturgeon As the effects of this vessel traffic were already considered in the April 2020 Biological Opinion issued for the Nexans Facility, and no take of shortnose sturgeon by vessel

strike was anticipated, and we do not anticipate any difference in the type or level of effects from vessel traffic from those considered in that opinion and no take is anticipated, US Wind's use of the Nexans Facility is also extremely unlikely to result in vessel strikes: the effects of vessel strike are thus discountable.

Summary of Effects of Vessel Operations on Shortnose Sturgeon
In summary, considering all vessel traffic over the life of the project, we anticipate vessel traffic related to the Maryland Wind project to cause the mortality of two shortnose sturgeon. This take has been evaluated in the above referenced Biological Opinions issued by NMFS to the USACE for the NJWP and Paulsboro Marine Terminal.

7.2.3.3 Giant Manta Ray

The only portion of the action area that overlaps with the distribution of Giant manta rays are the vessel transit routes south of approximately Atlantic City, NJ (i.e., primarily the areas transited by vessels traveling between the WDA and ports in the Delaware Bay, the Chesapeake Bay, South Carolina, and the Gulf of Mexico). Giant manta rays can be frequently observed traveling just below the surface and will often approach or show little fear toward humans or vessels (Coles 1916), which may also make them vulnerable to vessel strikes (Deakos 2010). Vessel strikes can injure or kill giant manta rays, decreasing fitness or contributing to non-natural mortality (Couturier et al. 2012; Deakos et al. 2011); however, vessel strikes are considered rare. Information about interactions between vessels and giant manta rays is limited. We have at least some reports of vessel strike, including a report of five giant manta rays struck by vessels from 2016 through 2018; individuals had injuries (i.e., fresh or healed dorsal surface propeller scars) consistent with a vessel strike. These interactions were observed by researchers conducting surveys from Boynton Beach to Jupiter, Florida (J. Pate, Florida Manta Project, pers. comm. to M. Miller, NMFS OPR, 2018) and it is unknown where the manta was at the time of the vessel strike. This lack of documented mortalities could also be the result of other factors that influence carcass detection (i.e., wind, currents, scavenging, decomposition etc.); however, giant manta rays appear to be able to be fast and agile enough to avoid most moving vessels, as anecdotally evidenced by videos showing rays avoiding interactions with high-speed vessels (Barnette 2018).The geographic area considered to have the highest risk of vessel strikes for giant manta ray is nearshore coastal waters and inlets along the east coast of Florida where recreational vessel traffic is concentrated; this area does not overlap with the action area. Given the few instances of confirmed or suspected strandings of giant manta rays attributed to vessel strike injury, the generally more offshore and dispersed distribution of manta rays in the Mid-Atlantic, and the seasonal distribution of the species in this portion of the action area, risk of giant manta rays being struck by vessels is considered extremely low.

The speed and maneuverability of giant manta rays, the slow operating speed of project vessels transiting through the portion of the action area where Giant manta rays occur, and the dispersed nature of Giant manta ray distribution in the open ocean area where these vessels will operate and overlap with manta ray distribution, make vessel strike extremely unlikely to occur and effects are discountable.

7.2.3.4 ESA Listed Whales

Background Information on the Risk of Vessel Strike to ESA Listed Whales
Vessel strikes from a variety of sizes of commercial, recreational, and military vessels have resulted in serious injury and fatalities to ESA listed whales (Laist et al. 2001, Lammers et al. 2003, Douglas et al. 2008, Laggner 2009, Berman-Kowalewski et al. 2010, Calambokidis 2012). Records of collisions date back to the early 17th century, and the worldwide number of collisions appears to have increased steadily during recent decades (Laist et al. 2001, Ritter 2012).
The most vulnerable marine mammals are those that spend extended periods at the surface feeding or in order to restore oxygen levels within their tissues after deep dives. Mother/calf pairs are at high risk of vessel strike because they frequently rest and nurse in nearshore habitats at or near the water surface, particularly in the Southeast calving area (Cusano et al. 2018; Dombroski et al. 2021). A summary of information on the risk of vessel strike to right whales is found in Garrison et al. 2022. Baleen whales, such as the North Atlantic right whale, seem generally unresponsive to vessel sound, making them more susceptible to vessel collisions (Nowacek et al. 2004). Many studies have been conducted analyzing the impact of vessel strikes on whales; these studies suggest that a greater rate of mortality and serious injury to large whales from vessel strikes correlates with greater vessel speed at the time of a ship strike (Laist et al. 2001, Vanderlaan and Taggart 2007 as cited in Aerts and Richardson 2008). Numerous studies have indicated that slowing the speed of vessels reduces the risk of lethal vessel collisions, particularly in areas where right whales are abundant and vessel traffic is common and otherwise traveling at high speeds (Vanderlaan and Taggart 2007; Conn and Silber 2013; Van der Hoop et al. 2015; Martin et al. 2016; Crum et al. 2019). Vessels transiting at speeds >10 knots present the greatest potential severity of collisions (Jensen and Silber 2004, Silber et al. 2009). Vanderlann and Taggart (2007) demonstrated that between vessel speeds of 8.6 and 15 knots, the probability that a vessel strike is lethal increases from 21% to 79%. In assessing records with known vessel speeds, Laist et al. (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 24.1 km/h (13 knots). NMFS' data on documented vessel strike events continues to affirm the role of high vessel speeds (> 10 knots (5.1 m/s)) in lethal collision events and supports existing studies implicating speed as a factor in lethal strikes events (87 FR 46921). While it remains unclear how whales generally, and right whales in particular, respond to close approaches by vessels (<460 m) and the extent to which this allows them to avoid being struck, Conn and Silber (2013) indicated that encounter rates were higher with fast-moving vessels than expected, which may be consistent with successful avoidance of slower vessels by whales.

Large whales also do not have to be at the water's surface to be struck. In a study that used scale models of a container ship and a right whale in experimental flow tanks designed to characterize the hydrodynamic effects near a moving hull that may cause a whale to be drawn to or repelled from the hull, Silber et al. (2010) found when a whale is below the surface (about one to two times the vessel draft), there is likely to be a pronounced propeller suction effect. This modeling suggests that in certain circumstances, particularly with large, fast moving ships and whales submerged near the ship, this suction effect may draw the whale closer to the propeller, increasing the probability of propeller strikes. Additionally, Kelley et al (2020) found that collisions that create stresses in excess of 0.241 megapascals were likely to cause lethal injuries to large whales and through biophysical modeling that vessels of all sizes can yield stresses higher than this critical level. NMFS' data on documented vessel strike events continues to affirm the role of high vessel speeds (>10 knots (5.1 m/s)) in lethal collision events and supports existing studies implicating speed as a factor in lethal strikes events. Growing evidence shows that vessel speed, rather than size, is the greater determining factor in the severity of vessel strikes on large whales; vessels less than 65 ft. in length accounted for 5 of the 12 documented lethal strike events of North Atlantic right whales in U.S. waters since 2008 (87 FR 46921). Of the six lethal vessel strike cases documented in U.S. waters and involving right whales since 1999 where vessel speed is known, only one involved a vessel transiting at under 10 knots (5.1 m/s) (87 FR 46921).

Reducing vessel speed is one of the most effective, feasible options available to reduce the likelihood of lethal outcomes from vessel collisions with right whales (87 FR 46921). In an effort to reduce the likelihood and severity of fatal collisions with right whales, NMFS established vessel speed restrictions in specific locations, primarily at key port entrances, and during certain times of the year, these areas are referred to as Seasonal Management Areas (SMA). A 10-knot speed restriction applies to vessels 65 feet and greater in length operating within any SMA (73 FR 60173, October 10, 2008). As noted above, NMFS has published proposed modifications to these regulations that would increase the scope of the speed restrictions including application of mandatory speed restrictions in some areas and times of year for smaller vessels than in the existing rule (87 FR 46921; August 1, 2022). That regulation has not been finalized and the potential effects of those regulations are not evaluated in this Opinion.

In the 2008 regulations, NMFS also established a DMA program whereby vessels are requested, but not required, to either travel at 10 knots or less or route around locations when certain aggregations of right whales are detected outside SMAs. These temporary protection zones are triggered when three or more whales are visually sighted within 2-3 miles of each other outside of active SMAs. The size of a DMA is larger if more whales are present. A DMA is a rectangular area centered over whale sighting locations and encompasses a 15-nautical mile buffer surrounding the sightings' core area to accommodate the whales' movements over the DMA's 15-day lifespan. The DMA lifespan is extended if three or more whales are sighted within 2-3 miles of each other within its bounds during the second week the DMA is active. Only verified sightings are used to trigger or extend DMAs; however, DMAs can be triggered by a variety of sources, including dedicated surveys, or reports from mariners. Acoustically triggered Slow Zones were implemented in 2020 to complement the visually triggered DMAs. The protocol for the current acoustic platforms that are implemented in the Slow Zone program specify that 3 upcalls must be detected (and verified by an analyst) to consider right whales as "present" or "detected" during a specific time period. Acknowledging that visual data and acoustic data differ, experts from NMFS' right whale Northeast Implementation Team, including NEFSC and Woods Hole Oceanographic Institute staff, developed criteria for accepting detection information from acoustic platforms. To indicate right whale presence acoustically (and be used for triggering notifications), the system must meet the following criteria: (1) evaluation has been published in the peer-reviewed literature, (2) false detection rate is 10% or lower over daily time scales and (3) missed detection rate is 50% or lower over daily time scales. For consistency, acoustically triggered Slow Zones are active for 15 days when right whales are detected and can be extended with additional detections. However, acoustic areas are established by rectangular areas encompassing a circle with a radius of 20 nautical miles around the location of the passive acoustic monitoring system.

In an analytical assessment of when the vessel speed restrictions were and were not in effect, Conn and Silber (2013) estimated the speed restrictions required by the ship strike rule reduced total ship strike mortality by 80 to 90%. In 2020, NMFS published a report evaluating the conservation value and economic and navigational safety impacts of the 2008 North Atlantic right whale vessel speed regulations. The report found that the level of mariner compliance with the speed rule increased to its highest level (81%) during 2018-2019. In most SMAs more than 85% of vessels subject to the rule maintained speeds under 10 knots, but in some portions of SMAs mariner compliance is low, with rates below 25% for the largest commercial vessels outside four ports in the southeast. Evaluations of vessel traffic in active SMAs revealed a reduction in vessel speeds over time, even during periods when SMAs were inactive. An assessment of the voluntary DMA program found limited mariner cooperation that fell well short of levels reached in mandatory SMAs. The report examined AIS-equipped vessel traffic (<65 ft. in length, not subject to the rule) in SMAs, in the four New England SMAs, more than 83% of all <65 ft. vessel traffic transited at 10 knots or less, while in the New York, Delaware Bay, and Chesapeake SMAs, less than 50% of transit distance was below 10 knots. The southern SMAs were more mixed with 55-74% of <65 ft. vessel transit distance at speeds under 10 knots (NMFS 2020). The majority of AIS-equipped <65 ft. vessel traffic in active SMAs came from four vessel types: pleasure, sailing, pilot, and fishing vessels (NMFS 2020).

The Maryland Wind WDA does not overlap with any SMAs, however, the vessel transit routes to a number of ports overlap with a number of Mid-Atlantic SMAs. Project vessels transiting to ports in Delaware River/Bay, Portsmouth, VA, and Corpus Christi, TX will travel through or adjacent to SMAs near the mouth of Delaware Bay, Chesapeake Bay, near Morehead City, NC and along the coast from Wilmington, NC to Charleston, SC. These Mid-Atlantic SMAs are in effect from November 1 - April 30 each year. Project vessels traveling to Corpus Christi will also travel through the Southeast SMA along the coast from Brunswick, GA to St. Augustine, GA which is in effect from November 15 – April 15 each year. All project vessels will comply with 10 knot speed restrictions within these active SMAs, regardless of vessel size, destination, or origin.

DMAs and acoustically triggered Slow Zones have been established in response to aggregations of right whales in the waters of Mid-Atlantic, and may overlap vessel transit routes and/or the lease area throughout the year. For example, in 2023, NMFS declared a total of 70 Slow Zones/DMAs along the U.S. East Coast (NOAA 2023, pers. Comm.). Of these, 31 were triggered by right whale sightings and 39 were triggered by acoustic detections. Slow Zones/DMAs were declared in 9 locations in the Northeast/Mid-Atlantic U.S. (Martha's Vineyard, MA, Virginia Beach, VA, Portsmouth, NH, Nantucket, MA, Boston, MA, Portland, ME, Ocean City, MD, New York Bight, NY, and Atlantic City, NJ) and in one location in the Southeast U.S. (Outer Banks, NC). As described in the BA, BOEM will require that Maryland Wind vessels of any size travel at speeds of 10 knots or less in any SMA or DMA/Slow Zone in all project phases; this requirement is also included in the proposed MMPA ITA for its 5-year operative period.

Exposure Analysis – ESA Listed Whales

We consider vessel strike of ESA listed whales in the context of specific project phases because the characteristics and volume of vessel traffic is distinctly different during the three phases of the project.

Effects of Vessel Transits in the in the Lease Area, Along the Cable Routes, and to/from Ports from Delaware Bay to Chesapeake Bay

ESA listed whales use portions of the action area throughout the year, including the portion of the action area where vessels will transit in the lease area, along the Maryland Wind export cable corridor, and between those locations and identified ports in MD, VA, DE, and NJ (see Section 5 and 6 for more information on distribution of whales in the action area). Baseline vessel traffic in the action area is described at the beginning of this section. Vessel traffic between the lease area/cable corridor and ports in MD, VA, DE, and NJ accounts for 99.5% of the anticipated vessel traffic during the construction phase (dependent on the actual ports used) and 100% of the anticipated traffic during the operations phase. Trips between the WDA and other ports, as well as trips within the U.S. EEZ by vessels transiting from Europe are addressed following this section.

To assess risk of vessel strike in the area where the majority of vessel traffic will occur (i.e., the WDA and the vessel transits routes to ports in MD, VA, DE, and NJ) we carried out a four-step process. First, we use the best available information to describe the existing records of vessel strike of right, fin, sei, and sperm whales in that geographic area. Second, we used the best available information on baseline traffic (i.e., the annual number of vessel transits within that geographic area absent the proposed action) and the information provided by BOEM and US Wind on the number of anticipated vessel transits in that area by Maryland Wind project vessels to determine to what extent vessel traffic would increase in this geographic area during each of the three phases of the Maryland Wind project. For example, if baseline traffic was 100 trips per year and the Maryland Wind project would result in 10 new trips in that area, we would conclude that traffic was likely to increase by 10%. Third, based on the assumption that risk of vessel strike is related to the amount of vessel traffic (i.e., that more vessels operating in that geographic area would lead to a proportional increase in vessel strike risk), we consider how, absent any avoidance or minimization measures, risk of vessel strike may increase in the area of concern. For example, if we predicted a 10% increase in vessel traffic we would consider that, absent any avoidance or minimization measures, the risk of vessel strike would increase by 10%. It is important to note that these steps were carried out without consideration of any measures designed to reduce vessel strike and the reasonable assumption that all vessels have the same likelihood of striking a whale. Finally, we considered the risk reduction measures that are part of the proposed action and whether, with those risk reduction measures in place, any vessel strike was reasonably certain to occur.

The numbers of baseline vessel transits (from relevant USCG Port Access Route studies, as cited herein) and Project vessel transits (described in BOEM's BA) were used to evaluate the effects of vessel traffic on listed species in the action area as this provides the most accurate representation of vessel traffic in the action area and from the proposed Project. As explained above, baseline vessel transits were estimated using vessel AIS density data (number of trips) which provides a quantifiable comparison and approximation to estimate risk to listed species from the increase in Project vessel traffic. We considered an approach using vessel-miles;

however, we have an incomplete baseline of vessel traffic in the region in the terms of vessel miles, as there is significant variability in vessel-mileage between vessel type and activity and no reliable way to obtain vessel miles from the existing baseline data we have access to. While data on the miles that project vessels will travel is partially available, without a robust baseline to compare it to, we are not able to provide an accurate comparison to baseline traffic levels. Additionally, while we can determine the straight line distance between any two points (e.g., Ocean City, MD and any particular point within the WDA), we do not know the exact routes that any vessel will take as that is influenced by weather, sea state, routing around SMAs or DMAs, and a number of other factors that would make predicting the vessel miles for any individual transit, or all anticipated transits, inexact and unreliable. Further, given that we are considering the area within which the vessels will operate (i.e., evaluating risk along particular vessel routes) we do not expect that the results of our analysis would be any different even if we did have the information necessary to evaluate the increase in vessel traffic in the context of miles traveled rather than number of trips. Based on this foregoing reasoning, using vessel trips results in a more accurate assessment of the risk of adding the US Wind vessels to the baseline than could have been carried out using vessel miles and we consider it the best available information for conducting the vessel strike risk analysis.

ESA listed whales use portions of the action area throughout the year, including the portion of the action area where vessels will transit in the Maryland Wind WDA and identified ports in MD, VA, DE, and NJ (see Section 5 and 6 for more information on distribution of whales in the action area). Baseline vessel traffic in the action area is described in Section 6.

We reviewed the best available data for the period since the 2008 vessel strike rule was implemented from the marine mammal stock assessment reports and serious injury and mortality reports produced by NMFS, for the period of 2009-2023 ((Henry et al. 2015 for 2009-2010 data, Henry et al. 2017 for 2011-2015 data, Henry et al. 2022 from 2016-2020 data; Henry et al. 2023 for 2017-2021 data; these are the most recent reports available). We also reviewed right whale data from the ongoing Unusual Mortality Event. From these reports, we identified a total of 9 records of ESA listed whales (1 right, 5 fin, 3 sei) with injuries consistent with vessel strike that were first detected in waters from Delaware Bay to Chesapeake Bay which is the best representation of the geographic area representing the lease area, the cable corridor, and the area where vessels will transit between these areas and the identified ports in MD, VA, DE, and NJ (Table 7.2.2. below) where nearly all of the project vessel traffic will occur. We did not identify any records of sperm whales struck in this portion of the action area.

Table 7.2.2. Information on ESA listed whales reported with injuries consistent with vessel strikes between in waters from Delaware Bay to Chesapeake Bay from 2008-2023.

ESA listed Whales with Injuries Consistent with Vessel Strikes		
Species	Total	Date and Location
North Atlantic right whale	1	2/12/23 Virginia Beach, VA
Fin Whale	5	10/1/09 Port Elizabeth, NJ; 3/18/10 off Bethany Beach, DE; 9/3/10 Cape Henlopen State Park, DE; 4/12/14 Port Elizabeth, NJ; 2/19/12 Fort Story, VA

Sei Whale	3	5/19/09 off Rehobeth Beach, DE; 3/26/11 Virginia Beach, VA; 5/7/14 Delaware River (on ship's bow)

Sources: Henry et al. 2023 (2017-2021 data), Henry et al. 2022 (2016-2020 data); Henry et al. 2017 (2011-2015); Glass et al. 2012 (2006-2010)

These mortalities were reported over a 15-year period (2009-2023). It is important to note that the locations recorded are, in nearly all cases, the area where the whale was first sighted and the actual location of the strike is unknown. For example, the sei whale recorded above was documented when the vessel came into port in the Delaware River; it is unknown where along the vessel's transit route the strike actually occurred. As such, it is difficult to identify a number of strikes of any of these species that has occurred in the geographic area of interest since 2008. Absent any mitigation measures we would generally expect an increase in risk proportional to the increase in vessel traffic. As such, this would increase risk during the construction period by 1.66%, during the operations and maintenance period by 1.7%, and by 2.4% during the decommissioning period. As noted above, there are records of a small number of ESA listed whales with injuries consistent with vessel strike that were first documented in the area of interest. In the portions of this area that overlap with high areas of vessel traffic (i.e., the existing SMAs) risk of vessel strike, particularly for right whales, is generally considered higher than in other areas with lower levels of vessel traffic. Sei and sperm whales are typically found in deeper waters of the continental shelf, and are expected to be rare in the Maryland Wind WDA and even less likely to occur in the nearshore/inland portions of the action area where vessels will transit between coastal ports and the WDA.

There are a number of factors that result in us determining that any potential increase in vessel strike is extremely unlikely to occur. As described above, a number of measures designed to reduce the likelihood of striking marine mammals including ESA listed large whales, particularly North Atlantic right whales, are included as part of the proposed action. These measures include seasonal speed restrictions in areas and at times of year when risk of strike is considered highest, monitoring via dedicated visual observers, PAM, and alternative monitoring technologies to be used at night or in other low visibility conditions to improve detection of whales in time to slow down and avoid a strike.

The vessel speed limit requirements proposed by US Wind, BOEM, and NMFS OPR are in accordance with measures outlined in NMFS Ship Strike Reduction Strategy as the best available means of reducing ship strikes of right whales and are consistent with the changes proposed to vessel size in the recent proposed rule; that is, they limit speed to 10 knots or less for all vessels in areas and times when right whales are most likely to occur. As described in Section 3.0 of this Opinion, all project vessels of all sizes will be required to operate at speeds of 10 knots or less (with exemptions for safety as noted above) when operating in any SMA, DMA, or Slow Zone. Outside of these areas, operating at speeds above 10 knots will only be allowed when consistent with implementation of measures included in a Vessel Strike Avoidance Plan. During the 5-year effective period of the MMPA ITA, this will include a requirement that vessels of any size will only be able to exceed 10 knots if they are outside of an SMA, DMA, or Slow Zone and are traveling within a transit corridor monitored by a PAM system specifically designed for the project area to detect right whales, consistent with a PAM plan approved by NMFS and BOEM, and no right whales have been documented within the previous 24 hour period. Year round, all underway vessels will have a dedicated visual observer to monitor for protected species, with that lookout having no other duties when the vessel is transiting at speeds greater than 10 knots. Lookouts will be required to have access to technology to ensure effective monitoring at night or in other low visibility conditions. After the MMPA ITA expires, BOEM will require continued implementation of an approved Vessel Strike Avoidance Plan that is determined by NMFS and BOEM to provide risk reduction equivalent to a 10 knot speed restriction.

Most ship strikes have occurred at vessel speeds of 13-15 knots or greater (Jensen and Silber 2003; Laist et al. 2001). An analysis by Vanderlaan and Taggart (2006) showed that at speeds greater than 15 knots, the probability of a ship strike resulting in death increases asymptotically to 100%. At speeds below 11.8 knots, the probability decreases to less than 50%, and at ten knots or less, the probability is further reduced to approximately 30%. In rulemaking, NMFS has concluded, based on the best available scientific evidence, that a maximum speed of 10 knots, as measured as "speed over ground", in certain times and locations, is the most effective and practical approach to reducing the threat of ship strikes to right whales.

Absent any information to the contrary, we consider that a 10-knot speed restriction similarly reduces the risk to other whale species. Substantial evidence (Laist et al., 2001; Jensen and Silber, 2003; Vanderlaan and Taggart, 2007; Kelley et al. 2020) indicates that vessel speed is an important factor affecting the likelihood and lethality of whale/vessel collisions. In a compilation of ship strikes of all large whale species that assessed ship speed as a factor in ship strikes, Laist et al. (2001) concluded that a direct relationship existed between the occurrence of a whale strike and the speed of the vessel. These authors indicated that most deaths occurred when a vessel was traveling at speeds of 14 knots or greater and that, as speeds declined below 14 knots, whales apparently had a greater opportunity to avoid oncoming vessels. Adding to the Laist et al. (2001) study, Jensen and Silber (2003) compiled 292 records of known or probable ship strikes of all large whale species from 1975 to 2002. Vessel speed at the time of the collision was reported for 58 of those cases; 85.5 percent of these strikes occurred at vessel speeds of 10 knots or greater. Effects of vessel speed on collision risks also have been studied using computer simulation models to assess hydrodynamic forces vessels have on a large whale (Knowlton et al., 1995; Knowlton et al., 1998). These studies found that, in certain instances, hydrodynamic forces around a vessel could act to pull a whale toward a ship. These forces increase with increasing speed and thus a whale's ability to avoid a ship in close quarters may be reduced with increasing vessel speed. Related studies by Clyne (1999) found that the number of simulated strikes with passing ships decreased with increasing vessel speeds, but that the number of strikes that occurred in the bow region increased with increasing vessel speeds. Additionally, vessel size has been shown to be less of a significant factor than speed, as biophysical modeling has demonstrated that vessels of all sizes can yield stresses likely to cause lethal injuries to large whales (Kelley et al. 2020). The speed reduction alone provides a significant reduction in risk of vessel strike as it both provides for greater opportunity for a whale to evade the vessel but also ensures that vessels are operating at such a speed that they can make evasive maneuvers in time to avoid a collision.

A number of measures will be in place to maximize the likelihood that during all times of the year and in all weather conditions that if whale is in the vicinity of a project vessel that the whale is detected, the captain can be notified and measures taken to avoid a strike (such as slowing down further and/or altering course). Although some of these measures have been developed to specifically reduce risk of vessel strike with right whales, all of these measures are expected to provide the same protection for other large whales as well. These measures apply regardless of the length of the transit and include dedicated PSOs or lookouts on all Project vessels during all phases to monitor the vessel strike avoidance zone and requirements to slow down less than 10 knots if a whale is spotted, alternative visual detection systems (e.g., thermal cameras) stationed on all transiting vessels that intend to operate at greater than 10 knots, and additional measures as outlined in Section 3.0. These measures are meant to increase earlier detection of whale presence and subsequently further increase time available to avoid a strike. Awareness of right whales in the area will also be enhanced through monitoring of reports on USCG Channel 16, communication between project vessel operators of any sightings, and monitoring of the NMFS Right Whale Sightings Advisory System.

Here, we explain how these measures support our determination that any increase in vessel strike is extremely unlikely to occur. Many of these measures are centered on vessel speed restrictions and increased monitoring. To avoid a vessel strike, a vessel operator both needs to be able to detect a whale and be able to slow down or move out of the way in time to avoid collision. The speed limits and monitoring measures that are part of the proposed action maximize the opportunity for detection and avoidance.

Vessel speed restrictions:
As explained above, during the 5-year effective period of the ITA, all vessels of all sizes, must operated at speeds of 10 knots or less unless they are outside of an SMA, DMA, or Slow Zone, and are operating in a transit corridor being monitored by PAM and no right whales have been detected via visual observation or PAM within or approaching the transit corridor for 24 hours. Following the effective period of the ITA, as described in the BA, proposed conditions of COP approval will require all vessels, regardless of size, to adhere to a 10 knot speed restriction in SMAs, DMAs, or Slow Zones or when any large whales are observed near an underway vessel; BOEM will require continued implementation of an approved Vessel Strike Avoidance Plan that is determined by NMFS and BOEM to provide risk reduction equivalent to a 10 knot speed restriction.

The only exceptions to these speed restrictions are in emergencies and if a vessel otherwise subject to a project related speed restriction (i.e., not a speed restriction required through regulation, such as a vessel 65’ or larger in an active SMA per the current vessel speed rule), is operating in an area being monitored by PAM or other means consistent with a NMFS and BOEM approved vessel strike avoidance plan submitted by US Wind that the agencies concur provides an equivalent level of protection to a 10 knot speed restriction.

By reducing speeds below 10 knots, the probability of a lethal ship strike is greatly reduced; additionally, reduced speeds provide greater time to react if a PSO/lookout observes an animal in the path of a vessel and therefore reduces the likelihood of any strike occurring at all.
The period of time and areas when vessels can travel at speeds greater than 10 knots are at times when North Atlantic right whales are expected to occur in very low numbers and thus the risk of a vessel strike is significantly lower. As noted above, PAM will be used to monitor for the presence of vocalizing whales in a defined transit corridor. Travel above 10 knots will only

occur in “transit corridors” with PAM when no right whales have been detected in the previous 24 hours, which decreases the potential for a vessel traveling greater than 10 knots to co-occur with a right whale. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all vessels must travel at 10 knots or less for the following 24 hours. Each subsequent detection will trigger a 24-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection of North Atlantic right whales in the transit corridor in the past 24 hours. This increases detectability beyond the area that an observer can see and enhances the effectiveness of required vessel avoidance measures. In all instances, PSOs/lookouts will be monitoring a vessel strike zone, see below.

Dedicated Visual Observers and Increased right whale awareness:
A number of measures will be required by BOEM and/or NMFS OPR to increase awareness and detectability of whales. Vessel operators and crews will receive protected species identification training that covers species identification as well as making observations in good and bad weather. All vessel operators and crews must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course (as appropriate) and regardless of vessel size, to avoid striking any marine mammal. During any vessel transits within or to/from the WDA, an observer would be stationed at the best vantage point of the vessel(s) to ensure that the vessel(s) are maintaining the appropriate separation distance from protected species. A PSO or crew lookout must be posted during all times a vessel is underway (transiting or surveying) to monitor for listed species. During vessel transits over 10 knots, these lookouts will have no other duty than to monitor for listed species. If a whale is sighted, the lookout will communicate to the vessel captain to slow down and take measures to avoid the sighted animal. Visual observers will also be equipped with alternative monitoring technology for periods of low visibility (e.g., darkness, rain, fog, etc.). At all times the lookout will be monitoring for presence of whales and ensuring that the vessel stays at least 500 m away from any right whale or unidentified large whale. If any whale is detected within 500 m of the vessel, speed will be reduced to less than 10 knots; if any right whale is observed within any distance from the vessel, speed will be reduced to less than 10 knots.

Year-round, all vessel operators will monitor the project's Situational Awareness System, WhaleAlert, US Coast Guard VHF Channel 16, and the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales once every 4-hour shift during project-related activities. The PSO and PAM operator monitoring teams for all activities will also monitor these systems no less than every 12 hours. If a vessel operator is alerted to a North Atlantic right whale detection within the project area, they will immediately convey this information to the PSO and PAM teams. All vessel operators must check for information regarding mandatory or voluntary ship strike avoidance (DMAs/Slow Zones and SMAs) and daily information regarding right whale sighting locations. Active monitoring of right whale sightings information provides situational awareness for monitoring of right whales in the area of vessel activities.

Passive Acoustic Monitoring:
As noted above, PAM monitoring in the lease area and the vessel transit routes is required for vessels to be able to operate above 10 knots (noting that PAM monitoring will not provide an

exception to speed reductions in SMAs or DMAs). If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all vessels must travel at 10 knots or less for the following 24 hours. Each subsequent detection will trigger a 24-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection of North Atlantic right whales in the transit corridor in the past 24 hours. The PAM array will be specifically designed for the transit corridor where it is deployed and for the specific function of being used to increase awareness of right whale presence in the area and reduce vessel speed risk; a plan will be developed by US Wind and reviewed by NMFS and BOEM and can not be implemented until approved. Given these requirements, we expect that any deployed PAM system will be highly effective at documenting vocalizing right whales. Approval will not be provided unless the agencies agree it provides an equivalent level of protection as a 10-knot speed restriction.

In summary, we expect that despite the increase in vessel traffic that will result from the proposed action, the multi-faceted measures that will be required of all Project vessels will enable the detection of any ESA listed whale that may be in the path of a Project vessel with enough time to allow for vessel operators to avoid any such whales. Combined with the already very low increased risk of vessel strike anticipated due to increased project vessel traffic, we expect that these measures will make it extremely unlikely that a Project vessel will strike a fin, sei, sperm, or right whale; thus, effects of vessel traffic in this area are discountable. No take is anticipated.

Effects of Vessel Transits to the Port of New York/New Jersey

In the BA, BOEM included the potential use of the Port of New York/New Jersey as an alternate port for project vessels during the 3-year construction phase. For this Opinion, we conservatively assume the number of vessel transits to the Port of New York/New Jersey would be the same as those expected for Baltimore (Sparrows Point), Maryland (i.e., up to 270 roundtrips during year 1; 668 roundtrips during year 2; 451 roundtrips during year 3; and less than one annual round trip during O&M, for a total of 1,390 roundtrips). These vessels would include heavy transport vessels, multipurpose OSVs, jack-up vessels, installation vessels, and fallpipe vessels. Some of these vessels are capable of transit speeds of up to 15 knots; however, all transits would be limited to 10 knots or less unless they are outside of an active SMA or Slow Zone/DMA and are operating within a “transit corridor” being monitored by real-time PAM that has had no detections of right whales in the previous 24 hours. Additionally, these vessels will have lookouts monitoring for whales. Vessels transiting between the Port of New York/New Jersey and the Maryland Wind WDA are expected to travel in shipping lanes when entering/leaving port and then transit offshore along typical commercial vessel transit routes.

As described in Section 6 of this Opinion, ESA listed whales occur in this area in varying distributions and abundances throughout the year. North Atlantic right whales occur in the area primarily in the fall and early spring, as some individuals in the population migrate through the Mid-Atlantic to the Southeast calving grounds. Fin whales most commonly occur throughout the year in offshore waters of the northern Mid-Atlantic. Sei whales typically are found offshore along the shelf break typically in northern Mid-Atlantic waters, primarily during the fall, winter, and spring. Sperm whales along the Mid-Atlantic are found offshore along the shelf break year-round. In general, ESA listed whales are expected to be highly dispersed in deeper offshore waters and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low in offshore waters.

If the Port of New York/New Jersey is selected as the alternate port, project vessels will represent an extremely small portion (up to 1,390 trips over the three-year construction period and less than one annual round trip during O&M) of the vessel traffic traveling through the New York Harbor portion of the action area. Considering, an estimated 85,092 vessel transits annually in the Upper New York Bay, Bay Ridge and Red Hook Channels, and New York Harbor Lower Entrance Channels, this is about an 0.5% increase in traffic in this area, assuming that all of these trips represent "new" trips for vessels that otherwise would not be operating in this area. Given that with few exceptions, these vessels will be traveling at speeds of 10 knots or less year-round and will be in compliance with vessel strike regulations, and have lookouts monitoring for whales, and in consideration of the extremely small increase in vessel traffic in this portion of the action area that these vessels will represent, it is extremely unlikely that any ESA listed whales will be struck by a project vessel operating in this portion of the action area. Therefore, effects to right, fin, sei, and sperm whales from vessel strike due to project vessels operating in this portion of the action area are discountable.

Effects of Vessel Transits to Cianbro Modular Manufacturing Facility (Brewer, ME)
As described in the BA, a small number of vessels will transit from the Cianbro Modular Manufacturing Facility (Brewer, Maine) to the Maryland Wind WDA. These vessels will be heavy transport vessels, during transit these vessels may travel up to 12 knots with speed of less than 10 knots more typical; however, conditions of the MMPA ITA and the COP approval would limit vessel speed to 10 knots or less. BOEM has indicated that during the entire three-year construction period there may be up to four vessel transits from the Cianbro facility to the WDA. Project vessels will represent an extremely small portion of the vessel traffic traveling through the EEZ.
In this portion of the action area, co-occurrence of project vessels and individual whales is expected to be extremely unlikely; this is due to the dispersed nature of whales in the open ocean and the only intermittent presence of project vessels (four transits over a three-year period). When operating outside of an active SMA or Slow Zone/DMA, these vessels could operate at speeds over 10 knots; however, they will have a dedicated lookout monitoring for whales and will be required to slow down if any whales are sighted. Given the limited amount of vessel trips in this area (i.e., up to four transits over a three-year period), the dispersed nature of whales in this offshore area, and the therefore limited potential for co-occurrence of a whale and one of these vessels, it is extremely unlikely that any ESA listed whales will be struck by a project vessel during one of the no more than four transits within the U.S. EEZ on its way to or from the Cianbro facility. The requirements for lookouts and to slow down if whales are observed would further decrease this risk. Therefore, effects to right, fin, sei, and sperm whales from vessel strike due to project vessels operating in this portion of the action area are discountable.

Effects of Vessel Transits to Charleston and Ports in the Gulf of Mexico
US Wind anticipates one round trip will be conducted from the Gulf of Mexico to the Maryland Wind WDA during year two of the 3-year construction phase of the project. If the Nexans Cable Plant is selected as the alternate port for cable storage and load out to the cable installation vessel, US Wind anticipates up to 16 trips to Charleston, SC over the 3-year construction phase

of the project. As described in Section 6.0, ESA listed whales occur in this area in varying distribution and abundance throughout the year. North Atlantic right whales occur in the area along coastal waters as they migrate through the Mid-Atlantic to the Southeast calving grounds, primarily in the fall and early spring. Fin whales most commonly occur throughout the year in offshore waters of the northern Mid-Atlantic. Sei whales typically are found offshore along the shelf break throughout the year, primarily in northern Mid-Atlantic waters. Sperm whales along the Mid-Atlantic and the Gulf of Mexico are found offshore along the shelf break year-round. In general, ESA listed whales are expected to be highly dispersed in deeper offshore waters and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low in offshore waters.

As explained above, over 49,317 vessel transits a year occur in the area surrounding the WDA. Given the presence of large ports in the South Atlantic, we expect similar levels of baseline vessel traffic along the coast south of Delaware Bay to Charleston (i.e., over 49,317 transits within the area annually). Considering the potential trips to Charleston and the Gulf of Mexico, this would be an increase in vessel traffic of no more than 0.034% in that 3-year period. Additionally, the multi-faceted measures, including 10-knot speed restrictions for vessels traveling to/from these ports, will enable the detection of any ESA listed whale that may be in the path of a Project vessel with enough time to allow vessel operators to avoid any such whales. We expect that these measures will make it extremely unlikely that a Project vessel will strike a whale.

Effects of Vessel Transits in the U.S. EEZ East of the Maryland Wind WDA
Due to project component and vessel availability, a small number of vessels will transit from ports in Europe to the Maryland Wind WDA; this section considers those vessel transits while in the U.S. EEZ. These vessels will be heavy transport vessels, during transit these vessels may travel up to 12 knots with speed of less than 10 knots more typical. BOEM has indicated that during the entire three-year construction period there may be up to 6 vessel transits from ports in Europe to the U.S. Project vessels will represent an extremely small portion of the vessel traffic traveling through the EEZ. In this portion of the action area, co-occurrence of project vessels and individual whales is expected to be extremely unlikely; this is due to the dispersed nature of whales in the open ocean and the only intermittent presence of project vessels (6 transits over a three year period). When operating outside of an active SMA or Slow Zone/DMA, these vessels could operate at speeds over 10 knots; however, they will have a dedicated lookout monitoring for whales and will be required to slow down (to 10 knots or less), stop their vessel, or alter course (as appropriate) to avoid getting within 500 m of any whale. Given the limited amount of vessel trips in this area (i.e., up to 6 trips over a three-year period), the dispersed nature of whales in this offshore area, and the limited potential for co-occurrence of a whale and one of these vessels, it is extremely unlikely that any ESA listed whales will be struck by a project vessel during one of the no more than six transits within the U.S. EEZ on its way to or from ports in Europe. The requirements for lookouts and to slow down if whales are observed would further decrease this risk. Therefore, effects to right, fin, sei, and sperm whales from vessel strike due to project vessels operating in this portion of the action area are discountable.

Summary of Effects of Vessel Traffic on ESA Listed Whales

In summary, while there is an increase in risk of vessel strike during all phases of the proposed project due to the increase in vessel traffic, because of the measures that will be in place, particularly the vessel speed restrictions and use of enhanced monitoring measures, we do not expect that this increase in risk will result in a vessel strike caused by the action. Based on the best available information on the risk factors associated with vessel strikes of large whales (i.e., vessel size and vessel speed), and the measures required to reduce risk, it is extremely unlikely that any project vessel will strike a right, fin, sei, or sperm whale during any phase of the proposed project. Therefore, effects to right, fin, sei, and sperm whales from vessel strike due to project vessels operating in the action area are discountable.

7.2.3.5 Sea Turtles

Background Information on the Risk of Vessel Strike to Sea Turtles
While research is limited on the relationship between sea turtles, ship collisions, and ship speeds, sea turtles are at risk of vessel strike where they co-occur with vessels. Sea turtles are vulnerable to vessel collisions because they regularly surface to breathe, and often rest at or near the surface. Sea turtles, with the exception of hatchlings and pre-recruitment juveniles, spend a majority of their time submerged (Renaud and Carpenter 1994; Sasso and Witzell 2006). Although, Hazel et al. (2007) demonstrated sea turtles preferred to stay within the three meters of the water's surface, despite deeper water being available. Any of the sea turtle species found in the action area can occur at or near the surface in open-ocean and coastal areas, whether resting, feeding or periodically surfacing to breathe. Therefore, all ESA listed sea turtles considered in the biological opinion are at risk of vessel strikes.

A sea turtle's detection of a vessel is likely based primarily on the animal's ability to see the oncoming vessel, which would provide less time to react to as vessel speed increases (Hazel et al. 2007), however, given the low vantage point of a sea turtle at the surface it is unlikely they are readily able to visually detect vessels at a distance. Hazel et al. (2007) examined vessel strike risk to green sea turtles and suggested that sea turtles may habituate to vessel sound and are more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in eliciting responses (Hazel et al. 2007). Regardless of what specific stressor associated with vessels turtles are responding to, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel et al. 2007). This is a concern because faster vessel speeds also have the potential to result in more serious injuries (Work et al. 2010). Although sea turtles can move quickly, Hazel et al. (2007) concluded that at vessel speeds above 4 km/hour (2.1 knots) vessel operators cannot rely on turtles to actively avoid being struck. Thus, sea turtles are not considered reliably capable of moving out of the way of vessels moving at speeds greater than 2.1 knots.

Stranding networks that keep track of sea turtles that wash up dead or injured have consistently recorded vessel propeller strikes, skeg strikes, and blunt force trauma as a cause or possible cause of death (Chaloupka et al. 2008). Vessel strikes can cause permanent injury or death from bleeding or other trauma, paralysis and subsequent drowning, infection, or inability to feed. Apart from the severity of the physical strike, the likelihood and rate of a turtle's recovery from a strike may be influenced by its age, reproductive state, and general condition at the time of injury. Much of what has been documented about recovery from vessel strikes on sea turtles has been inferred from observation of individual animals for some duration of time after a strike occurs (Hazel et al. 2007; Lutcavage et al. 1997). In the U.S., the percentage of strandings that were attributed to vessel strikes increased from approximately 10 percent in the 1980s to a record high of 20.5 percent in 2004 (NMFS and USFWS 2007). In 1990, the National Research Council estimated that 50-500 loggerhead and 5-50 Kemp's ridley sea turtles were struck and killed by boats annually in waters of the U.S. (NRC 1990). The report indicates that this estimate is highly uncertain and could be a large overestimate or underestimate.

Vessel strike has been identified as a threat in recovery plans prepared for all sea turtle species in the action area. As described in the Recovery Plan for loggerhead sea turtles (NMFS and USFWS 2008), propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 14.9% of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post or ante-mortem. The proportion of vessel-struck sea turtles that survive is unknown. In some cases, it is not possible to determine whether documented injuries on stranded animals resulted in death or were post-mortem injuries. However, the available data indicate that post-mortem vessel strike injuries are uncommon in stranded sea turtles. Based on data from off the coast of Florida, there is good evidence that when vessel strike injuries are observed as the principle finding for a stranded turtle, the injuries were both ante-mortem and the cause of death (Foley et al 2019). Foley et al. (2019) found that the cause of death was vessel strike or probable vessel strike in approximately 93% of stranded turtles with vessel strike injuries. Sea turtles found alive with concussive or propeller injuries are frequently brought to rehabilitation facilities; some are later released and others are deemed unfit to return to the wild and remain in captivity. Sea turtles in the wild have been documented with healed injuries so at least some sea turtles survive without human intervention. As noted in NRC 1990, the regions of greatest concern for vessel strike are outside the action area and include areas with high concentrations of recreational-boat traffic such as the eastern Florida coast, the Florida Keys, and the shallow coastal bays in the Gulf of Mexico. In general, the overall risk of strike for sea turtles in the Northwest Atlantic is considered greatest in areas with high densities of sea turtles and small, fast moving vessels such as recreational vessels (NRC 1990). This combination of factors in the action area is limited to nearshore areas in the southern extent of the action area, well outside the Maryland Wind WFA and the transit routes to Ocean City, MD where the vast majority of vessel traffic will occur.

Exposure Analysis – Sea Turtles

We consider vessel strike of ESA listed sea turtles in the context of specific project phases because the characteristics and volume of vessel traffic is distinctly different during the three phases of the project.

Transits in the Lease Area, Cable Corridor, and to/from Ports from Delaware Bay to Chesapeake Bay

Here we consider the risk of vessel strike to sea turtles from project vessels transiting between the lease area/cable corridors and the identified ports in Maryland, Virginia, Delaware, and New Jersey. We queried the NMFS' Sea Turtle Stranding and Salvage Network (STSSN) database for records of sea turtles with injuries consistent with vessel strike (recorded as definitive vessel and blunt force trauma in the database) in waters from Delaware Bay to Chesapeake Bay from 2013 to 2022. We selected this geographic area as it represents the waters that will be transited by project vessels traveling to/from the lease area/cable corridors and the ports identified in MD, VA, DE, and NJ, inclusive of those in Delaware River/Bay, Chesapeake Bay, and the O&M facility in Ocean City. The results from this query are presented in Table 7.2.3 and illustrated in Figure 7.2.2.

While we recognize that some vessel strikes may be post-mortem, the available data indicate that post-mortem vessel strike injuries are uncommon in stranded sea turtles (Foley et al. 2019). Out of the 1,587 reported sea turtle stranding cases (excluding cold stuns) in the waters in the Delaware Bay to Chesapeake Bay region during the 10-year time period (2013–2022) of data, there were 306 records of sea turtles recovered with definitive evidence from vessel strikes. In addition, there were 140 sea turtles with evidence from blunt force trauma, which indicates probable vessel collision. As anticipated based on the abundance of turtle species in the area, the majority of these records are of loggerhead sea turtles.

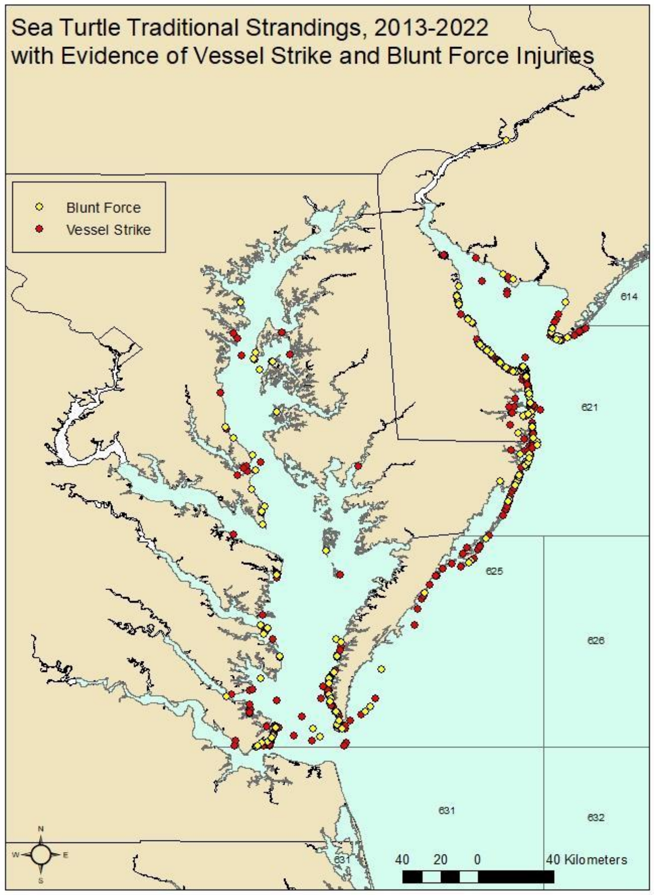
Based on the findings of Foley et al. (2019) that found that vessel strike was the cause of death in 93% of strandings with indications of vessel strike, we consider 93% of the sea turtle strandings recorded as “definitive vessel” and “blunt force trauma” had a cause of death attributable to vessel strike. Therefore, to estimate the number of interactions where vessel strike was the cause of death we first added the number of “definitive vessel” and “blunt force trauma” cases to get a total number of sea turtle strandings with indications of vessel strike, and then calculated 93% of the total (e.g., for loggerheads, we first added the “definitive vessel” (248) and “blunt force trauma” (106) then multiplied that value (354) by 0.93 (=329). The result is the number of turtles in the “total presumed vessel mortalities” column in Table 7.2.3.

Table 7.2.3. Preliminary STSSN cases from 2013 to 2022 with evidence of propeller strike or probable vessel collision in the waters in the Delaware Bay to Chesapeake Bay region and estimated presumed vessel mortalities.

Sea Turtles	Total Records	Definitive Vessel	Blunt Force Trauma	Total Presumed Vessel Mortalities*
Loggerhead	1,141	248	106	329
Green	133	6	5	10
Leatherback	33	14	2	15
Kemp’s	229	34	25	55

Source: STTSSN (March 2024)
*93% of the total of “definitive vessel” plus “blunt force trauma,” rounded to whole numbers

Figure 7.2.2. Location of Sea Turtle Strandings from 2013-2022 with Evidence of Vessel Strike or Blunt Force Trauma.



Source: NMFS/STSSN unpublished data (March 2024).

The data in Table 7.2.3 reflect stranding records, which represent only a portion of the total at-sea mortalities of sea turtles. Sea turtle carcasses typically sink upon death, and float to the surface only when enough accumulation of decomposition gasses cause the body to bloat (Epperly et al. 1996). Though floating, the body is still partially submerged and acts as a drifting object. The drift of a sea turtle carcass depends on the direction and intensity of local currents and winds. As sea turtles are vulnerable to human interactions such as fisheries bycatch and vessel strike, a number of studies have estimated at-sea mortality of marine turtles and the influence of nearshore physical oceanographic and wind regimes on sea turtle strandings. Although sea turtle stranding rates are variable, they may represent as low as five percent of total mortalities in some areas but usually do not exceed 20 percent of total mortality, as predators, scavengers, wind, and currents prevent carcasses from reaching the shore (Koch et al. 2013). Strandings of dead sea turtles from fishery interaction have been reported to represent as low as seven percent of total mortalities caused at sea (Epperly et al. 1996). Remote or difficult to access areas may further limit the amount of strandings that are observed. Because of the low probability of stranding under different conditions, determining total vessel strikes directly from raw numbers of stranded sea turtle data would vary between regions, seasons, and other factors such as currents.

To estimate unobserved vessel strike mortalities, we relied on available estimates from the literature. Based on data reviewed in Murphy and Hopkins-Murphy (1989), only six of 22 loggerhead sea turtle carcasses tagged within the South Atlantic and Gulf of Mexico region were reported in stranding records, indicating that stranding data represent approximately 27 percent of at-sea mortalities. In comparing estimates of at-sea fisheries induced mortalities to estimates of stranded sea turtle mortalities due to fisheries, Epperly et al. (1996) estimated that strandings represented 7 to13 percent of all at-sea mortalities.

Based on these two studies, both of which include waters of the U.S. East Coast, stranding data likely represent 7 to 27 percent of all at-sea mortalities. While there are additional estimates of the percent of at-sea mortalities likely to be observed in stranding data for locations outside the action area (e.g., Peck ham et al. 2008, Koch et al. 2013), we did not rely on these since stranding rates depend heavily on beach survey effort, current patterns, weather, and seasonal factors among others, and these factors vary greatly with geographic location (Hart et al. 2006). Thus, based on the mid-point between the lower estimate provided by Epperly et al. (1996) of seven percent, and the upper estimate provided by Murphy and Hopkins-Murphy (1989) of 27 percent, we assume that the STSSN stranding data represent approximately 17 percent of all at sea mortalities. This estimate closely aligns with an analysis of drift bottle data from the Atlantic Ocean by Hart et al. (2006), which estimated that the upper limit of the proportion of sea turtle carcasses that strand is approximately 20 percent.

To estimate the annual average vessel strike mortalities corrected for unobserved vessel strike mortalities, we adjusted our calculated total presumed vessel mortality with the detection value of 17%. The resulting, adjusted number of vessel strike mortalities of each species for the waters from Delaware Bay to Chesapeake Bay are presented in the "annual total presumed vessel mortalities" column in Table 7.2.4. In using the 17 percent correction factor, we assume that all sea turtle species and at-sea mortalities are equally likely to be represented in the STSSN dataset. That is, sea turtles killed by vessel strikes are just as likely to strand or be observed at sea and be recorded in the STSSN database (i.e., 17 percent) as those killed by other activities, such as interactions with fisheries, and the likelihood of stranding once injured or killed does not vary by species.

Table 7.2.4. Estimated Annual Vessel Strike Mortalities Corrected for Unobserved Vessel Strike Mortalities in the waters in the Delaware Bay to Chesapeake Bay region

Sea Turtles	Presumed Vessel Mortalities* Over 10 Years	Total Over 10 Years (17% detection rate)	Annual Total presumed vessel mortalities
Loggerhead	329	1,935	194
Green	10	59	6
Leatherback	15	88	9
Kemp's ridley	55	324	32

* 93% of the total of "definitive vessel" plus "blunt force trauma"

Finally, assuming a proportional relationship between vessel strikes and vessel traffic, we considered the phase-specific increase in vessel traffic and increased the number of baseline strikes to account for the increase in project vessel traffic. For these calculations, we assume a proportional relationship between vessel strikes and vessel traffic. The formula used to generate the estimate of project vessel strikes over the construction, operations, and decommissioning phases is: (annual baseline strikes)*(% increase in traffic)*(years of project phase). Note that the calculations illustrated here consider a three year construction period, a 30 year operational period, and two year decommissioning period.

Construction = 1.59% increase in traffic for 3 years

Loggerhead sea turtles: (194)(0.0159)(3) = 9.25 loggerhead sea turtles
Green sea turtles: (6)(0.0159)(3) = 0.29 green sea turtles
Leatherback sea turtles: (9)(0.0159)(3) = 0.43 leatherback sea turtles
Kemp's Ridley sea turtles: (32)(0.0159)(3) = 1.53 Kemp's Ridley sea turtles

Operation = 1.67% increase in traffic for 30 years

Loggerhead sea turtles: (194)(0.0167)(30) = 97.19 loggerhead sea turtles
Green sea turtles: (6)(0.0167)(30) = 3.01 green sea turtles
Leatherback sea turtles: (9)(0.0167)(30) = 4.51 leatherback sea turtles
Kemp's Ridley sea turtles: (32)(0.0167)(30) = 16.03 Kemp's Ridley sea turtles

Decommissioning = 2.39% increase in traffic for 2 years

Loggerhead sea turtles: (194)(0.0239)(2) = 9.27 loggerhead sea turtles
Green sea turtles: (6)(0.0239)(2) = 0.29 green sea turtles
Leatherback sea turtles: (9)(0.0239)(2) = 0.43 leatherback sea turtles
Kemp's Ridley sea turtles: (32)(0.0239)(2) = 1.53 Kemp's Ridley sea turtles

As explained above in section 7.2.2, US Wind is proposing to take and/or BOEM is proposing to require a number of measures designed to minimize the potential for strike of a protected species that will be implemented over the life of the project. These include reductions in speed in certain areas, including certain times of the year to minimize the risk of vessel strike of large whales, the use of trained look outs, slowing down if a sea turtle is sighted within 100 m of the operating vessel's forward path and if a sea turtle 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, and seasonally avoiding transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats). While we expect that these measures will help to reduce the risk of vessel strike of sea turtles, individual sea turtles can be difficult to spot from a moving vessel at a sufficient distance to avoid strike due to their low-lying appearance. With this information in mind, we expect that the risk reduction measures that are part of the proposed action will reduce collision risk overall but will not eliminate that risk. We are not able to quantify any reduction in risk that may be realized and expect that any reduction in risk may be small; therefore, we have not reduced the number of calculated vessel strikes in consideration of the avoidance and minimization measures that are incorporated into the proposed action.

To determine the likely total number of sea turtles that will be struck by project vessels, we have added up the numbers for each phase then rounded up to whole animals. As such, based on our analysis, the proposed action is expected to result in vessel strike of sea turtles up to the number identified in Table 7.2.5 below:

Table 7.2.5. Estimate of sea turtle vessel strikes as a result of the proposed action over the entire project period.

Species	Maximum Vessel Strike Anticipated
NWA DPS Loggerhead sea turtle	116
NA DPS green sea turtle	4
Leatherback sea turtle	6
Kemp's ridley sea turtle	20

While not all strikes of sea turtles are lethal, we have no way of predicting what proportion of strikes will be lethal and what proportion will result in recoverable injury. As such, for the purposes of this analysis, given the likelihood of vessel strike to cause serious injury or mortality, it is reasonable to assume that all strikes are likely to result in serious injury or mortality.

Effects of Vessel Transits to the Port of New York/New Jersey

In the BA, BOEM included the potential use of the Port of New York/New Jersey as an alternate port for project vessels during the 3-year construction phase. For this Opinion, we consider, based on the information presented in the BA, the number of vessel transits to the Port of New York/New Jersey would be the same as those expected for Baltimore (Sparrows Point), Maryland (i.e., up to 270 roundtrips during year 1; 668 roundtrips during year 2; 451 roundtrips during year 3; and less than one annual round trip during O&M, for a total of 1,390 roundtrips). These vessels would include heavy transport vessels, multipurpose OSVs, jack-up vessels, installation vessels, and fallpipe vessels and may transit up to 15 knots except when subject to vessel speed restrictions that would limit speeds to up to 10 knots. Vessels transiting between the Port of New York/New Jersey and the Maryland Wind WDA are expected to travel in shipping lanes when entering/leaving port and then transit offshore along typical commercial vessel transit routes.

As described in Section 6, ESA listed sea turtles occur in this area in varying distribution and abundance throughout the year, with a notable seasonal pattern. All listed sea turtle species have a seasonal migration where they move into more northerly waters (i.e. northern Mid-Atlantic, southern New England, parts of the Gulf of Maine) during the summer and then migrate back through the Mid-Atlantic to more southern areas through the fall and occur there throughout the spring. During Project vessel transits to ports in the Mid-Atlantic, in the deeper offshore waters of the action area, the species and age classes most likely to be impacted are hatchlings and pre-recruitment juveniles of all sea turtle species, all age classes of leatherback sea turtles, and occasionally adult loggerheads. Hatchlings and pre-recruitment juveniles of all sea turtle species may also occur in open-ocean habitats, where they reside among Sargassum mats. Sea turtles are expected to be highly dispersed in deeper offshore waters and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low in deeper offshore waters. In general, ESA listed sea turtles are expected to be highly dispersed in offshore waters on the continental shelf and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low. Project vessels have the greatest chance to co-occur with sea turtles in the nearshore waters as vessels enter New York Harbor (to transit to the Port of New York/New Jersey), however, in these areas vessels are expected to be traveling slowly which decreases the risk of vessel strike.

If the Port of New York/New Jersey is used as an alternative to Sparrows Point, project vessels will represent an extremely small portion (up to 1,390 trips over the three-year construction period and less than one annual round trip during O&M) of the vessel traffic traveling through the New York Harbor portion of the action area. Considering, an estimated 85,092 vessel transits annually in the Upper New York Bay, Bay Ridge and Red Hook Channels, and New York Harbor Lower Entrance Channels, this is about an 0.5% increase in traffic in this area, assuming that all of these trips represent "new" trips for vessels that otherwise would not be operating in this area. Given this extremely small increase in vessel traffic, any increased risk of vessel strike of sea turtles is also extremely small. As such, we expect that Maryland Wind vessels operating in this portion of the action area are extremely unlikely to strike any sea turtles; therefore, effects of vessel traffic on sea turtles by vessel strike in this portion of the action area are discountable.

Effects of Vessel Transits to Cianbro Modular Manufacturing Facility (Brewer, ME)
As described in the BA, a small number of vessels will transit from the Cianbro Modular Manufacturing Facility (Brewer, Maine) to the Maryland Wind WDA. These vessels will be heavy transport vessels, during transit these vessels may travel up to 12 knots with speed of less than 10 knots more typical. BOEM has indicated that during the entire three-year construction period there may be up to four vessel transits from the Cianbro facility to the WDA. Project vessels will represent an extremely small portion of the vessel traffic traveling through the Gulf of Maine.

In this portion of the action area, co-occurrence of project vessels and individual sea turtles is expected to be extremely unlikely; this is due to overall low abundance and limited seasonal occurrence of sea turtles in this portion of the action area, the dispersed nature of sea turtles in the open ocean, and the only intermittent presence of project vessels. Based on this, it is extremely unlikely that any sea turtles will occur along the vessel transit route at the same time that a project vessel is moving through the area. Together, this makes it extremely unlikely that any ESA listed sea turtles will be struck by a project vessel. Therefore, effects of vessel transits on sea turtles by vessel strike in this portion of the action area are discountable.

Effects of Vessel Transits to Charleston and Ports in the Gulf of Mexico
US Wind anticipates one round trip will be conducted from the Gulf of Mexico to the Maryland Wind WDA during year two of the 3-year construction phase of the project. If the Nexans Cable Plant is selected as the alternate port for cable storage and load out to the cable installation vessel, US Wind anticipates up to 16 trips to Charleston, SC over the 3-year construction phase of the project. Similar trips may also occur during decommissioning. Sea turtles are expected to be highly dispersed in deeper offshore waters and, given the large area over which Project vessels could potentially transit, the likelihood of co-occurrence is low in deeper offshore waters. Project vessels have the greatest chance to co-occur with sea turtles in the nearshore waters, near major ports, or in the shipping lanes. As explained above, over 49,317 vessel transits a year occur in the area surrounding the WDA. Given the presence of large ports in the South Atlantic, we expect similar levels of baseline vessel traffic along the coast south of Delaware Bay to

Charleston (i.e., over 49,317 transits within the area annually). Considering the potential trips to Charleston and the Gulf of Mexico, this would be an increase in vessel traffic of no more than 0.034% in that 3-year period. Based on this analysis, given the very small increase in vessel traffic and associated very small increase in subsequent risk, effects of this increase in traffic resulting in vessel strikes of sea turtles is extremely unlikely and thus discountable.

Effects of Vessel Transits in the U.S. EEZ
Due to project component and vessel availability, a small number of vessels will transit from ports in Europe to the Maryland Wind WDA; this section considers those vessel transits while they are operating in the U.S. EEZ. These vessels will be heavy transport vessels, during transit these vessels may travel up to 12 knots with speed of less than 10 knots more typical. BOEM has indicated that during the entire three-year construction period there may be up to 6 vessel transits from ports in Europe to the U.S. Project vessels will represent an extremely small portion of the vessel traffic traveling through the EEZ. In this portion of the action area, co-occurrence of project vessels and individual sea turtles is expected to be extremely unlikely; this is due to overall low abundance and limited seasonal occurrence of sea turtles in this portion of the action area, the dispersed nature of sea turtles in the open ocean, and the only intermittent presence of project vessels. Based on this, it is extremely unlikely that any sea turtles will occur along the vessel transit route at the same time that a project vessel is moving through the area. Together, this makes it extremely unlikely that any ESA listed sea turtles will be struck by a project vessel. Therefore, effects of vessel transits on sea turtles by vessel strike in this portion of the action area are discountable.

Summary of Effects of Vessel Traffic on ESA Listed Sea Turtles
In summary, we expect that the operation of project vessels over the life of the proposed action (i.e., 30 years) will result in the strike and mortality of up to 116 loggerhead, 4 green, 6 leatherback, and 20 Kemp's ridley sea turtles.

7.2.3.6 Consideration of Potential Shifts in Vessel Traffic
Here, we consider how the proposed project may result in shifts or displacement of existing vessel traffic. As presented in the Navigational Safety Risk Assessment ("NSRA;" see COP, Volume II, Appendix K1), the proposed WTG spacing is sufficient to allow the passage of vessels between the WTGs, and the directional trends of the vessel data are roughly in-line with the direction of the rows of WTGs as currently designed. However, transit through the lease area will be a matter of risk tolerance, and up to the individual vessel operators. While the presence of the WTGs and OSSs will not result in any requirements to reroute vessel traffic, it is possible that it will result in changes to vessel routes due to operator preferences and risk tolerances. Currently, vessel traffic in the Maryland Wind WDA consists primarily of commercial (cargo and tanker) vessels which pass through the lease area as they are exiting the outbound lane of the Traffic Separation Schemes and heading south. Vessels also pass through the lease area as they are coming from the south and entering the inbound lane of the Traffic Separation Scheme. While commercial fishing activity within the lease area appears minimal, the lease area is transited by vessels traveling to farther offshore fishing grounds. Depending on final layout, existing vessel traffic may transit within the turbines in the Maryland Wind WDA, or operators may avoid the Maryland Wind WDA and transit around it. However, this potential shift in traffic does not increase the risk of interaction with listed species as densities of listed species are not

incrementally higher outside the Maryland Wind WDA such that risk of ship strike would increase. As such, even if there is a shift in vessel traffic outside of the WDA or any other change in traffic patterns due to the construction and operation of the project, any effects to listed species would be so small that they would not be able to be meaningfully measured, evaluated, or detected and are therefore, insignificant.

7.2.4 Air Emissions Regulated by the OCS Air Permit

OCS Air Regulations are generally implemented and enforced by the EPA Regional Offices, but this authority may be delegated to state or local air permitting agencies that meet specific criteria (62 FR 46409). As described in section 1.1 (*Regulatory Authorities*) of this Opinion, the EPA has delegated authority to administer OCS Air Regulations to the state of Maryland. US Wind has applied for an OCS Air Permit from the Maryland Department of Environmental (MDE). To date, MDE has not issued a proposed or draft OCS air permit. As described by EPA, the Outer Continental Shelf (OCS) Air Regulations, found at 40 CFR part 55, establish the applicable air pollution control requirements, including provisions related to permitting, monitoring, reporting, fees, compliance, and enforcement, for facilities subject to the Clean Air Act (CAA) Section 328. Applicants within 25 nautical miles of a state seaward boundary are required to comply with the air quality requirements of the nearest or corresponding onshore area, including applicable permitting requirements. Applicants located beyond 25 nautical miles from the state seaward boundary are subject to federal air quality requirements and will likely need an OCS permit complying with the EPA's Prevention of Significant Deterioration (PSD) preconstruction permit program, and/or Part 71 Title V operating permit program requirements, and are subject to New Source Performance Standards and some standards for Hazardous Air Pollutants promulgated under Section 112 of the CAA.

The "potential to emit" for Maryland Wind OCS source's includes emissions from vessels installing the WTGs and the OSSs, engines on the WTGs and OSSs, as well as vessels that are at and are traveling within 25 miles to-and-from the windfarm during construction, operations and maintenance of the windfarm. Criteria air pollutant emissions and their precursors generated from the construction and operation of the windfarm include nitrogen oxides, carbon monoxide, sulfur dioxide, particulate matter, and volatile organic compounds. These air pollutants are associated with the combustion of diesel fuel in a vessel's propulsion and auxiliary engines and the engine(s) located on WTGs and OSS. The BA notes that Maryland Offshore Wind must demonstrate compliance with the national ambient air quality standards (NAAQS). The NAAQS are health-based standards that the EPA sets to protect public health with an adequate margin of safety. Prevention of significant deterioration (PSD) increments. The PSD increments are designed to ensure that air quality in an area that meets the NAAQS does not significantly deteriorate from baseline levels.

In the BA, BOEM determined that the impact from air pollutant emissions is anticipated to be minor and short-term in nature. They determine that because the permitting entiry will require compliance with the NAAQS and the NAAQS are designed to ensure that air quality does not significantly deteriorate from baseline levels, it is reasonable to conclude that any effects to listed species from these emissions will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are insignificant. At this time, there is no information on the effects of air quality on listed species that may occur in the action area. However, as the

NAAQS and PSD increments are designed to ensure that air quality in the area regulated by the permit do not significantly deteriorate from baseline levels, it is reasonable to conclude that any effects to listed species from these emissions will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, are insignificant. Reinitiation of consultation may be required if permit terms and/or effects are likely to be different than anticipated.

7.3 Effects of Species during Construction

Here, we consider the effects of the proposed action on listed species from exposure to stressors as well as alterations or disruptions to habitat and environmental conditions caused by project activities during the construction phase of the project. Specifically, we address inter-array and export cable installation including the sea-to-shore and inshore transitions, turbidity resulting from project activities including dredging, cable installation, foundation installation, and installation of scour protection, and project lighting during construction. Noise associated with these activities is discussed in section 7.1; associated vessel activities are discussed in section 7.2. Shortnose sturgeon are extremely unlikely to occur in the portion of the action area where these activities will take place; as such effects are extremely unlikely to occur and discountable.

7.3.1 Cable Installation

As described in section 3 above, a number of cables will be installed as part of the Maryland Wind project. Activities associated with cable installation include seabed and bay bottom preparation, cable laying, and activities to support the sea to shore transition at the 3R's Beach landfall location as well as the inshore cable transition into Indian River Bay. Effects of these activities are described here.

US Wind is proposing to lay the inter-array cable and offshore export cable using cable installation equipment that would include either a jet plow, mechanical cutting/trenching, or conventional cable plow. Cable laying and burial may occur simultaneously using a lay and bury tool, or the cable may be laid on the seabed and then trenched post-lay. The burial method will be dependent on suitable seabed conditions and sediments along the cable route.

If seabed conditions do not permit burial of inter-array or export cables, US Wind is proposing to employ other methods of cable protection such as: (1) rock placement, (2) concrete mattresses, and (3) cable protection systems (US Wind BA, 2024). Cable inspection would be carried out to confirm the cable burial depth along the route and to identify the need for any further remedial burial activities and/or secondary cable protection. US Wind anticipates up to 10 percent of the interarray and offshore export cables would require one of the protective measures.

The offshore export cables will connect with inshore export cables; inshore export cables will connect with onshore export cables using HDD. The water side of up to three HDD ducts may utilize temporary gravity cells or a casing pipe to support landfall of the export cables. Dredging for barge access in locations along the Inshore Export Cable Routes in Indian River Bay is addressed below.

7.3.1.1 Pre-lay Grapnel Run

Prior to installation of the cables, a pre-lay grapnel run would be performed to locate and clear obstructions such as abandoned fishing gear and other marine debris. The pre-lay grapnel run will involve towing a grapnel, via the main cable-laying vessel, along the benthos of the cable burial route. During the pre-lay grapnel run, the cable-lay vessel will tow the grapnel at slow speeds (i.e., approximately 1 knot or less) to ensure all debris is removed. Given the very slow speed of the operation, any listed species in the vicinity are expected to be able to avoid the devices and avoid an interaction. Additionally, the cable for the grapnel run will remain taught as it is pulled along the benthos; there is no risk for any listed species to become entangled in the cable. For these reasons, any interaction between the pre-lay grapnel run and ESA-listed species is extremely unlikely to occur. As any material moved during the pre-lay grapnel run would be placed adjacent to the cable corridor any effects to listed species from these changes in the structure of the habitat are extremely unlikely to occur. Effects of all activities associated with pre-lay grapnel runs are discountable.

7.3.1.2 Cable Laying

Cable laying operations proceed at speeds of <1 knot. At these speeds, any sturgeon, sea turtle, or whale is expected to be able to avoid any interactions with the cable laying operation. Additionally, as the cable will be taut as it is unrolled and laid in the trench, there is no risk of entanglement. Based on this information adverse effects caused by this activity, including entanglement of any species during the cable laying operation, are extremely unlikely to occur, and are therefore, discountable. Effects of turbidity from cable laying are considered below.

7.3.1.3 Sea-to-Shore and Inshore Transitions

As noted above, HDD will be used at up to three locations: between the Atlantic Ocean and the landfall location at 3R's Beach; from 3R's Beach into Indian River Bay (Old Basin Cove); and from the Indian River (Deep Hole) to the US Wind Onshore substations. The HDD methodology will involve drilling underneath the seabed or bay bottom and the intertidal area using a drilling rig positioned onshore. Before HDD begins, a temporary cofferdam or casing pipe may be installed where the conduit exits from the seabed, bay bottom, or river bottom to facilitate cable pull-in. Alternatively, the HDD might be installed without a cofferdam. If conditions require a cofferdam, it will be installed as a 60 m long and 10 m wide (197 ft. long and 33 ft. wide) gravity cell structure placed on the bottom using ballast weight; this methodology does not require any pile driving. Noise associated with pile driving for the casing pipe is addressed in section 7.1.

Excavation of the gravity cell exit pits would be carried out with a mechanical dredge. Mechanical dredging entails lowering the open bucket or clamshell through the water column, closing the bucket after impact on the bottom, lifting the bucket up through the water column, and emptying the bucket into a barge or truck. The bucket operates without suction or hydraulic intake, moves relatively slowly through the water column, and impacts only a small area of the aquatic bottom at any time. In order to be captured in a dredge bucket, an animal must be on the bottom directly below the dredge bucket as it impacts the substrate and remain stationary as the bucket closes. Species captured in dredge buckets can be injured or killed if entrapped in the bucket or buried in sediment during dredging and/or when sediment is deposited into the dredge scow. Species captured and emptied out of the bucket can suffer stress or injury, which can lead to mortality.

Whales
As explained above, ESA listed whales are extremely unlikely to occur in the shallow, nearshore waters of the Delaware coast where the sea to shore activities will take place, including any mechanical dredging. Therefore, we do not expect any ESA listed whales to be exposed to effects of dredging.

Sea Turtles
Sea turtles are seasonally present along the Delaware coast and Indian River Bay and if dredging occurs during summer months, may be present in the areas where mechanical dredging for HDD exit pits occur. Sea turtles are not known to be vulnerable to capture in mechanical dredges, presumably because they are able to avoid the dredge bucket. Thus, if a sea turtle were to be present at the dredge sites, it would be extremely unlikely to be captured, injured, or killed as a result of dredging operations carried out by a mechanical dredge, because of the anticipated behavioral response. That response, however, would likely be short and the sea turtle would resume its normal behavior without fitness consequences once it perceived it was safe. Based on this information, capture or collection of a sea turtle in a mechanical dredge is not expected. Any effects to individual sea turtles from avoiding the dredge bucket will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Atlantic Sturgeon
The risk of interactions between sturgeon and mechanical dredges is generally considered very low but is thought to be highest in areas where large numbers of sturgeon are known to aggregate. The risk of capture may also be related to the behavior of the sturgeon in the area. While foraging, sturgeon are at the bottom interacting with the sediment. This behavior may increase the susceptibility of capture with a dredge bucket. For entrapment to occur, an individual sturgeon would have to be present directly below the dredge bucket at the time of operation and be unable to escape. Mechanical dredging is a common activity throughout the range of Atlantic sturgeon and very few interactions have ever been recorded. Given that dredging will occur in shallow near shore areas outside of any known aggregation area, the co-occurrence of an Atlantic sturgeon and the dredge bucket is extremely unlikely. As such, entrapment or any interactions with sturgeon and the mechanical dredge is not expected and effects to Atlantic sturgeon are discountable. Any effects to individual sturgeon from avoiding the dredge bucket will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Giant Manta Ray
Giant manta ray are seasonally present along the Delaware coast; however, they are expected to remain largely offshore and are not expected in the shallow nearshore waters where mechanical dredging for HDD exit pits occur. The giant manta ray is not known to be vulnerable to capture in mechanical dredges, presumably because of their speed and maneuverability. Thus, even in the unlikely event that a giant manta ray were to be present at the dredge sites, it would be extremely unlikely to be captured, injured, or killed as a result of dredging operations carried out by a mechanical dredge, because of the anticipated behavioral response. Based on this information, capture or collection of a giant manta ray in a mechanical dredge is not expected and effects to giant manta rays are discountable. Any effects to individual giant manta rays from

avoiding the dredge bucket will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

7.3.1.4 Dredging for Barge Access in Indian River Bay

Prior to installation of the inshore export cables, dredging in Indian River Bay will be carried out to increased depths sufficient to accommodate the draft of the cable lay installation barge. Dredging of approximately 73,676 cubic yards of sediments within a 39.01-acre area will be conducted using either mechanical or hydraulic means. The dredged material will be dewatered and placed in trucks for transfer to an upland disposal facility. Disposal of dredged material will be in accordance with relevant components of EPA guidelines, USACE guidelines, and permit conditions. No effects to ESA listed species are anticipated from upland disposal of dredged material.

Hydraulic Cutterhead Dredging

Here, we consider effects to listed species of using a cutterhead dredge in Indian River Bay. ESA listed whales are not known to occur in Indian River Bay and thus would not be exposed to any effects of this dredging. Additionally, Leatherback sea turtles and the giant manta ray are pelagic species that are not expected to occur in the inshore areas where dredging during installation of the inshore export cables would occur, as such, leatherback sea turtles and giant manta rays would not be exposed to any effects of dredging. Adult and juvenile loggerhead, Kemp's ridley, and green sea turtles are seasonally present in Indian River Bay from May through the end of November. Sea turtles may be exposed to effects of the dredging during the proposed timing of dredging activities between October and March. Atlantic sturgeon may be present within Indian River Bay from October to December prior to migrating further offshore to deeper waters. Therefore, Atlantic sturgeon may be present in Indian River Bay during the proposed dredging activities.

A cutterhead dredge operates with the dredge head buried in the sediment; a flow field is produced by the suction of the operating dredge head. The amount of suction produced is dependent on linear flow rates inside the pipe and the pipe diameter (Clausner and Jones 2004). High flow rates and larger pipes create greater suction velocities and wider flow fields. The suction produced decreases exponentially with distance from the dredge head (Boysen and Hoover 2009). With a cutterhead dredge, material is pumped directly from the dredged area to a disposal site. The dredged material conducted during cutterhead dredging operations may be transferred to an upland disposal facility via dump trucks.

Sea Turtles

Sea turtles are not known to be vulnerable to capture in cutterhead dredges, presumably because they are able to avoid the dredge head, the dredge head is buried in the sediment, and the intake velocity surrounding the dredge head is low. Thus, if a sea turtle were to be present in the area where dredging was occurring, it would be extremely unlikely to be captured, injured, or killed as a result of dredging operations carried out by a cutterhead dredge. Based on this information, interactions between sea turtles and the cutterhead dredge are extremely unlikely to occur and effects are discountable.

Atlantic Sturgeon
Non-larval sturgeon (i.e., juveniles, sub-adults, and adults) are considered to be mobile enough to avoid the suction of an oncoming cutterhead dredge and we expect that any sturgeon in the vicinity of such an operation would be able to avoid the intake and escape. An individual sturgeon would need to be in the immediate area where the dredge is operating to be entrained (i.e., within one meter of the dredge head) for their even to be the potential for interaction with the draghead; as such, the overall risk of entrainment is low. Information from tracking studies in the James and Delaware River support this assessment of entrainment risk; during a number of studies of behavior of tagged Atlantic sturgeon in areas being actively dredged, none of the tagged sturgeon were attracted to or entrained in the operating of dredges and there was no evidence that the dredge impacted behavior (Balazik et al., 2020, Reine et al. 2014). Based on the information presented here, entrainment, injury, or mortality of any Atlantic sturgeon is extremely unlikely to occur and effects are discountable.

Mechanical Dredging
Mechanical dredging entails lowering the open bucket or clamshell through the water column, closing the bucket after impact on the bottom, lifting the bucket up through the water column, and emptying the bucket into a barge or truck. The bucket operates without suction or hydraulic intake, moves relatively slowly through the water column, and impacts only a small area of the aquatic bottom at any time. In order to be captured in a dredge bucket, an animal must be on the bottom directly below the dredge bucket as it impacts the substrate and remain stationary as the bucket closes. Species captured in dredge buckets can be injured or killed if entrapped in the bucket or buried in sediment during dredging and/or when sediment is deposited into the dredge scow. Species captured and emptied out of the bucket can suffer stress or injury, which can lead to mortality. As noted above, ESA listed whales and giant manta rays are extremely unlikely to occur in the area where mechanical dredging may occur; as such, effects are discountable.

Sea Turtles
Sea turtles may be present in the area to be mechanically dredged. However, they are not known to be vulnerable to capture in mechanical dredges, presumably because they are able to avoid the dredge bucket. Thus, if a sea turtle were to be present at the dredge sites, it would be extremely unlikely to be captured, injured, or killed as a result of dredging operations carried out by a mechanical dredge, because of the anticipated behavioral response. That response, however, would likely be short and the sea turtle would resume its normal behavior without fitness consequences once it perceived it was safe. Based on this information, interactions between sea turtles and the mechanical dredge causing adverse effects are extremely unlikely to occur. Any effects to individual sturgeon from avoiding the dredge bucket will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Atlantic Sturgeon
The risk of interactions between sturgeon and mechanical dredges is considered very low but is thought to be highest in areas where large numbers of sturgeon are known to aggregate. The risk of capture may also be related to the behavior of the sturgeon in the area. While foraging, sturgeon are at the bottom interacting with the sediment. This behavior may increase the susceptibility of capture with a dredge bucket. For entrapment to occur, an individual sturgeon would have to be present directly below the dredge bucket at the time of operation. Mechanical

dredging is a common activity throughout the range of Atlantic sturgeon and very few interactions have ever been recorded. Given that dredging will not occur in areas where concentrations of sturgeon occur and the available information on use of the action area by sturgeon, the co-occurrence of an Atlantic sturgeon and the dredge bucket is extremely unlikely. As such, entrapment or any interactions with sturgeon causing adverse effects during the dredging operations is also extremely unlikely. Any effects to individual sturgeon from avoiding the dredge bucket will be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

7.3.1.5 Jetting, Plowing, and Trenching during Cable Laying

Jetting involves the use of pressurized water jets to liquefy the sediment, creating a trench in which the cable is laid. Mechanical plowing involves dragging a cable plow along the seabed to create a small trench. Mechanical trenching involves the use of a trenching machine with a chain or wheel cutter fitted with picks capable of cutting through hard materials not suitable for plowing or jetting. Cable laying operations proceed at speeds of <1 knot. At these speeds, any sturgeon, sea turtle, or whale is expected to be able to avoid any interactions with the cable laying operation. Additionally, as the cable will be taut as it is unrolled and laid in the trench, there is no risk of entanglement. Based on this information adverse effects caused by these activities, including entanglement of any species during the cable laying operation, are extremely unlikely to occur and effects are discountable.

7.3.2 Turbidity from Cable Installation

Installation of the US Wind export cables and inter-array cables would disrupt bottom habitat and suspend sediment in the water column. Potential types of equipment that may cause temporary increases in turbidity and sediment resuspension during cable installation include the use of a jet plow, mechanical plow, or a mechanical trench. As described in the BA, sediment dispersion modeling was conducted for US Wind's Offshore and Inshore Export Cable Corridors (see COP, Section 4.2.1, Appendices II-B2 and II-B3 for detailed descriptions; US Wind BA 2023). Cable installation would produce the most extensive measurable suspended sediment impacts on the surrounding environment.

The sediment transport modeling for the Offshore Export Cables and Inter-array Cables indicated that most sediments suspended by jet plowing will remain in a narrow corridor along the Offshore Export Cable Corridor and the Inter-array Cables. The overwhelming majority of deposition thicker than 0.2 mm is predicted to occur within 91 m (300 ft) of the proposed cable path. Most of the fluidized sediments lost to the water column are expected to quickly settle back to the seafloor. Suspended sediment concentrations are predicted to be less than 200 mg/L at distances greater than 137 m (450 ft) from the Offshore Export Cables and Inter-array Cables. Model results indicate that the suspended sediment plume resulting from jet plowing will have a short duration. The model results show that increases in suspended sediment concentrations above 10 mg/L over ambient are only of short duration (hours). All suspended sediment plumes are predicted to disappear within 24 hours after the completion of jetting operations.
The sediment transport modeling for the Indian River Bay indicated that most of the fluidized sediments lost to the water column are predicted to quickly settle back to the bay floor and deposition thicknesses greater than 0.2 inches (5 mm) will typically occur within 30 meters (95 ft) of the cables regardless of route. Suspended sediment concentrations are predicted to be less

than 200 mg/L at distances greater than 1,400 m (4,600 ft) from the Export Cables. Model results indicate that the suspended sediment plume resulting from jet plowing will have a limited duration. Suspended sediment plumes greater than 10 mg/L are predicted to disappear within 24 hours after the completion of jetting operations.
All sediment impacts from cable installation would be localized around the source of disturbance and intermittent in association with the duration of bed-disturbing activities.

Whales
In a review of dredging impacts to marine mammals, Todd et al. (2015) found that direct effects from turbidity have not been documented in the available scientific literature. Because whales breathe air, some of the concerns about impacts of TSS on fish (i.e., gill clogging or abrasion) are not relevant. Cronin et al. (2017) suggest that vision may be used by North Atlantic right whales to find copepod aggregations, particularly if they locate prey concentrations by looking upwards. However, Fasick et al. (2017) indicate that North Atlantic right whales certainly must rely on other sensory systems (e.g. vibrissae on the snout) to detect dense patches of prey in very dim light (at depths >160 meters or at night). Because ESA listed whales often forage at depths deeper than light penetration (i.e., it is dark), which suggests that vision is not relied on exclusively for foraging, TSS that reduces visibility would not be expected to affect foraging ability. Data are not available regarding whales avoidance of localized turbidity plumes; however, Todd et al. (2015) conclude that since marine mammals often live in turbid waters and frequently occur at depths without light penetration, impacts from turbidity are not anticipated to occur. As such, any effects to ESA listed whales from exposure to increased turbidity during cable installation are extremely unlikely to occur and thus discountable. If turbidity-related effects did occur, they would likely be so small that they cannot be meaningfully measured, evaluated, or detected and would therefore be insignificant. Effects to whale prey are considered below.

Sea Turtles
Similar to whales, because sea turtles breathe air, some of the concerns about impacts of TSS on fish (i.e., gill clogging or abrasion) are not relevant. There is no scientific literature available on the effects of exposure of sea turtles to increased TSS. Michel et al. (2013) indicates that since sea turtles feed in water that varies in turbidity levels, changes in such conditions are extremely unlikely to inhibit sea turtle foraging even if they use vision to forage. Based on the available information, we expect that any effects to sea turtles from exposure to increased turbidity during dredging or cable installation are extremely unlikely to occur and thus discountable. If turbidity-related effects did occur, they would likely be so small that they could not be meaningfully measured, evaluated, or detected and would therefore be insignificant. Effects to sea turtle prey are addressed below in section 7.3.3.1.

Atlantic sturgeon
Atlantic sturgeon are adapted to natural fluctuations in water turbidity through repeated exposure (e.g., high water runoff in riverine habitat, storm events) and are adapted to living in turbid environments (Hastings 1983, ECOPR Consulting 2009). Atlantic sturgeon forage at the bottom by rooting in soft sediments meaning that they are routinely exposed to high levels of suspended sediments. Few data have been published reporting the effects of suspended sediment on sturgeon. Garakouei et al. (2009) calculated Maximum Allowable Concentrations (MAC) for

total suspended solids in a laboratory study with *Acipenser stellatus* and *A. persicus* fingerlings (7-10 cm TL). The MAC value for suspended sediments was calculated as 853.9 mg/L for *A. stellatus* and 1,536.7 mg/L for *A. persicus*. All stellate sturgeon exposed to 1,000 and 2,320 mg/L TSS for 48 hours survived. All Persian sturgeon exposed to TSS of 5,000, 7,440, and 11,310 mg/L for 48 hours survived. Given that Atlantic sturgeon occupy similar habitats as these sturgeon species, we expect them to be a reasonable surrogate for Atlantic sturgeon. Wilkens et al. (2015) contained young of the year Atlantic sturgeon (100-175 mm TL) for a 3-day period in flow-through aquaria, with limited opportunity for movement, in sediment of varying concentrations (100, 250 and 500 mg L−1 TSS) mimicking prolonged exposure to suspended sediment plumes near an operating dredge. Four-percent of the test fish died; one was exposed to 250 TSS and three to 500 TSS for the full three-day period. The authors concluded that the impacts of sediment plumes associated with dredging are minimal where fish have the ability to move or escape. As tolerance to environmental stressors, including suspended sediment, increases with size and age (ASMFC, 2012); we expect that the subadult and adults in the action area would be less sensitive to TSS than the test fish used in both of these studies.

Any Atlantic sturgeon within 20 m of the cable laying operations would be exposed to TSS concentrations greater than 200 mg/L. These elevated TSS levels are not expected to persist for more than 24 hours at a time until the activity is completed and suspended sediment settles back to the seabed. Based on the information summarized above, any exposure to TSS would be below levels that would be expected to result in any effects to the subadult or adult Atlantic sturgeon occurring in the action area. As such, Atlantic sturgeon are extremely unlikely to experience any physiological or behavioral responses to exposure to increased TSS and effects are discountable. Effects to sturgeon prey are addressed below.

Giant Manta Ray

Giant manta rays are able to swim through or avoid any temporary increase in turbidity without harm, as they are exposed to turbidity and lower water clarity throughout their range. As such, giant manta rays are extremely unlikely to experience any physiological or behavioral responses to exposure to increased TSS and effects are discountable. Effects to giant manta ray prey are addressed below.

7.3.3 Impacts of Cable Installation Activities on Prey

Here we consider the potential effects of cable installation on prey of whales, sea turtles, Atlantic sturgeon and the giant manta ray due to impacts of sediment disturbance during dredging or cable laying and resulting exposure to increased TSS. We provide a brief summary of the prey that the various listed species forage on and then consider the effects of dredging and cable installation on prey, with the analysis organized by prey type. We conduct this analysis to consider whether listed species could be exposed to adverse effects due to adverse consequences to species on which they forage.

Summary of Information of Feeding of ESA-listed Species

Right whales

Right whales feed almost exclusively on copepods, a type of zooplankton. Of the different kinds of copepods, North Atlantic right whales feed especially on late stage *Calanus finmarchicu*s, a large calanoid copepod (Baumgartner et al.. 2007), as well as *Pseudocalanus spp*. and *Centropages spp*. (Pace and Merrick 2008). Because a right whale's mass is ten or eleven orders of magnitude larger than that of its prey (late stage *C. finmarchicus* is approximately the size of a small grain of rice), right whales are very specialized and restricted in their habitat requirements – they must locate and exploit feeding areas where copepods are concentrated into high-density patches (Pace and Merrick 2008). Right whale foraging along the cable route is expected to be rare as this is outside the area where foraging typically occurs; any foraging would be limited to occasional, opportunistic events.

Fin whales

Fin whales in the North Atlantic eat pelagic crustaceans (mainly euphausiids or krill, including *Meganyctiphanes norvegica* and *Thysanoessa inerrnis*) and schooling fish such as capelin (*Mallotus villosus*), herring (*Clupea harengus*), and sand lance (*Ammodytes spp*.) (NMFS 2010). Fin whales feed by lunging into schools of prey with their mouth open, using their 50 to 100 accordion-like throat pleats to gulp large amounts of food and water. A fin whale eats up to 2 tons of food every day during the summer months.

Sei whales

An average sei whale eats about 2,000 pounds of food per day. They can dive 5 to 20 minutes to feed on plankton (including copepods and krill), small schooling fish, and cephalopods (including squid) by both gulping and skimming.

Sperm whales

Sperm whales hunt for food during deep dives with feeding occurring at depths of 500–1000 m depths (NMFS 2010). Deepwater squid make up the majority of their diet (NMFS 2010). Given the shallow depths of the area where the cable will be installed (less than 50 m), it is extremely unlikely that any sperm whales would be foraging in the area affected by the cable installation and extremely unlikely that any potential sperm whale prey would be affected by cable installation or dredging activities.

Sea turtles

Green sea turtles feed primarily on sea grasses and may feed on algae. Loggerhead turtles feed on benthic invertebrates such as gastropods, mollusks, and crustaceans. Diet studies focused on North Atlantic juvenile stage loggerheads indicate that benthic invertebrates, notably mollusks and benthic crabs, are the primary food items (Burke et al. 1993, Youngkin 2001, Seney 2003). Limited studies of adult loggerheads indicate that mollusks and benthic crabs make up their primary diet, similar to the more thoroughly studied neritic juvenile stage (Youngkin 2001). Kemp's ridleys primarily feed on crabs, with a preference for portunid crabs including blue crabs; crabs make up the bulk of the Kemp's ridley diet (NMFS et al. 2011).

Leatherback sea turtles feed exclusively on jellyfish. A study of the foraging ecology of leatherbacks off the coast of Massachusetts indicates that leatherbacks foraging off Massachusetts primarily consume the scyphozoan jellyfishes, *Cyanea capillata* and *Chrysaora quinquecirrha*, and ctenophores, while a smaller proportion of their diet comes from holoplanktonic salps and sea butterflies (*Cymbuliidae*) (Dodge et al. 2011); we expect leatherbacks in the Maryland Wind area to be foraging on similar species.

Atlantic sturgeon
Atlantic sturgeon are opportunistic benthivores that feed primarily on mollusks, polychaete worms, amphipods, isopods, shrimps and small bottom-dwelling fishes (Smith 1985, Dadswell 2006). A stomach content analysis of Atlantic sturgeon captured off the coast of New Jersey indicates that polycheates were the primary prey group consumed; although the isopod *Politolana concharum* was the most important individual prey eaten (Johnson et al. 2008). The authors determined that mollusks and fish contributed little to the diet and that some prey taxa (i.e., polychaetes, isopods, amphipods) exhibited seasonal variation in importance in the diet of Atlantic sturgeon. Novak et al. (2017) examined stomach contents from Atlantic sturgeon captured at the mouth of the Saco River, Maine and determined that American Sand Lance *Ammodytes americanus* was the most common and most important prey.

Giant Manta Ray
The giant manta ray primarily feeds on planktonic organisms such as euphausiids, copepods, mysids, decapod larvae and shrimp, but some studies have noted their consumption of small and moderate sized fishes as well (Bertolini 1933; Bigelow and Schroeder 1953; Carpenter and Niem 2001; The Hawaii Association for Marine Education and Research Inc. 2005; Rohner et al. 2017a; Stewart et al. 2017). For example, Rohner et al. (2017a) documented two species of myctophid fishes (*Myctophum asperum* and *My. Spinosum*) in the stomach contents of giant manta rays in the Bohol Sea (Philippines).

7.3.3.1 Effects on the Prey Base of ESA-listed Species in the Action Area
Dredging
Dredging will result in a temporary loss of benthic prey in the areas being dredged. We have considered the potential effects on sea turtles and Atlantic sturgeon that may forage opportunistically along the Inshore Export Cable Routes in the Indian River Inlet and Bay where dredging will occur. Given that the Indian River Inlet is a very high-energy environment that is consistently erosional, the area is subject to frequent shifting sediments. Given that the areas impacted are small and that recolonization is expected, any losses of benthic resources will be small and temporary. Therefore, effects to Atlantic sturgeon and sea turtles are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and will be insignificant.

Exposure to Increased Turbidity

Copepods
Copepods exhibit diel vertical migration; that is, they migrate downward out of the euphotic zone at dawn, presumably to avoid being eaten by visual predators, and they migrate upward into surface waters at dusk to graze on phytoplankton at night (Baumgartner and Fratantoni 2008; Baumgartner et al. 2011). Baugmartner et al. (2011) concludes that there is considerable variability in this behavior and that it may be related to stratification and presence of phytoplankton prey with some copepods in the Gulf of Maine remaining at the surface and some remaining at depth. Because copepods even at depth are not in contact with the substrate, we do not anticipate any burial or loss of copepods during installation of the cable. We were unable to identify any scientific literature that evaluated the effects to marine copepods of exposure to

TSS. Based on what we know about effects of TSS on other aquatic life, it is possible that high concentrations of TSS could negatively affect copepods. However, given that: the expected TSS levels are below those that are expected to result in effects to even the most sensitive species evaluated; the sediment plume will be transient and temporary (i.e., persisting in any one area for no more than three hours); elevated TSS is limited to the bottom 3 meters of the water column; and will occupy only a small portion of the WFA at any given time, any effects to copepod availability, distribution, or abundance on foraging whales would be so small that they could not be meaningfully evaluated, measured, or detected. Therefore, effects are insignificant.

Fish
As explained above, elevated TSS will be experienced along the cable corridor during cable installation. Anticipated TSS levels are below the levels expected to result in the mortality of fish that are preyed upon by fin or sei whales or Atlantic sturgeon. In general, fish can tolerate at least short-term exposure to high levels of TSS. Wilber and Clarke (2001) reviews available information on the effects of exposure of estuarine fish and shellfish to suspended sediment. In an assessment of available information on sublethal effects to non-salmonids, they report that the lowest observed concentration–duration combination eliciting a sublethal response in white perch was 650 mg/L for 5 d, which increased blood hematocrit (Sherk et al. 1974 in Wilber and Clarke 2001). Regarding lethal effects, Atlantic silversides and white perch were among the estuarine fish with the most sensitive lethal responses to suspended sediment exposures, exhibiting 10% mortality at sediment concentrations less than 1,000 mg/L for durations of 1 and 2 days, respectively (Wilber and Clarke 2001). Forage fish in the action area will be exposed to maximum TSS concentration-duration combinations far less than those demonstrated to result in sublethal or lethal effects of the most sensitive non-salmonids for which information is available. Based on this, we do not anticipate the mortality of any forage fish; therefore, we do not anticipate any reduction in fish as prey for fin or sei whales or Atlantic sturgeon; any effects to these listed species as a result of effects to prey will be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore insignificant.

Benthic Invertebrates
In the BA, BOEM indicates that an area approximately 50-feet wide along the cable corridor and 5-feet at the splice vaults will be disturbed during cable installation; this is likely to result in the mortality of some benthic invertebrates in the path of the jet plow. Immediately following cable installation, this area will likely be devoid of any benthic invertebrates. However, given the narrow area, we expect recolonization to occur from adjacent areas that were not disturbed; therefore, this reduction in potential forage will be temporary.

As explained above, elevated TSS will be experienced along the cable corridor during cable installation. Because polychaete worms live in the sediment, we do not expect any effects due to exposure to elevated TSS in the water column. Wilbur and Clarke (2001) reviewed available information on effects of TSS exposure on crustacean and report that in experiments shorter than 2 weeks, nearly all mortality of crustaceans occurred with exposure to concentrations of suspended sediments exceeding 10,000 mg/L and that the majority of these mortality levels were less than 25%, even at very high concentrations. Wilbur and Clarke (2001) also noted that none of the crustaceans tested exhibited detrimental responses at dosages within the realm of TSS exposure anticipated in association with dredging. Based on this information, we do not anticipate any effects to crustaceans resulting from exposure to TSS associated with cable installation. Given the thin layer of deposition associated with the settling of TSS out of the water column following cable installation we do not anticipate any effects to benthic invertebrates. Based on this analysis, we expect any impact of the loss of benthic invertebrates to foraging Kemp's ridley and loggerhead sea turtles and Atlantic sturgeon due to cable installation to be so small that they cannot be meaningfully measured, evaluated, or detected and, therefore, are insignificant.

Jellyfish
A literature search revealed no information on the effects of exposure to elevated TSS on jellyfish. However, given the location of jellyfish in the water column and the information presented in the BA that indicates that any sediment plume associated with cable installation will be limited to the bottom 3 meters of the water column, we expect any exposure of jellyfish to TSS to be minimal. Based on this analysis, effects to leatherback sea turtles resulting from effects to their jellyfish prey are extremely unlikely to occur.

Water Withdrawal for Jet Trenching
Fish eggs and larvae (ichthyoplankton), as well as zooplankton, are expected to be entrained during jet trencher embedment of the offshore and inshore export cables. Jet trencher equipment uses seawater to circulate through hydraulic motors and jets during installation. Although this seawater is released back into the ocean, survival rates of entrained eggs, larvae, and zooplankton are unknown and it is possible that entrained organisms will be killed. Given that only the smallest organisms would be vulnerable to entrainment, only early life stages may be affected by jet plow entrainment; later life stages will not be affected. These will be one-time losses and will occur over a short period. A previous assessment conducted for the South Fork Wind Farm found that the total estimated losses of zooplankton and ichthyoplankton from jet trencher entrainment were less than 0.001% of the total zooplankton and ichthyoplankton abundance present in the project area, which encompassed a linearly buffered region of 15 km around the export cable and 25 km around the wind farm (INSPIRE Environmental, 2018b). We would expect similar impacts from the US Wind cable installation given the similarity of the environmental conditions, species present, and equipment to be used. Given the extremely small, localized, and one-time losses of ichthyoplankton, we expect any effects to the forage base for ESA listed species would be equally small, localized, and temporary. As such, effects to ESA listed species are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore, insignificant.

7.3.4 Turbidity during WTG and OSS Foundation Installation
Pile driving for WTG, OSS, and Met Tower installation as well as the deposition of rock for scour protection at the base of these foundations may result in a minor and temporary increase in suspended sediment in the area immediately surrounding the foundation or scour protection being installed. The amount of sediment disturbed during these activities is minimal; thus, any associated increase in TSS will be small and significantly lower than the TSS associated with cable installation addressed above. Given the very small increase in TSS associated with foundation installation and placement of scour protection, any physiological or behavioral responses by ESA listed species from exposure to TSS are extremely unlikely to occur and thus

discountable. Similarly, effects to listed species from any effects to prey would be too small to meaningfully measure, detect, or evaluate, and therefore, are insignificant.

7.3.5 Installation of Suction Bucket Foundations

Suction bucket foundations are considered as an alternative to the up to 4 OSS foundations. To facilitate the installation of suction bucket foundations, a low-flow suction pump is installed at the top of each caisson (or "bucket"). During deployment, after the suction bucket has settled into the seafloor due to gravity, the suction pump will slowly remove water from within the bucket to create an area of reduced pressure against the seafloor, which will assist the suction bucket in completing penetration to the target depth. It is anticipated that the pump will operate at low enough rates so as not to disturb bottom sediments. As such, while there may be some minor suspension of sediment as the bucket settles into the sediment, no turbidity or suspended sediment is anticipated to result from the pumping operations. While specifics of the pump were not described in the BA and are not yet available, in assessments of other suction bucket foundation installations (e.g., BA for the Atlantic Shores South Project), BOEM indicates that the pump will have screens with mesh size of approximately 0.841 mm (i.e., openings in the mesh are smaller than 1 mm). Combined with the anticipated low pump speed, we expect that this will make impingement or entrainment of any aquatic organisms, including small prey items such as copepods (2-5 mm), extremely unlikely to occur. The removed water will be released immediately outside the suction bucket. Effects to listed species due to disturbance of bottom sediments and pumping of water, inclusive of consideration of effects to prey, from installation of the suction bucket foundations are extremely unlikely to occur and thus discountable.

7.3.6 Turbidity during Shoreside Improvements at the O&M Facility

As described in the BA, site improvements at the proposed O&M facility will include the replacement of a timber pier and the existing bulkhead/quay wall. All pile installation will be completed with an impact hammer; effects of noise are considered in section 7.1. Given the shallow (<3 m), inland location of these harbor side activities, we do not expect any whales, sea turtles, sturgeon, or giant manta rays to be exposed to any effects of turbidity or other habitat conditions due to site improvement activities for the O&M facility. Therefore, no effects are anticipated.

7.3.7 Lighting

In general, lights will be required on offshore platforms and structures, vessels, and construction equipment during construction. Construction activities could occur 24 hours a day to minimize the overall duration of activities and the associated period of potential impact on marine species. Although not anticipated, US Wind expects that pile driving that was started during daylight could continue after dark or in low visibility conditions. Construction and support vessels would be required to display lights when operating at night and deck lights would be required to illuminate work areas. However, lights would be down shielded to illuminate the deck, and would not intentionally illuminate surrounding waters. If sea turtles, Atlantic sturgeon, whales, giant manta rays, or their prey are attracted to the lights, it could increase the potential for interaction with equipment or associated turbidity. However, due to the nature of project activities and associated seafloor disturbance, turbidity, and noise, listed species and their prey are not likely to be attracted by lighting because they are disturbed by these other factors. As such, we have determined that any effects of project lighting on sea turtles, sturgeon, or whales are extremely unlikely to occur and thus discountable.

Lighting may also be required at on shore areas, such as where the cables will make landfall. Many of the onshore areas used for staging will be part of an industrial port where artificial lighting already exists. Sea turtle hatchlings are known to be attracted to lights and artificial beach lighting is known to disrupt proper orientation towards the sea. However, due to the distance from the nearest nesting beach to the project area (the straight-line distance through the Atlantic Ocean from Virginia Beach, VA, the northernmost area where successful nesting has occurred, and the WFA is over 200 km), there is no potential for project lighting to impact the orientation of any sea turtle hatchlings and there will therefore be no effects to ESA-listed sea turtles.

7.4 Effects to Habitat and Environmental Conditions during Operation

Here, we consider the effects to listed species from alterations or disruptions to habitat and environmental conditions during the operations phase of the project. Specifically, we address electromagnetic fields and heat during cable operation, project lighting during operations, and the effects of project structures.

7.4.1 Electromagnetic Fields and Heat during Cable Operation

Electromagnetic fields (EMF) are generated by current flow passing through power cables during operation and can be divided into electric fields (called E-fields, measured in volts per meter, V/m) and magnetic fields (called B-fields, measured in μT) (Taormina et al. 2018). Buried cables reduce, but do not entirely eliminate, EMF (Taormina et al. 2018). When electric energy is transported, a certain amount is lost as heat by the Joule effect, leading to an increase in temperature at the cable surface and a subsequent warming of the sediments immediately surrounding the cable; for buried cables, thermal radiation can warm the surrounding sediment in direct contact with the cable, even at several tens of centimeters away from it (Taormina et al. 2018).

To minimize EMF generated by cables, all cabling would be contained in electrical shielding (i.e., bitumen impregnated hessian tape and polypropylene threads) to prevent detectable direct electric fields. US Wind would also bury cables to a target burial depth of approximately 3.3 – 9.8 ft (1– 3 m) below the surface. The electrical shielding and burial are expected to control the intensity of EMF. However, magnetic field emissions cannot be reduced by shielding, although multiple-stranded cables can be designed so that the individual strands cancel out a portion of the fields emitted by the other strands. Normandeau et al. (2011) compiled data from a number of existing sources, including 19 undersea cable systems in the U.S., to characterize EMF associated with cables consistent with those proposed for wind farms. The dataset considers cables consistent with those proposed by US Wind (i.e., up to 275 kV). In the paper, the authors present information indicating that the maximum anticipated magnetic field would be experienced directly above the cable (i.e., 0 m above the cable and 0 m lateral distance), with the strength of the magnetic field dissipating with distance. Based on this data, the maximum anticipated magnetic field would be 7.85 μT at the source, dissipating to 0.08 μT at a distance of 10 m above the source and 10 m lateral distance. By comparison, the Earth's geomagnetic field strength ranges from approximately 20 to 75 μT (Bochert and Zettler 2006) and the estimated

EMF level in the Maryland Wind Lease Area is 549 milligauss (mG; 54.9 microteslas [μT]) (NOAA n.d.).

When electric energy is transported, a certain amount gets lost as heat, leading to an increased temperature of the cable surface and subsequent warming of the surrounding environment (OSPAR 2009). As described in Taormina et al. (2018), the only published field measurement study results are from the 166 MW Nysted wind energy project in the Baltic Sea (maximal production capacity of about 166 MW), in the proximity of two 33 and 132 kV AC cables buried approximately 1 m deep in a medium sand area. In situ monitoring showed a maximal temperature increase of about 2.5 ºC at 50 cm directly below the cable and did not exceed 1.4°C in 20 cm depth above the cable (Meißner et al., 2007). Taormina et al. caution that application of these results to other locations is difficult, considering the large number of factors affecting thermal radiation including cable voltage, sediment type, burial depth, and shielding. The authors note that the expected impacts of submarine cables would be a change in benthic community makeup with species that have higher temperature tolerances becoming more common. Taormina et al. conclude at the end of their review of available information on thermal effects of submarine cables that considering the narrowness of cable corridors and the expected weakness of thermal radiation, impacts are not considered to be significant. Based on the best available scientific information summarized here, and lacking any site-specific predictions of thermal radiation from the Maryland Wind project inter-array cable and Maryland Wind export cable, we expect that any impacts will be limited to a change in species composition of the infaunal benthic invertebrates immediately surrounding the cable corridor. As such, we do not anticipate thermal radiation to change the abundance, distribution, or availability of potential prey for any species. As any increase in temperature will be limited to areas within the sediment around the cable where listed species do not occur, we do not anticipate any exposure of listed species to an increase in temperature associated with the cable. Therefore, effects are extremely unlikely to occur and are discountable.

Atlantic sturgeon

Sturgeons are electrosensitive and use electric signals to locate prey. Information on the impacts of magnetic fields on fish is limited. A number of fish species, including sturgeon, are suspected of being sensitive to such fields because they have magnetosensitive or electrosensitive tissues, have been observed to use electrical signals in seeking prey, or use the Earth's magnetic field for navigation during migration (EPRI 2013). Atlantic sturgeon have specialized electrosensory organs capable of detecting electrical fields on the order of 0.5 millivolts per meter (mV/m) (Normandeau et al. 2011). As noted in the BA, modeling was not carried out for the Maryland Wind cables. However, modeling carried out for the nearby Ocean Wind 1 Wind Farm, with similar cables is available. Modeling for the Ocean Wind 1 Wind Farm cables (Exponent Engineering, P.C. (2018)) calculated that the maximum induced electrical field strength inter-array cables and export cables would be 0.43 mV/m or less, which is slightly below the detection threshold for this species. Additionally, this analysis only considered EMF associated with buried cable segments. Based on relative magnetic field strength, the induced electrical field in cable segments that are covered by electrical armoring will exceed the 0.5-mV/m threshold. This suggests that Atlantic sturgeon would be able to detect the induced electrical fields in immediate proximity to those cable segments.

Wyman et al. (2023) investigated the migration behaviors of adult green sturgeon in relation to the cable energization status (off/on) for a ±200 kilovolt direct current (DC) transmission line buried through a portion of the green sturgeon's spawning migration pathway in San Francisco Bay. Detection data collected along the migration route when the transmission line was energized and not energized allowed the authors to assess whether the energized cable - and by inference the magnetic field from its load - may have affected the green sturgeon's migratory behavior. Study results provided varied evidence for an association between cable status and migration behavior. For example, a higher percentage of inbound fish were able to successfully transit inbound after the cable was energized, but this effect did not reach the level of significance. Outbound fish took longer to transit when the cable was energized. Additionally, fish transiting along both inbound and outbound migration paths were not significantly influenced by the cable's energization status, but results suggest a potential subtle relationship between cable energization and the location of inbound and outbound fish migration paths. We note that the findings of Wyman et al. (2023) are not transferable to the proposed AC cables for the Maryland Wind project. This is because of differences in EMF fields generated by DC cable systems compared to EMF fields generated by AC cable systems. DC cable systems such as the one described in Wyman et al. (2023) generate static EMF fields in the vicinity of the cable route, while AC systems like the proposed cable cause time-varying elliptic EMF fields (Lesur and Deschamps 2012). As a result, we expect biological responses to static (DC) or elliptic (AC) fields to be distinct.

Bevelhimer et al. 2013 examined the behavioral responses of Lake Sturgeon to electromagnetic fields. The authors also report on a number of studies, which examined magnetic fields associated with AC cables consistent with the characteristics of the cables proposed by US Wind and report that in all cases magnetic field strengths are predicted to decrease to near-background levels at a distance of 10 m from the cable. Like Atlantic sturgeon, Lake Sturgeon are benthic oriented species that can utilize electroreceptor senses to locate prey; therefore, they are a reasonable surrogate for Atlantic sturgeon in this context. Bevelhimer et al. 2013 carried out lab experiments examining behavior of individual lake sturgeon while in tanks with a continuous exposure to an electromagnetic source mimicking an AC cable and examining behavior with intermittent exposure (i.e., turning the magnetic field on and off). Lake sturgeon consistently displayed altered swimming behavior when exposed to the variable magnetic field. By gradually decreasing the magnet strength, the authors were able to identify a threshold level (average strength ~ 1,000–2,000 μT) below which short-term responses disappeared. The anticipated maximum exposure of an Atlantic sturgeon to the proposed cable would range from 13.7 to 76.6 milligauss (mG) (1.37 to 7.66 μT) on the bed surface above the buried and exposed Maryland Wind cable, and 9.1 to 65.3 mG (.91 to 6.53 μT) above the buried and exposed inter-array cable, respectively. This is several orders of magnitude below the levels that elicited a behavioral response in the Bevelhimer et al. (2013) study. Induced field strength would decrease effectively to 0 mG within 25 feet of each cable (Exponent Engineering, P.C. 2018). By comparison, the earth's natural magnetic field is more than five times the maximum potential EMF effect from the Project. Background electrical fields in the action area are on the order of 1 to 10 mG from the natural field effects produced by waves and currents; this is several times higher than the EMF anticipated to result from the project's cables. As such, it is extremely unlikely that there will be any effects to Atlantic sturgeon due to exposure to the electromagnetic field from the proposed cable; therefore, effects are discountable.

ESA-Listed Whales

The current literature suggests that cetaceans can sense the Earth's geomagnetic field and use it to navigate during migrations but not for directional information (Normandeau et al. 2011). It is not clear whether they use the geomagnetic field solely or in addition to other regional cues. It is also not known which components of the geomagnetic field cetaceans are sensing (i.e. the horizontal or vertical component, field intensity or inclination angle). Marine mammals appear to have a detection threshold for magnetic intensity gradients (i.e. changes in magnetic field levels with distance) of 0.1 percent of the earth's magnetic field or about 0.05 microtesla (μT) (Kirschvink 1990). Assuming a 50-mG (5 μT) sensitivity threshold (Normandeau 2011), marine mammals could theoretically be able to detect EMF effects from the inter-array and US Wind export cables, but only in close proximity to cable segments lying on the bed surface. Individual marine mammals would have to be within 3 feet (1 m) or less of those cable segments to encounter EMF above the 50-mG detection threshold.

As described in Normandeau et al. (2011), there is no scientific evidence as to what the response to exposures to the detectable magnetic field would be. However, based on the evidence that magnetic fields have a role in navigation it is reasonable to expect that any effects would be related to migration and movement. Given the limited distance from the cable that the magnetic field will be detectable, the potential for effects is extremely limited. Even if listed whales did avoid the corridor along the cable route in which the magnetic field is detectable, the effects would be limited to minor deviations from normal movements. As such, any effects are likely to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Sea Turtles

Sea turtles are known to possess geomagnetic sensitivity (but not electro sensitivity) that is used for orientation, navigation, and migration. They use the Earth's magnetic fields for directional or compass-type information to maintain a heading in a particular direction and for positional or hemap-type information to assess a position relative to a specific geographical destination (Lohmann et al. 1997). Multiple studies have demonstrated magneto sensitivity and behavioral responses to field intensities ranging from 0.0047 to 4000 μT for loggerhead turtles, and 29.3 to 200 μT for green turtles (Normandeau et al. 2011). While other species have not been studied, anatomical, life history, and behavioral similarities suggest that they could be responsive at similar threshold levels. For purposes of this analysis, we will assume that leatherback and Kemp's ridley sea turtles are as sensitive as loggerhead sea turtles.

Sea turtles are known to use multiple cues (both geomagnetic and nonmagnetic) for navigation and migration. However, conclusions about the effects of magnetic fields from power cables are still hypothetical, as it is not known how sea turtles detect or process fluctuations in the earth's magnetic field. In addition, some experiments have shown an ability to compensate for "miscues," so the absolute importance of the geomagnetic field is unclear.

Based on the demonstrated and assumed magneto sensitivity of sea turtle species that occur in the action area, we expect that loggerhead, leatherback, and Kemp's ridley sea turtles will be able to detect the magnetic field. As described in Normandeau et al. (2011), there is no scientific evidence as to what the response to exposures to the detectable magnetic field would be. However, based on the evidence that magnetic fields have a role in navigation it is reasonable to expect that effects would be related to migration and movement; however, the available information indicates that any such impact would be very limited in scope. As noted in Normandeau (2011), while a localized perturbation in the geomagnetic field caused by a power cable could alter the course of a turtle, it is likely that the maximum response would be some, probably minor, deviation from a direct route to their destination. Based on the available information, effects to sea turtles from the magnetic field associated with the Maryland Wind project inter-array cable and Maryland Wind export cables are expected to be so small that they cannot be meaningfully measured, detected, or evaluated and are, therefore, insignificant.

Giant Manta Ray
Giant manta rays belong to the subclass Elasmobranchii, which includes sharks, rays, and skates. All elasmobranchs are electroreceptive, detecting electric stimuli passively (Collin and Whitehead 2004). Kalmijn (1982, 1984, 2000, 2003) postulates that the electroreceptive system is the basis for geomagnetic orientation in elasmobranchs. Nevertheless, the electrosensitivity of manta rays is unknown (Deakos 2010). Hutchison et al. (2018) used the Little skate as a model organism for elasmobranchs in field tests to assess the effects of EMF from subsea cables on benthic and demersal species. During experiments to observe behavioral responses to variable electrical currents in a cable (i.e., 16 AMPs, 345 AMPSs, and 1175 AMPs), corresponding to a magnetic field of 51.6, 55.3, and 65.3 µT and deviations from the Earth's magnetic field of 0.3, 4.0, and 14 µT respectively. Little skate were observed to increase their movement and the amount of time they spend near the seafloor in the presence of an EMF that exceeded background levels (Hutchison et al. 2018). Variability in individual speeds and distances traveled were also greater in the presence of a high EMF. While the skates modified their behavior in the presence of EMF alteration, the altered EMF did not prevent them from accessing any part of the study area (Hutchison et al. 2018).

For the aforementioned study, it is important to reiterate that while the giant manta ray and the Little skate are both elasmobranchs, the Little skate is a benthic species. In contrast, the giant manta ray is a pelagic species that appears to exhibit a high degree of plasticity in terms of their use of depths within their habitat (Miller and Klimovich 2017). Given the giant manta ray's pattern of habitat use in the pelagic zone, we expect that giant manta rays will spend very little time in proximity to the seafloor. Based on the evidence that electric fields have a role in navigation it is reasonable to expect that any effects would be related to orientation and movement. Additionally, the potential for effects is extremely limited due to the limited distance from the cable that the electric field will be detectable. Even if giant manta rays were exposed to electric fields induced by magnetic fields along the offshore cable route, the effects would be limited to minor deviations from normal movements. As such, any effects are likely to be so small that they cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

Effects to Prey
Effects to forage fish, jellyfish, copepods, and krill are extremely unlikely to occur given the limited distance into the water column that any magnetic field associated with the cables is detectable. We have considered whether magnetic fields associated with the operation of the

cables could impact benthic organisms that serve as sturgeon and sea turtle prey. Information presented in the BA summarizes a number of studies on the effects of exposure of benthic resources to magnetic fields. According to these studies, the survival and reproduction of benthic organisms are not thought to be affected by long-term exposure to static magnetic fields (Bochert and Zettler 2004, Normandeau *et al*. 2011). Results from the 30-month post-installation monitoring for the Cross Sound Cable Project in Long Island Sound indicated that the benthos within the transmission line corridor for this project continues to return to pre-installation conditions. The presence of amphipod and worm tube mats at a number of stations within the transmission line corridor suggest construction and operation of the transmission line did not have a long-term negative effect on the potential for benthic recruitment to surface sediments (Ocean Surveys 2005). Therefore, no impacts (short-term or long-term) of magnetic fields on prey for any listed species in the action area are expected.

7.4.2 Lighting and Marking of Structures

To comply with FAA and USCG regulations, the WTGs, OSSs, and Met Tower will be marked with a distinct lettering/numbering scheme and with lighting. The USCG requires that offshore wind lessees obtain permits for private aids to navigation (PATON, see 33 CFR part 67) for all structures located in or near navigable waters of the United States (see 33 CFR part 66) and on the OSSs. PATON regulations require that individuals or organizations mark privately owned marine obstructions or other similar hazards. No additional buoys or markers will be installed in association with the PATON.

US Wind construction and installation vessels would introduce stationary and mobile artificial light sources to the marine component of the action area. Construction and installation and O&M lighting will be limited to the minimum necessary to ensure safety and compliance with applicable regulations. US Wind will also use Aircraft Detection Lighting System (ALDS) (or similar system), pursuant to approval by the FAA and commercial and technical feasibility at the time of FDR/FIR approval. Each WTG will be marked and lit with both USCG and approved aviation lighting. If any ESA listed species, or their prey, are attracted to the lights, it could increase the potential for interaction with equipment or associated turbidity. However, due to the nature of project activities and associated seafloor disturbance, turbidity, and noise, listed species and their prey are not likely to be attracted by lighting because they are disturbed by these other factors. As such, we have determined that any effects of project lighting on sea turtles, ESA listed fish, or whales are extremely unlikely and thus, discountable.

In addition to vessel lighting, the WTGs will be lit for navigational and aeronautical safety. Lighting may also be required at on shore areas, such as where the cables will make landfall. Many of the onshore areas used for staging will be part of an industrial port where artificial lighting already exists. Sea turtle hatchlings are known to be attracted to lights and artificial beach lighting is known to disrupt proper orientation towards the sea. However, due to the distance from the nearest nesting beach to the project area (the straight-line distance through the Atlantic Ocean from Virginia Beach, VA, the northernmost area where successful nesting has occurred, and the WFA is approximately 200 km), there is no potential for project lighting to impact the orientation of any sea turtle hatchlings in known nesting beaches. While we recognize that rare nesting events have been recorded in New York and New Jersey, these remain unexpected events that require human intervention (i.e., nest relocation) to produce successful hatchlings and this does not change our conclusions regarding the impacts of project lighting.

7.4.3 WTG,OSS, and Met Tower Foundations

The physical presence of structures in the water column has the potential to disrupt the movement of listed species but also serve as an attractant for prey resources and subsequently listed species. Structures may also provide habitat for some marine species, creating a reef effect. The foundations and generation of wind energy may affect the in-water and in-air conditions, which can result in changes to ecological conditions in the marine environment. Here, we consider the best scientific data that is currently available to address the potential effects on ESA listed species from the Maryland Wind project.

7.4.3.1 Consideration of the Physical Presence of Structures on Movements of Listed Species

The only wind turbines currently in operation in U.S. waters are the five WTGs that make up the Block Island Wind Farm, the two WTGs that are part of the Coastal Virginia Offshore Wind pilot project, and the 12 South Fork Wind Project WTGs . Construction of theVineyard Wind 1 project is currently underway, with a limited number of turbines operational at this time. We have not identified any reports or publications that have examined or documented any changes in listed species distribution or abundance at any of these projects and have no information to indicate that the presence of these WTGs has resulted in any change in distribution of any ESA listed species.

As explained in section 6 of this Opinion, the WFA is used by Atlantic sturgeon for migration and for opportunistic foraging. Consistent with information from other coastal areas that are not aggregation areas, we expect individual Atlantic sturgeon to be present in the WFA for short periods of time (<2 days; Ingram et al. 2019, Rothermal et al. 2020). Because Atlantic sturgeon carry out portions of their life history in rivers, they are frequently exposed to structures in the water such as bridge piers and pilings. There is ample evidence demonstrating that sturgeon routinely swim around and past large and small structures in waterways, often placed significantly closer together than even the minimum distance of the closest WTGs (see e.g., AKRF 2012). As such, we do not anticipate that the presence of the WTGs, OSSs, or the Met Tower will affect the distribution of Atlantic sturgeon in the action area or their ability to move through the action area.

The giant manta ray has a distributional range that includes offshore Delaware and Maryland; thus, the species may be present in the WFA (Farmer et al. 2022). Sightings data from the SEFSC and the North Atlantic Right Whale Consortium indicate giant manta rays are likely to be present in the WFA in the summer and fall when they are more abundant in the Mid-Atlantic (Farmer et al. 2022). Within its range, giant manta rays are commonly found offshore, in oceanic waters, and near productive coastlines (Marshall et al. 2009, Kashwagi et al. 2011). NMFS SERO has completed numerous ESA section 7 consultations that consider actions that may affect giant manta rays, particularly in coastal areas such as inlets, Intracoastal Waterways, bays, and estuaries. Consistent with the analyses in SERO’s pier consultations for nearshore and inshore locations (e.g. SERO 2022, 2023, and 2024), we do not anticipate that the presence of large fixed structures in open water will create an obstruction for giant manta rays to move around these features and through the action area freely.

Given their distribution largely in the open ocean, whales and sea turtles may rarely encounter large fixed structures in the water column such as the turbine foundations; thus, there is little information to evaluate the effects that these structures will have on the use of the area by these species. Sea turtles are often sighted around oil and gas platforms and fishing piers in the Gulf of Mexico which demonstrates they do not have an aversion to structures and may utilize them to forage or rest (Lohoefener 1990, Rudloe and Rudloe 2005). Given the monopiles' large size (12 m diameter) and presence above and below water, we expect that whales and sea turtles will be able to visually detect the structures and, as a result, we do not expect whales or sea turtles to collide with the stationary foundations. Listed whales are the largest species that may encounter the foundations in the water column. Of the listed whales considered in this opinion, fin whales are the largest species at up to 25.9 m. Based on the spacing of the foundations (1 x 1 nm grid) relative to the sizes of the listed species that may be present in the WFA, we do not anticipate that the foundations would create a barrier or restrict the ability of any listed species to move through the area freely.

While there is currently no before/after data for any of the ESA listed species that occur in the action area in the context of wind farm development, data is available for monitoring of harbor porpoises before, during, and after construction of three offshore wind projects in Europe. We consider that data here.

Horns Rev 1 in the North Sea consists of 80 WTGs laid out as an oblique rectangle of 5 km x 3.8 km (8 horizontal and 10 vertical rows). The distance between turbines is 560 m in both directions. The project was installed in 2002 (Tougaard et al. 2006). The turbines used at the Horns Rev 1 project are older geared WTGs and not more modern direct-drive turbines, which are quieter (Elliot et al. 2019; Tougaard et al. 2020). The Horns Rev 1 project has a smaller number of foundations to the Maryland Wind project (80 foundations in Hons Rev and 126 in Maryland Wind) but turbine spacing is significantly closer together (0.5 km compared to at least 1.8 km). Pre-construction baseline data was collected with acoustic recorders and with ship surveys beginning in 1999; post-construction acoustic and ship surveys continued until the spring of 2006. In total, there were seven years of visual/ship surveys and five years of acoustic data. Both sets of data indicate a weak negative effect on harbor porpoise abundance and activity during construction, which has been tied to localized avoidance behavior during pile driving, and no effects on activity or abundance linked to the operating wind farm (Tougaard et al. 2006). Teilmann et al. (2007) reports on continuous acoustic harbor porpoise monitoring at the Nysted wind project (Baltic Sea) before, during, and after construction. The results show that echolocation activity significantly declined inside Nysted Offshore Wind Farm since the pre-construction baseline during and immediately after construction. Teilmann and Carstensen (2012) update the dataset to indicate that echolocation activity continued to increase as time went by after operations began. Thompson et al. (2010) reported similar results for the Beatrice Demonstrator Project, where localized (1-2 km) responses of harbor porpoises were found through PAM, but no long term changes were found. Scheidat et al. (2011) reported results of acoustic monitoring of harbor porpoise activity for one year prior to construction and for two years during operation of the Dutch offshore wind farm Egmond aan Zee. The results show an overall increase in acoustic activity from baseline to operation, which the authors note is in line with a general increase in porpoise abundance in Dutch waters over that period. The authors also note that acoustic activity was significantly higher inside the wind farm than in the reference areas, indicating that the occurrence of porpoises in the wind farm area increased during the operational period, possibly due to an increase in abundance of prey in this area or as refuge from heavy vessel traffic outside of the wind farm area. Teilmann and Carstensen (2012) discuss the results of these three studies and are not able to determine why harbor porpoises reacted differently to the Nysted project. One suggestion is that as the area where the Nysted facility occurs is not particularly important to harbor porpoises, animals may be less tolerant of disturbance associated with the operations of the wind farm. It is important to note that the only ESA listed species that may occur within the WFA that uses echolocation is the sperm whale. Baleen whales, which includes North Atlantic right whales, fin, blue, and sei whales, do not echolocate. Sperm whales use echolocation primarily for foraging and social communication (NMFS 2010, NMFS 2015, Miller et al. 2004, Watwood et al. 2006); sperm whales are expected to occur in low densities in the WFA due to the shallow depths and more typical distribution near the continental shelf break and further offshore. Sperm whale foraging is expected to be limited in the lease area because sperm whale prey occurs in deeper offshore waters (500-1,000m) (NMFS 2010). Therefore, even if there was a potential for the presence of the WTGs or foundations to affect echolocation, it is extremely unlikely that this would have any effect on sperm whales given their rarity in the WFA. Consideration of the effects of operational noise on whale communication is presented in section 7.1 of this Opinion.

Absent any information on the effects of wind farms or other foundational structures on the local abundance or distribution of whales, sea turtles, Atlantic sturgeon, and giant manta rays, it is difficult to predict how listed whales, sea turtles, Atlantic sturgeon, and giant manta rays will respond to the presence of the foundations in the water column. However, considering just the physical structures themselves, given the spacing between the turbines we do not expect that the physical presence of the foundations alone will affect the distribution of whales, sea turtles, or marine fishes in the action area or affect how these animals move through the area. Additionally, the available data on harbor porpoises supports the conclusion that if there are decreases in abundance during wind farm construction those are not sustained during the operational period. As explained in section 7.1, we have determined that effects of operational noise will be insignificant and are not likely to disturb or displace whales, sea turtles, Atlantic sturgeon, or giant manta rays. In the sections below, we consider the potential for the reef effect to affect species distribution in the WFA and the potential for the foundations and WTGs to affect habitat conditions and prey that could influence the abundance and distribution of listed species in the WFA.

7.4.3.2 Habitat Conversion and Reef Effect Due to the Presence of Physical Structures

As described in the BA, long-term habitat alteration would result from the installation of the foundations, scour protection around the WTG, OSS, and Met Tower foundations, as well as cable protection along any portions of the inter-array and export cables that could not be buried to depth. Scour protection would be a maximum of 7 feet (2 meters) in height from the seabed level and would have an area of 0.19 acres per monopile.

The footprint of 126 WTG, OSS, and Met Tower foundations and associated scour protection in the form of boulders and concrete mats would permanently modify approximately 26.08 acres of seabed. In addition, approximately 74.08 acres of the seabed and approximately 23.13 acres of bay bottom would be permanently modified in order to protect inter-array, export, and interconnection cables. In total, permanent habitat disturbance of 123.29 acres is anticipated to result from the project. The addition of the WTGs, OSSs, and a Met Tower, spaced 0.77 and 1.02 nautical miles (1.43 and 1.89 kilometers) between positions, is expected to result in a habitat shift in the area immediately surrounding each monopile from soft sediment, open water habitat system to a structure-oriented system, including an increase in fouling organisms. Overall, construction of the US Wind foundations, cables, and associated scour protection would transform 123.29 acres (0.5 km^2) of soft bottom habitat into coarse, hard bottom habitat. For context, lease area OCS-A 0490 is approximately 79,707 acres. Over time (weeks to months), the areas with scour protection are likely to be colonized by sessile or mobile organisms (e.g., sponges, hydroids, crustaceans). This results in a modification of the benthic community in these areas from primarily infaunal organisms (e.g., amphipods, polychaetes, bivalves). Hard-bottom and vertical structures in a soft-bottom habitat can create artificial reefs, thus inducing the 'reef' effect (Taormina et al. 2018). The reef effect is usually considered a beneficial impact, associated with higher densities and biomass of fish and decapod crustaceans in the area immediately surrounding the new structure (Taormina et al. 2018). This could provide a potential increase in available forage items for sea turtles compared to the surrounding soft-bottoms; however, this change in distribution/aggregation of some species does not necessarily increase overall biomass. In the North Sea, Coolen et al. (2018) sampled epifouling organisms at offshore oil and gas platforms and compared data to samples from the Princess Amalia Wind Farm (PAWF) and natural rocky reef areas. The 60 PAWF monopile turbine foundations with rock scour protection were deployed between November 2006 and March 2007 and surveys were carried out in October 2011 and July 2013. This study demonstrated that the WTG foundations and rocky scour protection acted as artificial reef with a rich abundance and diversity of epibenthic species, comparable to that of a natural rocky reef.

Stenburg et al. (2015) studied the long-term effects of the Horns Rev 1 offshore wind farm (North Sea) on fish abundance, diversity, and spatial distribution. Gillnet surveys were conducted in September 2001, before the WTGs were installed, and again in September 2009, 7 years post-construction at the wind farm site and at a control site 6 km away. The three most abundant species in the surveys were whiting (*Merlangius merlangus*), dab (*Limanda limanda*), and sand lance (*Ammodytidae spp*.). Overall fish abundance increased slightly in the area where the wind farm was constructed but declined in the control area 6 km away. None of the key fish species or functional fish groups showed signs of negative long-term effects due to the wind farm. Whiting and the fish group associated with rocky habitats showed different distributions relative to the distance to the artificial reef structures introduced by the turbines. Rocky habitat fishes were most abundant close to the turbines while whiting was most abundant away from them. The authors also note that the wind farm development did not appear to affect the sand-dwelling species dab and sand lance, suggesting that the direct loss of habitat (<1% of the area around the wind farm) and indirect effects (e.g. sediment composition) were too low to influence their abundance. Species diversity was significantly higher close to the turbines. The authors conclude that the results indicate that the WTG foundations were large enough to attract fish species with a preference for rocky habitats, but not large enough to have adverse negative effects on species inhabiting the original sand bottom between the turbines. However, more research is still needed within offshore wind farm areas because each offshore wind farm area contains different environmental characteristics. For instance, research from Daewel et al. (2022) suggest changes in organic sediment distribution and quantity could have an effect on the habitat quality for benthic species such as Ammodytes spp. (e.g., sand lance) that live in the sediments within wind farm areas.

Methratta and Dardick (2019) carried out a meta-analysis of studies in Europe to examine finfish abundance inside wind farms compared to nearby reference sites. The overall effect size was positive and significantly different from zero, indicating greater abundance of fish inside of wind farm areas compared to the reference sites. More specifically, the study determined increases were experienced for species associated with both soft-bottom and complex-bottom habitat but changes in abundance for pelagic species were not significantly different from zero. The authors report that no significant negative effects on abundance were identified.

Hutchison et al. (2020) describes benthic monitoring that took place within the Block Island Wind Farm (BIWF, Rhode Island) to assess spatiotemporal changes in sediment grain size, organic enrichment, and macrofauna, as well as the colonization of the jacket foundation structures, up to four years post-installation. The greatest benthic modifications occurred within the footprint of the foundation structures through the development of mussel aggregations. Additionally, based on the presence of juvenile crabs (Cancer sp.),the authors conclude that the BIWF potentially serves as a nursery ground, as suggested from increased production rates for crabs (*Cancer pagurus*) at European OWFs (Krone et al., 2017). The dominant mussel community created three-dimensional habitat complexity on an otherwise smooth structure, benefiting small reef species such as cunner (*Tautogolabrus adspersus*), while at a larger scale, the turbine structures hosted abundant black sea bass (*Centropristis striata*) and other indigenous bentho-pelagic fish.

For the Maryland Wind project, effects to listed species from the loss of soft bottom habitat and conversion of soft bottom habitat to hard bottom habitat may occur if this habitat shift resulted in changes in use of the area (considered below) by listed species or resulted in changes in the availability, abundance, or distribution of forage species.

The only forage fish species we expect to be impacted by the loss of soft-bottom habitat would be sand lance (*Ammodytes spp.).* The ESA listed species in the WDA that may forage on sand lance include Atlantic sturgeon, fin, and sei whales. As sand lance are strongly associated with sandy substrate, and the project would result in a loss of such soft bottom, there would be a reduction in availability of habitat for sand lance that theoretically could result in a localized reduction in the abundance of sand lance in the action area. However, even just considering the WFA, which is dominated by sandy substrate, the loss or conversion of soft bottom habitat is very small, just over 0.13% (and an even smaller percentage of the action area). The results from Stenburg et al. (2015; summarized above) suggest that this loss of habitat is not great enough to impact abundance in the area and that there may be an increase in abundance of sand lance despite this small loss of habitat. However, even in a worst case scenario assuming that the reduction in the abundance of sand lance is directly proportional to the amount of soft substrate lost, we would expect a 0.13% reduction in availability of sand lance in the lease area and a 0.0001% reduction in the sand lance available as forage for fin and sei whales and Atlantic sturgeon in the action area. Given this small, localized reduction in sand lance and that sand lance are only one of many species the fin and sei whales and Atlantic sturgeon may feed on in the action area, any effects to these species are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, insignificant.

Based on the available information (e.g., Methratta and Dardick 2019, Stenburg et al. 2015), we expect that there may be an increase in abundance of schooling fish in the WFA that sei or fin whales may prey on but that this increase may be a result of redistribution of species to the WFA rather than a true increase in abundance. Either way, at the scale of the action area, the effects of any increase in abundance of schooling fish resulting from the reef effect will be so small that the effects to sei or fin whales cannot be meaningfully measured, evaluated, or detected. Similarly, we expect that there may be an increase in jellyfish and other gelatinous organism prey of leatherback sea turtles but that at the scale of the action area, any effects to leatherback sea turtles will be so small that they cannot be meaningfully measured, evaluated, or detected. Because we expect sperm whale foraging to be limited in the WFA (due to the shallow depths and location inshore of the shelf break), any effects to sperm whale foraging as a result of localized changes in the abundance or distribution of potential prey items are extremely unlikely. Atlantic sturgeon would experience a reduction in infaunal benthic organisms, such as polychaete worms, in areas where soft substrate is lost or converted to hard substrate. As explained above, the action area is not an aggregation area or otherwise known to be a high use area for foraging. Any foraging by Atlantic sturgeon is expected to be limited to opportunistic occurrences. Similar to the anticipated reduction in sand lance, the conversion of soft substrate to hard substrate may result in a proportional reduction in infaunal benthic organisms that could serve as forage for Atlantic sturgeon. Assuming that the reduction in the abundance of infaunal benthic organisms in the action area is directly proportional to the amount of soft substrate lost, we would expect an extremely small (0.13% of the lease area and an even smaller percentage of the total action area) reduction in the abundance of these species as forage for Atlantic sturgeon in the action area. Given that any reduction in potential prey items for Atlantic sturgeon will be small, localized, and patchy and that the WDA is not an area that sturgeon are expected to be dependent on for foraging, any effects to Atlantic sturgeon are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, insignificant. Also, to the extent that epifaunal species richness is increased in the WFA due to the reef effect of the WTGs and their scour protection, and to the extent that sturgeon may feed on some of these benthic invertebrates, any negative effects may be offset.

The available information suggests that the prey base for Kemp's ridley and loggerhead sea turtles may increase in the action area due to the reef effect of the WTGs, associated scour protection, and an increase in crustaceans and other forage species. However, given the small size of the area impacted and any potential resulting increase in available forage, any effects of this patchy and localized increase in abundance are likely to be so small that they cannot be meaningfully measured, evaluated, or detected. No effects to the forage base of green sea turtles are anticipated as no effects on marine vegetation are anticipated.

No effects to copepods that serve as the primary prey for right whales are anticipated to result from the reef effect considered here. In section 7.4.3.3 below, we explain how the physical presence of the foundations may affect ecological conditions that could impact the distribution, abundance, or availability of copepods.

7.4.3.3 Effects to Oceanic and Atmospheric Conditions due to Presence of Structures and Operation of WTGs

As explained in section 6.0 (*Environmental Baseline*), the Maryland Wind WFA is located within multiple defined marine areas. Here, we consider the best available information on how the presence and operation of 114 WTGs, 4 OSSs, and 1 Met Tower from the proposed Maryland Wind project may affect the oceanographic and atmospheric conditions in the action area and whether there will be any consequences to listed species.

A number of theoretical, model-based, and observational studies have been conducted to help inform the potential effects offshore wind farms may have on the oceanic and atmospheric environment; summaries of several of these studies are described in this section. In 2022, NMFS contracted with EA Engineering to prepare a literature review on this topic. Much of the information in this section of the Opinion is based on that review. In general, most of these studies discuss local scale effects (within the area of a wind facility) and are focused in Europe, specifically the North Sea, where commercial-scale offshore wind farms are already in operation. At various scales, documented effects include increased turbulence, changes in sedimentation, reduced water flow, and changes in: hydrodynamics, wind fields, stratification, water temperature, nutrient upwelling, and primary productivity.

Two turbines were installed offshore Virginia in the summer of 2020 where the weather and hydrodynamic conditions were measured during the installation period; however, no additional reports or literature about oceanographic or atmospheric impacts during operation has been published (HDR 2020). Similarly, no reports or literature about oceanographic or atmospheric impacts during operation of the five turbines at the Block Island Wind Farm have been published. As described in the *Environmental Baseline* section, offshore construction for the Vineyard Wind 1 and South Fork Wind projects, both located north of the US Wind WFA, began in the summer of 2023. The South Fork project became fully operational in the spring of 2024. We are not aware of any available studies about the effects of either project on oceanographic or atmospheric conditions.

Background Information on Oceanic and Atmospheric Conditions in the Project Area

At the broadest scale, the Maryland Wind project is located within the U.S. Northeast Shelf Large Marine Ecosystem, which extends from the Gulf of Maine to Cape Hatteras, North Carolina (Kaplan 2011). The WDA is located within the Southern Mid-Atlantic Bight sub-region of the Northeast U.S. Shelf Ecosystem, which is distinct from other regions based on differences in productivity, species assemblages and structure, and habitat features (Cook and Auster 2007). The physical oceanography of this region is influenced by the seafloor, freshwater input from multiple rivers and estuaries, large-scale weather patterns, and tropical or winter coastal storm events. Weather-driven surface currents, tidal mixing, and estuarine outflow all contribute to driving water movement through the area (Kaplan 2011). These dynamic regional ocean properties support a diverse and productive ecosystem that undergoes variability across multiple time scales.

A variety of existing oceanographic research and monitoring is conducted in the region by state and federal agencies, academic institutions, and non-governmental organizations using an array of platforms including ships, autonomous vehicles, buoys, moorings, and satellites. Research and monitoring efforts include measuring the physical and biological structure of the ocean environment including variables such as temperature, chlorophyll, and salinity at a range of depths as well as long-term shelf-wide surveys that provide data used to estimate spawning stock biomass, overall fish biodiversity, zooplankton abundance, information on the timing and location of spawning events, and insight to detect changes in the environment.

In the waters of the WFA and further south and east along the continental shelf, the broad, year-round pattern of currents are generally understood. Shelf currents in the Maryland Wind project area generally flow in a southerly direction (Wilkinson et al. 2009). These bottom currents are influenced by local bathymetry and regional density gradients. Prominent bottom features of the Mid-Atlantic Bight include a series of ridges and troughs. On the OCS off the coast of Delaware, the largest slopes are associated with sand ridges, which are generally parallel to the shoreline and are actively modified by ocean currents (Goff et al 2005). Geophysical surveys in and near portions of the lease area identified a total of 93 percent of the seafloor slope within the WFA and Offshore Export Cable Route as 1 degree or less. Within the Offshore Export Cable Route, the slope did not exceed 5 degrees, and is therefore classified as a gentle slope. Steeper slopes exceeding 20 degrees were identified in the western portion of the Lease Area.

On a seasonal scale, the greater Mid-Atlantic Bight region experiences one of the largest transitions in stratification in the entire Atlantic Ocean (Castelao, Glenn, and Schofield, 2010). Starting in the late spring, a strong thermocline develops at approximately 20 m depth across the middle to outer shelf, and forms a thermally isolated body of water known as the “cold pool” which shifts annually but generally extends from the waters of southern New England (in some years, the WFA is on the northern edge of the cold pool) to Cape Hatteras. Starting in the fall, the cold pool breaks down and transitions to cold and well-mixed conditions that last through the winter (Houghton et al. 1982). The cold pool is particularly important to a number of demersal and pelagic fish and shellfish species in the region, but also influences regional biological oceanography as wind-assisted transport and stratification have been documented to be important components of plankton transport in the region (Checkley et al. 1988, Cowen at al. 1993, Hare et al. 1996, Grothues et al. 2002, Sullivan et al. 2006, Narvaez et al. 2015, Munroe et al. 2016). The region also experiences upwelling in the summer driven by southwest winds associated with the Bermuda High (Glenn & Schofield 2003; Glenn et al. 2004). Cold nutrient-rich water from the cold pool can be transported by upwelling events to surface and nearshore waters. At the surface, this cold water can form large phytoplankton blooms, which support many higher trophic species (Sha et al. 2015).

The cold pool supports prey species for ESA-listed species, both directly through providing habitat and indirectly through its influence on regional biological oceanography, which supports a productive ecosystem (Kane 2005, Chen et al. 2018, Winton et al. 2018). Lower-trophic plankton species are well adapted to take advantage of the variable seasonality of the regional ecosystem, and support the upper food web for species such as pelagic fish, sea turtles, and marine mammals (Kenney and Vigness-Raposa 2010, Pershing and Stamieszkin 2019). Though plankton exhibit movement behavior, physical and oceanographic features (e.g. tidal mixing fronts, thermal fronts, freshwater plumes, internal waves, stratification, horizontal and vertical currents, and bathymetry) are the primary drivers that control aggregations and concentrate them by orders of magnitude (Pershing and Stamieszkin 2019, Kraus et al. 2019).

Many marine species including fish, sea turtles, and marine mammals forage around these physical and oceanographic features where prey is concentrated. Physical and oceanographic features are the primary drivers that control aggregations and concentrations of plankton. ESA-listed species in the region primarily feed on five prey resources - zooplankton, pelagic fish, gelatinous organisms, marine vegetation, and benthic mollusks. Of the listed species in the area, North Atlantic right whales are the only obligate zooplanktivores (i.e., they eat only zooplankton). Sei and fin whales may be present in the WFA, however in addition to plankton both species eat small schooling fish.

As described in the *Environmental Baseline*, North Atlantic right whales have been observed in or near Delaware waters during all four seasons; however, they are most common in spring when they are migrating north and in fall during their southbound migration (Kenney and Vigness-Raposa 2010, Roberts et al. 2016). These seasonal occurrence observations are aligned with more recent findings from aerial survey data collected from 2017-2020, where North Atlantic right whales were seen in waters adjacent to New York during all seasons except summer (Zoidis et al. 2021). Aerial and PAM surveys suggest North Atlantic right whales are more common in the Mid-Atlantic region during winter and spring; however, recent analysis of detections from PAM indicate some year-round presence (Davis et al. 2017; Bailey et al. 2018). Barco et al. (2015) reported pulses of North Atlantic right whale sightings during winter months offshore the Maryland and Delaware WEAs, with some individuals displaying potential feeding behaviors. The species has been detected acoustically in every month of the year in the vicinity of the Maryland WEA, though the highest presence occurred from November through April (Bailey et al. 2018). A higher acoustic occurrence was noted for the species after 2010 in the Mid-Atlantic region, likely due to broad-scale distribution shifts in prey species (Davis et al. 2017).
Based on the best available scientific information, North Atlantic right whales may opportunistically forage in the Maryland Wind WDA when suitably dense patches of prey are present. However, this is not a primary foraging area, an area where individuals are expected to be resident, and it is not known or expected to routinely support sustained foraging behavior.

Effects on Water Temperature
A modeling study was conducted for the Great Lakes region of the U.S. to simulate the impact of 432 9.5 MW (4.1 GW total) offshore wind turbines on Lake Erie's dynamic and thermal structure. Model results showed that the wind farms did have an impact on the area they were built in by reducing wind speed and wind stress, which led to less mixing, lower current speeds and higher surface water temperature (Afsharian et al. 2020). The model demonstrated reduced wind speed and stress leading to less mixing, lower current speeds, and higher surface water temperatures (1-2.8°C, depending on the month). No changes to temperatures below the surface are reported. The authors note that these impacts were limited to the vicinity of the wind farm. Though modeled in a lake environment, these results may be informative for predicting effects in the marine environment as the presence of structures and interactions with wind and water may act similarly; however, given the scale of the model and specificity of the modeled conditions and outputs to Lake Erie it is not possible to directly apply the results to an offshore wind project in the action area generally or the Maryland Wind project in particular.

Some literature is available that considers the potential impacts of wind power development on temperature. Miller and Keith (2018) developed a model to better understand climatic impacts due to wind power extraction; however, the paper addresses how a modeled condition would affect average surface temperatures over the continental U.S. and does not address offshore wind turbines or any effects on ocean water temperatures. Wang and Prinn (2010 and 2011) carried out modeling to simulate the potential climatic effects of onshore and offshore wind power installations; they found that while models of large scale onshore wind projects resulted in localized increases in surface temperature (consistent with the pattern observed in the Miller and Keith paper), the opposite was true for models of offshore wind projects. The authors found a local cooling effect, of up to 1°C, from similarly sized offshore wind installations. The authors provide an explanation for why onshore and offshore turbines would result in different localized effects.

Golbazi et al. 2022 simulated the potential changes to near-surface atmospheric properties caused by large offshore wind farms equipped with offshore wind turbines of 10 and 15 MW. In the model, they simulated 30 GW of offshore wind turbines located in identified lease and planning areas in the U.S. Atlantic. The model results show that, at hub height, an average wind speed deficit of 0.5 m/s extends up to 50 km downwind from the edge of the farms with an average wind speed reduction at the surface that is 0.5 m s/1 or less (a 10% maximum reduction) within the project footprint. This results in a slight cooling, up to −0.06 K, at the surface in the summer. The authors conclude that, on average, meteorological changes at the surface induced by 10-15 MW offshore wind turbines will be nearly imperceptible in the summer. They also note that future research is needed to explore changes in other seasons.

If the effects predicted by the model in Golbazi et al. and Wang and Prinn are realized as a result of the Maryland Wind project, minor cooling of waters in the action area in the summer months would be expected. We do not anticipate that any minor cooling of waters in the action area in the summer months would have any effects on the abundance or distribution of listed species or the abundance or distribution of prey. Based on the available information, any effects to listed species from any changes in water temperature (if there are any at all) will be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant.

Ocean-Atmosphere and Wind Field Interactions

Studies have examined the wind wakes produced by turbines and the subsequent turbulence and reductions in wind speed, both in the atmosphere and at the ocean surface. In general, as an air current moves towards and past a turbine, the structure reduces air velocities (reduced kinetic energy in the atmosphere) downstream and has the potential to generate turbulence near the ocean surface. This relative velocity deficit and increased turbulence near turbine structures create a cone-shaped wake of wind change (known as wind wake) in the downstream region from the turbine. Wind wakes vary in size and magnitude and vary based on natural environmental conditions (i.e. wind speed, direction) and turbine size and layout. Studies elucidating the relationship between offshore wind facilities and the atmospheric boundary layer, meteorology, downstream areas, and the interface with the ocean are still emerging. No in-situ studies have been carried out in the U.S. to date. Alterations to wind fields and the ocean–atmosphere interface have the potential to modify both atmospheric and hydrodynamic patterns, potentially on large spatial scales up to dozens of miles (~20+ km) from the offshore wind facility (Dorrell et al. 2022, Gill et al. 2020, Christiansen et al. 2022). Interactions between the ocean and the atmosphere in the presence of wind turbine structures are highly variable based on ambient wind speed, the degree of atmospheric stability, and the number of turbines in operation. Generally, a wind energy facility is expected to reduce average wind speeds both upstream and downstream; however, studies report a wide range of values for average wind speed deficits, in terms of both magnitude and spatial extent. Wind wake propagation generally extends longer in stable atmospheric conditions where there is less influence from vertical mixing (Christiansen et al. 2022, Golbazi et al. 2022). Upstream of a large, simulated offshore wind facility, Fitch et al. (2012) found wind blocking effects to reduce average wind speeds by 1% as far as 9 miles (15 km) ahead of the facility. Downstream of an offshore wind facility, wind speeds may be reduced up to 46%, with wind wakes ranging from 3 to 43 miles (5 to 70 km) from the turbine or array (Christiansen and Hasager 2005; Carpenter et al. 2016; Platis et al. 2018; Cañadillas et al. 2020; van Berkel et al. 2020; Floeter et al. 2022). Wind speed deficit is greatest at hub height downstream of the facility, with the deficit decreasing closer to the ocean surface (Golbazi et al. 2022). However, while models and observations indicate that the maximum wind speed deficit occurs at hub height inside the wind wake downstream of an offshore wind energy facility, reduction in average wind speeds near the ocean surface has also been modeled and observed (Christiansen et al. 2022). Simulations of multiple, clustered, large offshore wind facilities in the North Sea suggest that wind wake may extend as far as 62 miles (100 km) (Siedersleben et al. 2018). On the U.S. northeast shelf, wind wakes emerging from simulations of full lease area buildouts with 15 megawatt WTGs (150 m hub height) were shown to combine and extend as far as 93 miles (150 km) on certain days (Golbazi et al. 2022). Wind speed reduction may occur in an area up to 100 times larger than the offshore wind facility itself (van Berkel et al. 2020). A recent study investigated long-range wind wake deficit potential in the New York Bight offshore development area using weather research and forecasting (WRF) offshore wind facility parameterization. ArcVera Renewables (2022) determined that expert literature that used engineering wake loss models has under-predicted wind wakes, and their study describes wind wakes that extend up to or greater than 62 miles (100 km) downstream of large offshore wind facilities.

Models have predicted reductions in surface winds and wind stress over tens of kilometers downwind from turbine arrays and may be influenced by closely adjacent wind farms (Christiansen et al. 2022). A study on the effect of large offshore wind farms (~ 80 turbines) in Europe on the local wind climate using satellite synthetic aperture radar found that a decrease of the mean wind speed is found as the wind flows through the wind farms, leaving a velocity deficit of 8–9% on average, immediately downstream of the wind turbine arrays. Wind speed was found to recover to within 2% of the free stream velocity over a distance of 5–20 km past the wind farm, depending on the ambient wind speed, the atmospheric stability, and the number of turbines in operation (Christiansen & Hasager 2005). Christiansen et al. (2022) found that simulated wind wakes varied individually in size and intensity due to the different sizes of North Sea facilities and due to superposition of neighboring wakes, with the strongest wind speed deficits modeled in densely built areas. Using an aircraft to measure wind speeds around turbines, Platis et al. (2018) found a reduction in wind speed within 10km of the turbine.

Ocean-Atmosphere Responses to Wind Field Interactions

The disturbance of wind speed and wind wakes from wind farms can cause oceanic responses such as upwelling, downwelling, and desertification (van Berkel et al. 2020; Dorrell et al. 2022;

Floeter et al. 2022). According to Broström (2008), an offshore wind facility can cause a divergence/convergence in the upper ocean due to a strong horizontal shear in the wind stress and resulting curl of the wind stress. This divergence and convergence of wind wakes can cause upwelling and downwelling. Upwelling can have significant impacts on local ecosystems due to the influx of nutrient rich, cold, deep, water that increases biological productivity and forms the basis of the lower trophic level. Broström 2008 indicates that the induced upwelling by a wind farm will likely increase primary production, which may affect the local ecosystem. Oceanic response to an altered wind field is predicted to extend several kilometers around offshore wind facilities and to be strong enough to influence the local pelagic ecosystem (Broström 2008; Ludewig 2015; Floeter et al. 2022). Floeter et al. (2022) conducted the first observations of wind wake-induced upwelling/downwelling dipoles and vertical mixing downstream of offshore wind facilities in the North Sea. The study identified two characteristic hydrographic signatures of wind wake-induced dipoles. First, distinct changes in mixed layer depth and water column potential energy anomaly were observed over more than 3 miles (5 kilometers). Second, the thermocline exhibited diagonal excursions, with maximum vertical displacement of 46 feet (14 meters) over a dipole dimension of 6–7 miles (10–12 kilometers). Additionally, research by Daewel et al. (2022) suggests that ongoing offshore wind energy developments can have a significant impact on coastal marine ecosystems. This study deduced that wind wakes of large offshore wind energy clusters in the North Sea cause large-scale changes in annual primary production with local changes of up to 10%. These changes occur within the immediate vicinity of the offshore wind energy cluster and travel over a wider region (up to 1–2 kilometers outside the cluster of projects).

Wave amplitude within and surrounding offshore wind energy facilities may be altered by changes to the wind field. A decrease in surface roughness can be observed in optical and radar images at considerable distances down-wind of an offshore wind facility under certain conditions (Forster 2018). Johnson et al. (2021b) analyzed localized turbulence effects of various proposed offshore wind build-out scenarios using a three-dimensional model from Cape Hatteras to offshore Cape Cod, with a finer mesh embedded in the Massachusetts/Rhode Island wind energy area. Results of the hydrodynamic modeling suggested that the extraction of wind energy by offshore wind facilities in the Massachusetts/Rhode Island wind energy area could reduce current magnitude and wave height. By modifying the sea surface wind shear stress, wind energy extraction affected the wind field within and beyond the modeled facility (comprising a full build-out of the wind energy area with 1,063 turbines, each 12-MW). Relative to the modeled baseline, significant wave height was reduced by up to 2.46 feet (0.75 meter) inside the facility, by up to 1.48 feet (0.45 meter), just outside the facility, and up to 0.49 foot (0.15 meter) at the coast.

The regional impact of wind wakes is challenging to quantify due to natural spatiotemporal variability of wind fields, sea levels, and local ocean surface currents in the northeast shelf (Floeter et al. 2022). Individual dipole patterns can either superimpose or decrease airflow velocities, for example depending on the spatial orientation of the tidal ellipse in relation to the direction of the wind wake (Floeter et al. 2022). Offshore wind facilities may create a damming effect where a regional high pressure zone is created upwind of the turbines and air deflects up and over the turbine causing a low pressure zone in the middle. This air mass returns to the surface downstream of the turbine field, creating a dipole local high/low pressure zone on the ocean surface which can affect local currents including upwelling and downwelling (Christiansen et al. 2022). Increased airflow velocities near the water surface result in decreased water surface elevation of a 2-millimeter magnitude, while decreased airflow velocities result in increased water surface elevation of a similar magnitude (Christiansen et al. 2022). This magnitude may be negligible in the context of the substantial year-to-year changes in annually averaged coastal sea level in the northeast shelf (i.e., 650 millimeters), which is attributed to the region's existing along-shelf wind stress (Andres et al. 2013; Li et al. 2014). Christiansen et al. (2022) modeled sea surface velocity changes downstream of multiple offshore arrays in the North Sea and found that induced changes equated to a "substantial" 10–25% of the interannual and decadal sea surface velocity variability in the region.

Hydrodynamic Interactions
The introduction of offshore wind energy facilities into ocean waters influences adjacent ocean flow characteristics, as turbine foundation structures and currents, tides, etc. interact. The dynamics of ocean flow past vertical structures has received relatively more study in well-mixed seas than in strongly stratified seas (Dorrell et al. 2022). Most studies on wake and turbulence caused by foundation structures are gleaned from modeled simulations, as field studies are challenging due to the numerous variables and natural variability in flow (Schultze et al. 2020). Only two studies to date have observed in situ the response of stratified waters to the presence of offshore wind energy facilities (Floeter et al. 2017; Schultze et al. 2020).

Hydrodynamic effects of offshore wind facilities and their secondary effects are only beginning to be studied within United States shelf waters. Johnson et al. (2021) prepared a hydrodynamic modeling study investigating the potential impacts of offshore wind energy development on oceanographic conditions in the northeast shelf, assessing the changes in hydrodynamic conditions resulting from a theoretical modeled offshore wind facility in the MA-RI WEA. The results suggest that introduction of 1,063 12 MW WTGs would influence the thermal stratification by introducing additional mixing. The model suggests a relative deepening in the thermocline compared to baseline temperatures of approximately 3.3 to 6.6 ft. (1 to 2 m) and retention of colder water within the footprint of the modeled wind facility through the summer months (Johnson et al. 2021). The study also suggested that the thermocline would, on average, move deeper in both the spring and summer, with more cold water retained within the footprint of the offshore wind facility (Johnson et al. 2021). The results of Johnson et al. (2021) contrast with a European field study by Floeter et al. (2017) in the German North Sea, which found a doming of the thermocline and enhanced mixing, or more uniform temperatures, in the layer below the thermocline. While the Floeter et al. (2017) study observed changes in vertical mixing, and enhanced local upwelling, these changes may be due to natural variability. Additionally, there are numerous differences between the sites in southern New England and the German North Sea. First, the climate setting and hydrodynamic conditions differ (e.g., offshore wind facility locations relative to the shelf, general circulation around the offshore wind facilities, temperature and stratification regime, depth, and solar radiation and heat transfer). Second, the operational status of the actual and modeled offshore wind facilities differs (i.e., there being no current speed reduction due to wind wake loss in the German North Sea study) (Johnson et al. 2021). Additionally, while Johnson et al. (2021) conclude that the introduction of the offshore wind energy structures modifies temperature stratification by introducing additional mixing, the model did not include influences from strong storms, which are a primary component of mixing in the southern New England region. The authors acknowledge that the model's single year of simulations would require additional years to assess year-to-year variability of the model parameters and that modeling of this nature is more suited for a review of differences between scenarios rather than absolute accuracy of individual scenarios. Also, the wind turbine wake loss model and corresponding wind speed and sea surface wind stress reduction were only confined to the domain of the model that were inside the offshore wind development area which limits the application of the results outside of that area.

Using remote sensing, Vanhellemont and Ruddick (2014) showed that offshore wind facilities can have impacts on suspended sediments. Wakes of turbidity from individual foundations were observed to be in the same direction as tidal currents, extending 30–150 m wide, and several kilometers in length. However, the authors indicate the environmental impact of these wakes and the source of the suspended material were unknown. Potential effects could include decreased underwater light field, sediment transport, and downstream sedimentation (Vanhellemont and Ruddick 2014).

The primary structure-induced hydrodynamic effects of wind turbine foundations are friction and blocking, which increase turbulence, eddies, sediment erosion, and turbidity in the water column (van Berkel et al. 2020). A number of studies have investigated the impacts of offshore wind farms on stratification and turbulence (Carpenter et al. 2016, Dorrell et al. 2022; Schultz et al. 2020). As water moves past wind turbine foundations the foundations generate a turbulent wake that will contribute to a mixing of a stratified water column or may disperse aggregations of plankton. These studies have demonstrated decreased flow and increased turbulence extending hundreds of meters from turbine foundations. However, the magnitude is highly dependent on the local conditions (e.g. current speed, tides, and wind speed), with faster flow causing greater turbulence and extending farther from the foundation. Carpenter et al. (2016) used a combination of numerical models and in situ measurements from two wind facilities (Bard 1 and Global Tech 1) to conduct an analysis of the impact of increased mixing in the water column due to the presence of offshore wind structures on the seasonal stratification of the North Sea. Based on the model results and field measurements, estimates of the time scale for how long a complete mixing of the stratification takes was found to be longer, though comparable to, the summer stratification period in the North Sea. The authors concluded that it is unlikely the two wind facilities would alter seasonal stratification dynamics in the region. The estimates of mixing were found to be influenced by the pycnocline thickness and drag of the foundations of the wind turbines. For there to be a significant impact on stratification from the hydrodynamic impacts of turbine foundations over a large area, large regions (length of 100 km) of the North Sea would need to be covered with wind farms; however the actual threshold was not defined (Carpenter et al. 2016). Schultz et al. 2020 found similar results in the same area of the German Bight of the North Sea.

Monopiles were found to increase localized vertical mixing due to the turbulence from the wakes generated from the foundations, which in turn could decrease localized seasonal stratification and could affect nutrient cycling on a local basis. Using both observational and modeling methods to study impacts of turbines on turbulence, Schultze et al. (2020) found through modeling simulations that turbulence remained within the first 100 m from the turbine foundation under a range of stratified conditions. Field measurements at the offshore wind facility DanTysk in the German Bight of the southern North Sea observed a wake area 70 m wide and 300 m long from a single monopile foundation during weak stratification (0.5°C surface-to bottom temperature difference). No wake or turbulence was detected in stronger thermal stratification (~3°C surface-to-bottom temperature difference) (Schultze et al. 2020). The foundations at DanTysk are 6 m diameter monopiles. Similarly, a laboratory study measured peak turbulence within 1 monopile diameter distance from the foundation and that downstream effects (greater than 5% of background) persisted for 8–10 monopile diameters distances from the foundation (Miles, Martin, and Goddard 2017).

Impacts on stratification and turbulence could lead to changes in the structure, productivity, and circulation of the oceanic regions; however, the scale and degree of those effects is dependent in part on location. If wind projects are constructed in areas of tidal fronts, the physical structure of wind turbine foundations may alter the structure of fronts, which could affect distribution of prey and lead to effects to the marine vertebrates that use these oceanic structures for foraging (Cazenave et al. 2016). As areas of frontal activity are often pelagic biodiversity hotspots, altering their structure may decrease efficient foraging opportunities for listed species. In relation to the role of tides in wake-induced hydrodynamic perturbations, Christiansen et al. found that tide-related hydrodynamic features (e.g., currents and fronts) influence the development of wake effects in the coastal ocean. Tidal currents were found to be able to counter changes in horizontal surface currents and in shallower waters, tidal stirring influences how wake effects translate to changes in vertical transport and density stratification (Christiansen et al. 2022). In an empirical bio-physical study, Floeter et al. (2017) used a remotely operated vehicle to record conductivity, temperature, depth, oxygen, and chlorophyll-a measurements of an offshore wind facility in the North Sea. Vertical mixing was found to be increased within the footprint of the wind facility, leading to a doming of the thermocline and a subsequent transport of nutrients into the surface mixed layer. Though discerning a wind facility-induced relationship from natural variability is difficult, wind facilities may cause enhanced mixing, and due to the interaction between turbulence levels and the growth of phytoplankton, this could have cascading effects on nutrient levels, ecosystems, and marine vertebrates (Carpenter et al. 2016, Floeter et al. 2017). Water flowing around turbine foundations may also cause eddies to form, potentially resulting in more retention of plankton in the region when combined with daily vertical migration of the plankton (Chen et al. 2016, Nagel et al. 2018). However, it is important to note that these conclusions from Chen et al. (2016) are hypothesized based on a modeling study and are yet to be studied in-situ or observed in the Atlantic OCS.

Van Berkel et al (2020) investigated available information on the effects of offshore wind facilities on hydrodynamics and implications for fish. The authors report that changes in the demersal community have been observed close to wind farms (within 50 m) and that those changes are related to structure-based communities at the wind farm foundations (e.g., mussels). The authors also report on long-term studies of fish species at the Horns Reef project (North Sea) and state that no significant changes in abundance or distribution patterns of pelagic and demersal fish have been documented between control sites and wind farm sites or inside/between the foundations at wind facilities. They report that any observed changes in density were consistent with changes in the general trend of species reflected in larger scale stock assessment reports (see also Stenberg et al. 2015).

Modeling experiments have demonstrated that the introduction of monopiles could have an impact on the M2 amplitude (semidiurnal tidal component due to the moon) and phase duration. Modeling showed the amplitude increased between 0.5-7% depending on the preexisting amphidrome, defined as the geographical location, which has zero tidal amplitude for one harmonic constituent of the tide. Changes in the tidal amplitude may increase the chances of coastal flooding in low-lying areas. However, we have no information to suggest that any potential effects on M2 amplitude would have any effects on marine resources generally or ESA-listed species specifically.

The National Academies of Sciences, Engineering, and Medicine recently released a report "Potential Hydrodynamic Impacts of Offshore Wind Energy on Nantucket Shoals Regional Ecology: An Evaluation from Wind to Whales" which considered the potential for offshore wind facilities in the Nantucket Shoals region to affect oceanic physical processes and how hydrodynamic alterations may affect the local to regional ecosystem, particularly North Atlantic right whale foraging and prey resources (NASEM 2023). The findings in the report acknowledge that offshore wind energy development may impact oceanic physical processes that influence right whales through the abundance and distribution of their prey, but acknowledge significant uncertainty in the potential impacts from offshore wind development, and therefore provided a number of recommendations for additional observational research and modeling studies (NASEM 2023). The report noted that the magnitude of potential effects from offshore wind development may be less than from ongoing climate induced changes. We note that this does not necessarily mean that impacts from offshore wind development will be non-significant or not detectable and that they may be incremental as additional development occurs. We also acknowledge that changes to the southern New England ecosystem that may result from offshore wind development may be difficult to discern from those attributable to climate change particularly absent a robust monitoring strategy. There is no information to suggest that the Maryland Wind facility will have any effect on the ecology of Nantucket Shoals; this is due to the distance between the project and the Shoals (approximately 500 km).

Primary Production and Plankton Distribution
The influence of altered atmospheric and hydrodynamic turbulence on the vertical mixing of the water column may impact the delivery of nutrients to the euphotic zone, the upper layer of the water column that receives sufficient light penetration for photosynthesis, and which generally occurs within the upper 100–170 ft. (30–52 m) of the water column in the northeast shelf (Ma and Smith 2022). Seasonal mixing of the water column provides nutrients to support phytoplankton growth, with primary production at deeper depths being limited by lack of sunlight (Dorrell et al. 2022). As water flows around turbine and OSS foundations there is the potential that aggregations of planktonic prey may be dispersed due to the increased mixing caused by water moving around foundations; however, it is also possible that foundations will act to trap prey if eddies form in the wake of turbine foundations or concentrate prey in a convergent current situation. However, decreased mixing could also cause increased stratification and subsequently affect the exchange of nutrients, heat, and trap prey. Modeling studies in the Southern New England region predict changes in distribution patterns of planktonic larvae under offshore wind build-out scenarios (Johnson et al. 2021, Chen et al. 2021), suggesting similar impacts could occur with right whale's zooplankton prey. Similar

modeling studies have not been carried out for the Mid-Atlantic where the Maryland Wind project will be located.

A few studies have been conducted to evaluate how altered hydrodynamic patterns around offshore wind projects could affect primary production as well as upper trophic levels. Floeter et al., 2017 demonstrated with empirical data from the southern North Sea that increased vertical mixing at an offshore wind farm resulted in the transport of nutrients to the surface mixed layer and subsequent uptake by phytoplankton in the photic zone. Increased primary production could increase the productivity of bivalves and other macrobenthic suspension feeders that are expected to be a major component of artificial reef communities that form on turbine foundations (Slavik et al., 2019, Mavraki et al., 2020; Daewel et al. 2022). The results of analyses conducted by Floeter et al. 2017 and Friedland et al. 2021 suggest that wind farm effects on phytoplankton and zooplankton might extend to upper trophic level impacts, potentially modifying the distribution and abundance of finfish and invertebrates. However, the spatial scale of these effects could range from localized within individual farms to broader spatial scales (Carpenter et al., 2016; Bakhoday-Paskyabi et al., 2018).

Wang et al. 2018 evaluated pre and post-construction water column properties (water temperature, dissolved oxygen, and suspended matter concentration) and zooplankton community structure at an offshore wind facility in China. The facility consisted of 70 WTGs (232 MW total) located in the intertidal zone less than 11 km from the shore in the Yellow Sea. The goal of this study was to examine the responses of the zooplankton community to the establishment of an offshore wind facility, the causes of any observed effects, and their relation to environmental factors in the study area. The analysis documented changes in the zooplankton community (e.g., seasonal increases and decreases in macro and microzooplankton). However, given that there are significant differences in the location and conditions between the site in China and the Maryland Wind WFA (e.g., tidal flat/intertidal zone vs. offshore) and the layout of the site (WTGs are much closer together at the China site) it is not clear that the results of this study will be informative for the Maryland Wind project.

Daewel et al. 2022 used modeling to demonstrate the effects of wind wake from offshore wind projects in the North Sea on primary productivity. The model results show that the systematic modifications of stratification and currents alter the spatial pattern of ecosystem productivity; annual net primary production (netPP) changes in response to offshore wind facility wind wake effects in the southern North Sea show both areas with a decrease and areas with an increase in netPP of up to 10%. There was a decrease in netPP in the center of the large offshore wind facility clusters in the inner German Bight and at Dogger Bank, which are both situated in highly productive frontal areas, and a netPP increase in areas around these clusters in the shallow, near-coastal areas of the German Bight and at Dogger Bank. The authors note that additional work is needed to identify the robustness of these patterns with respect to different weather conditions and interannual variations. They also note that when integrated over a larger area, the estimated positive and negative changes tend to even out. Besides the changes in the pelagic ecosystem, the model results highlight a substantial impact on sedimentation and seabed processes. The overall, large-scale reduction in average current velocities results in reduced bottom-shear stress to up to 10% locally; however, averaged over larger areas the effect is less pronounced with only a 0.2% increase North Sea wide. The model also indicates an impact of an offshore wind facility on bottom water oxygen in the southern North Sea. In an area with a bathymetric depression (Oyster Grounds), the dissolved oxygen concentrations in late summer and autumn were further reduced by about 0.3 mg l^{-1} on average and up to 0.68 mg l^{-1} locally. In other areas of the southern North Sea, the effect was estimated to be less severe, or even showing an increase in dissolved oxygen concentration, along the edges of Dogger Bank for example.

Consideration of Potential Effects of the Maryland Wind Project

In general, the studies referenced above describe varying scales of impacts on the oceanographic and atmospheric processes as a resultant effect of offshore wind turbine development. These impacts include increased turbulence generated by the presence of turbine foundations, extraction of wind by turbine operations reducing surface wind stress and altering water column turbulence, and upwelling and downwelling caused by the divergence and convergence of wind wakes (Miles et al. 2021). Oceanographic and atmospheric effects are possible at a range of temporal and spatial scales, based on regional and local oceanographic and atmospheric conditions as well as the size and locations of wind farms. However, discerning a wind farm-induced relationship from natural variability is difficult and very specific to local environmental conditions where the wind farm is located. As described above, the particular effects and magnitudes can vary based on a number of parameters, including model assumptions and inputs, study site, oceanographic and atmospheric conditions, turbine size, and wind farm size and orientation (Miles et al. 2021).

Here, we consider the Environmental Baseline, the information presented above regarding available studies, incorporate the layout and parameters of the Maryland Wind Project and local oceanographic and atmospheric conditions, and evaluate effects to ESA-listed species. We note that while we are using the best available scientific information to assess effects of the Maryland Wind project, given the lack of site specific data, there is uncertainty about how offshore wind projects in the action area may alter oceanographic processes and the biological systems that rely on them. However, based on observed and modeled results described in the summary of the best available scientific information above, we do expect effects to occur, but acknowledge there is uncertainty regarding the scale/magnitude and extent of these effects in the context of the Mid-Atlantic bight ecosystem and the Maryland Wind project specifically. The best available scientific information suggests that some impacts require very large scale wind development before they would be realized; as such, we note that the conclusions reached here are specific to the scope of the Maryland Wind project (114 WTGs and their foundations, up to 4 OSSs and their foundations, and 1 Met Tower, total approximate capacity of 2 gigawatts) and its specific geographic location in consideration of the Environmental Baseline, which takes into consideration the presence and operation of other identified offshore wind projects located within the Maryland Wind action area. The analysis and conclusions reached here may not be reflective of the consequences of larger scale development in the region or even a single project in a different location.

As explained above, based on the available information, we do not find any evidence that installation of up to 126 foundations and operation of WTGs and OSSs for the Maryland Wind project would lead to ocean warming that could affect ESA-listed whales, sea turtles or fish or that there is the potential for the Maryland Wind project to contribute to or exacerbate warming ocean conditions; if anything, the project may result in minor, localized cooling.

When applying studies conducted outside the greater Mid-Atlantic Bight region to our consideration of the potential effects of the Maryland Wind project on environmental conditions, it should be noted that the seasonal stratification over the summer, particularly in the studies conducted in the North Sea, is much less than the peak stratification seen in the greater Mid-Atlantic Bight region (Castelao, Glenn, and Schofield, 2010). The conditions in the North Sea are more representative of weaker stratification, similar to conditions seen in the Mid-Atlantic Bight during the spring or fall (van Leeuwen et al. 2015). Because of the weaker stratification during the spring and fall, the Mid-Atlantic Bight ecosystem may be more susceptible to changes in hydrodynamics due to the presence of structures and potential for increased turbulence during this period when waters are more unstable than during highly stratified conditions in the summer (Kohut and Brodie 2019, Miles et al. 2021).

Offshore wind energy development is likely to alter the atmospheric and the physical and biological oceanographic environments due to the influence of the energy extraction on the wind stress at the ocean surface; further, the physical presence of the in-water turbine foundations could influence the flow and mixing of water. Resultant, increased stratification could affect the timing and rate of breakdown of the cold pool in the fall, which could have cascading effects on species in the region. However, as described above, the available information (Carpenter et al. 2016, Schultz et al. 2020) indicates that in order to see significant impacts on strong stratification such as the cold pool, large regions would need to be covered by wind turbines. Given the scale of the Maryland Wind project (up to 126 foundations), any effects of stratification are not expected to reach the scale that would affect the timing and rate of breakdown of the cold pool in the fall. Also, at this time, the available information does not suggest that the effects of the Maryland Wind project in addition to the other permitted offshore wind projects in the action area, would be sufficiently great to affect the timing and rate of breakdown of the cold pool. Based on the available information, it is likely that the Maryland Wind project will produce a wind wake from operation of the turbines and that the foundations themselves will lead to disruptions in local conditions. The scale of these effects is expected to range in distance, with effects to turbulence, eddies, and turbidity extending on a scale of hundreds of meters up to 1 km from each foundation (Floeter et al. 2017, van Berkel et al. 2020). Documented changes in mixed layer depth and thermocline conditions extending up to 12 km between the paired upwelling peak and downwelling patterns (dipole) at one wind facility with the upwelling and downwelling extending approximately 20 km from the wind facility (Floeter et al. 2022). Similar effects on mixed layer depth and thermocline conditions may occur in the lee of the Maryland WFA when the wind and current direction is consistent. These changes in conditions may alter the distribution of nutrients, primary production, and plankton. Alterations to wind fields and the ocean– atmosphere interface have the potential to modify both atmospheric and hydrodynamic patterns, potentially on large spatial scales up to tens of kilometers (Gill et al. 2020; Christiansen et al. 2022). As noted above, oceanic response to an altered wind field is predicted to extend several kilometers around offshore wind facilities and to be strong enough to influence the local pelagic ecosystem (Brostrom 2008, Ludewig 2015, Floeter et al. 2022).
Due to the linkages between oceanography and food webs, lower-tropic level prey species that support listed species may be affected by changes in stratification and vertical mixing. There is limited information on which to base an assessment of the degree that the proposed project will result in any such impacts. No studies of utility scale offshore wind farms in the region nor along

either coast of the United States have been carried out; therefore, there are no projects in coastal waters of the United States that can be used to evaluate potential impacts of the proposed Maryland Wind project. Thus we primarily have results from research conducted on offshore wind projects in other countries available to evaluate potential impacts on the oceanographic and atmospheric environment, and potential subsequent effects on protected species and their prey. Results of in-situ research, and modeling and simulation studies, show that offshore wind facilities can reduce wind speed and wind stress which can lead to less mixing, lower current speeds, and higher surface water temperature (Afsharian et al. 2020); increase localized vertical mixing due to the turbulence from the wakes produced from water flowing around turbine foundations (Miles, Martin, and Goddard 2017, Schultz et al. 2020); cause wind wakes that will result in detectable changes in vertical motion and/or structure in the water column (upwelling and downwelling) (Christiansen & Hasager 2005, Broström 2008); and result in detectable sediment wakes downstream from a wind farm by increased turbidity (Vanhellemont and Ruddick, 2014). We have considered if these factors could result in disruption of prey aggregations, primarily of planktonic organisms transported by currents such as copepods and gelatinous organisms (salps, ctenophores, and jellyfish medusa).

This possible effect is primarily relevant to North Atlantic right whales, giant manta rays, and leatherback sea turtles as their planktonic prey (calanoid copepods and gelatinous organisms) are the only listed species' prey in the region whose aggregations are primarily driven by hydrodynamic processes. As aggregations of plankton, which provide a dense food source for listed species to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities for listed species. As aggregations of zooplankton, which provide a dense food source for North Atlantic right whales to efficiently feed upon, are concentrated by physical and oceanographic features, increased mixing may disperse aggregations and may decrease efficient foraging opportunities for North Atlantic right whales. Increased mixing may also increase the nutrient supply to the upper water column and in turn cause phytoplankton blooms, thus creating a food source for zooplankton. Potential effects of hydrodynamic changes in prey aggregations are specific to listed species that feed on plankton, whose movement is largely controlled by water flow, as opposed to other listed species which eat fish, cephalopods, crustaceans, and marine vegetation, which are either more stationary on the seafloor or are more able to move independent of typical ocean currents. Prey aggregations may also be influenced by the physical presence of turbine foundations and subsequent reef effect; this is considered in section 7.4.3.2. Based on the best available scientific information cited and assessed herein, we do not expect the scope of oceanographic, atmospheric, or hydrodynamic effects from the proposed Maryland Wind project to be large enough to influence regional conditions that could affect the distribution of prey, mainly plankton, or conditions that aggregate prey in the broader Mid-Atlantic Bight region or within or around the Maryland Wind WDA in a way that would have adverse effects on ESA listed species that are reasonably certain to occur. We expect individual turbine/near-field effects to be the primary drivers of changes in zooplankton distribution with potential effects occurring due to far-field effects from energy extraction in the lee of the WFA. We expect localized impacts to oceanic conditions to extend tens of kilometers from the outermost row of foundations in the Maryland Wind lease area that would vary directionally based on the direction of the wind and flow of water (Gill et al. 2020, Christiansen et al. 2022, Floeter et al. 2022). However, given the limited right whale foraging that is expected to occur in and around the WDA, and the currently available information, we are not able to determine that any local disruptions would result in adverse effects to foraging right whales. We do not expect the construction and operation of the Maryland Wind project to alter broad regional current patterns, and thus expect any alteration of the biomass of plankton in the region, and therefore, the total food supply, to be so small that adverse effects on ESA listed species are extremely unlikely to occur and are therefore, discountable.

Although uncertainty remains as to the magnitude and intensity of effects offshore wind farms may have on altering oceanographic processes, studies demonstrate increased turbulence may occur in the wake of turbine (and OSS) foundations. These turbulence wakes have been detected up to 300 m from the turbine foundation (Miles, Martin, and Goddard 2017, Schultz et al. 2020). Peak turbulence area is expected within the distance equivalent to the diameter of a single monopole, with turbulence measurable (greater than 5% above background) within a distance equivalent to 8-10 times the diameter of a single monopole (Miles, Martin and Goddard 2017), for the Maryland Wind project that would be a distance of 80 to 110 m. We would expect that any effects on the distribution of prey due to turbulence from the foundation would be limited to the area where changes in turbulence would be experienced. These anticipated localized changes down-current of the foundations of the wind turbines could result in localized changes in plankton distribution and abundance within discrete areas of the Maryland Wind WFA extending up to 300 m down-current from each foundation (Floeter et al. 2017). The wind facilities measured in Floeter et al. employed tripod/tri-pile foundations; due to their open structure, the tripod/tri-pile foundations may not produce a wake effect as long as monopiles. Based on the spacing of the turbines (1.43 km x 1.89 km), the available information suggests limited opportunity for these areas to interact and overlap which is expected to limit the impact of the distribution of plankton to small, discrete areas within the WFA. Based on the available information, we do not expect the changes from the Maryland Wind project to affect the oceanographic forces transporting zooplankton into the area; therefore, while there may be changes in the distribution of plankton within the WFA, we do not expect any overall reduction in biomass of plankton. Thus, because we do not anticipate any change in the biomass of zooplankton, we do not anticipate any higher trophic level impacts; that is, we do not anticipate any associated effects to gelatinous organisms, pelagic fish, or benthic invertebrates that depend on plankton as forage.

As noted above, right whales are obligate zooplanktivores in the actionarea, feeding exclusively on copepods, which are primarily aggregated by physical and oceanographic features. Based on observations of right whales and abundance of C. finmarchicus, Record et al. (2019) hypothesized that a 40,000 m2 threshold for C. finmarchicus represents the regional copepod abundance at which high-density, exploitable, small-scale patches within a region are likely to occur. Mayo and Marx (1990) and Murison and Gaskin (1989) estimated the immediate decision-making threshold for right whale feeding to be approximately 1,000 m3 for Cape Cod Bay and the Bay of Fundy, respectively. Kenney et al. (1986) estimated the minimum concentrations necessary for right whale feeding to provide a net energetic benefit over the long term to be in the 105–106 m3 range. While we do not expect the US Wind WTGs and the foundations to affect the abundance of copepods in the WFA or any broader area, the distribution of copepods in the WFA footprint may be affected; however, given the limited foraging by right whales in the WFA and surrounding area that may be affected by changes in ecological conditions, any limited impacts on the distribution of copepods would have effects on right whales that are so small that they cannot be meaningfully measured, evaluated, or detected and thus insignificant. Similarly, we do not expect any changes in the abundance of leatherback sea turtle's jellyfish prey, and anticipate that any changes in distribution of jellyfish would have effects on leatherbacks that are so small that they cannot be meaningfully measured, evaluated, or detected and thus insignificant. We do not anticipate a larger disruption to conditions that would aggregate prey in the lease area due to the small scale of the project and the distance from frontal features.

Given the localized and patchy effects anticipated to the distribution and aggregation of prey, and that we do not expect any overall reduction in the amount of prey in the action area, any effects to foraging individual right whales, giant manta rays, or leatherback sea turtles are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant. Atlantic sturgeon in the marine environment primarily feed on benthic invertebrates and small fish such as sand lance, which are either free swimming or live on the seafloor. Hydrodynamic effects are not likely to impact the distribution or availability of their prey, and any effects to Atlantic sturgeon are extremely unlikely to occur and are thus discountable. Effects to the benthic prey base of green, Kemp's ridley, and loggerhead sea turtles are also extremely unlikely to occur and are thus discountable. Fin and sei whales feed on both small schooling fish and zooplankton, including copepods. We expect the Maryland Wind project to have localized effects on the distribution and aggregation of zooplankton prey species as described above; however, we do not expect any overall reduction in the amount of prey in the action area. Any effects to individual fin and sei whales are expected to be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant. We do not expect any impacts to the abundance or distribution of the cephalopods on which sperm whales forage as these prey typically occur further offshore and are free swimming. As no effects to sperm whale prey are anticipated, we do not expect any effects to sperm whales.
We note that as the scale of offshore wind development in the Mid-Atlantic Bight increases and the area occupied by wind turbines increases, the scope and scale of potential hydrodynamic impacts may also increase and influence the environmental baselines for future projects. We also note that development outside of this area (i.e., the MA-RI WEAs, Gulf of Maine) could affect regional patterns of zooplankton distribution, including copepods. Our Biological Opinions prepared for the Vineyard Wind 1, South Fork, Ocean Wind 1, Revolution Wind, Empire Wind, Sunrise Wind, Atlantic Shores South, CVOW, and New England Wind Projects (i.e., the commercial scale wind projects in the action area) assessed the construction, operation, and decommissioning of each project and concluded that there may be localized changes in the respective lease areas and surrounding waters within a few hundred meters to tens of kilometers down-current/downwind of the foundations and WTGs, with effects on zooplankton prey limited to the area within a few hundred meters of each foundation. As noted in the Environmental Baseline, offshore wind development to the north and south of the Maryland Wind WDA is underway. The closest lease areas for which projects have completed ESA section 7 consultation are the CVOW-C project, located approximately 190 km to the south of the Maryland Wind project and the Ocean Wind 1 project, located approximately 75 km to the north. Once built we expect that these projects will be too far away for oceanographic, hydrodynamics, or atmospheric effects to be experienced in the US Wind WFA. Therefore, while in the future there may be addictive effects resulting from the buildout of multiple adjacent lease areas, the conclusions

reached in this analysis do not change when considering the effects in the context of the *Environmental Baseline*.

7.5 Effects of Marine Resource Survey and Monitoring Activities

US Wind will carry out survey and monitoring activities in and near the WDA. As described in Section 3.0 of this Opinion, these will include a commercial ventless pot survey and a recreational charter fisheries survey designed to monitor black sea bass availability; and deployment of PAM buoys or autonomous PAM devices to record ambient noise and characterize the presence of protected species, specifically marine mammals. We note that some of the surveys and monitoring activities described in the BA and considered in this Opinion may be funded or otherwise supported by US Wind and carried out by other entities; however, they are considered effects of the proposed action as they would not occur but for BOEM's proposed approval of US Wind's COP and are reasonably certain to occur.

In this section, we consider the effects of the marine resource survey and monitoring activities on listed species in the action area by describing the effects of interactions between listed species and proposed survey gear and the other sampling and monitoring methodologies, and then analyze risk and determine likely effects to sea turtles, listed whales, giant manta rays, and Atlantic sturgeon. Section 7.1 of the Opinion addresses the effects of noise during surveys, including HRG surveys; as noted there, the operating frequencies of the SSS and MBES equipment proposed for use in the benthic monitoring mean that no effects to ESA listed species will occur even if individuals are exposed to the noise from that equipment. Effects of Project vessel operations (e.g. increased vessel transit and traffic), including the operations related to vessels that will be used for survey and monitoring activities, are considered in Section 7.2, above, and are not repeated here.

7.5.1 Assessment of Effects of Benthic Monitoring, Acoustic Telemetry Monitoring, PAM, and SAV Monitoring

Passive Acoustic Monitoring

PAM is used to measure, monitor, record, and determine the sources of sound in underwater environments. Moored PAM systems or autonomous PAM devices will be used prior to, during, and following construction. PAM will be used to characterize the presence of marine mammals through passive detection of vocalizations, and will be used to record ambient noise, project vessel noise, pile driving noise, and WTG operational noise. Moored PAM systems are stationary and may include platforms that reside completely underwater with no surface expression (i.e., HARPs, high-frequency acoustic recording packages) or may consist of buoys (at the surface) connected via a data and power cable to an anchor or bottom lander on the seafloor. Moored PAM systems will use the best available technology to reduce any potential risks of entanglement and deployment will comply with best management practices designed to reduce the risk of entanglement in anchored monitoring gear (see Appendix B of NMFS 2021a, Appendix C to this Opinion). For moored PAM systems, there are cables connecting the hydrophones and/or buoy to the anchor or lander; however, entanglement is extremely unlikely to occur. The cables associated with moored systems have a minimum bend radius that minimizes entanglement risks and does not create loops during deployments, further minimizing entanglement risks. There are no records of any entanglement of listed species in moored PAM systems, and we do not anticipate any such entanglement will occur. The risk of entanglement of any ESA-listed species with moored PAM systems is extremely unlikely to occur and thus discountable.

Mobile systems may include autonomous PAM devices that may operate at the surface or operate throughout the water column. These vehicles produce virtually no self-generated noise and travel at slow operational speeds (~0.25 m/s) as they collect data. Moored and mobile systems will be deployed and retrieved by vessels; maintenance will also be carried out from vessels. Potential effects of vessel traffic for all activities considered in this consultation are addressed in Section 7.2. The small size and slow operational speeds of mobile PAM systems make the risk of a collision between the system and a listed species extremely unlikely to occur. Even in the extremely unlikely event that a whale, sea turtle, or Atlantic sturgeon bumped into the mobile PAM system, it is extremely unlikely that there would be any consequences to the individual because of the relative lightweight of the mobile PAM system, slow operating speeds, small size, and rounded shape.

Based on the analysis herein, it is extremely unlikely that any ESA listed species will interact with any PAM system; any effects to ESA listed species of the PAM monitoring are extremely unlikely to occur and are therefore, discountable.

Biotelemetry Survey

As part of the TailWinds project funded by US Wind, six acoustic receivers will be deployed within and adjacent to the Maryland Wind lease area and will receive maintenance in six-month intervals. Data collected through these receivers will be made available through the Mid-Atlantic Acoustic Telemetry Observation System online portal (https://matos.asascience.com/project/detail/240). This monitoring effort is designed to detect the presence of tagged fish species within the vicinity of the project area; however, no new tagging of fish species is proposed within this monitoring effort. Operationally, the acoustic receiver devices just record the presence of nearby tagged animals. No listed species will be tagged as part of this monitoring effort.

For moored acoustic receivers, there are cables connecting the hydrophones and/or buoy to the anchor or lander; however, entanglement is extremely unlikely to occur. The cables associated with moored systems have a minimum bend radius that minimizes entanglement risks and does not create loops during deployments, further minimizing entanglement risks. There are no records of any entanglement of listed species in moored acoustic systems, and we do not anticipate any such entanglement will occur. Entanglement of any ESA-listed species with these moored telemetry systems is extremely unlikely to occur and thus discountable.

Other Buoy Deployments

BOEM has indicated that one or more data collection buoys, including MetOcean buoys, may be deployed in the WDA to provide weather and other data in the project area. Best management practices for moored buoys used for data collection associated with offshore wind projects are described in the June 29, 2021 informal programmatic consultation between NMFS/GARFO and BOEM on certain geophysical and geotechnical survey activities and data collection buoy deployment (see Appendix C of this Opinion). The minimization measures in Appendix C are incorporated as elements of the proposed action for this opinion. BOEM has indicated that any data collection buoys deployed as part of the Maryland Wind project will be consistent with the best management practices and project design criteria included in the June 2021 consultation. Therefore, consistent with the conclusions of the 2021 programmatic, we expect any effects to ESA listed species to be extremely unlikely to occur and therefore, discountable.

7.5.2 Assessment of Risk of Interactions with Trap Surveys

As described in Section 3.0, ventless trap/pot gear will be used in a BAG as well as a BACI sampling design to evaluate changes in the distribution and abundance of black sea bass in the Maryland Wind WFA and adjacent reference areas in the Maryland Wind WDA. The commercial pot survey consists of rigs of 15 commercial pots each, with pots spaced proximate and distant to turbine structures to capture both turbine- and project-scaled changes in BSB catch rates. Monthly pot surveys (March through November) of six rigs (four in the Project area and two in an adjacent control area) will be conducted. Prior to each monthly survey, a subset of four project and two control sites will be randomly selected from all possible turbine and control sites. Pots will be soaked for a single night (<24 hours) and retrieved. Upon pot retrieval, black sea bass would be counted and measured for total length and weight, and for a retained subsample of fish, data is collected in the laboratory for sex, diet, and condition index. All other species would be identified to the lowest taxon possible and enumerated. Each trawl will be comprised of unbaited ventless traps. All trap gear will follow all applicable regulations and also employ "ropeless" methodology, which will eliminate vertical lines and surface buoys except for when trap trawls will be hauled to the surface by the vessel conducting the survey. No wet storage of trap gear is proposed; as such, the gear will be removed from the water between survey periods and at the end of the survey season.

ESA Listed Whales

Factors Affecting Interactions and Existing Information on Interactions

Any line in the water column, including line resting on or floating above, the seafloor set in areas where whales occur, theoretically has the potential to entangle a whale (Hamilton et al. 2019, Johnson et al. 2005). Entanglements may involve the head, flippers, or fluke; effects range from no apparent injury to death. Large whales are generally vulnerable to entanglement in vertical and groundlines associated with trap/pot gear.

The general scenario that leads to a whale becoming entangled in gear begins with a whale encountering gear. It may move along the line until it comes up against something such as a buoy or knot. When the animal feels the resistance of the gear, it is likely to thrash, which may cause it to become further entangled in the lines associated with gear. The buoy may become caught in the whale's baleen, against a pectoral fin, or on some other body part. Consistent with the best available information on gear configurations to reduce entanglement risk, all applicable gear modifications and amendments and risk reduction measures will be consistent with the requirements and regulations implementing the Atlantic Large Whale Take Reduction Plan (50 CFR Parts 229 and 697). As explained above, there will be no vertical lines attached to the survey gear; thus, there will be no lines between the bottom and the surface. The only lines associated with the surveys will be the sinking groundlines resting on the bottom that are attaching traps together in a trawl. We note that neither the BA or the survey plan describe any other vertical lines associated with the survey and any modification to include traditional vertical lines, either attached to the survey gear or adjacent or alongside it to "mark" the location is not considered here. Any such change to the proposed action would require reinitiation of this consultation.

Sei and Sperm Whales
Sei and sperm whales typically occur in deep, offshore waters near or beyond the continental shelf break; this is well offshore of where the trap and pot surveys will take place. Records of observed sei and sperm whale entanglements are limited due to their offshore distribution, while this may reduce the potential for observations it also reduces the overlap between many fisheries and these species. From 2016-2020, in the western North Atlantic there was 1 mortality, 1 serious injury, and 1 non-serious injury from entanglement for sei whales and no documented interactions between fishing gear and sperm whales (Henry et al. 2022). Although entanglements have been documented for sei whales, the fishing gear in these cases involved the use of buoys/vertical lines which pose a much higher risk to all whale species as the line is present in the entire water column. The use of ropeless gear with only sinking groundlines, greatly reduces any risk to sei and sperm whales given the line is in contact with the seafloor. These species are also rare in the survey area and thus potential for co-occurrence is low.

In order for a sei or sperm whale to be vulnerable to entanglement in the trap survey gear, the whale would have to first co-occur in time and space with that gear, that is it would need to be in the same area that the traps are being fished and the whales would need to be moving along the seafloor and interact with the groundline with either their open mouth, flippers, or tail. During retrieval of each trap trawl, the survey vessel would be hauling gear and thus the groundline connecting to each trap would be in the water column at this point, however, this would only be for a short time (minutes) as the gear is being actively hauled. As the survey vessels will have a lookout for protected species, no gear would be retrieved or deployed if protected species are observed, thus further reducing any risk for interaction while the gear is being hauled. Given the rarity of sei and sperm whales in the survey area, the relatively small amount of gear (6 rigs with 15 pots per rig) that will be utilized over the course of five years, and ropeless trap gear (with no vertical lines or buoys) that will be used and thus require a sei or sperm whale to physically interact with the groundline resting on the seafloor, it is extremely unlikely that a sei or sperm whale would encounter this gear; therefore, effects are discountable. We do not expect the entanglement of any sei or sperm whales to occur in the gear set for US Winds' ventless trap surveys.

Fin and North Atlantic Right Whales
Fin whales and North Atlantic right whales may occur year round in the area where the trap surveys will take place. As discussed above in Section 6.1, feeding fin whales are most likely to occur in the area from March to October based on sand lance availability; however, the species occurs in all months with non-sequential peaks in density. North Atlantic right whales are most likely to occur in the area from December through April, with the highest probability of occurrence extending from January through April. The trap survey, which will result in gear set intermittently from March – November, will predominantly occur at the time of year when the lowest numbers of right whales occur in the survey area, through the beginning of the survey period will overlap with the months where North Atlantic right whales are likely to be migrating through the region.

The Environmental Impact Statement (EIS) prepared for the Atlantic Large Whale Take

Reduction Plan (ALWTRP EIS, NMFS 2021b) determined that entanglement in commercial fisheries gear represents the highest proportion of all documented serious and non-serious incidents reported for fin whales and right whales. Entanglement risk primarily occurs with the vertical line of trap/pot gear, but groundlines also pose a risk as right whales have been shown to utilize the entire water column (Hamilton and Kraus 2019). Fin whales may also use the entire water column, however, they are not known to feed right above the seafloor given their feeding mechanism (lunge feeding) and prey (small schooling fish, krill) (Friedlaender et al. 2020). For a fin or right whale to interact with the groundline, it must also interact with the seafloor. In an analysis of the North Atlantic right whale photo-identification catalog, sightings of right whales with seafloor sediment on their bodies showed that between 1980 and 2016, there were 2,053 detections of right whales with 'mud' on their bodies. Although these sightings were throughout their range and in all months, 92.7% of all detections occurred in the Bay of Fundy in the summer (Hamilton and Kraus 2019). Right whale dive behavior demonstrates that whales may be feeding just above the seafloor at times (Baumgartner et al. 2017). There are no records of fin whale entanglements in groundlines. Entanglement in the groundline of trap/pot gear is rare for right whales, as it requires the animal to maneuver themselves under the groundline and then wrap themselves. The use of sinking groundline makes this even less likely to occur.

In order for a fin or right whale to be vulnerable to entanglement in the trap survey gear, the whale would have to first co-occur in time and space with that gear, that is it would need to be in the same area that the traps are being fished and the whales would need to be moving along the seafloor and interact with the groundline with either their open mouth, flippers, or tail in a way that resulted in entanglement. Fin whales are common throughout the Mid-Atlantic region during the time of year the trap surveys will be conducted, however, fin whales are not known to interact with the seafloor when they feed, and there have not been any interactions of fin whale entanglements in groundlines. During the time of year when the trap surveys will be conducted (March-November), right whales are at their lowest density in the areas where the trap surveys will be conducted. The species has been detected acoustically in every month of the year in the vicinity of the Maryland WEA, though the highest presence occurred from November through April (Bailey et al. 2018). The species is less commonly observed in the region during July, August, and September when they are more likely to be in northern feeding grounds. Thus, we expect few instances of overlap in space/time between right whales and the survey gear. Additionally, as established above, entanglement would require an individual to move at least part of its body underneath the sinking groundline and become wrapped.

During retrieval of each trap trawl, the survey vessel would be hauling gear and thus the groundline connecting to each trap would be in the water column at this point, however, this would only be for a short internment time as the gear is being actively hauled. As the survey vessels will have a lookout for protected species, no gear would be retrieved or deployed if protected species are observed, thus further reducing any risk for interaction while the gear is being hauled.

Given the small amount of gear 12 total trawls (BAG survey design) with 6 rigs periodically deployed 18 times per year that will be utilized over the course of five years, the ropeless trap gear (with no vertical lines or buoys) that will be used and thus require a fin or right whale to physically interact with the groundline resting on the seafloor, the fact that no fin whale entanglements in groundlines have been reported, and the time of year when surveys will occur is when right whale occurrence is lowest in the survey area, it is extremely unlikely that a fin or right whale would encounter this gear and effects are discountable. No entanglement or other interactions between right or fin whales and the ventless trap survey gear is anticipated.

Effects to Prey

The proposed trap survey activities will not have any effects on the availability of prey for right, fin, sei, and sperm whales. Right whales and sei whales feed on copepods (Perry et al. 1999). Copepods are very small organisms that will pass through trap/pot gear rather than being captured in it. Similarly, fin whales feed on krill and small schooling fish (e.g., sand lance, herring, mackerel) (Aguilar 2002). The size of the trap/pot gear is too large to capture any fish that may be prey for listed whales. Sperm whales feed on deep water species that do not overlap with the study area where trap and pot activities will occur.

Sea Turtles

Factors Affecting Interactions and Existing Information on Interactions

Available entanglement data for sea turtles indicate they may be vulnerable to entanglement in trap/pot gear, primarily the vertical lines; however, the trap gear used for the US Wind survey will not use vertical lines. Thus the only entanglement risk to sea turtles is the sinking groundline. Sea turtles in the survey area are too big to be caught in the traps themselves since the vents/openings leading inside are far smaller (5 inches) than any of these species. Given data documented in the GAR STDN database, leatherback sea turtles seem to be the most vulnerable turtle to entanglement in vertical lines of fixed fishing gear in the action area. Long pectoral flippers may make leatherback sea turtles more vulnerable to entanglement. In 2007, a leatherback sea turtle was entangled in the lines connecting whelk pots (GAR STDN, unpublished data).

Leatherbacks entangled in fixed gear are often restricted with the vertical buoy line wrapped tightly around the flippers multiple times suggesting entangled leatherbacks are typically unable to free themselves from the gear (Hamelin et al. 2017). Leatherback entanglements in trap/pot gear may be more prevalent at certain times of the year when they are feeding on jellyfish in nearshore waters (i.e., Cape Cod Bay) where trap/pot fishing gear is concentrated. Hard-shelled turtles also entangle in vertical lines of trap/pot gear. Due to leatherback sea turtles' large size, they likely have the strength to wrap fixed fishing gear lines around themselves, whereas small turtles such as Kemp's ridley or smaller juvenile hard-shelled turtles likely do not. However, entanglement in the groundline of trap/pot gear is rare as it requires the animal to maneuver themselves under the groundline and then wrap themselves.

Records of stranded or entangled sea turtles show entanglement of trap/pot lines around the neck, flipper, or body of the sea turtle; these entanglements can severely restrict swimming or feeding (Balazs 1985). Constriction of a sea turtle's neck or flippers can lead to severe injury or mortality. While drowning is the most serious consequence of entanglement, constriction of a sea turtle's flippers can amputate limbs, also leading to death by infection or to impaired foraging or swimming ability. If the turtle escapes or is released from the gear with line attached, the flipper may eventually become occluded, infected, and necrotic. Entangled sea turtles can also be more vulnerable to collision with boats, particularly if the entanglement occurs at or near the surface (Lutcavage et al. 1997).

Estimating Interactions with Sea Turtles

Small turtles such as Kemp's ridley or smaller juvenile hard-shelled turtles likely do not have the strength to maneuver themselves under the groundline and then wrap themselves in it. Due to the size of Kemp's ridley and green sea turtles in the areas where the trap survey will be conducted, interactions with these species in the groundlines of the trap gear are extremely unlikely to occur.

Larger turtles such as loggerhead turtles or leatherback turtles may forage along the seafloor and have the strength to maneuver themselves under the groundline and then wrap themselves in it, however, given the groundline is in contact with the seafloor it is unlikely sea turtles would come in contact with it. This risk is further reduced by the small amount of gear that will be set and the short duration that it will be present. During retrieval of each trap trawl, the survey vessel would be hauling gear and thus the groundline connecting to each trap would be in the water column at this point, however, this would only be for a short internment time as the gear is being actively hauled. As the survey vessels will have a lookout for protected species, no gear would be retrieved or deployed if protected species are observed, thus further reducing any risk for interaction while the gear is being hauled. Based on this information, it is extremely unlikely that loggerhead or leatherback turtles will be captured or entangled in the trap gear deployed as part of the proposed surveys. Therefore, effects are discountable for all ESA-listed sea turtles and we do not expect any sea turtles to be entangled in the proposed trap survey.

Effects to Prey

Sea turtle prey items such as horseshoe crabs, other crabs, whelks, and fish may be removed from the marine environment as bycatch in trap/pot gear. None of these are typical prey species of leatherback sea turtles or of neritic juvenile or adult green sea turtles. Therefore, the US Wind trap survey will not affect the availability of prey for leatherback and green sea turtles in the action area. Neritic juveniles and adults of both loggerhead and Kemp's ridley sea turtles are known to feed on these species that may be caught as bycatch in the trap/pot gear. However, all bycatch is expected to be returned to the water alive, dead, or injured to the extent that the organisms will shortly die. Injured or deceased bycatch would still be available as prey for sea turtles, particularly loggerheads, which are known to eat a variety of live prey as well as scavenge dead organisms. Given this information, any effects on sea turtles from collection of potential sea turtle prey in the trap/pot gear will be so small that they cannot be meaningfully measured, detected, or evaluated and, therefore, effects are insignificant.

Atlantic Sturgeon

Factors Affecting Interactions and Existing Information on Interactions

Entanglement or capture of Atlantic sturgeon in trap gear is extremely unlikely. To become captured or entangled in the trap gear, sturgeon would either need to enter the trap or become wrapped in the sinking groundline between each trap. A review of all available information resulted in several reported captures of Atlantic sturgeon in trap/pot gear in Chesapeake Bay as part of a reward program for reporting Atlantic sturgeon in Maryland, yet all appeared to be juveniles no greater than two feet in length. Juvenile Atlantic sturgeon do not occur in the area where the US Wind surveys will take place. In addition, there has been one observed interaction, in 2006, on a trip where the top landed species was blue crab (NEFSC observer/sea sampling database, unpublished data). There is no evidence to suggest that sturgeon are susceptible to entanglement in ropes and line associated with stationary trap and pot fishing gear and there are no incidents of trap/pot gear captures or entanglements of sturgeon reported in ten federal fisheries ((1) American lobster, (2) Atlantic bluefish, (3) Atlantic deep-sea red crab, (4) mackerel/squid/butterfish, (5) monkfish, (6) Northeast multispecies, (7) Northeast skate complex, (8) spiny dogfish, (9) summer flounder/scup/black sea bass, and (10) Jonah crab fisheries). Baited stationary pots such as the commercial pots included in the FRMP are unlikely to pose a risk to Atlantic sturgeon; fish traps and pots were not recorded as potential sources for capture of Atlantic sturgeon in the Northeast Fisheries Observer Program data (Dunton et al. 2015). Atlantic sturgeon prey items, such as mollusks and fish; shortnose sturgeon prey items, such as mollusks and crustaceans; and giant manta ray prey items, such as small fish, may be removed from the marine environment as bycatch in trap gear. However, any bycatch prey items will be returned to the site.

Although Atlantic sturgeon may feed along the seafloor in the Maryland Wind WDA, we do not expect them to move beneath the sinking groundline and then wrap themselves in the groundline and become entangled. Based on this information, it is extremely unlikely that Atlantic sturgeon from any DPS will be captured or entangled in the trap gear deployed as part of the proposed surveys. Therefore, effects are discountable.

Giant Manta Rays

Giant manta rays are vulnerable to capture and entanglement in some fishing gear, including driftnet and purse seine fisheries (Croll et al. 2016; Lawson et al. 2017). The use of ropeless gear, which eliminates the use of buoy lines, is expected to eliminate the potential entanglement risk for any giant manta rays in the survey area. We do not expect them to move beneath the sinking groundline and then wrap themselves in the groundline and become entangled. Based on this information, it is extremely unlikely that any Giant manta rays will be captured or entangled in the trap gear deployed as part of the proposed surveys. No effects to Giant manta ray prey are anticipated. Therefore, effects of these surveys on Giant manta rays are discountable.

7.5.3 Assessment of Risk of Interactions with Recreational Fishing Surveys

Over 6 years, monthly angling surveys (May-October) will occur at two reference artificial reef sites and two sites where turbines are to be sited. The 6-year survey is divided into 2-year phases corresponding with a BAG design. In each year, six monthly surveys (May-October) will deploy standard angling techniques to obtain catch rates at two reference artificial reef sites and at two sites where turbine foundations will be constructed. For each month, one control and one turbine site will be visited per day across two days, with the order of site visits randomized within a day and all sites visited within a 2-day period. The fishing methods employed will be drift and jigging methods commonly used for black sea bass angling including clam/squid bait, 2-hook rig, 3/0 J-hooks, barrel swivels, and lead sinkers; the effort unit is a 3-minute drop (Cullen and Stevens 2020), with each site fished for 45 minutes (15 drops/angler). Anglers include the mate, a scientific crew, and a volunteer.

At each site, a jigging trial would be conducted by the mate upon arrival for a 15- minute period prior to the onset of the drift, near-bottom angling. During each survey, wind speed and direction, wave height, ranked classes of cloud cover, and bottom temperatures would be recorded and used as possible covariates in analysis of catch rates. Angler type would be recorded and evaluated for possible confounding effects (mate: high experience; scientist: moderate experience; volunteer: variable experience). Fish will be measured for condition on deck (stage of barotrauma, hooking injuries), length and weight, and, for a retained subsample of fish (10 per site and survey, preserved on dry ice), data will be collected in the laboratory for sex, diet, and condition index. Fish not retained and showing signs of barotrauma will be vented and returned to the water (Ruderhausen et al. 2020).

ESA Listed Whales and Sea Turtles and Fish

No effects to ESA-listed whales, sea turtles, and giant manta rays are anticipated to result from rod-and-reel sampling as the limited survey effort, short drop times, and avoidance of fishing at times and in areas where any protected species are detected will make any interactions extremely unlikely to occur. Rod-and-reel sampling poses a risk of capture for Atlantic sturgeon due to the baited hooks. Despite general concerns about the risk of capture via rod-and-reel for Atlantic sturgeon, we have determined that capture is extremely unlikely to occur. This is because of the limited amount of gear (3 anglers with 15 drops/angler at a site for 45 minutes), the short soak time (3 minutes per drop), and the normal behavior of Atlantic sturgeon as benthic oriented fish which results in limited occurrence in the water column where reel drops are expected to occur. Based on the analysis herein, it is extremely unlikely that any ESA-listed species will interact with the structure-associated fishes survey activities, and any effects to ESA-listed species because of structure-associated fishes surveys are extremely unlikely to occur.

7.5.4 Impacts to Habitat

Here we consider any effects of the proposed marine resource survey and monitoring activities on habitat of listed species. The black sea bass ventless pots will be set on the ocean floor, which could result in disturbance of benthic resources. Acoustic receivers and moored PAM systems may include a lander or anchor that would rest on the seafloor. However, the size of the area that would be disturbed by setting this gear is extremely small and any effects to benthic resources would be limited to temporary disturbance of the bottom in the immediate area where the gear is set. Although ventless pots will rest on the seafloor, Carmichael et al. (2015) found that traps/pots have little or low impact on bottom habitat. In an analysis of effects to habitat from fishing gears, mud and sand habitats were found to recover more quickly than coarser substrates (see Appendix D in NEFMC 2016, NEFMC 2020). No effects to any ESA listed species are anticipated to result from this small, temporary, intermittent, disturbance of the bottom sediments.

7.6 Consideration of Potential Shifts or Displacement of Fishing Activity

As described in section 7.2 (*Effects of Project Vessels*) the lease area and the area along the cable corridors support commercial and recreational fishing activity throughout the year at low to moderate levels compared to the larger surrounding region (Volume II, TRC COP 2023). Fishing activity includes a variety of fixed gear (e.g. gillnets, pot/traps) and mobile gear fisheries (e.g. trawl (bottom and mid-water) and dredge (clam and scallop)), as well as hook and line. A variety of species are targeted including sea scallops, summer flounder, scup, black sea bass, surfclam, ocean quahog, spiny dogfish, mackerel, squid, and butterfish (Volume II, TRC COP 2023). Fishing effort is highly variable due to factors including target species distribution and abundance, environmental conditions, fishing regulations, season, and market value. Within the Maryland Wind WDA, the scallop dredge was the primary commercial fishing gear utilized in terms of value (Volume II, TRC COP 2023). Bottom otter trawls (inshore and offshore) represented the primary gear in terms of vessels across the Mid-Atlantic region (Volume II, TRC COP 2023). The primary landed commercial species in tonnage for Maryland primarily come from inshore fisheries including blue crab, striped bass and oysters with additional significant species such as whelk, black sea bass, lobster, sea scallops, flounder species, monkfish, etc. (Appendix F2, TRC COP 2023). As addressed in sections 5 (*Status of the Species*) and 6 (*Environmental Baseline*) of this Opinion, interactions between fishing gear (e.g., bycatch, entanglement) and listed whales, sea turtles, giant manta rays, and Atlantic sturgeon occur throughout their range and may occur in the action area.

Here, we consider how a potential shift or displacement of fishing activity from the lease area and cable corridors, because of the proposed project, may affect ESA-listed whales, sea turtles, giant manta rays, and Atlantic sturgeon. As described in section 3.5.5 of the DEIS, potential impacts to fishing activities in the lease area and along the cable corridors during the construction phase of the proposed project are primarily related to accessibility (BOEM DEIS 2023). During the construction and decommissioning phases, potential effects to fishing operations include displacement of vessel transit routes and shifts in fishing effort due to disruption in access to fishing grounds in the areas where construction activities will occur due to the presence of Project vessels and construction activities. Impacts to fishing operations during the operational phase may result from changes in habitat conditions and perceived or real access challenges.

While changes in distribution and abundance of species targeted by commercial fisheries could occur during construction due to exposure to increased sediment, noise, and vibration, these effects are anticipated to be short-term and localized and not result in any changes in abundance or distribution of target species that would be great enough to result in changes in patterns of fishing activity. To the extent that construction has negative effects on the reproductive success of commercial fish species (e.g., longfin squid spawning), there is the potential for a decrease in fish abundance and future consequences on fishing activity. Impacts during the decommissioning phase of the Project are expected to be similar. Displacement of fishing vessels and shifts in operations during the construction and decommissioning phases that are related to a shift or change in target species distribution and abundance are expected. Although the magnitude of the shifts is unknown based on the natural variability of the fisheries, fisheries impacts related to habitat impacts are likely to be related to the footprint of temporary and permanent disturbance (168 acres of temporary disturbance in the inshore portion of the export cable, 34 acres of temporary disturbance for the offshore export cable, 30 acres of temporary disturbance from the inter-array cable, and 74.8 acres of temporary disturbance from the foundation installations) impacted by construction or decommissioning and short construction and decommissioning periods (2-3 years each) (BOEM BA 2023).

During the operational phase of the project, the potential impacts to fishing activity are primarily anticipated from potential accessibility issues due to the presence and spacing of WTGs and the OSSs as well as potential avoidance of the inter-array and export cable routes due to concerns related to avoiding the potential for snags or other interactions with the cable or cable protection. Additionally, there may be localized impacts on the abundance and distribution of some target species due to changes in habitat conditions (e.g., foundations and scour protection, noise and vibration associated with turbine operations, consequences of reef effect resulting in changes in localized species composition). While there are no restrictions proposed for fishing activity in the WDA, the presence and spacing of structures (approximately 1x1 nautical miles) may impede fishing operations for certain gear types. Additionally, as explained in section 7.4, the structures will provide new hard bottom habitat in the WDA creating a "reef effect" that may attract fish and, as a result, fishermen, particularly recreational anglers and party/charter vessels. This could create vessel congestion and could dissuade commercial vessels from fishing among the structures.

The potential for shifts in fishing effort due to the proposed project is expected to vary by gear type and vessel size. Of the gear types that fish within the lease area and cable corridors are likely to encounter, bottom tending mobile gear is more likely to be displaced than fixed gear, with larger fishing vessels using dredges and trawl gear, including mid-water trawl gear, more likely to be displaced compared to smaller fishing vessels using similar gear types that may be easier to maneuver. However, even without any area use restrictions, there may be different risk tolerances among vessel captains that could lead to at least a temporary reduction in fishing effort in the lease area and along the cable corridors during construction and decommissioning activities, and longer-term reduction of fishing effort during the operational phase of the project. Space use conflicts due to displacement of commercial fishing activity from the lease area to surrounding waters could cause a temporary or permanent reduction in such fishing activities within the lease area and an increase in fishing activities elsewhere. Additionally, there could be increased potential for gear conflicts within the lease area as commercial fisheries and for-hire and private recreational fishing compete for space between turbines, especially if there is an increase in recreational fishing for structure-affiliated species attracted to the foundations (e.g., black sea bass). Fixed gear fisheries, such as the monkfish and spiny dogfish gillnet fishery, may resume or even increase fishing activity in the lease area and along the cable corridors shortly after construction because these fisheries are relatively static (i.e., relatively stationery in location), though there may be small shifts in gear placement to avoid areas very close to project infrastructure. Mobile fisheries, such as surfclam and sea scallop dredging and squid trawl fisheries may take longer to resume fishing activity within the lease area or along the cable corridors as the physical presence of the new Project infrastructure may alter the habitat, behavior of fishing vessels, and target species. However, for all fisheries, any changes in fishing location are expected to be limited to moves to nearby, geographically adjacent areas, particularly on the fringes of the lease area, given the distribution of target species and distance from home ports, all of which limit the potential for significant geographic shifts in distribution of fishing effort.

Fishing vessel activity (transit and active fishing) is high throughout the Mid-Atlantic Bight as a whole, with higher levels of effort occurring outside of the WDA than within the WDA (Section 17.5, Volume II, TRC COP 2023). The scale of the proposed Project (no more than 114 WTG foundations plus the OSSs and met tower) and the footprint of the lease area (approximately 80,000 acres, with project foundations and associated scour protection occupying only a small fraction of that) relative to the size of available fishing area are small. Fishing activity will not be legally restricted within the lease area and the proposed spacing of the turbines could allow for fishing activity to occur, depending on the risk tolerance of the operator and weather conditions. Any reduction in fishing effort in the lease area would reduce the potential for interactions between listed species and fishing gear in the lease area, yet any beneficial effect would be expected to be so small that it cannot be meaningfully measured, evaluated, or detected. Similarly, any effects to listed species from shifts of fishing effort to areas outside of the WDA are also expected to be so small that they cannot be meaningfully measured, evaluated, or detected. This is because any potential shifts are expected to be limited to small changes in geographic area and any difference in the risk of interaction between fishing gear and listed species is expected to be so small that it cannot be meaningfully measured, detected, or evaluated and are therefore insignificant.

As explained in Section 7.4 above, the presence of new structures (e.g., WTGs and OSS foundations) may also act as artificial reefs and could theoretically attract a range of species, including listed species such as sea turtles and sturgeon if the foundations serve to aggregate their prey. As explained in section 7.4, any changes in biomass around the foundations are expected to be so small and localized that they would have insignificant effects on the distribution, abundance, and use of the lease area by listed sea turtles or Atlantic sturgeon. We do not expect that any reef effect would result in any increase in species preyed on by giant manta rays, North Atlantic right, fin or sei whales and note that sperm whales are generally not expected to forage in the shallow waters of the lease area. As noted previously, we do not expect any effects on the distribution, abundance, or use of the lease area by ESA listed whales that would be attributable to the physical presence of the foundations.

This potential increase in biomass around the new structures of the Maryland Wind project may result in an increase in recreational anglers targeting structure affiliated fish species and subsequently may increase incidental interactions between recreational anglers and listed species. At the Block Island Wind Farm (Rhode Island), and at offshore wind farms in Europe, recreational fishermen have expressed a generally positive sentiment about the wind farm as an enhanced fishing location due to the structures as there are no other offshore structures or artificial reefs in surrounding waters (Hooper, Hattam & Austern 2017, ten Brink & Dalton 2018, Smythe, Bidwell & Tyler 2021). Interactions between listed species, particularly sea turtles, and recreational fishing do occur, especially in areas where target species and listed species co-occur (Rudloe & Rudloe 2005, Seney 2016, Swingle et al. 2017, Cook, Dunch & Coleman 2020). Listed sea turtles may be attracted to the structures of the foundations to forage and seek refuge and also may be attracted to bait used by anglers, depending on species.

The lease area supports a moderate level of recreational fishing activity, primarily in the summer (Volume II, TRC COP 2023). There are three wrecks present in the northern portions of the lease area that draw recreational fishing activity (Appendix F2, TRC COP 2023). If there is an increase in recreational fishing in the lease area, it is likely that this will represent a shift in fishing effort from areas outside the lease to within the lease and/or an increase in overall effort. Given the limited number of project foundations (114 WTGs plus OSSs and Met Tower) proposed to be installed and vessel safety concerns regarding being too close to foundations and other vessels, the likelihood of a significant number of recreational fishermen aggregating around the same turbine foundation at the same time is low. It is not likely that targeted recreational fishing pressure will increase to a point of causing a heightened risk of negative impact for any listed species; that is, effects will be so small that they cannot be meaningfully measured, evaluated, or detected and are, therefore, insignificant.

Whales colliding/hitting vessels, primarily recreational vessels engaged in fishing activities is uncommon to begin with, but can happen[44], primarily when prey of whales and species targeted by fishermen co-occur. As mentioned in section 7.4.3.1, it is expected whales will be able to transit the lease area freely given the spacing between turbine foundations and as explained in section 7.4.3.2, turbine foundations are not expected to cause an increase in prey that would then result in greater co-occurrence of prey, target species, whales, and vessels and thus risk of whales colliding with vessels engaged in fishing. We expect the risk posed to protected species from any shifts and/or displacement of recreational fishing effort caused by the action to be so small that they cannot be meaningfully measured, evaluated, or detected and are therefore, insignificant. For the same reasons, we do not expect any increased vessel strike risk from fishing vessels and Atlantic sturgeon or sea turtles.

In summary, we expect the risks of entanglement, bycatch, or incidental hooking interactions due to any shifts or displacement of recreational or commercial fishing activity caused by the proposed Project to be so small that they cannot be meaningfully measured, evaluated, or detected; therefore, effects to listed species are insignificant.

7.7 Repair and Maintenance Activities

US Wind personnel conducting O&M activities would access the lease area on an as-needed basis. With no personnel living offshore, the WTGs and OSS would be remotely monitored and controlled by the Supervisory Control and Data Acquisition (SCADA) system, which connects the WTGs to the OSS and the OSS to the Maryland Wind Export Cable-Interconnection Facility with fiber optic cables that would be embedded in the inter-array and export cables. Personnel would not be required to be present except to inspect equipment and conduct repairs. Effects of vessel traffic associated with repairs and maintenance during the operations phase is considered in Section 7.2 (*Effects of Project Vessels)* above. Effects of noise associated with project vessels and aircraft are addressed in Section 7.1 (Underwater Noise) above; these effects were determined to be insignificant.

Project components would be inspected within a 5-year timeframe. Underwater inspection would include visuals and eddy current tests conducted by divers or remotely operated vehicles. Effects of inspections and associated surveys are considered in sections 7.1 and 7.5 above. As described in the COP, US Wind expects that project components will undergo at least annual inspections, with routine/planned, and unanticipated maintenance occurring over the life of the project.

BOEM has indicated that given the burial depth of the inter-array cable and the Maryland Wind Cable-Offshore, displacement, or damage by vessel anchors or fishing gear is unlikely. Mechanical inspections of the Maryland Wind Export Cable would include a cable burial assessment and debris field inspection. US Wind would perform mechanical inspections on a 5-year basis or following a storm event that may necessitate an unplanned inspection. In the event that cable repair was necessary due to mechanical damage, it could be necessary to remove a portion of the cable and splice in a new section. We determined that acoustic and habitat based effects of cable installation would be insignificant or extremely unlikely to occur; as any cable

[44] https://boston.cbslocal.com/2021/07/13/block-island-whale-boat-rescue/

repair will essentially follow the same process as cable installation except in only a small portion of the cable route and for a shorter period of time, we expect that the effects will be the same or less and therefore would also be insignificant.

Based on our review of the planned repair and maintenance activities described in the BA, DEIS, and COP, no additional effects on listed species beyond those considered in the previous sections of this Opinion are anticipated to result from repair and maintenance activities over the life of the project (Volume I, TRC COP 2023).

7.8 Unexpected/Unanticipated Events

In this section, we consider the "non-routine activities and low probability events" that were identified by BOEM in the DEIS (section 2.3). These events, while not part of the proposed action, include collisions between vessels, allisions (defined as a strike of a moving vessel against a stationary object) between vessels and project structures (WTG, OSS, Met Tower), failure of WTGs or OSSs due to a weather event or seismic activity, and accidental spills.

7.8.1 Vessel Collision/Allision with Foundation

A vessel striking a wind turbine theoretically could result in a spill or catastrophic failure/collapse of the turbine. However, there are several measures in place that ensure such an event is extremely unlikely to occur. These include: inclusion of project components on nautical charts which would limit the likelihood of a vessel operator being unaware of the project components while navigating in the area; compliance with lighting and marking required by the USCG which is designed to allow for detection of the project components by vessels in the area; and, spacing of turbines to allow for safe navigation through the project area. Because of these measures, a vessel striking a turbine foundation or the OSS is extremely unlikely to occur. The Navigational Risk Assessment prepared for the project reaches similar conclusions and determined that it is highly unlikely that a vessel will strike a foundation and even in the unlikely event that such a strike did occur, the collapse of the foundation is highly unlikely even considering the largest/heaviest vessels that could transit the lease area. Therefore, based on this information, any effects to listed species that could theoretically result from a vessel collision/allision are extremely unlikely to occur and thus discountable.

7.8.2 Failure of WTGs due to Weather Event

As explained in the Maryland Wind COP (2023) and DEIS (section 2.3), US Wind designed the proposed Project components to withstand severe weather events. The WTGs are equipped with safety devices to ensure safe operation during their lifetime. These safety devices may vary depending on the WTG selected and may include vibration protection, over speed protection, and aerodynamic and mechanical braking systems, as well as electrical protection devices.

Few hurricanes pass through the Mid-Atlantic. The Lease Area experiences a return period of 15 to 20 years for hurricanes with wind speeds equal to or in excess of 64 knots (118.5 kilometers per hour [km/h]). The estimated return period for hurricanes with wind speeds equal to or in excess of 96 knots (177.8 km/h) is 44 to 68 years (Volume II, TRC COP 2023). The area is subjected to frequent Nor'easters that form offshore between Georgia and New Jersey, and typically reach maximum intensity in New England. These storms are usually characterized by winds from the Northeast, heavy precipitation, wind, storm surges, and rough seas. As described in the Navigation Safety Risk Assessment (DNV 2022, COP Appendix II-K1), winds are primarily directed from the southwest and northwest; however, fresh winds are exclusively from the west to northeast while gale winds come from the north to northeast. Highest wind speeds occur in the winter months and the annual average wind speed is 13.1 knots (DNV 2022, COP Appendix II-K1). Although hurricanes are relatively infrequent in the Mid-Atlantic, wave heights in the region of the lease area range between averages of .9 m and 1.4 m with lowest averages in the summer months while the maximum wave height recorded in the lease area was 8.4 m (28 m) (DNV 2022, COP Appendix II-K1). US Wind does not foresee a hazard to the integrity of WTGs due to ice accumulation because, should ice accumulate on WTG blades, the weight and center of mass of the blade would change causing an imbalance in the rotor. Should the rotor continue to rotate, it would vibrate, and vibrational sensors installed in the WTG would automatically trigger the WTG to shut down.

BOEM has indicated that the proposed WTGs will meet design criteria to withstand extreme weather conditions that may be faced in the future and include consideration of 50 and 100-year 10 minute wind speed values and ocean forces. The 50-year 10 minute wind speed is estimated to be 96 knots and the 100-year 10 minute wind speed is estimated to be 105 knots. (A 100-year 10-minute wind speed means there is a 1-percent chance of that event occurring in any given year, similarly a 50-year wind speed means there is a 2% chance of that happening in any given year.). The design will also be in accordance with various standards including International Electrotechnical Commission (IEC) 61400-1 and 61400-3. These standards require designs to withstand forces based on a 50-year return interval for the turbines, and 100-year return interval for electrical substation platforms. The requirements for extreme metocean loading are based on 50-yr return interval site-specific conditions for most operating load cases with a 500-yr abnormal "robustness" load case check (a 500-year event has a 0.2% chance of occurring in any given year). In the DEIS, BOEM states that the design standards are adequate even considering the predicted increase in hurricane activity that is anticipated to result from climate change (BOEM DEIS 2023).

Given that the project components are designed to endure wind and wave conditions that are far above the maximum wind and wave conditions recorded at the nearest weather monitoring buoy to the project, and exceed conditions for which there is only a 1% chance of occurring in any year (100-year event), it is not reasonable to conclude that project components will experience a catastrophic failure due to a weather event over the next 25 years. In other words, project components have been designed to withstand conditions that are not expected to occur more than once over the next 100 years (e.g., exceeding 100-year 10 minute wind speed values and ocean forces). As a catastrophic failure would require conditions that are extremely unlikely to occur, even considering projections of increased hurricane activity related to climate change projections over the next 25 years: any associated potential impacts to listed species are also extremely unlikely to occur and effects are discountable.

7.8.3 Failure of WTGs due to Seismic Activity

There are multiple fault lines within the vicinity of Maryland; however, none are known to be currently active. Since 1758, most of the recorded 70 earthquakes occurring within Maryland have been minor (less than or equal to magnitude 4: non-damaging but felt) (Maryland Geological Survey 2022). The distance between the project area and local fault lines is such that events such as fault rupture, where fault movements are significant enough to breach the surface (which only occurs in a portion of earthquakes) are unlikely to occur in the lease area; therefore, effects to listed species are extremely unlikely to occur and are discountable.

7.8.4 Oil Spill/Chemical Release

As explained in the Oil Spill Response Plan (OSRP) (Volume I, Appendix A, TRC COP 2023), the worst-case discharge scenario would be a structural failure of the offshore substation. The Maryland Wind Offshore Wind Farm would have up to about 158,460 gallons (636,521 liters) of coolants, oils, lubricants, and diesel fuel in its 114 WTG foundations and about 339,888 gallons (1,286,596 liters) of coolants, oils, lubricants, and diesel fuel in its 4 OSS foundations (COP, Volume I, Appendix A, Tables 7 and 8; TRC 2023 as cited in BOEM DEIS 2023). Accidental spills of these fluids could lead to short-term periods of hazardous air pollutant emissions. Both the WTGs and OSSs have been designed to have secondary containment with a capacity that is in excess of all identified oils, grease, and lubricants (Appendix A, TRC COP 2023). As explained above, catastrophic loss of any of the structures is extremely unlikely; therefore, the spill of oil from these structures is also extremely unlikely to occur. Modeling presented by BOEM in the BA (from Bejarano et al. 2013) indicates that there is a 0.01% chance of a "catastrophic release" of oil from the wind facility in any given year. Given the 25-year life of this project, the modeling supports our determination that such a release is extremely unlikely to occur.

The Bejarano et al. (2013) modeling indicates the only incidents calculated to occur within the life of the Proposed Action are spills of up to 90 to 440 gallons (340.7 to 1,665.6 liters) of WTG fluid or a diesel fuel spill of up to 2,000 gallons (7,570.8) with model results suggesting that such spills would occur no more frequently than once in 10 years and once in 10-50 years, respectively. However, this modeling assessment does not account for any of the spill prevention plans that will be in place for the project which are designed to reduce risk of accidental spills/releases. Considering the predicted frequency of such events (i.e., no more than 3 WTG fluid spills over the 25-year life of the WTGs and no more than one diesel spill over the life of the project), and the reduction in risk provided by adherence to USCG and BSEE requirements as well as adherence to the spill prevention plan both of which are designed to eliminate the risk of a spill of any substance to the marine environment, we have determined that any fuel or WTG fluid spill is extremely unlikely; as such, any exposure of listed species to any such spill is also extremely unlikely to occur and thus discountable.

7.9 Project Decommissioning

As described in the BA and DEIS, under 30 CFR Part 285 and commercial Renewable Energy Lease OCS-A 0490, US Wind would be required to remove or decommission all installations and clear the seabed of all obstructions created by the proposed Project within 2 years of the termination of its lease. All facilities would need to be removed 15 feet (4.6 meters) below the mudline unless otherwise authorized (30 CFR § 585.910(a)). The portion buried below 15 feet (4.6 meters) would remain, and the depression refilled with the temporarily removed sediment. BOEM expects that WTGs and the OSS would be disassembled and the piles cut below the mudline. US Wind would clear the area after all components have been decommissioned to ensure that no unauthorized debris remains on the seabed. A cable-laying vessel would be used to remove as much of the inter-array and Maryland Wind Export Cable transmission cables from the seabed as practicable to recover and recycle valuable metals. Cable segments that cannot be easily recovered would be left buried below the seabed or rock armoring.

Information on the proposed decommissioning is very limited and the information provided to us in the BA, DEIS, and COP limits our ability to carry out a thorough assessment of effects on listed species. Here, we evaluate the information that is available on the decommissioning. As described in the DEIS, prior to the expiration of the lease (or after completion of the commercial activities on the lease), US Wind would be required to submit a decommissioning application to BSEE. This would be subject to an approval process that is independent of the proposed COP approval. BOEM indicates in the DEIS that the approval process will include an opportunity for public comment and consultation with municipal, state, and federal management agencies. US Wind would need to obtain separate and subsequent approval from BOEM to retire any portion of the Proposed Action in place. Given that approval of the decommissioning application will be a discretionary Federal action, albeit one related to the present action, we anticipate that a determination will be made based on the best available information at that time whether reinitiation of this consultation is necessary to consider effects of decommissioning that are different from those considered here.

As described in section 7.0 of the COP, it is anticipated that the equipment and vessels used during decommissioning will likely be similar to those used during construction and installation (Volume I, TRC COP 2023). For offshore work, vessels would likely include cable laying vessels, crane barges, jack-up barges, larger support vessels, tugboats, crew transfer vessels, and possibly a vessel specifically built for erecting WTG structures. Effects of the vessel traffic anticipated for decommissioning are addressed in the vessel effects section of this Opinion. As described below, we have determined that all other effects of decommissioning will be insignificant.

As described in the COP prepared by TRC (2023), if cable removal is required, the first step of the decommissioning process would involve disconnecting the inter-array 66kV cables from the WTGs. Next, the inter-array cables would be pulled out of the J-tubes or similar connection and extracted from their embedded position in the seabed. In some places, in order to remove the cables, it may be necessary to jet plow the cable trench to fluidize the sandy sediments covering the cables. Then, the cables will be reeled up onto barges. Lastly, the cable reels will then be transported to the port area for further handling and recycling. The same general process will likely be followed for the 230-275 kV offshore export cable. If protective concrete mattresses or rocks were used for portions of the cable run, they will be removed prior to recovering the cable. We determined that acoustic and habitat based effects of cable installation would be insignificant or extremely unlikely to occur; as the cable removal will essentially follow the same process as cable installation except in reverse, we expect that effects will be the same and therefore would also be insignificant or extremely unlikely to occur.

Prior to dismantling the WTGs, they would be properly drained of all lubricating fluids, according to the established operations and maintenance procedures and the OSRP. Removed fluids would be brought to the port area for proper disposal and/or recycling. Next, the WTGs would be deconstructed (down to the transition piece at the base of the tower) in a manner closely resembling the installation process. The blades, rotor, nacelle, and tower would be sequentially disassembled and removed to port for recycling using vessels and cranes similar to those used during construction. It is anticipated that almost all of the WTG will be recyclable, except possibly for any fiberglass components. After removing the WTGs, the steel transition pieces and foundation components would be decommissioned.

Sediments inside the monopile could be suctioned out and temporarily stored on a barge to allow access for cutting. Because this sediment removal would occur within the hollow base of the monopile, no listed species would be exposed to effects of this operation. The foundation and transition piece assembly is expected to be cut below the seabed in accordance with the BOEM's removal standards (30 C.F.R. 250.913). The portion of the foundation below the cut will likely remain in place. Depending upon the available crane's capacity, the foundation/transition piece assembly above the cut may be further cut into several more manageable sections to facilitate handling. Then, the cut piece(s) would be lifted out of the water and placed on a barge for transport to an appropriate port area for recycling.

The steel foundations would likely be cut below the mudline using one or a combination of: underwater acetylene cutting torches, mechanical cutting, or a high pressure water jet. The OSS foundation piles will likely be removed according to the same procedures used in the removal of the WTG foundations.

In the BA, BOEM did not provide any estimates of underwater noise associated with pile cutting, and we did not identify any reports of underwater noise monitoring of pile cutting with the proposed methods. Hinzmann et al. (2017) reports on acoustic monitoring of removal of a met-tower monopile associated with the Amrumbank West offshore wind project in the North Sea off the coast of Germany. Internal jet cutting (i.e., the cutter was deployed from inside the monopile) was used to cut the monopile approximately 2.5 m below the mudline. The authors report that the highest sound levels were between 250 and 1,000 Hz. Frequent stopping and starting of the noise suggests that this is an intermittent, rather than continuous noise source. The authors state that values of 160 dB SELcum and 190 dB Peak were not exceeded during the jet cutting process. At a distance of 750 m from the pile, noise attenuated to 150.6 dB rms. For purposes of this consultation, and absent any other information to rely on, we assume that these results are predictive of the underwater noise that can be expected during pile removal during project decommissioning. As such, using these numbers, we would not expect any injury to any listed species because the expected noise levels are below the injury thresholds for whales, sea turtles, giant manta rays, and Atlantic sturgeon. We also do not expect any exposure to noise that could result in behavioral disturbance of sea turtles or whales because the noise is below the levels that may result in behavioral disturbance.

Any giant manta ray or Atlantic sturgeon within 750 m of the pile being cut would be exposed to underwater noise that is expected to elicit a behavioral response. Exposure to that noise could result in short-term behavioral or physiological responses (e.g., avoidance, stress). Exposure would be brief, just long enough to detect and swim away from the noise, and consequences limited to avoidance of the area within 750 m of the pile during the activity. As such, effects to Atlantic sturgeon or giant manta rays will be so small that they cannot be meaningfully measured, evaluated, or detected, and would be insignificant.

The sediments previously removed from the inner space of the pile would be returned to the depression left once the pile is removed. To minimize sediment disturbance and turbidity, a vacuum pump and diver or ROV-assisted hoses would likely be used. This, in combination with the removal of the stones used for scour protection and any concrete mattresses used along the cable route, would reverse the conversion of soft bottom habitat to hard bottom habitat that would occur as a result of project construction. Removal of the foundations would remove the potential for reef effects in the lease area. As we determined that effects of habitat conversion due to construction would be insignificant, we expect the reverse to also be true and would expect that effects of habitat conversion back to pre-construction conditions would also be insignificant.

7.10 Consideration of the Effects of the Action in the Context of Predicted Climate Change due to Past, Present, and Future Activities

Climate change is relevant to the *Status of the Species*, *Environmental Baseline*, *Effects of the Action*, and *Cumulative Effects* sections of this Opinion. In the *Status of the Species* section, climate change as it relates to the status of particular species is addressed. Rather than include partial discussion in several sections of this Opinion, we are synthesizing our consideration of the effects of the proposed action in the context of anticipated climate change here[45].

In general, waters in the Mid-Atlantic are warming and are expected to continue to warm over the 25-year life of the Maryland Wind project (considering construction, operations, and decommissioning). However, waters in the North Atlantic Ocean have warmed more slowly than the global average or slightly cooled. This is because of the Gulf Stream's role in the Atlantic Meridional Overturning Circulation (AMOC). Warm water in the Gulf Stream cools, becomes dense, and sinks, eventually becoming cold, deep waters that travel back equatorward, spilling over features on the ocean floor and mixing with other deep Atlantic waters to form a southward current approximately 1500 m beneath the Gulf Stream (IPCC 2021). Global surface temperatures reached 1.1°C above 1850-1900 levels in 2011-2020 (IPCC 2023) and 0.93°C for ocean temperatures. Globally averaged surface ocean temperatures are projected to increase by approximately 0.7 °C by 2030 and 1.4 °C by 2060 compared to the 1986-2005 average (IPCC 2014), with increases of closer to 2°C predicted for the geographic area that includes the action area. Data from the NOAA weather buoy closest to the lease area (44009) collected from 1984-2008 indicate a mean temperature range from a low of 5.56°C in the winter to a high of 24.33°C in the summer (Volume II, TRC COP 2023). Based on current predictions (IPCC 2014), this could shift to a range of 7.56°C in the winter to 26.33°C in the summer. Global mean sea level increased by 0.20 m between 1901 and 2018; the average rate of sea level rise was 1.3 mm/year between 1901 and 1971, increasing to 1.9 mm /year between 1971 and 2006, and further increasing to 3.7 mm/year between 2006 and 2018 (IPCC 2023). Sea level rise is expected to continue (IPCC 2023) and may affect salt water intrusion into rivers which may affect Atlantic sturgeon. Ocean acidification is also expected to increase over the life of the project (Hare et al. 2016) which may affect the prey of a number of ESA listed species. Ocean acidification is

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[45] The analysis presented here is made in consideration of NMFS Guidance for Treatment of Climate Change in NMFS ESA Decisions (updated 2023); available at: https://www.fisheries.noaa.gov/s3/2023-05/02-110-18-renewal-kdr.pdf

contributing to reduced growth or the decline of zooplankton and other invertebrates that have calcareous shells (Pacific Marine Environmental Laboratory [PMEL] 2020).

We have considered whether it is reasonable to expect ESA listed species whose northern distribution does not currently overlap with the action area to occur in the action area over the project life due to a northward shift in distribution. We have determined that it is not reasonable to expect this to occur. This is largely because water temperature is only one factor that influences species distribution. Even with warming waters we do not expect hawksbill sea turtles to occur in the action area because there will still not be any sponge beds or coral reefs that hawksbills depend on and are key to their distribution (NMFS and USFWS 2013). We also do not expect giant manta ray or oceanic whitetip shark to occur in the lease area. Oceanic whitetip shark are a deep-water species (typically greater than 184 m) that occurs beyond the shelf edge on the high seas (Young et al. 2018). Giant manta ray also occur in deeper, offshore waters and occurrence in shallower nearshore waters is coincident with the presence of coral reefs that they rely on for important life history functions (Miller and Klimovich 2017). Smalltooth sawfish do not occur north of Florida. Their life history depends on shallow estuarine habitats fringed with vegetation, usually red mangroves (Norton et al. 2012); such habitat does not occur in the lease area and would not occur even with ocean warming over the course of the proposed action. As such, regardless of the extent of ocean warming that may be reasonably expected in the action area over the life of the project, the habitat will remain inconsistent with habitats used by ESA listed species that currently occur south of the lease area. Therefore, we do not anticipate that any of these species will occur in the lease area over the life of the proposed action.

We have also considered whether climate change will result in changes in the use of the action area by Atlantic sturgeon, giant manta rays, or the ESA listed turtles and whales considered in this consultation. In a climate vulnerability analysis, Hare et al. (2016) concluded that Atlantic sturgeon are relatively invulnerable to distribution shifts. Given the extensive range of the species along nearly the entire U.S. Atlantic Coast and into Canada, it is unlikely that Atlantic sturgeon would shift out of the action area over the life of the project. If there were shifts in the abundance or distribution of sturgeon prey, it is possible that use of lease area by foraging sturgeon could become more or less common. However, even if the frequency and abundance of use of the lease area by Atlantic sturgeon increased over time, we would not expect any different effects to Atlantic sturgeon than those considered based on the current distribution and abundance of Atlantic sturgeon in the action area.

Use of the action area by sea turtles is driven at least in part by sea surface temperature, with sea turtles absent from the lease area and cable corridors from the late fall through mid-spring due to colder water temperatures. An increase in water temperature could result in an expansion of the time of year that sea turtles are present in the action area and could increase the frequency and abundance of sea turtles in the action area. However, even with a 2°C increase in water temperatures, winter and early spring mean sea surface temperatures in the lease area are still too cold to support sea turtles. Therefore, any expansion in annual temporal distribution in the action area is expected to be small and on the order of days or potentially weeks, but not months. Any changes in distribution of prey would also be expected to affect distribution and abundance of sea turtles and that could be a negative or positive change. It has been speculated that the nesting range of some sea turtle species may shift northward as water temperatures warm. Currently, nesting in the mid-Atlantic is extremely rare. In order for nesting to be successful, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings to survive when they enter the water. Predicted increases in water temperatures over the life of the project are not great enough to allow successful rearing of sea turtle hatchlings in the action area. Therefore, we do not expect that over the time-period considered here, that there would be any nesting activity or hatchlings in the action area. Based on the available information, we expect that any increase in the frequency and abundance of use of the lease area by sea turtles due to increases in mean sea surface temperature would be small. Regardless of this, we would not expect any different effects to sea turtles than those considered based on the current distribution and abundance of sea turtles in the action area. Further, given that any increase in frequency or abundance of sea turtles in the action area is expected to be small we do not expect there to be an increase in risk of vessel strike above what has been considered based on current known distribution and abundance.

Giant manta rays are present in the Mid-Atlantic and are regularly cited during surveys (Farmer et al. 2022). Records north of Cape Hatteras were concentrated during the summer months (mainly June through September) and showed use of the outer continental shelf, slope, and nearshore waters while the majority of sightings occurred on the shelf and in proximity to the slope edge (Farmer et al. 2022). Farmer et al. (2022) also reported giant manta ray sightings in bays and estuaries in the southern U.S. and Gulf of Mexico. The detection information was used to model potential distribution, which showed preference for sea surface temperatures from 63°F to 90°F (17°C to 32°C), with a strong affinity for thermal fronts (Farmer et al. 2022). As expected from the sighting records, the model predicted the highest probability of occurrence north of Cape Hatteras during warmer months when water temperatures are highest (May to October). Forward predictions by the model show a northward shift for this species distribution through 2024 (Farmer et al. 2022). This indicates that giant manta rays are likely to be present in the area and that presence could increase as the populations shift northward. Given the extensive range of the species along the southern U.S. Atlantic Coast and the observed northward shifts, it is unlikely that giant manta rays would shift out of the action area over the life of the project. If there were shifts in the abundance or distribution of the zooplankton that serve as their prey, it is possible that use of lease area by foraging manta rays could become more or less common. However, even if the frequency and abundance of use of the lease area by giant manta rays increased over time, we would not expect any different effects to giant manta rays than those considered based on the current distribution and abundance of giant manta rays in the action area.

The distribution, abundance and migration of baleen whales reflects the distribution, abundance and movements of dense prey patches (e.g., copepods, euphausiids or krill, amphipods, shrimp), which have in turn been linked to oceanographic features affected by climate change (Learmonth et al. 2006). Changes in plankton distribution, abundance, and composition are closely related to ocean climate, including temperature. Changes in conditions may directly alter where foraging occurs by disrupting conditions in areas typically used by species and can result in shifts to areas not traditionally used that have lower quality or lower abundance of prey.

Climate change is unlikely to affect the frequency or abundance of sperm whales in the action area. The species rarity in the lease area is expected to continue over the life of the project due to the depths in the area being shallower than the open ocean deep-water areas typically frequented by sperm whales and their prey. Two of the significant potential prey species for fin whales in the lease area are sand lance and Atlantic herring. Hare et al. (2016) concluded that climate change is likely to negatively impact sand lance and Atlantic herring but noted that there was a high degree of uncertainty in this conclusion. The authors noted that higher temperatures may decrease productivity and limit habitat availability. A reduction in small schooling fish such as sand lance and Atlantic herring in the lease area could result in a decrease in the use of the area by foraging fin whales. The distribution of copepods in the North Atlantic, including in the lease area, is driven by a number of factors that may be impacted by climate change. Record et al. (2019) suggests that recent changes in the distribution of North Atlantic right whales are related to recent rapid changes in climate and prey and notes that while right whales may be able to shift their distribution in response to changing oceanic conditions, the ability to forage successfully in those new habitats is also critically important. Warming in the deep waters of the Gulf of Maine is negatively impacting the abundance of *Calanus finmarchicus*, a primary prey for right whales. *C. finmarchicus* is vulnerable to the effects of global warming, particularly on the Northeast U.S. Shelf, which is in the southern portion of its range (Grieve et al. 2017). Grieve et al. (2017) used models to project *C. finmarchicus* densities into the future under different climate scenarios considering predicted changes in water temperature and salinity. Based on their results, by the 2041–2060 period, 22 – 25% decreases in *C. finmarchicus* density are predicted across all regions of the Northeast U.S. shelf. A decrease in abundance of right whale prey in the WDA could be expected to result in a similar decrease in abundance of right whales in the WDA over the same time scale; however, whether the predicted decline in *C. finmarchicus* density is great enough to result in a decrease in right whale presence in the action area over the life of the project is unknown. Further, we note that right whale foraging in the action area is limited and opportunistic and it is unlikely that any shift in prey distribution would increase the potential for right whale foraging in the lease area.

Right whale calving occurs off the coast of the Southeastern U.S. In the final rule designating critical habitat, the following features were identified as essential to successful calving: (1) calm sea surface conditions associated with Force 4 or less on the Beaufort Scale, (2) sea surface temperatures from 7 °C through 17 °C; and, (3) water depths of 6 to 28 meters where these features simultaneously co-occur over contiguous areas of at least 231 km^2 during the months of November through April. Even with a 2°C shift in mean sea surface temperature, waters off Maryland and Delaware in the November to April period will not be warm enough to support calving. While there could be a northward shift in calving over this period, it is not reasonable to expect that over the life of the project that calving would occur in the WDA. Further, given the thermal tolerances of young calves (Garrison 2007) we do not expect that the distribution of young calves would shift northward into the action area such that there would be more or younger calves in the action area.

Based on the available information, it is difficult to predict how the use of the action area by large whales may change over the operational life of the project. However, we do not expect changes in use by sperm whales. Changes in habitat used by sei, fin, and right whales may be related to a northward shift in distribution due to warming waters and a decreased abundance of prey. However, it is also possible that reductions in prey in other areas, including the Gulf of Maine, result in persistence of foraging by some species in the WDA over time. Based on the information available at this time, it seems most likely that the use of the WDA by large whales will decrease or remain stable. As such, we do not expect any changes in abundance or distribution that would result in different effects of the action than those considered in the *Effects of the Action* section of this Opinion. To the extent new information on climate change, listed species, and their prey becomes available in the future, reinitiation of this consultation may be necessary.

8.0 CUMULATIVE EFFECTS

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 C.F.R. §402.02). Future Federal actions that are not consequences of the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. As explained in the Endangered Species Section 7 Consultation Handbook (NMFS and FWS 1998): "The concept of cumulative effects is frequently misunderstood as it relates to determining likely jeopardy or adverse modification. Cumulative effects include effects of future State, tribal, local, and private actions, not involving a Federal action, that are reasonably certain to occur within the action area under consideration. Future Federal actions requiring separate consultation (unrelated to the proposed action) are not considered in the cumulative effects section" 4-31. It is important to note that, while there may be some overlap, the ESA definition of cumulative effects is not equivalent to the definition of "cumulative impacts" as described in the Maryland Wind DEIS. Under NEPA, "cumulative effects…are the impact on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions. While the effects of past and ongoing Federal projects within the action area for which consultation has been completed are evaluated in both the NEPA and ESA processes (Section 6.0 *Environmental Baseline*), reasonably foreseeable future actions by federal agencies must be considered (see 40 CFR 1508.7) in the NEPA process but not the ESA Section 7 process.

"Gathering information on cumulative effects often requires more effort than merely gathering information on a proposed action. One of the first places to seek cumulative effects information is in documents provided by the action agency such as NEPA analyses for the action" (Section 7 Handbook, 4-32. We reviewed the list of past, ongoing and planned actions identified by BOEM in the DEIS and determined that most (other offshore wind energy development activities; undersea transmission lines, gas pipelines, and other submarine cables (e.g., telecommunications); tidal energy projects; marine minerals use and ocean-dredged material disposal; military use; Federal fisheries use, management, and monitoring surveys, and, oil and gas activities) do not meet the ESA definition of cumulative effects because we expect that if any of these activities were proposed in the action area, or proposed elsewhere yet were to have future effects inside the action area, they would require at least one Federal authorization or permit and would therefore require their own ESA section 7 consultation. BOEM identifies global climate change as a cumulative impact in the DEIS. Because global climate change is not a future state or private activity, we do not consider it a cumulative effect for the purposes of this consultation. Rather, future state or private activities reasonably certain to occur and contribute to climate change's effects in the action area are relevant. However, given the difficulty of parsing out climate change effects due to past and present activities from those of future state and private activities, we discussed the effects of the action in the context of climate change due to past, present, and future activities in section 7.10 of the *Effects of the Action* section above. The remaining cumulative impacts identified in the DEIS (marine transportation, coastal development, and state and private fisheries use and management) are addressed below.

It is important to note that because any future offshore wind project will require section 7 consultation, these future wind projects do not meet the ESA definition of cumulative effects and, even those that are considered "reasonably foreseeable" have thus been excluded from the cumulative effects analysis in this Opinion consistent with regulation, guidance and agency practice. All OSW projects, however, are properly evaluated in the sequential Section 7 process. In each successive consultation, the effects on listed species of other offshore wind projects that have been approved and may be under construction or operation will be considered to the extent they influence the status of the species and/or environmental baseline according to the best available scientific information. We have presented information on the South Fork, Vineyard Wind 1, Ocean Wind, Empire Wind, Sunrise Wind, CVOW, Revolution Wind, Atlantic Shores South, and New England Wind projects in the *Environmental Baseline* of this Opinion to provide context for the effects of approved offshore wind projects in general and specifically those activities that are affecting listed species that occur in the action area.

During this consultation, we searched for information on future state, tribal, local, or private (non-Federal) actions reasonably certain to occur in the action area or have effects in the action area. We did not find any information about non-Federal actions other than what has already been described in the *Environmental Baseline*. The primary non-Federal activities that will continue to have substantially similar effects in the action area are and that are reasonably certain to occur: Recreational fisheries, fisheries authorized by states, use of the action area by private vessels, discharge of wastewater and associated pollutants, and coastal development authorized by state and local governments. Any coastal development that requires a Federal authorization, inclusive of a permit from the USACE, would require future section 7 consultation and would not be considered a cumulative effect. We do not have any information to indicate that effects of these activities over the life of the proposed action will have different effects than those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change, and the cumulative effects thus reflects the continued status and trends described in the *Status of the Species* and *Environmental Baseline* sections of this Opinion and we expect that effects of those future State or private activities, not involving Federal activities, are reasonably certain to occur within the action area for the proposed action evaluated in this consultation.

9.0 INTEGRATION AND SYNTHESIS OF EFFECTS

The Integration and Synthesis section is the final step in our assessment of the effects and corresponding risk posed to ESA-listed species and designated critical habitat affected as a result of implementing the proposed action. In Section 4, we determined that the project will have no effect of gulf sturgeon, the Gulf of Maine DPS of Atlantic salmon, Nassau grouper, scalloped hammerhead sharks, smalltooth sawfish, any species of ESA listed corals, critical habitat designated for the North Atlantic right whale, the Gulf of Maine DPS of Atlantic salmon, the Gulf of Maine DPS of Atlantic sturgeon, the Carolina DPS of Atlantic sturgeon, the Northwest

Atlantic DPS of loggerhead sea turtles, or elkhorn or staghorn corals. We concluded that the proposed action is not likely to adversely affect blue whales, Rice's whales, hawksbill sea turtles, and oceanic whitetip sharks. Those species and critical habitat for which we reached a "not likely to adversely affect" conclusion are addressed in section 4 of this Opinion.

In this section, for the species not addressed in section 4 (i.e. those species likely to be adversely affected by the proposed action), we add the *Effects of the Action* (Section 7) to the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), while also considering effects in context of climate change and the S*tatus of the Species* (Section 5), to formulate the agency's biological opinion as to whether the proposed action "reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing its numbers, reproduction, or distribution" (50 CFR §402.02; the definition of "jeopardize the continued existence of" an ESA-listed species). The purpose of this analysis in this Opinion is to determine whether the proposed action is likely to jeopardize the continued existence of North Atlantic right, fin, sei, or sperm whales, five DPSs of Atlantic sturgeon, shortnose sturgeon, giant manta rays, the Northwest Atlantic DPS of loggerhead sea turtles, North Atlantic DPS of green sea turtles, or leatherback or Kemp's ridley sea turtles. As noted below, we have determined that there will be no effects to critical habitat designated for the New York Bight DPS of Atlantic sturgeon beyond those effects included in the Environmental Baseline.

Below, for the listed species that may be adversely affected by the proposed action (i.e., those species affected by the action and for which *all* effects are not extremely unlikely (discountable) and/or insignificant) we summarize the status of the species and consider whether the action will result in reductions in reproduction, numbers, or distribution of these species. We then consider whether any reductions in reproduction, numbers, or distribution resulting from the action would reduce appreciably the likelihood of both the survival and recovery of these species, consistent with the definition of "jeopardize the existence of" (50 C.F.R. §402.02) for purposes of sections 7(a)(2) and 7(b)of the federal Endangered Species Act and its implementing regulations.
In addition, we use the following guidance and regulatory definitions related to survival and recovery to guide our jeopardy analysis. In the NMFS/USFWS Section 7 Consultation Handbook (1998), for the purposes of determining whether jeopardy is likely, survival is defined as, "the species' persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter." Recovery is defined in regulation as, "Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act." 50 C.F.R. §402.02

9.1 Shortnose Sturgeon

The only portions of the action area that overlaps with the distribution of shortnose sturgeon are the Delaware River where vessels transiting to/from the Paulsboro Marine Terminal and New

Jersey Wind Port will travel; the Cooper River where vessels transiting to/from the Nexans cable facility will travel; the Penobscot River where vessels transiting to/from the Cianbro Modular Manufacturing Facility will travel; New York Harbor where vessels transiting to/from the Port of New York/New Jersey will travel; and the upper Chesapeake Bay and C&D canal.

NMFS completed ESA consultation on the construction and operation of the Paulsboro facility in November 2023 (the Opinion was a result of reinitiation and replaced the July 2022 Paulsboro Opinion); in the November 2023 Opinion, we considered effects of all vessels using the Paulsboro Marine Terminal over a 10-year period and the risk of vessel strike to shortnose sturgeon from those vessel operations. In the November 2023 Opinion, NMFS concluded that vessel operations associated with the terminal were likely to adversely affect, but not likely to jeopardize the continued existence of shortnose sturgeon. In this Opinion, we identify the portion of the take (i.e., lethal vessel strike) identified in the Paulsboro Opinion that would be attributable to the US Wind vessels. As described in sections 2, 6, and 7 of this Opinion, based on the number of vessel trips to Paulsboro identified in BOEM's BA, we have determined that US Wind's vessels utilizing the Paulsboro Marine Terminal will strike and kill up to one shortnose sturgeon while transiting the Delaware River. The effects of these vessel trips are included in the *Environmental Baseline* for the Maryland Wind project.

NMFS completed ESA consultation on the construction and operation of the NJWP in February 2022; in the February 2022 Opinion, we considered effects of all vessels using the NJWP over a 25-year period and the risk of vessel strike to shortnose sturgeon from those vessel operations. In the February 2022 Opinion, NMFS concluded that the vessel operations associated with NJWP were likely to adversely affect, but not likely to jeopardize the continued existence of shortnose sturgeon. In this Opinion, we identify the portion of the take (i.e., lethal vessel strike) identified in the NJWP Opinion that would be attributable to the US Wind vessels. As described in sections 2, 6, and 7 of this Opinion, based on the number of vessel trips to NJWP identified in BOEM's BA, we have determined that US Wind's vessels utilizing the NJWP will strike and kill up to one shortnose sturgeon while transiting the Delaware River. The effects of these vessel trips are included in the *Environmental Baseline* for the Maryland Wind project.

NMFS SERO issued a Biological Opinion to USACE for the construction and operations of the Nexans Cable Facility in May 2020. NMFS concluded that the construction and use of the Nexans Facility was likely to adversely affect but not likely to jeopardize shortnose sturgeon. However, the only adverse effects to sturgeon were dredging and riprap installation. In the Opinion, NMFS concluded that vessel strikes between vessels using the facility to transport cable were extremely unlikely to occur based on the frequency of vessel operations, type of vessel, and low transit speed and that vessels using the facility were not likely to adversely affect shortnose sturgeon. As explained in section 7.2 of this Opinion, US Wind will use the Nexans facility to support cable installation. As the effects of this vessel traffic were already considered in the 2020 Biological Opinion issued for the Nexans Facility, and no take of shortnose sturgeon by vessel strike was anticipated, US Wind's use of the Nexans Facility is also extremely unlikely to result in vessel strikes, and no take is anticipated.

The only other effects of the action that shortnose sturgeon would be exposed to are vessel transits in the upper Chesapeake Bay, New York Harbor, and the Penobscot River. We have determined that those effects are extremely unlikely to occur and discountable. We have not identified any effects of the Maryland Wind project on shortnose sturgeon that are beyond (i.e. different or in addition to) what was considered in the three consultations addressed above. As such, consistent with the conclusions of the Paulsboro, NJWP, and Nexans consultations we have determined that the proposed actions considered here are likely to adversely affect (for vessel transits to Paulsboro, NJWP, and Nexans) but not likely to jeopardize the continued existence of shortnose sturgeon (for vessel transits to Paulsboro, NJWP, and Nexans).

9.2 Critical Habitat Designated for the New York Bight DPS of Atlantic Sturgeon

The critical habitat designation for the New York Bight DPS is for habitats that support successful Atlantic sturgeon reproduction and recruitment. The Delaware River critical habitat unit extends from the Trenton-Morrisville Route 1 Toll Bridge at approximately RKM 213.5, downstream to where the main stem river discharges into Delaware Bay at approximately RKM 78. The action area overlaps with a portion of the Delaware River critical habitat unit designated for the New York Bight DPS. The only project activity that may affect this critical habitat is the transit of project vessels to or from the Paulsboro Marine Terminal in Paulsboro, NJ (approximately RKM 139) and the New Jersey Wind Port in Hope Creek, NJ (approximately RKM 84).

The Biological Opinions prepared by NMFS for the Paulsboro and New Jersey Wind Port considered effects of construction of these port facilities and the effects of anticipated vessel calls to the respective port on critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the November 7, 2023, Biological Opinion NMFS concluded that the construction and use of the Paulsboro Marine Terminal was not likely to adversely affect critical habitat designated for the New York Bight DPS of Atlantic sturgeon. In the February 25, 2022, Biological Opinion NMFS concluded that the construction and use of the New Jersey Wind Port was likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon. As explained in that Opinion, NMFS determined that there would be temporary and permanent effects as a result of construction and mitigation activities and that use of the NJWP channels by deep draft vessels and periodic maintenance dredging will continue to reduce the value of the habitat over the 25-year expected life-time of the NJWP operations. As explained in sections 6 and 7 of this Opinion, we are not able to determine the proportional effects of US Wind's vessel use of these port facilities on critical habitat, but we determined it is within the scope of effects considered in the respective Opinions. The effects of these vessel trips on critical habitat designated for the New York Bight DPS of Atlantic sturgeon are included in the Environmental Baseline for the Maryland Wind project. We have not identified any effects to designated critical habitat for the New York Bight DPS of Atlantic sturgeon from the Maryland Wind project that are beyond what was considered in the Paulsboro and New Jersey Wind Port consultations. As such, consistent with the conclusions of the New Jersey Wind Port consultation we have determined that the proposed actions considered here, and specifically the use of the NJWP by US Wind vessels, are likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon.

9.3 Atlantic Sturgeon

In the *Effects of the Action* section above, we determined that entanglement or capture in marine resource surveys is extremely unlikely to occur. While exposure to pile driving noise may result in a behavioral response from individuals close enough to the noise source to be disturbed, we determined that effects of that noise exposure will be insignificant; no take of any type including harm, harassment, injury, or mortality is expected to result from exposure to project noise. We determined that all effects to habitat and prey would be insignificant or extremely unlikely to occur. All effects of project operations, including operational noise and the physical presence of the turbine foundations and electric cables, and effects to Atlantic sturgeon from changes to ecological conditions are extremely unlikely to occur or insignificant.

As described in sections 2, 6, and 7 of this Opinion, based on the number of vessel trips to the Paulsboro Marine Terminal identified in BOEM's BA, we have determined that US Wind's vessels utilizing the Paulsboro Marine Terminal will strike and kill up to one New York Bight DPS Atlantic sturgeon while transiting the Delaware River. We also expect that project vessels transiting to/from the NJWP will strike and kill up to four Atlantic sturgeon (two New York Bight DPS Atlantic sturgeon and 2 Atlantic sturgeon from the Chesapeake Bay, South Atlantic, or Gulf of Maine DPS). Maryland Wind project vessels transiting the Chesapeake Bay Entrance are expected to strike and kill up to three Atlantic sturgeon (two New York Bight DPS Atlantic sturgeon and one Atlantic sturgeon from the Chesapeake Bay DPS). For transits to/from the Paulsboro Marine Terminal and the NJWP, the effects of these vessel trips and the loss of these individuals from their respective DPS is included in the *Environmental Baseline* for this Opinion. No other strikes of Atlantic sturgeon from any DPS are anticipated as a result of any other project vessel traffic, inclusive of consideration of vessel traffic in the Cooper River where vessels transiting to/from the Nexans cable facility will travel; in the Penobscot River where vessels transiting to/from the Cianbro Modular Manufacturing Facility will travel; in the New York Harbor where vessels transiting to/from the Port of New York/New Jersey will travel; and in Indian River Bay where vessels operating along the inshore cable route will travel.

9.3.1 Gulf of Maine DPS Atlantic sturgeon

The Gulf of Maine DPS is listed as threatened. While Atlantic sturgeon occur in several rivers in the Gulf of Maine DPS, recent spawning has only been documented in the Kennebec River. There are no abundance estimates for the Gulf of Maine DPS as a whole. The estimated effective population size of the Kennebec River is less than 70 adults, which suggests a relatively small spawning population (NMFS 2022). NMFS estimated adult and subadult abundance of the Gulf of Maine DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013, Kocik et al. 2013) and concluded that subadult and adult abundance of the Gulf of Maine DPS was 7,455 sturgeon (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as one year old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012a; Hilton et al. 2016).

Gulf of Maine origin Atlantic sturgeon are subject to numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage or for the DPS as a whole. The ASMFC stock assessment concluded that the abundance of the Gulf of Maine DPS is “depleted” relative to historical levels. The Commission also noted that the Gulf of Maine is particularly data poor among all five DPSs. The assessment concluded that there is a 51 percent probability that the abundance of the Gulf of Maine DPS has increased since implementation of the 1998 fishing moratorium. The Commission also concluded that there is a relatively high likelihood (74 percent probability) that mortality for the Gulf of Maine DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). However, the Commission noted that there was considerable uncertainty related to these numbers, particularly concerning trends data for the Gulf of Maine DPS. For example, the stock assessment notes that it was not clear if: (1) the percent probability for the trend in abundance for the Gulf of Maine DPS is a reflection of the actual trend in abundance or of the underlying data quality for the DPS; and, (2) the percent probability that the Gulf of Maine DPS exceeds the mortality threshold actually reflects lower survival or was due to increased tagging model uncertainty owing to low sample sizes and potential emigration.

As described in the 5-Year Review for the Gulf of Maine DPS (NMFS 2022), the demographic risk for the DPS is “moderate”[46] because of its low productivity (i.e., relatively few adults compared to historical levels), low abundance (i.e., only one known spawning population and low DPS abundance, overall), and limited spatial distribution (i.e., limited spawning habitat within the one river known to support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. However, the recovery potential is considered high.

The effects of the proposed Maryland Wind project are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, vessel strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Maryland Wind project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the *Environmental Baseline* and in consideration of *Cumulative Effects* and climate change. The only adverse effects of the proposed action on GOM DPS Atlantic sturgeon are the effects of vessel traffic in the Delaware River from US Wind vessels transiting to the New Jersey Wind Port, which is expected to result in the mortality of up to 2 GOM DPS Atlantic sturgeon; this is included in the *Environmental Baseline*. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of

[46] 84 FR 18243; April 30, 2019 - Listing and Recovery Priority Guidelines.

Atlantic sturgeon in the action area. All effects to Atlantic sturgeon from impacts to habitat and prey will be insignificant.

The proposed project will not result in the mortality of any Gulf of Maine DPS Atlantic sturgeon beyond what is considered in the *Environmental Baseline* (inclusive of the mortality of up to two GOM DPS Atlantic sturgeon resulting from US Wind's vessel transits to/from the NJWP in the Delaware River). There will be no effects on reproduction other than the loss of the potential future reproductive output of two individuals already addressed in the Baseline. The proposed action is not likely to reduce distribution, because the action will not impede Gulf of Maine DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the Gulf of Maine DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the Gulf of Maine DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated reduction in the potential future reproduction; (2) the proposed action will not change the status or trends of the DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of Gulf of Maine DPS Atlantic sturgeon in the action area and no consequence on the distribution of the DPS throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering Gulf of Maine DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Gulf of Maine DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that Gulf of Maine DPS Atlantic sturgeon can rebuild to a point where listing of the Gulf of Maine DPS of Atlantic sturgeon as threatened or endangered throughout all or a significant portion of its range is no longer necessary.

No Recovery Plan for the Gulf of Maine DPS has been published. The Recovery Plan would outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018[47]). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Gulf of Maine DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Gulf of Maine DPS likelihood of recovery.

This action will not change the status or trend of the Gulf of Maine DPS. The proposed action will not affect the distribution of Atlantic sturgeon Gulf of Maine DPS across the historical range. The proposed action will not result in mortality or reduction in future reproductive output and will not impair the species' resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the Gulf of Maine DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the Gulf of Maine DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened; that is, the proposed action will not appreciably reduce the likelihood of recovery of the Gulf of Maine DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Gulf of Maine DPS of Atlantic sturgeon. These conclusions were made in consideration of the threatened status of the Gulf of Maine DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals

[47] Available online at: https://media.fisheries.noaa.gov/dam-migration/ats_recovery_outline.pdf; last accessed April 25, 2024

are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.3.2 New York Bight DPS Atlantic sturgeon

The New York Bight DPS is listed as endangered. While Atlantic sturgeon occur in several rivers in the New York Bight, recent spawning has only been documented in the Hudson and Delaware rivers. The essential physical features necessary to support spawning and recruitment are also present in the Connecticut and Housatonic Rivers (82 FR 39160; August 17, 2017). However, there is no current evidence that spawning is occurring nor are there studies underway to investigate spawning occurrence in those rivers; except one recent study where young of year (YOY) fish of were captured in the Connecticut River (Savoy *et al.* 2017). Genetic analysis suggests that the YOY fish belonged to the South Atlantic DPS; at this time, we do not know if these fish were the result of a single spawning event due to unique straying of the adults from the South Atlantic DPS's spawning rivers. NMFS estimated adult and subadult abundance of the New York Bight DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters and concluded that subadult and adult abundance of the New York Bight DPS was 34,566 sturgeon (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as one year old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012a; Hilton et al. 2016).

The 2017 ASMFC stock assessment determined that abundance of the New York Bight DPS is "depleted" relative to historical levels (ASMFC 2017). The assessment also determined there is a relatively high probability (75 percent) that the New York Bight DPS abundance has increased since the implementation of the 1998 fishing moratorium, and a 31 percent probability that mortality for the New York Bight DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). The Commission noted, however, there is significant uncertainty in relation to the trend data. Moreover, new information suggests that the Commission's conclusions primarily reflect the status and trend of only the DPS's Hudson River spawning population.

New York Bight DPS origin Atlantic sturgeon are subject to numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. The largest single source of mortality appears to be capture as bycatch in commercial fisheries operating in the marine environment. Because early life stages and juveniles do not leave the river, they are not impacted by fisheries occurring in federal waters. Bycatch and mortality also occur in state fisheries; however, the primary fishery that impacted juvenile sturgeon (the shad fishery) has now been closed and there is no indication that it will reopen soon. New York Bight DPS Atlantic sturgeon are killed as a result of other anthropogenic activities in the Hudson, Delaware, and other rivers within the New York Bight as well; sources of potential mortality include vessel strikes and entrainment in dredges.

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, vessel strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of New York Bight DPS Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Maryland Wind project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the *Environmental Baseline* and in consideration of Cumulative Effects and climate change. The adverse effects of the proposed action on New York Bight DPS Atlantic sturgeon are limited to the anticipated lethal vessel strike of up to 5 New York Bight DPS Atlantic sturgeon from US Wind vessels transiting through the Chesapeake Bay Entrance (2 individuals) and within the Delaware River to/from the Paulsboro Marine Terminal (1 individual) and/or NJWP (2 individuals). We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any New York Bight DPS Atlantic sturgeon to be struck by any project vessels beyond the 5 strikes anticipated in the Chesapeake Bay entrance area and in the Delaware River/Delaware Bay. The 3 strikes anticipated in the Delaware River/Delaware Bay are addressed in the *Environmental Baseline*; thus, the only additional mortality is the anticipated strike of 2 New York Bight DPS Atlantic sturgeon over the 3 year construction period. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of New York Bight DPS Atlantic sturgeon in the action area. All effects to Atlantic sturgeon New York Bight DPS from impacts to habitat and prey will be insignificant.

The only expected mortality of any Atlantic sturgeon beyond what is considered in the *Environmental Baseline* (inclusive of the mortality of up to five New York Bight DPS Atlantic sturgeon resulting from US Wind's vessel traffic in the Delaware River) is two individuals expected to be struck and killed over the three year period that project vessels will be using ports in MD and VA and be transiting through the Chesapeake Bay entrance. There will be no effects on reproduction other than the loss of the potential future reproductive output of these two individuals. The proposed action is not likely to reduce distribution because the action will not impede New York Bight DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution within the action area will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the New York Bight DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the New York Bight DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will result in mortality and associated potential future reproduction of only two Atlantic sturgeon beyond what has been accounted for in the Environmental Baseline (death and loss of future reproductive potential of no more than 5 subadult or adult New York Bight DPS Atlantic sturgeon total (over a 35-year period), which represents an extremely small percentage of the DPS); (2) the proposed action will not change the status or trends of the New York Bight DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of New York Bight DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering New York Bight DPS Atlantic sturgeon. In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the New York Bight DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing as threatened or endangered under Section 4(a) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that New York Bight DPS Atlantic sturgeon can rebuild to a point where listing of the New York Bight DPS of Atlantic sturgeon as endangered or threatened is no longer appropriate.

No Recovery Plan for the New York Bight DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For New York Bight DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the New York Bight DPS likelihood of recovery.

This action will not change the status or trend of the New York Bight DPS. The proposed action will not affect the distribution of Atlantic sturgeon across the historical range. The proposed action will result in only a small amount (2 individuals over a 3 year period) of mortality or reduction in future reproductive output beyond what was considered in the Environmental Baseline and given the loss of only 2 individuals will not impair the species' resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the New York Bight DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the New York Bight DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened or endangered; that is, the proposed action will not appreciably reduce the likelihood of recovery of the New York Bight DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the New York Bight DPS of Atlantic sturgeon. These conclusions were made in consideration of the endangered status of the New York Bight DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.3.3 Chesapeake Bay DPS of Atlantic sturgeon

The Chesapeake Bay DPS is listed as endangered. While Atlantic sturgeon occur in several rivers in the Chesapeake Bay DPS, at the time of listing spawning was only known to occur in the James River. Since the listing, there is evidence of additional spawning populations in the Chesapeake Bay DPS, including the Pamunkey River, a tributary of the York River, and in Marshyhope Creek, a tributary of the Nanticoke River (Hager et al. 2014, Kahn et al. 2014, Richardson and Secor 2016, Secor et al. 2021). Detections of acoustically-tagged adult Atlantic sturgeon along with historical evidence suggests that Atlantic sturgeon belonging to the Chesapeake Bay DPS may be spawning in the Mattaponi and Rappahannock rivers as well (Hilton et al. 2016, ASMFC 2017, Kahn et al. 2019). However, information for these populations is limited and the research is ongoing.

Chesapeake Bay DPS Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently no census nor enough information to establish a trend, for any life stage, for the James River spawning population, or for the DPS as a whole. However, the NEAMAP data indicates that the estimated ocean population of Chesapeake Bay DPS Atlantic sturgeon is 8,811 sub-adult and adult individuals (2,203 adults and 6,608 subadults). The ASMFC (2017) stock assessment determined that abundance of the Chesapeake Bay DPS is "depleted" relative to historical levels. The assessment, while noting significant uncertainty in trend data, also determined that there is a relatively low probability (36 percent) that abundance of the Chesapeake Bay DPS has increased since the implementation of the 1998 fishing moratorium, and a 30 percent probability that mortality for the Chesapeake Bay DPS exceeds the mortality threshold used for the assessment (ASMFC 2017).

As described in the 5-Year Review for the Chesapeake Bay DPS (NMFS 2022), the demographic risk for the DPS is “High” because of its low productivity (e.g., relatively few adults compared to historical levels and irregular spawning success), low abundance (e.g., only three known spawning populations and low DPS abundance, overall), and limited spatial distribution (e.g. limited spawning habitat within each of the few known rivers that support spawning). There is also new information indicating genetic bottlenecks as well as low levels of inbreeding. However, the recovery potential is considered high.

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, vessel strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Maryland Wind project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the Environmental Baseline and in consideration of Cumulative Effects and climate change. The adverse effects of the proposed action on Chesapeake Bay DPS Atlantic sturgeon are limited to the anticipated lethal strike of up to 3 Chesapeake Bay DPS Atlantic Sturgeon from US Wind vessels transiting through the Chesapeake Bay Entrance (1 individual) and within the Delaware River to/from the NJWP (2 individuals). We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any Chesapeake Bay DPS Atlantic sturgeon to be struck by any project vessels beyond the 3 strikes anticipated in the Chesapeake Bay entrance area and in the Delaware River/Delaware Bay. The 2 strikes anticipated in the Delaware River/Delaware Bay from project vessels transiting to/from NJWP are addressed in the *Environmental Baseline*; thus, the only additional mortality is the anticipated strike of 1 Chesapeake Bay DPS Atlantic sturgeon over the 3 year construction period. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of Chesapeake Bay DPS Atlantic sturgeon in the action area. All effects to Atlantic sturgeon Chesapeake Bay DPS from impacts to habitat and prey will be insignificant.

The only expected mortality of any Chesapeake Bay DPS Atlantic sturgeon beyond what is considered in the *Environmental Baseline* (inclusive of the mortality of up to two Chesapeake Bay DPS Atlantic sturgeon resulting from US Wind’s vessel traffic in the Delaware River) is one individual expected to be struck and killed over the three year period that project vessels will be using ports in MD and VA and be transiting through the Chesapeake Bay entrance. There will be no effects on reproduction other than the loss of the potential future reproductive output of this individual and the loss of the potential future reproductive output of two individuals already addressed in the Baseline. The proposed action is not likely to reduce distribution, because the action will not impede Chesapeake Bay DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the Chesapeake Bay DPS (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the Chesapeake Bay DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Chesapeake Bay DPS Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will result in mortality and associated potential future reproduction of only one Atlantic sturgeon beyond what has been accounted for in the Environmental Baseline (death and loss of future reproductive potential of no more than 3 subadult or adult Chesapeake Bay DPS Atlantic sturgeon total (over a 35-year period), which represents an extremely small percentage of the DPS); (2) the proposed action will not change the status or trends of the species as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of Chesapeake Bay DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering Chesapeake Bay DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Chesapeake Bay DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as "in danger of extinction throughout all or a significant portion of its range" (endangered) or "likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range…" (threatened) is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that Chesapeake Bay DPS Atlantic sturgeon can rebuild to a point where listing of the Chesapeake Bay DPS of Atlantic sturgeon as threatened or endangered is no longer appropriate.

No Recovery Plan for the Chesapeake Bay DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migrating, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Chesapeake Bay DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Chesapeake Bay DPS likelihood of recovery.

This action will not change the status or trend of the Chesapeake Bay DPS. The proposed action will not affect the distribution of Chesapeake Bay DPS Atlantic sturgeon across its historical range. The proposed action will result in only a small amount (1 individual over a 3 year period) of mortality or reduction in future reproductive output beyond what was considered in the Environmental Baseline and given the loss of only 1 individual, this will not impair the species' resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the Chesapeake Bay DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the Chesapeake Bay DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened; that is, the proposed action will not appreciably reduce the likelihood of recovery of the Chesapeake Bay DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Chesapeake Bay DPS of Atlantic sturgeon. These conclusions were made in consideration of the endangered status of the Chesapeake Bay DPS of Atlantic sturgeon, the effects of the action other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.3.4 Carolina DPS of Atlantic sturgeon

The Carolina DPS is listed as endangered. Atlantic sturgeon from the Carolina DPS spawn in the rivers of North Carolina south to the Cooper River, South Carolina. There are currently seven spawning subpopulations within the Carolina DPS: Roanoke River, Tar-Pamlico River, Neuse River, Northeast Cape Fear and Cape Fear Rivers, Waccamaw and Great Pee Dee Rivers, Black River, Santee and Cooper Rivers. NMFS estimated adult and subadult abundance of the Carolina DPS based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters (Damon-Randall et al. 2013, Kocik et al. 2013) and concluded that subadult and adult abundance of the Carolina DPS was 1,356 sturgeon (339 adults and 1,017 subadults) (NMFS 2013). This number encompasses many age classes since, across all DPSs, subadults can be as young as two years old when they first enter the marine environment, and adults can live as long as 64 years (Balazik et al. 2012; Hilton et al. 2016). Very few data sets are available that cover the full potential life span of an Atlantic sturgeon. The ASMFC concluded for the Stock Assessment that it could not estimate abundance of the Carolina DPS or otherwise quantify the trend in abundance because of the limited available information. However, the Stock Assessment was a comprehensive review of the available information, and used multiple methods and analyses to assess the status of the Carolina DPS and the coast wide stock of Atlantic sturgeon. For example, the Stock Assessment Subcommittee defined a benchmark, the mortality threshold, against which mortality for the coast wide stock of Atlantic sturgeon as well as for each DPS were compared[48] to assess whether the current mortality experienced by the coast wide stock and each DPS is greater than what it can sustain. This information informs the current trend of the Carolina DPS.

In the Stock Assessment, the ASMFC concluded that abundance of the Carolina DPS is "depleted" relative to historical levels and there is a relatively low probability (36 percent) that abundance of the Carolina DPS has increased since the implementation of the 1998 fishing moratorium. The ASMFC also concluded that there is a relatively low likelihood (25 percent probability) that mortality for the Carolina DPS does not exceed the mortality threshold used for the Stock Assessment (ASMFC 2017).

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, vessel strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the Environmental Baseline, may occur in the action area over the life of the proposed action. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this

[48] The analysis considered both a coast wide mortality threshold and a region-specific mortality threshold to evaluate the sensitivity of the model to differences in life history parameters among the different DPSs (e.g., Atlantic sturgeon in the northern region are slower growing, longer lived; Atlantic sturgeon in the southern region are faster growing, shorter lived).

project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Maryland Wind project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the Environmental Baseline and in consideration of Cumulative Effects and climate change. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any Carolina DPS Atlantic sturgeon to be struck by any project vessels. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of the Carolina DPS Atlantic sturgeon in the action area. All effects to the Carolina DPS Atlantic sturgeon from impacts to habitat and prey will be insignificant.

The proposed project will not result in the mortality of any Carolina DPS Atlantic sturgeon. There will be no effects on reproduction of any Carolina DPS Atlantic sturgeon. The proposed action is not likely to reduce distribution, because the action will not impede Carolina DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.
Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the Carolina DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the Carolina DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Carolina DPS Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging, migrating and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated potential future reproduction; (2) the proposed action will not change the status or trends of the DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of Carolina DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering Carolina DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Carolina DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as threatened or endangered " is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that Carolina DPS Atlantic sturgeon can rebuild to a point where the Carolina DPS of Atlantic sturgeon is no longer likely to become an endangered or threatened species within the foreseeable future throughout all or a significant portion of its range.

No Recovery Plan for the Carolina DPS has been published. The Recovery Plan would outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migrating, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For Carolina DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the Carolina DPS likelihood of recovery.
This action will not change the status or trend of the Carolina DPS. The proposed action will not affect the distribution of the Carolina DPS Atlantic sturgeon across the historical range. The proposed action will not result in mortality or reduction in future reproductive output of the Carolina DPS and will not impair the DPS's resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the Carolina DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the Carolina DPS of Atlantic sturgeon can be brought to the point at which listing as threatened or endangered is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of the Carolina DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Carolina DPS of Atlantic sturgeon. These conclusions were made in consideration of the endangered status of the

Carolina DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals are exposed to within the action area as described in the Environmental Baseline and Cumulative Effects, and any anticipated effects of climate change.

9.3.5 South Atlantic DPS of Atlantic sturgeon

The South Atlantic DPS Atlantic sturgeon is listed as endangered and Atlantic sturgeon originate from at least six rivers where spawning potentially still occurs. Secor (2002) estimates that 8,000 adult females were present in South Carolina prior to 1890. In Georgia, prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery. Secor (2002) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in Georgia prior to 1890. At the time of listing, only six spawning subpopulations were thought to have existed in the South Atlantic DPS: Combahee River, Edisto River, Savannah River, Ogeechee River, Altamaha River (including the Oconee and Ocmulgee tributaries), and the Satilla River. Three of the spawning subpopulations in the South Atlantic DPS are relatively robust and are considered the second (Altamaha River) and third (Combahee/Edisto River) largest spawning subpopulations across all five DPSs. Peterson et al. (2008) estimated the number of spawning adults in the Altamaha River was 324 (95 percent CI: 143-667) in 2004 and 386 (95 percent CI: 216-787) in 2005. Bahr and Peterson (2016) estimated the age-1 juvenile abundance in the Savannah River from 2013-2015 at 528 in 2013, 589 in 2014, and 597 in 2015. No census of the number of Atlantic sturgeon in any of the other spawning rivers or for the DPS as a whole is available. However, the NEAMAP data indicates that the estimated ocean population of South Atlantic DPS Atlantic sturgeon sub-adults and adults is 14,911 individuals (3,728 adults and 11,183 subadults).

The 2017 ASMFC stock assessment determined that abundance of the South Atlantic DPS is "depleted" relative to historical levels (ASMFC 2017). Due to a lack of suitable indices, the assessment was unable to determine the probability that the abundance of the South Atlantic DPS has increased since the implementation of the 1998 fishing moratorium. However, it was estimated that there is a 40 percent probability that mortality for the South Atlantic DPS exceeds the mortality threshold used for the assessment (ASMFC 2017). We note that the Commission expressed significant uncertainty in relation to the trends data.

The effects of the action are in addition to ongoing threats in the action area, which include incidental capture in state and federal fisheries, vessel strikes, coastal development, habitat loss, contaminants, and climate change. Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline*, may occur in the action area over the life of the proposed action. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Atlantic sturgeon in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action due to anticipated climate change.

We have considered effects of the Maryland Wind project over the construction, operations, and decommissioning periods in consideration of the effects already accounted for in the

Environmental Baseline and in consideration of Cumulative Effects and climate change. The only adverse effects of the proposed action on South Atlantic DPS Atlantic sturgeon include the effects of vessel traffic in the Delaware River from US Wind vessels transiting to the New Jersey Wind Port, which are expected to result in the mortality of up to 2 South Atlantic DPS Atlantic Sturgeon which are included in the Environmental Baseline. We do not anticipate any adverse effects to result from exposure to pile driving or any other noise source including HRG surveys and operational noise. We do not expect any South Atlantic DPS Atlantic sturgeon to be struck by any project vessels. We do not expect the operation or existence of the turbines and other facilities, including the electric cables, to result in any changes in the abundance, reproduction, or distribution of South Atlantic DPS Atlantic sturgeon in the action area. All effects to South Atlantic DPS Atlantic sturgeon from impacts to habitat and prey will be insignificant.
The proposed project will not result in the mortality of any Atlantic sturgeon beyond what is considered in the Environmental Baseline (inclusive of the mortality of no more than two South Atlantic DPS Atlantic sturgeon resulting from US Wind's vessel traffic in the Delaware River). There will be no effects on reproduction other than the loss of the potential future reproductive output of two individuals already addressed in the Baseline. The proposed action is not likely to reduce distribution, because the action will not impede South Atlantic DPS Atlantic sturgeon from accessing any seasonal aggregation areas, including foraging, spawning, or overwintering grounds. Any consequences to distribution will be minor and temporary and limited to the temporary avoidance of areas with increased noise during pile driving.

Based on the information provided above, the proposed action will not appreciably reduce the likelihood of survival of the South Atlantic DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect the South Atlantic DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in consequences to the environment which would prevent Atlantic sturgeon from completing their entire life cycle or completing essential behaviors including reproducing, foraging and sheltering. This is the case because: (1) the proposed action will not result in any mortality and associated potential future reproduction beyond mortality from vessel strike attributed to US Wind vessels and accounted for in the Environmental Baseline; (2) the proposed action will not change the status or trends of the DPS as a whole; (3) there will be no effect on the levels of genetic heterogeneity in the population; (4) the action will have only a minor and temporary consequence on the distribution of South Atlantic DPS Atlantic sturgeon in the action area and no consequence on the distribution of the species throughout its range; and, (5) the action will have only an insignificant effect on individual foraging or sheltering South Atlantic DPS Atlantic sturgeon.

In rare instances, an action that does not appreciably reduce the likelihood of a species' survival might appreciably reduce its likelihood of recovery. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the South Atlantic DPS of Atlantic sturgeon will survive in the wild, which includes consideration of recovery potential. Here, we consider whether the action will appreciably reduce the likelihood of recovery from the perspective of ESA Section 4. As noted above, recovery is defined as the improvement in status such that listing under Section 4(a) as threatened or endangered is no longer appropriate. Thus, we have considered whether the proposed action will appreciably reduce the likelihood that South Atlantic DPS Atlantic sturgeon can rebuild to a point where the South Atlantic DPS of Atlantic sturgeon is no longer likely to become an endangered or threatened species within the foreseeable future throughout all or a significant portion of its range.

No Recovery Plan for the South Atlantic DPS has been published. The Recovery Plan would outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. In January 2018, we published a Recovery Outline for the five DPSs of Atlantic sturgeon (NMFS 2018). This outline is meant to serve as an interim guidance document to direct recovery efforts, including recovery planning, until a full recovery plan is developed and approved. The outline provides a preliminary strategy for recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. To allow that to happen for sturgeon, individuals must have access to enough habitat in suitable condition for foraging, resting, migration, and spawning. Conditions must be suitable for the successful development of early life stages. Mortality rates must be low enough to allow for recruitment to all age classes so that successful spawning can continue over time and over generations. There must be enough suitable habitat for spawning, foraging, resting, and migrations of all individuals. For South Atlantic DPS Atlantic sturgeon, habitat conditions must be suitable both in the natal river and in other rivers and estuaries where foraging by subadults and adults will occur and in the ocean where subadults and adults migrate, overwinter and forage. Habitat connectivity must also be maintained so that individuals can migrate between important habitats without delays that impact their fitness. As described in the vision statement in the Recovery Outline, subpopulations of all five Atlantic sturgeon DPSs must be present across the historical range. These subpopulations must be of sufficient size and genetic diversity to support successful reproduction and recovery from mortality events. The recruitment of juveniles to the sub-adult and adult life stages must also increase and that increased recruitment must be maintained over many years. Recovery of these DPSs will require conservation of the riverine and marine habitats used for spawning, development, foraging, and growth by abating threats to ensure a high probability of survival into the future. Here, we consider whether this proposed action will reduce the South Atlantic DPS likelihood of recovery. This action will not change the status or trend of the South Atlantic DPS. The proposed action will not affect the distribution of South Atlantic DPS Atlantic sturgeon across the historical range. The proposed action will not result in mortality or reduction in future reproductive output beyond what was considered in the *Environmental Baseline* and will not impair the DPS's resiliency, genetic diversity, recruitment, or year class strength. The proposed action will have only insignificant effects on habitat and forage and will not impact habitat in a way that makes additional growth of the population less likely, that is, it will not reduce the habitat's carrying capacity. This is because impacts to forage will be insignificant or extremely unlikely, and the area that sturgeon may avoid is small. Any avoidance will be temporary and limited to the period of time when pile driving is occurring. For these reasons, the action will not reduce the likelihood that the South Atlantic DPS can recover. Therefore, the proposed action will not appreciably reduce the likelihood that the South Atlantic DPS of Atlantic sturgeon can be brought to the point at which listing as threatened or endangered is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of the South Atlantic DPS.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the South Atlantic DPS of Atlantic sturgeon. These conclusions were made in consideration of the status of the South Atlantic DPS of Atlantic sturgeon, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change.

9.4 Giant Manta Ray

As described in the *Status of the Species*, giant manta rays can be found worldwide and are listed as threatened throughout its range. There are no current and accurate abundance estimates available, as the species tends to be only sporadically observed. Giant manta rays occur seasonally in the portion of the action area south of latitude 40 N, including the Maryland Wind WDA. We have not identified any adverse effects from the proposed action or the Connected Action, inclusive of consideration of all activities that are anticipated to occur in the portion of the action area that overlaps with the distribution of giant manta rays. As all effects of the activities considered in this Opinion to giant manta rays will be insignificant and/or discountable, the proposed action, inclusive of the Connected Action at the O&M facility is not likely to adversely affect giant manta rays. Because the proposed action is not likely to adversely affect giant manta rays, and no take of individuals will occur, it is also, by definition, not likely to jeopardize the continued existence of the species. Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the Giant Manta Ray. These conclusions were made in consideration of the status of the Giant Manta Ray, the effects of the action, other stressors that individuals are exposed to within the action area as described in the Environmental Baseline and Cumulative Effects, and any anticipated effects of climate change.

9.5 Sea Turtles

Our effects analysis determined that impact pile driving noise is likely to adversely affect a number of individual ESA-listed sea turtles in the action area and cause behavioral response and stress (meeting the definition of harassment in the context of ESA take) but that no temporary threshold shift (TTS), PTS, serious injury, or mortality is anticipated. We determined that impacts to hearing (masking) and avoidance behavior would not result in vessel strike or entanglement or capture in fishing gear. We determined that exposure to other project noise, including HRG surveys and operational noise will have effects that are insignificant or discountable. We expect that project vessels will strike and kill no more than 6 leatherback, 116 NWA DPS loggerhead, 4 NA DPS green, and 20 Kemp's ridley sea turtles over the 35-year life of the project, inclusive of the construction, operation, and decommissioning periods. We do not expect the entanglement or capture of any sea turtles in the marine resources surveys. We also determined that effects to habitat and prey are insignificant or discountable. In this section, we discuss the likely consequences of these effects to individual sea turtles, the populations those individuals represent, and the species/DPS those populations comprise.

While this biological opinion relies on the best available scientific and commercial information, our analysis and conclusions include uncertainty about the basic hearing capabilities of sea turtles, such as how they use sound to perceive and respond to environmental cues, and how temporary changes to their acoustic soundscape could affect the normal physiology and behavioral ecology of these species. Vessel strikes are expected to result in more significant effects on individuals than other stressors considered in this Opinion because these strikes are expected to result in serious injury or mortality. Significant behavioral disruption from exposure to pile driving noise is expected; however, these temporary effects are expected to exert significantly less adverse effects on any individual than severe injuries and permanent non-lethal injuries. We have determined the number of exposures that will meet the ESA definition of harassment; no behavioral disturbances will be severe enough to meet the ESA definition of harm.

In this section we assess the likely consequences of these effects to the sea turtles that have been exposed, the populations those individuals represent, and the species/DPS those populations comprise. Section 5.2 described current sea turtle population statuses and the threats to their survival and recovery. Most sea turtle populations have undergone significant to severe reduction by human harvesting of both eggs and sea turtles, loss of beach nesting habitats, as well as severe bycatch pressure in worldwide fishing industries. The *Environmental Baseline* identified actions expected to generally continue for the foreseeable future for each of these species of sea turtle that may affect sea turtles in the action area. As described in section 7.10, climate change may result in a northward distribution of sea turtles, which could result in a small change in the abundance, and seasonal distribution of sea turtles in the action area over the 35-year life of the Maryland Wind project. However, as described there, given the cool winter water temperatures in the action area and considering the amount of warming that is anticipated, any shift in seasonal distribution is expected to be small (potential additional weeks per year, not months) and any increase in abundance in the action area is expected to be small. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change.

9.5.1 Northwest Atlantic DPS of Loggerhead Sea Turtles

The Northwest Atlantic DPS of loggerhead sea turtles is listed as threatened. Based on nesting data and population abundance and trends at the time, NMFS and USFWS determined in 2011 that the Northwest Atlantic DPS should be listed as threatened and not endangered based on: (1) the large size of the nesting population, (2) the overall nesting population remains widespread, (3) the trend for the nesting population appears to be stabilizing, and (4) substantial conservation efforts are underway to address threats (76 FR 58868, September 22, 2011).

It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and USFWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the Status of the Species, Environmental Baseline, and Cumulative Effects sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, vessel interactions, and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, others remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but whose success cannot be quantified. There are five subpopulations of loggerhead sea turtles in the western North Atlantic (recognized as recovery units in the 2008 recovery plan for the species). These subpopulations show limited evidence of interbreeding. As described in the Status of the Species, recent assessments have evaluated the nesting trends for each recovery unit. Nesting trends are based on nest counts or nesting females; they do not include non-nesting adult females, adult males, or juvenile males or females in the population. Nesting trends for each of the loggerhead sea turtle recovery units in the Northwest Atlantic Ocean DPS are variable. Overall, short-term trends have shown increases, however, over the long-term the DPS is considered stable.

Estimates of the total loggerhead population in the Atlantic are not currently available. However, there is some information available for portions of the population. From 2004-2008, the loggerhead adult female population for the Northwest Atlantic ranged from 20,000 to 40,000 or more individuals (median 30,050), with a large range of uncertainty in total population size (NMFS SEFSC 2009). The estimate of Northwest Atlantic adult loggerhead females was considered conservative for several reasons. The number of nests used for the Northwest Atlantic was based primarily on U.S. nesting beaches. Thus, the results are a slight underestimate of total nests because of the inability to collect complete nest counts for many non-U.S. nesting beaches within the DPS. In estimating the current population size for adult nesting female loggerhead sea turtles, the report simplified the number of assumptions and reduced uncertainty by using the minimum total annual nest count (i.e., 48,252 nests) over the five years. This was a particularly conservative assumption considering how the number of nests and nesting females can vary widely from year to year (e.g., the 2008 nest count was 69,668 nests, which would have increased the adult female estimate proportionately to between 30,000 and 60,000). In addition, minimal assumptions were made about the distribution of remigration intervals and nests per female parameters, which are fairly robust and well known. A loggerhead population estimate using data from 2001-2010 estimated the loggerhead adult female population in the Northwest Atlantic at 38,334 individuals (SD =2,287) (Richards et al. 2011). These population studies are consistent with the definition of the Northwest Atlantic DPS.

The AMAPPS surveys and sea turtle telemetry studies conducted along the U.S. Atlantic coast in the summer of 2010 provided preliminary regional abundance estimate of about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NMFS 2011c). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified sea turtle sightings (NMFS 2011c). Although there is much uncertainty in these population estimates, they provide some context for evaluating the size of the likely population of loggerheads in the Northwest Atlantic which is an indication of the size of the Northwest Atlantic DPS.
The impacts to Northwest Atlantic DPS loggerhead sea turtles from the proposed action are expected to result in the mortality of up to 116 individuals due to vessel strike over the 35-year construction, operations and decommissioning period and the exposure of up to 374 loggerhead sea turtles from the DPS to noise that will result in behavioral disturbance that meets the ESA definition of harassment. We determined that all other effects of the action would be insignificant or extremely unlikely to occur. In total, we expect the proposed action to result in

the mortality of up to 116 Northwest Atlantic (NWA) DPS loggerheads over the 35-year life of the project.

The 374 loggerhead sea turtles that experience harassment would experience behavioral disturbance; we also expect these turtles would experience physiological stress during the period that their normal behavioral patterns are disrupted. These temporary conditions are expected to return to normal over a relatively short period of time; however, it is possible that individual sea turtles may be exposed to pile driving noise and experience behavioral disturbance on multiple days during a construction season. Behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 2 hours, but likely much less), thus we expect recovery between any subsequent exposures. The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise source; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, behavioral disruption will create or increase the risk of injury for the affected sea turtles compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption would result in an actual injury or affect an individual sea turtle's fitness (i.e., survival or reproduction); therefore, as explained in section 7.1, the adverse effects meet the definition of harassment and not harm in the context of the ESA definition of take.

The mortality of 116 loggerhead Northwest Atlantic DPS sea turtles in the action area over the 35-year life of the project (inclusive of 3 years of in-water construction, 30 years of operations, and 2 years of decommissioning) would reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed actions (assuming all other variables remained the same). The Peninsular Florida Recovery Unit and the Northern Recovery Unit represent approximately 87% and 10%, respectively of all nesting effort in the Northwest Atlantic DPS (Ceriani and Meylan 2017, NMFS and USFWS 2008). We expect that the majority of loggerheads in the action area originated from the Northern Recovery Unit (NRU) or the Peninsular Florida Recovery Unit (PFRU).

The Northern Recovery Unit, from the Florida-Georgia border through southern Virginia, is the second largest nesting aggregation in the DPS, with an average of 5,215 nests from 1989-2008, and approximately 1,272 nesting females (NMFS and U.S. FWS 2008). For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and U.S. FWS 2007a). Recently, the trend has been increasing. Ceriani and Meylan (2017) reported a 35% increase for this recovery unit from 2009 through 2013. A longer- term trend analysis based on data from 1983 to 2019 indicates that the annual rate of increase is 1.3 percent (Bolten et al. 2019).

Annual nest totals for the PFRU averaged 64,513 nests from 1989-2007, representing approximately 15,735 females per year (NMFS and USFWS 2008). Nest counts taken at index

beaches in Peninsular Florida showed a significant decline in loggerhead nesting from 1989 to 2007, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). From 2009 through 2013, a 2 percent decrease for the Peninsular Florida Recovery Unit was reported (Ceriani and Meylan 2017). Using a longer time series from 1989-2018, there was no significant change in the number of annual nests; however, an increase in the number of nests was observed from 2007 to 2018 (Bolten et al. 2019).
The loss of 116 NWA DPS loggerheads over the 35 years of the project represents an extremely small percentage of the number of sea turtles in the PFRU or NRU. Even if the total population of the PFRU was limited to 15,735 loggerheads (the number of nesting females), the loss of 116 individuals would represent approximately 0.74% of the population. If the total NRU population was limited to 1,272 sea turtles (the number of nesting females), and all 116 individuals originated from that population, the loss of those individuals would represent approximately 9.1% of the population; however, given the distribution of loggerheads from the different nesting beaches, this is an extremely unlikely outcome and is not expected. Even just considering the number of adult nesting females the loss of 116 individuals over 35 years is extremely small and would be even smaller when considered for the total recovery unit and represents an even smaller percentage of the DPS as a whole.

As noted in the *Environmental Baseline*, the status of loggerhead Northwest Atlantic DPS sea turtles in the action area is expected to be the same as that of each recovery unit over the life of the project (stable to increasing). The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the DPS as a whole. Considering the extremely small percentage of the populations that will be killed, it is unlikely that these deaths will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the Northwest Atlantic DPS. We make this conclusion in consideration of the status of the DPS as a whole, the status of loggerhead NWA DPS sea turtles in the action area, and in consideration of the threats experienced by NWA DPS loggerheads in the action area as described in the *Environmental Baseline* and *Cumulative Effects* sections of this Opinion. As described in section 7.10, climate change may result in changes in the distribution or abundance of loggerheads in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

Any effects on reproduction are limited to the future reproductive output of the individuals that die. Even assuming that all of these losses were reproductive female (which is unlikely given the expected even sex ratio in the action area), given the number of nesting adults in each of these populations, it is unlikely that the expected loss of loggerheads would affect the success of nesting in any year. Additionally, this extremely small reduction in potential nesters is expected to result in a similarly small reduction in the number of eggs laid or hatchlings produced in future years and similarly, an extremely small effect on the strength of subsequent year classes with no detectable effect on the trend of any recovery unit or the DPS as a whole. The proposed actions will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting. Additionally, given the small percentage of the DPS that will be killed as a result of the proposed actions, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

The proposed action is not likely to reduce distribution because while the action will temporarily affect the distribution of individual loggerheads through behavioral disturbance changes in distribution will be temporary and limited to movements to nearby areas in the WDA. As explained in section 7, we expect the project to have insignificant effects on use of the action area by Northwest Atlantic DPS loggerheads.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of this DPS of loggerheads because the DPS is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the DPS population and the number of loggerheads in the DPS is likely to be stable or increasing over the time period considered here.

Based on the information provided above, the death of 116 NWA DPS loggerheads over the 35 year life of the project will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the DPS will continue to persist into the future with sufficient resilience to allow for recovery and eventual delisting). The actions will not affect Northwest Atlantic DPS loggerheads in a way that prevents the DPS from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent loggerheads in this DPS from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 116 loggerheads over a 35-year period represents an extremely small percentage of the DPS as a whole; (2) the death of 116 loggerheads over that period will not change the status or trends of any recovery unit or the DPS as a whole; (3) the loss of 116 loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 116 Northwest Atlantic DPS loggerheads over a 35 year period is likely to have an extremely small effect on reproductive output that will be insignificant at the recovery unit or DPS level; (5) the actions will have only a minor and temporary effect on the distribution of NWA DPS loggerheads in the action area and no effect on the distribution of the DPS throughout its range; and, (6) the actions will have no effect on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that this DPS of loggerhead sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, NMFS and the USFWS issued a recovery plan for the Northwest Atlantic population of loggerheads (NMFS and USFWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Loggerheads have a stable trend; as explained above, the loss of 116 NWA DPS loggerheads over the life span of the proposed actions (35 years) will not affect the population trend. The number of loggerheads likely to die as a result of the proposed actions is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches and nesting beaches will therefore not be affected; all effects to habitat within the action area will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed actions will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent this DPS of the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be negligible over the long-term and the actions are not expected to have long term impacts on the future growth of the DPS or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that the NWA DPS of loggerhead sea turtles can be brought to the point at which their listing as threatened or endangered is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of the NWA DPS of loggerhead sea turtles.

Based on the analysis presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of the NWA DPS of loggerhead sea turtles. These conclusions were made in consideration of the threatened status of NWA DPS loggerhead sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of loggerhead sea turtles in the action area.

9.5.2 North Atlantic DPS of Green Sea Turtles

The North Atlantic DPS of green sea turtles is listed as threatened under the ESA. As described in the *Status of the Species*, the North Atlantic DPS of green sea turtles is the largest of the 11 green turtle DPSs with an estimated abundance of over 167,000 adult females from 73 nesting sites. All major nesting populations demonstrate long-term increases in abundance (Seminoff et al. 2015b). In 2021, green turtle nest counts on the 27-core index beaches in Florida reached more than 24,000 nests recorded. Green sea turtles face numerous threats on land and in the water that affect the survival of all age classes. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue for this DPS, the DPS appears to be somewhat resilient to future perturbations. As described in the *Environmental Baseline* and *Cumulative Effects*, North Atlantic DPS green sea turtles in the action area are exposed to pollution and experience vessel strike and fisheries bycatch. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of North Atlantic DPS green sea turtles in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

There are four regions that support high nesting concentrations in the North Atlantic DPS: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), United States (Florida), and Cuba. Using data from 48 nesting sites in the North Atlantic DPS, nester abundance was estimated at 167,528 total nesters (Seminoff et al. 2015). The years used to generate the estimate varied by nesting site but were between 2005 and 2012. The largest nesting site (Tortuguero, Costa Rica) hosts 79 percent of the estimated nesting. It should be noted that not all female turtles nest in a given year (Seminoff et al. 2015). Nesting in the area has increased considerably since the 1970s, and nest count data from 1999-2003 suggested that 17,402-37,290 females nested there per year (Seminoff et al. 2015). In 2010, an estimated 180,310 nests were laid at Tortuguero, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equated to somewhere between 30,052 and 64,396 nesters in 2010 (Seminoff et al. 2015). Nesting sites in Cuba, Mexico, and the United States were either stable or increasing (Seminoff et al. 2015). More recent data is available for the southeastern United States. Nest counts at Florida's core index beaches have ranged from less than 300 to almost 41,000 in 2019. The Index Nesting Beach Survey (INBS) is carried out on a subset of beaches surveyed during the Statewide Nesting Beach Survey (SNBS) and is designed to measure trends in nest numbers. The nest trend in Florida shows the typical biennial peaks in abundance and has been increasing (https://myfwc.com/research/wildlife/sea- turtles/nesting/beach-survey-totals/). The SNBS is broader but is not appropriate for evaluating trends. In 2019, approximately 53,000 green turtle nests were recorded in the SNBS (https://myfwc.com/research/wildlife/sea-turtles/nesting/). Seminoff et al. (2015) estimated total nester abundance for Florida at 8,426 turtles.

NMFS recognizes that the nest count data available for green sea turtles in the Atlantic indicates increased nesting at many sites. However, we also recognize that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future.
The impacts to North Atlantic DPS green sea turtles from the proposed action are expected to result in the harassment (behavioral disturbance) of 22 individuals due to exposure to pile driving noise and the mortality of 4 individuals due to vessel strike over the 35-year life of the project inclusive of construction, operations, and decommissioning. We determined that all other effects

of the action would be insignificant or extremely unlikely. In total, we anticipate the proposed action will result in the mortality of 4 North Atlantic DPS green sea turtles over the 35-year life of the project.

The 22 green sea turtles that experience harassment would experience behavioral disturbance ; we also expect these turtles would experience physiological stress during the period that their normal behavioral patterns are disrupted. These temporary conditions are expected to return to normal over a relatively short period of time; however, it is possible that individual sea turtles may be exposed to pile driving noise and experience behavioral disturbance on multiple days during a construction season. Behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 2 hours, but likely much less), thus we expect recovery between any subsequent exposures. The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise source; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, behavioral disruption will create or increase the risk of injury for the affected sea turtles compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption would result in an actual injury or affect an individual sea turtle's fitness (i.e., survival or reproduction); therefore, as explained in section 7.1, the adverse effects meet the definition of harassment and not harm in the context of the ESA definition of take.

The death of four North Atlantic DPS green sea turtles, whether a male or female, immature or mature, would reduce the number of green sea turtles as compared to the number of green that would have been present in the absence of the proposed actions assuming all other variables remained the same. The loss of four green sea turtles represents a very small percentage of the DPS as a whole. Even compared to the number of nesting females (17,000-37,000), which represent only a portion of the number of North Atlantic DPS green sea turtles, the mortality of four NA DPS green turtles represents less than 0.024% of the DPS's nesting population. The loss of these sea turtles would be expected to reduce the reproduction of green sea turtles as compared to the reproductive output of green sea turtles in the absence of the proposed action. As described in the *Status of the Species* section above, we consider the trend for North Atlantic DPS green sea turtles to be stable. As noted in the Environmental Baseline, the status of North Atlantic DPS green sea turtles in the action area is expected to be the same as that of each recovery unit over the life of the project. As explained below, the death of these 4 NA DPS green sea turtles will not appreciably reduce the likelihood of survival for this DPS for the reasons outlined below. We make this conclusion in consideration of the status of the DPS as a whole, the status of North Atlantic DPS green sea turtles in the action area, and in consideration of the threats experienced by green sea turtles in the action area as described in the *Environmental Baseline* and *Cumulative Effects* sections of this Opinion.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of greens because: this DPS of the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of greens is likely to be increasing and at worst is stable. The proposed actions are not likely to reduce distribution of greens because the actions will not cause more than a temporary disruption to foraging and migratory behaviors.

Based on the information provided above, the death of four North Atlantic DPS green sea turtles over the 35-year life of the project, will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that this DPS of the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect green sea turtles in a way that prevents this DPS of the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent green sea turtles from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the DPS for this species' nesting trend is increasing; (2) the death of 4 green sea turtles represents an extremely small percentage of the DPS as a whole; (3) the loss of 4 green sea turtles will not change the status or trends of the DPS as a whole; (4) the loss of 4 green sea turtles is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of 4 green sea turtles is likely to have a negligible or undetectable effect on reproductive output of the DPS as a whole; (6) the action will have insignificant and temporary effects on the distribution of greens in the action area and no effect on its distribution throughout the DPS's range; and (7) the action will have no effect on the ability of green sea turtles to shelter and only an insignificant effect on individual foraging green sea turtles.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that this DPS of green sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that this DPS of the species can rebuild to a point where listing is no longer appropriate. A Recovery Plan for Green sea turtles was published by NMFS and USFWS in 1991. The plan outlines the steps necessary for recovery and the criteria, which, once met, would ensure recovery. In order to be delisted, green sea turtles must experience sustained population growth, as measured in the number of nests laid per year, over time. Additionally, "priority one" recovery tasks must be achieved, nesting habitat must be protected (through public ownership of nesting beaches), and stage class mortality must be reduced.

The proposed actions will not appreciably reduce the likelihood of survival of green sea turtles in this DPS. Also, it is not expected to modify, curtail or destroy the range of the DPS since it will result in an extremely small reduction in the number of green sea turtles in any geographic area and since it will not affect the overall distribution of green sea turtles other than to cause minor temporary adjustments in movements in the action area. As explained above, the proposed actions are likely to result in the mortality of four North Atlantic DPS green sea turtles; however, as explained above, the loss of these individuals over this time period is not expected to affect the persistence of green sea turtles or the trend for this DPS of the species. The actions will not affect nesting habitat and will have only an extremely small effect on mortality. The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent this DPS of the species from growing in a way that leads to recovery, and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of greens and a small reduction in the amount of potential reproduction due to the loss of four individuals, these effects will be negligible or undetectable in the DPS over the long-term, and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that green sea turtles in this DPS can be brought to the point at which their listing as endangered or threatened is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of this DPS of green sea turtles. Despite the threats faced by individual North Atlantic DPS green sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the DPS of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

Based on the analysis presented herein, the effects of the proposed actions are not likely to appreciably reduce the likelihood of both the survival and recovery of the North Atlantic DPS of green sea turtles. These conclusions were made in consideration of the threatened status of the North Atlantic DPS of green sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of green sea turtles in the action area.

9.5.3 Leatherback Sea Turtles

Leatherback sea turtles are listed as endangered under the ESA. Leatherbacks are widely distributed throughout the oceans of the world and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, Mediterranean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback nesting occurs on beaches of the Atlantic, Pacific, and Indian Oceans as well as in the Caribbean (NMFS and USFWS 2013). Leatherbacks face a multitude of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed.

The most recent published assessment, the leatherback status review, estimated that the total index of nesting female abundance for the Northwest Atlantic population of leatherbacks is 20,659 females (NMFS and USFWS 2020). This abundance estimate is similar to other estimates. The TEWG estimated approximately 18,700 (range 10,000 to 31,000) adult females using nesting data from 2004 and 2005 (TEWG 2007). The IUCN Red List assessment for the NW Atlantic Ocean subpopulation estimated 20,000 mature individuals (male and female) and approximately 23,000 nests per year (data through 2017) with high inter-annual variability in annual nest counts within and across nesting sites (Northwest Atlantic Leatherback Working Group 2019). The estimate in the status review is higher than the estimate for the IUCN Red List assessment, likely due to a different remigration interval, which has been increasing in recent years (NMFS and USFWS 2020). For this analysis, we found that the status review estimate of 20,659 nesting females represents the best available scientific information given that it uses the most comprehensive and recent demographic trends and nesting data.

In the 2020 status review, the authors identified seven leatherback populations that met the discreteness and significance criteria of DPSs (NMFS and USFWS 2020). These include the Northwest Atlantic, Southwest Atlantic, Southeast Atlantic, Southwest Indian, Northeast Indian, West Pacific, and East Pacific. The population found within the action area is that identified in the status review as the Northwest Atlantic DPS. While NMFS and USFWS concluded that seven populations met the criteria for DPSs, the species continues to be listed as a species at the global level across its entire range (85 FR 48332, August 10, 2020) as the agency has taken no action to list one or more DPSs. While we reference the DPSs and stocks to analyze the status and trends of various populations, our jeopardy analysis is based on the range-wide status of the species as listed.

Previous assessments of leatherbacks concluded that the Northwest Atlantic population was stable or increasing (TEWG 2007, Tiwari et al. 2013b). However, as described in the *Status of the Species,* more recent analyses indicate that the overall trends are negative (NMFS and USFWS 2020, Northwest Atlantic Leatherback Working Group 2018, 2019). At the stock level, the Working Group evaluated the NW Atlantic – Guianas-Trinidad, Florida, Northern Caribbean, and the Western Caribbean stocks. The NW Atlantic – Guianas-Trinidad stock is the largest stock and declined significantly across all periods evaluated, which was attributed to an exponential decline in abundance at Awala-Yalimapo, French Guiana as well as declines in Guyana; Suriname; Cayenne, French Guiana; and Matura, Trinidad. Declines in Awala-Yalimapo were attributed, in part, due to beach erosion and a loss of nesting habitat (Northwest Atlantic Leatherback Working Group 2018). The Florida stock increased significantly over the long-term, but declined from 2008-2017 (Northwest Atlantic Leatherback Working Group 2018). Slight increases in nesting were seen in 2018 and 2019, however, nest counts remain low compared to 2008-2015 (https://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/). The Northern Caribbean and Western Caribbean stocks have also declined. The Working Group report also includes trends at the site-level, which varied depending on the site and time period, but were generally negative especially in the recent period.

Similarly, the leatherback status review concluded that the Northwest Atlantic DPS exhibits decreasing nest trends at nesting aggregations with the greatest indices of nesting female abundance. Though some nesting aggregations indicated increasing trends, most of the largest ones are declining. This trend is considered to be representative of the DPS (NMFS and USFWS 2020). Data also indicated that the Southwest Atlantic DPS is declining (NMFS and USFWS 2020).

Populations in the Pacific have shown dramatic declines at many nesting sites (Mazaris et al. 2017, Santidrián Tomillo et al. 2017, Santidrián Tomillo et al. 2007, Sarti Martínez et al. 2007, Tapilatu et al. 2013). The IUCN Red List assessment estimated the number of total mature individuals (males and females) at Jamursba-Medi and Wermon beaches to be 1,438 turtles (Tiwari et al. 2013a). More recently, the leatherback status review estimated the total index of nesting female abundance of the West Pacific DPS at 1,277 females for the West Pacific DPS and 755 females for the East Pacific DPS (NMFS and USFWS 2020). The East Pacific DPS has exhibited a decreasing trend since monitoring began with a 97.4 percent decline since the 1980s or 1990s, depending on nesting beach (Wallace et al. 2013). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Most recently, the 2020 status review estimated that the total index of nesting female abundance for the SW Indian DPS is 149 females and that the DPS is exhibiting a slight decreasing nest trend (NMFS and USFWS 2020). While data on nesting in the Northeast Indian Ocean DPS is limited, the DPS is estimated at 109 females. This DPS has exhibited a drastic population decline with extirpation of the largest nesting aggregation in Malaysia (NMFS and USFWS 2020).

The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females, and egg harvesting; of these, as described in the *Environmental Baseline* and *Cumulative Effects*, fisheries bycatch occurs in the action area. Leatherback sea turtles in the action area are also at risk of vessel strike. As noted in the Cumulative Effects section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of leatherback sea turtles in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

The impacts to leatherback sea turtles from the proposed action are expected to result in the harassment (inclusive of behavioral disturbance) of 12 individuals due to exposure to impact pile driving noise. We also expect that 6 leatherbacks will be struck and killed by a project vessel over the 35-year life of the project inclusive of construction, operations, and decommissioning. We determined that all other effects of the action would be insignificant or extremely unlikely to occur and discountable. In total, over the 35-year life of the project, we anticipate the proposed action will result in the mortality of 6 and the harassment of 12 (behavioral disturbance) leatherback sea turtles.

The 12 leatherback sea turtles that experience harassment would experience behavioral disturbance; we also expect these turtles would experience physiological stress during the period that their normal behavioral patterns are disrupted. These temporary conditions are expected to return to normal over a relatively short period of time; however, it is possible that individual sea turtles may be exposed to pile driving noise and experience behavioral disturbance on multiple days during a construction season.

Behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 2 hours, depending on pile type, but likely much less), thus we expect recovery between any subsequent exposures. The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise sourced; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, behavioral disruption will create or increase the risk of injury for the affected sea turtles compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption would result in an actual injury or affect an individual sea turtle's fitness (i.e., survival or reproduction).

As noted above, the proposed project is expected to result in the mortality of no more than 6 leatherbacks. The death of 6 leatherbacks due to vessel strike over the life span of the project represents an extremely small percentage of the number of leatherbacks in the North Atlantic, just 0.03% even considering the lowest population estimate of nesting females (20,659; NMFS and USFWS 2020) and an even smaller percentage of the species as a whole. Considering the extremely small percentage of the population that will be killed, it is unlikely that this death will have a detectable effect on the numbers and population trends of leatherbacks in the North Atlantic or the species as a whole.

Any effects on reproduction are limited to the future reproductive output of the individual killed. Even assuming that the mortality is to a reproductive female, given the number of nesting females in this population (20,659), it is unlikely that the expected loss of no more than 6 leatherbacks over 35 years would affect the success of nesting in any year. Additionally, this extremely small reduction in a potential nester is expected to result in a similarly small reduction in the number of eggs laid or hatchlings produced in future years and similarly, an extremely small effect on the strength of subsequent year classes with no detectable effect on the trend of any nesting beach or the population as a whole. The proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

The proposed action is not likely to reduce distribution because while the action will temporarily affect the distribution of individual leatherbacks through behavioral disturbance, changes in distribution will be temporary and limited to movements to nearby areas in the WDA. As explained in section 7 of this Opinion, we expect the project to have insignificant effects on use of the action area by leatherbacks.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of leatherbacks because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of leatherbacks is likely to be stable or increasing over the period considered here.

Based on the information provided above, the death of 6 leatherbacks over the 35-year life of the project will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for recovery and eventual delisting). The actions will not affect leatherbacks in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent leatherbacks from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of 6 leatherbacks represents an extremely small percentage of the Northwest Atlantic population and an even smaller percentage of the species as a whole; (2) the death of 6 leatherbacks will not change the status or trends of any nesting beach, the Northwest Atlantic population or the species as a whole; (3) the loss of 6 leatherback is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of 6 leatherbacks is likely to have an extremely small effect on reproductive output that will be insignificant at the nesting beach, population, or species level; (5) the actions will have only a minor and temporary effect on the distribution of leatherbacks in the action area and no effect on the distribution of the species throughout its range; and, (6) the actions will have no effect on the ability of leatherbacks to shelter and only an insignificant effect on individual foraging leatherbacks.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed actions will not appreciably reduce the likelihood that leatherback sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed actions will affect the likelihood that leatherbacks can rebuild to a point where listing is no longer appropriate. In 1992, NMFS and the USFWS issued a recovery plan for leatherbacks in the U.S. Caribbean, Atlantic, and Gulf of Mexico (NMFS and USFWS 1992). The plan includes three recovery objectives:

1) The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, USVI, and along the east coast of Florida.
2) Nesting habitat encompassing at least 75 percent of nesting activity in USVI, Puerto Rico, and Florida is in public ownership.
3) All priority one tasks have been successfully implemented.

The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Because the death of 6 leatherbacks over the 35-year life of the project is such a small percentage of the population and is not expected to affect the status or trend of the species, it will not affect the likelihood that the adult female population of loggerheads increases over time. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed actions will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all effects to habitat will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that habitat based recovery criteria will be achieved. The proposed actions will also not affect the ability of any of the recovery tasks to be accomplished.

The effects of the proposed actions will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of leatherbacks and a small reduction in the amount of potential reproduction due to the loss of these individual, these effects will be negligible or undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the species or its potential for recovery. Therefore, based on the analysis presented above, the proposed actions will not appreciably reduce the likelihood that leatherback sea turtles can be brought to the point at which their listing as endangered or threatened is no longer appropriate. Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached here do not change.
Based on the analysis presented herein, the proposed actions are not likely to appreciably reduce the survival and recovery of leatherback sea turtles. These conclusions were made in consideration of the endangered status of leatherback sea turtles, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance and distribution of leatherback sea turtles in the action area; that is, the proposed action will not appreciably reduce the likelihood of recovery of leatherback sea turtles.

Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed actions will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed actions in light of the status of the species rangewide and in the action area, the environmental baseline, cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.
Based on the analysis presented herein, the effects of the proposed action, are not likely to appreciably reduce the likelihood of both the survival and recovery of leatherback sea turtles.
These conclusions were made in consideration of the endangered status of leatherback sea turtles, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of leatherback sea turtles in the action area.

9.5.4 Kemp's Ridley Sea Turtles

Kemp's ridley sea turtles are listed as an endangered species under the ESA. They occur in the Atlantic Ocean and Gulf of Mexico, the only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963, NMFS and USFWS 2015, USFWS and NMFS 1992).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with other sea turtles species, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females and the age structure of the population, nest counts cannot be used to estimate the total population size (Meylan 1982, Ross 1996). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. It is the best proxy we have for estimating population changes.

Following a significant, unexplained one-year decline in 2010, Kemp's ridley sea turtle nests in Mexico reached a record high of 21,797 in 2012 (Gladys Porter Zoo nesting database, unpublished data). In 2013 and 2014, there was a second significant decline in Mexico nests, with only 16,385 and 11,279 nests recorded, respectively. In 2015, nesting in Mexico improved to 14,006 nests, and in 2016 overall numbers increased to 18,354 recorded nests. There was a record high nesting season in 2017, with 24,570 nests recorded (J. Pena, pers. comm. to NMFS SERO PRD, August 31, 2017 as cited in NMFS 2020(c) and decreases observed in 2018 and again in 2019. In 2019, there were 11,140 nests in Mexico. It is unknown whether this decline is related to resource fluctuation, natural population variability, effects of catastrophic events like the Deepwater Horizon oil spill affecting the nesting cohort, or some other factor. A small nesting population is also emerging in the United States, primarily in Texas. From 1980-1989, there were an average of 0.2 nests/year at Padre Island National Seashore (PAIS), rising to 3.4 nests/year from 1990-1999, 44 nests/year from 2000-2009, and 110 nests per year from 2010-2019. There was a record high of 353 nests in 2017 (NPS 2020). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, characterized by a significant decline in 2010, followed by a second decline in 2013-2014, but with a rebound in 2015-2017 (NMFS 2020c) and decreases in nesting in 2018 and 2019 (NPS 2020).

Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (NMFS and USFWS 2015, TEWG 2000). Gallaway et al. (2016) developed a stock assessment model for Kemp's ridley to evaluate the relative contributions of conservation efforts and other factors toward this species' recovery. Terminal population estimates for 2012 summed over ages 2 to 4, ages 2+, ages 5+, and ages 9+ suggest that the respective female population sizes were 78,043 (SD = 14,683), 152,357 (SD = 25,015), 74,314 (SD =10,460), and 28,113 (SD = 2,987) (Gallaway et al. 2016). Using the standard IUCN protocol for sea turtle assessments, the number of mature individuals was recently estimated at 22,341 (Wibbels and Bevan 2019). The calculation took into account the average annual nests from 2016-2018 (21,156), a clutch frequency of 2.5 per year, a remigration interval of 2 years, and a sex ratio of 3.17 females: 1 male. Based on the data in their analysis, the assessment concluded the current population trend is unknown (Wibbels and Bevan 2019). However, some positive outlooks for the species include recent conservation actions, including the expanded TED requirements in the shrimp fishery (84 FR 70048, December 20, 2019) and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS and USFWS 2015).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by nuclear DNA analyses (i.e., microsatellites) (NMFS et al. 2011). If this holds true, then rapid increases in population over one or two generations would likely prevent any negative consequences in the genetic variability of the species (NMFS et al. 2011). Additional analysis of the mtDNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

Fishery interactions are the main threat to the species. The species' limited range and low global abundance make its resilience to future perturbation low. The status of Kemp's ridley sea turtles in the action area is the same as described in the Status of the Species. As described in the Environmental Baseline and Cumulative Effects, fisheries bycatch and vessel strike are likely to continue to occur in the action area over the life of the project. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of Kemp's ridley sea turtles in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change. The impacts to Kemp's ridley sea turtles from the proposed action are expected to result in the harassment (behavioral disturbance) of 1 individual due to exposure to impact pile driving noise. We also expect that 20 Kemp's ridley sea turtles will be struck and killed by a project vessel over the 35-year life of the project inclusive of construction, operations, and decommissioning. We determined that all other effects of the action would be insignificant or extremely unlikely to occur. In total, we expect the proposed action to result in the mortality of 20 Kemp's ridley sea turtles over the 35-year life of the project.

The 1 Kemp's ridley sea turtle that experiences harassment would experience behavioral disturbance; we also expect this turtle would experience physiological stress during the period that their normal behavioral pattern is disrupted. These temporary conditions are expected to return to normal over a relatively short period of time; however, it is possible that individual sea turtles may be exposed to pile driving noise and experience behavioral disturbance on multiple days during a construction season. Behavioral disturbance and stress will cease after exposure to pile driving noise ends (up to 2 hours, but likely much less), thus we expect recovery between any subsequent exposures. The energetic consequences of the evasive behavior and delay in resting or foraging will be disruptive for the period of time that the individual is exposed to the noise sourced; however, the limited duration means that these consequences are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in breeding or nesting. As a result of the energetic costs, evasive behaviors, and temporary impact on the ability to detect environmental cues which could affect the ability to avoid threats, behavioral disruption will create or increase the risk of injury for the affected sea turtle compared to those that are not exposed to these noise sources. However, as established herein, the temporary and limited nature of these effects means that it is unlikely that the behavioral disruption would result in an actual injury or affect an individual sea turtle's fitness (i.e., survival or reproduction); therefore, as explained in section 7.1, the adverse effects meet the definition of harassment and not harm in the context of the ESA definition of take.

The mortality of 20 Kemp's ridleys over a 35 year time period represents a very small percentage of the Kemp's ridleys worldwide. Even taking into account just nesting females (7-8,000), the death of one Kemp's ridley represents less than 0.29% of the nesting female population. While the death of three Kemp's ridley sea turtles will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed actions, it is not likely that this reduction in numbers will change the status of this species or its stable to increasing trend as this loss represents a very small percentage of the population. Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals.

A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction, as any dead Kemp's ridleys would have no potential for future reproduction. In 2006, the most recent year for which data is available, there were an estimated 7-8,000 nesting females. While the species is thought to be female biased, there are likely to be several thousand adult males as well. Given the number of nesting adults, it is unlikely that the loss of 20 Kemp's ridley sea turtles over 35 years would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable to increasing trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede Kemp's ridleys from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

While generally speaking, the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population and the number of Kemp's ridleys is likely to be increasing and at worst is stable.

Based on the information provided above, the death of 20 Kemp's ridley sea turtles over 35 years will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The proposed action will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) the death of 20 Kemp's ridleys represents an extremely small percentage of the species as a whole; (3) the death of 20 Kemp's ridleys will not change the status or trends of the species as a whole; (4) the loss of these Kemp's ridley is not likely to have an effect on the levels of genetic heterogeneity in the population; (5) the loss of these Kemp's ridleys is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (6) the actions will have only a minor and temporary effect on the distribution of Kemp's ridleys in the action area and no effect on the distribution of the species throughout its range; and, (7) the actions will have no effect on the ability of Kemp's ridleys to shelter and only an insignificant effect on individual foraging Kemp's ridleys.

In rare instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, NMFS and the USFWS issued a recovery plan for Kemp's ridleys (NMFS et al. 2011). The plan includes a list of criteria necessary for recovery, including:

1. An increase in the population size, specifically in relation to nesting females[49];
2. An increase in the recruitment of hatchlings[50];
3. An increase in the number of nests at the nesting beaches;
4. Preservation and maintenance of nesting beaches (i.e. Rancho Nuevo, Tepehuajes, and Playa Dos); and,
5. Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

Kemp's ridleys have an increasing trend; as explained above, the loss of 20 Kemp's ridleys over the 35-year life of the project will not affect the population trend. The number of Kemp's ridleys likely to die as a result of the proposed actions is an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for

[49] A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur

[50] Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that criteria one, two, or three will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches and nesting beaches will not be affected; therefore, the proposed actions will have no effect on the likelihood that recovery criteria four will be met. All effects to habitat will be insignificant or extremely unlikely to occur; therefore, the proposed actions will have no effect on the likelihood that criteria five will be met.

The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction. Further, the actions will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of Kemp's ridleys and a small reduction in the amount of potential reproduction, these effects will be negligible or undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which their listing as endangered or threatened is no longer appropriate; that is, the proposed action will not appreciably reduce the likelihood of recovery of Kemp's ridley sea turtles.

Despite the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed actions. We have considered the effects of the proposed action in light of the status of the species, Environmental Baseline and cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change.

Based on the analysis presented herein, the effects of the proposed action, including the mortality of 20 Kemp's ridleys, are not likely to appreciably reduce the likelihood of both the survival and recovery of this species. These conclusions were made in consideration of the endangered status of Kemp's ridley sea turtles, effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance and distribution of Kemp's ridleys in the action area.

9.6 Marine Mammals

We determined that exposure to project noise other than pile driving (e.g., noise from operational WTGs) will have effects that are insignificant or are extremely unlikely to occur. We also determined that adverse effects to habitat and prey are either not reasonably certain to occur or are insignificant or discountable and concluded that with the incorporation of vessel strike risk reduction measures that are part of the proposed action, strike of an ESA listed whale by a project vessel is extremely unlikely to occur. Additionally, entanglement or capture in marine resource surveys is extremely unlikely to occur.

Our effects analysis determined that pile driving is likely to adversely affect ESA-listed marine mammals in the action area and cause temporary threshold shift (TTS), behavioral response, and stress in a small number of individual North Atlantic right, fin, and sei whales; we determined these effects meet the definition of harassment in the context of ESA take. As addressed in section 7.1, animals exposed to sufficiently intense sound exhibit an increased hearing threshold (i.e., poorer sensitivity) for some period of time following exposure; this is called a noise-induced threshold shift (TS). The magnitude of TS normally decreases over time following cessation of the noise exposure, TS that eventually returns to zero (i.e., the threshold returns to the pre-exposure value), is called TTS (Southall et al. 2007). TTS represents primarily tissue fatigue and is reversible (Southall et al., 2007). In addition, other investigators have suggested that TTS is within the normal bounds of physiological variability and tolerance and does not represent physical injury (*e.g.*, Ward, 1997). Therefore, NMFS does not consider TTS to constitute auditory injury. No injury of any kind, including PTS is anticipated, for any ESA listed whales. In this section, we discuss the likely consequences of the anticipated adverse effects to the individual whales that have been exposed, the populations those individuals represent, and the species those populations comprise.

Our analyses identified the likely effects of the Maryland Wind project, which requires authorizations from a number of federal agencies as described in section 3 of this Opinion, on the ESA-listed species that will be exposed to these actions. We measure effects to individuals of endangered or threatened marine mammals using changes in the individual's "fitness" or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect listed marine mammals exposed to an action's effects to experience reductions in fitness, we would not expect the action to impact that animal's health or future reproductive success. Therefore, we would not expect adverse consequences on the overall reproduction, abundance, or distribution of the populations those individuals represent or the species those populations comprise. As a result, if we conclude that listed animals are not likely to experience reductions in their fitness, we would conclude our assessment. If, however, we conclude that listed animals are likely to experience reductions in their fitness, we would assess the consequences of those fitness reductions for the population represented in an action area and the species the population supports.

As documented in section 7 of this Opinion, the adverse effects anticipated on North Atlantic right, fin, and sei whales resulting from the proposed action are from sounds produced during pile driving to install WTG, OSS, and Met Tower foundations. We have not identified any adverse effects to sperm whales. While this Opinion relies on the best available scientific and commercial information as cited herein, our analysis and conclusions include uncertainty about the basic hearing capabilities of some marine mammals; how these animals use sounds as environmental cues; how they perceive acoustic features of their environment; the importance of sound to the normal behavioral and social ecology of species; the mechanisms by which human-generated sounds affect the behavior and physiology (including the non-auditory physiology) of exposed individuals; and the circumstances that could produce outcomes that have adverse consequences for individuals and populations of exposed species. Based on the best available information and exercising our best professional judgment, as explained in section 7 of this Opinion, we expect the effects of exposure to noise from impact pile driving below the MMPA Level A harassment threshold but above the MMPA Level B harassment threshold to have adverse, but temporary, effects on the behavior of individual fin, right, and sei whales that we have determined to cause harassment under the ESA. As is evident from the available literature cited herein, behavioral responses to pile driving noise are expected to be short-term, with the animal returning to normal behavior patterns shortly after the exposure is over (e.g., Goldbogen et al. 2013a; Silve et al. 2015); TTS and any associated behavioral effect is expected to resolve within a week. While Southall et al. (2016) suggested that even minor, sub-lethal behavioral changes may still have significant energetic and physiological consequences given sustained or repeated exposure, as explained in section 7 of this Opinion, we do not expect such sustained or repeated exposure of any individuals in this case. Any repeated exposure would be limited to individuals experiencing minor TTS in a subsequent construction season after fully recovering from exposure the previous year.

9.6.1 North Atlantic Right Whales

As described in the *Status of the Species*, the endangered North Atlantic right whale is currently in decline in the western North Atlantic (Pace et al. 2017b; Pace et al. 2021) and experiencing an unusual mortality event (Daoust et al. 2017). Linden (2023) updated the population size estimate of North Atlantic right whales (at the beginning of 2022 using the most recent year of available sightings data (collected through December 2022). The estimated population size in 2022 was 356 whales, with a 95% credible interval ranging from 346 to 363. As noted in that paper, the sharp decrease observed from 2015-2020 appears to have slowed, though the right whale population continues to experience annual mortalities above recovery thresholds.

Modeling indicates that low female survival, a male-biased sex ratio, and low calving success are contributing to the population's current decline (Pace et al. 2017b). The species has low genetic diversity, as would be expected based on its low abundance, and the species' resilience to future perturbations (i.e., its ability to recover from declines in numbers of reductions) is expected to be very low (Hayes et al. 2018). Vessel strikes and entanglement of right whales in U.S. and Canadian waters continue to occur. Entanglement in fishing gear appears to have had substantial health and energetic costs that affect both survival and reproduction of right whales (van der Hoop et al. 2017a). Due to the declining status of North Atlantic right whales, the resilience of this population to stressors that would impact the distribution, abundance, and reproductive potential of the population is low. As described in the most recent 5-year Review, North Atlantic right whales are considered to be at a high demographic risk because of rapid population decline, habitat destruction, and continuing threats to recovery (NMFS 2022). The species faces a high risk of extinction and the population size is small enough that the death of any individual would be expected to have a measurable effect on the projections on its population status, trend, and dynamics. We note here that the proposed action is not expected to result in the serious injury or mortality of any North Atlantic right whale.

As described in the *Environmental Baseline* and *Status of the Species* sections, ongoing effects in the action area (e.g., global climate change, decreased prey abundance, vessel strikes, and entanglements in U.S. state and federal fisheries) have contributed to concern for the species' persistence. Sub-lethal effects from entanglement cannot be separated out from other stressors (e.g., prey abundance, climate variation, reproductive state, vessel collisions) which co-occur and affect calving rates. Entanglement in fishing gear and vessel strikes are currently understood to be the most significant threats to the species and, as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change is expected to continue to negatively affect right whales throughout their range, including in the action area, over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

The distribution of right whales overlaps with some parts of the vessel transit routes that will be used through the 35-year life of the project. A number of measures designed to reduce the risk of vessel strike, including deploying lookouts and traveling at reduced speeds in areas where right whales are most likely to occur, are part of the proposed action. As explained in section 7.2, we have determined that strike of a right whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a right whale and any associated injury or mortality is not an expected outcome of the Maryland Wind project.

Based on the type of survey gear that will be deployed, we concluded that all effects to right whales from the surveys of marine resources planned for the Maryland Wind project and considered as part of the proposed action will be insignificant or discountable. We have concluded that capture or entanglement of a right whale and any associated injury or mortality is not an expected outcome of the Maryland Wind project.

As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with a number of other project activities (e.g., HRG surveys, vessels) are expected to be insignificant. We also determined that effects of construction, operation, and decommissioning, inclusive of project noise, will have insignificant effects on right whale prey. As right whales do not echolocate, there is no potential for noise or other project effects to affect echolocation. The area around operating WTGs where operational noise may be above ambient noise is expected to be very small (not greater than 50 -100 m) and any effects to right whales from avoiding that very small area would be insignificant. For HRG surveys, the best available data (Crocker and Fratantonio 2016) indicates that the area with noise above the level that would be disturbing to right whales is very small. Given the small area, the shutdown and clearance requirements, and that we only expect a whale exposed to that noise to swim just far enough way to avoid it (less than 500 m), effects are insignificant.

A number of measures that are part of the proposed action, including a seasonal restriction on impact pile driving, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during pile driving monitored by PSOs on multiple platforms supplemented by PAM out to 10km, reduce the potential for exposure of right whales to pile driving noise. With these measures in place, we do not anticipate the exposure of any right whales to noise that could result in PTS, other injury, or mortality. However, even with these avoidance and minimization measures in place, we expect 6 North Atlantic right whales to experience TTS (resolving within a week), temporary behavioral disturbance (up to approximately 2 hours considering the time to install each monopile) meeting the definition of take by harassment under the ESA and associated temporary physiological stress during the construction period due to exposure to pile driving noise. As explained in the *Effects of the Action* section, all of these impacts, including TTS, are expected to be temporary with normal behaviors resuming quickly after the noise ends (see Goldbogen et al. 2013a; Melcon et al. 2012). Any TTS will resolve within a week of exposure (that is, hearing sensitivity will return to normal within one week of exposure) and is not expected to affect the long term health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007). Given that foundation installation will occur over three construction seasons, it is possible that some individuals may be exposed to project noise in more than one year; however, we expect full recovery between exposures such that there would be no cumulative or additive effects experienced by the individual whale. This is due to the minor and temporary nature of the TTS and behavioral response, inclusive of stress.

As explained in section 7.1, we have also considered whether TTS, masking, or avoidance behaviors experienced by the 6 right whales exposed to noise above the MMPA Level B harassment threshold would be likely to increase the risk of vessel strike or entanglement in fishing gear. We would not expect the TTS to span the entire communication or hearing range of right whales given the frequencies produced by pile driving do not span entire hearing ranges for right whales. Additionally, though the frequency range of TTS that right whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from US Wind's pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. As such, any effects of TTS on the ability of a right whale to communicate with other right whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats are expected to be minor and temporary. As such, we do not expect TTS or masking to affect the ability of a right whale to avoid a vessel or any other threat that may be detected with acoustic cues. These risks are lowered even further by the short duration of TTS (resolving within a week) and masking (limited only to the time that the whale is exposed to the pile driving noise). In addition, as explained in section 7.1, we do not expect that avoidance of pile driving noise would result in right whales moving to areas with higher risk of vessel strike or entanglement in fishing gear; increased risk of vessel strike or entanglement in fishing gear as a result of exposure to pile driving noise is extremely unlikely to occur. This determination was made in consideration of the distance a whale is expected to travel to avoid disturbing levels of noise and the distribution of vessel traffic and fishing activity in the WDA and surrounding waters (i.e. no meaningful difference in vessel traffic or fishing effort between the two and thus no increased risk).

We have considered if pile driving noise may mask right whale calls and could have effects on mother-calf communication and behavior. As noted in section 7.1, presence of mother-calf pairs is unlikely in the WDA during the May – November pile driving window. However, even if a mother-calf pair was exposed to pile driving noise, we do not anticipate that masking would result in fitness consequences given their short-term nature. As noted in section 7.1, when calves leave the foraging grounds off the coast of the southeastern U.S. at around four months of age, they are expected to be more robust and less susceptible to a missed or delayed nursing opportunity. Any masking of communications or any delays in nursing due to swimming away from the pile driving noise would only last for the duration of the exposure to pile driving noise; no longer than 2 hours (as harassment is only expected as a result of exposure to noise from

driving monopiles), and likely far less time than that. This temporary disruption is not expected to have any health consequences to the calf or mother due to its short-term duration and the ability to resume normal behaviors as soon as they are out of range of the disturbance.
We expect that right whales in the WDA are migrating, or socializing, with limited, occasional, and opportunistic foraging occurring. As explained in the effects analysis, if suitable densities of copepod prey are present, right whales may forage in the WDA; however, the WDA is outside of the areas where right whales are documented to aggregate and persist due to the presence of prey. Based on the best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that the up to 6 right whales exposed to ESA harassment levels of noise during pile driving will return to normal behavioral patterns after the exposure ends. As such, even if a right whale exposed to pile driving noise was foraging, this disruption would be short term and impact no more than one foraging event on a single day.

As explained in section 7.1, exposure to noise that may result in harassment is only expected for the monopiles. Therefore, exposure to noise for more than 2 hours is not expected to occur considering the duration of pile driving, the area where noise will be elevated and the anticipated swim speed and behavioral response (avoidance). An animal exhibiting the anticipated avoidance response to foundation installation noise would experience a cost in terms of the energy associated with traveling away from the acoustic source. Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the MMPA Level B harassment threshold would take a direct path to get outside of the noisy area.

There would likely be an energetic cost associated with any temporary displacement or change in migratory route, and disruption of a single foraging event, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (see Southall et al. 2007a). Similarly, the disruption of a single foraging event lasting for a few hours on a single day is not expected to affect the health of an animal, even an animal in poor condition. The energetic consequences of the evasive behavior and delay in resting or foraging for a few hours on a single day are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in future breeding or calving. Stress responses are also anticipated to occur as a result of noise exposure and the accompanying behavioral response. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase of stress that could result in physiological consequences to the animal (Southall et al. 2007). Given the short period of time during which elevated noise will be experienced, we do not anticipate long duration exposures to occur, and we do not anticipate the associated stress of exposure to result in long-term effects to affected individuals**.**

As explained in section 7 of this Opinion, the only adverse effects to North Atlantic right whales expected to result from the Maryland Wind project are the temporary behavioral disturbance and/or TTS (minor and temporary hearing impairment), inclusive of masking and stress, as a result of exposure to noise during impact pile driving for foundation installation. While we do not anticipate these effects to have long-term consequences, these behavioral consequences, combined with TTS, are expected to create a short-term likelihood of injury by substantially disturbing normal behavioral patterns as the disturbance is experienced: these adverse effects thus meet NMFS's interim guidance definition of take by harassment under the ESA. These adverse effects will be experienced by up to 6 individual right whales as a result of exposure to noise from pile driving. As explained in section 7 of this Opinion, these effects do not meet the ESA definition of harm. No harm, injury (auditory or other), serious injury, or mortality is expected due to exposure to any aspect of the proposed action during the construction, operations, or decommissioning phases of the project, including exposure to sources of underwater noise (e.g. impact pile driving).

As described in greater detail in Section 7.1, while the anticipated behavioral disruptions, TTS, masking, and stress that are anticipated to result from exposure to noise during pile driving, will meet the ESA definition of harassment, we do not expect injury or any long-term fitness consequences to any of the up to 6 individual North Atlantic right whales that will be harassed. Our analysis considered the overall number of exposures to acoustic stressors that are expected to result in ESA take by harassment, inclusive of behavioral responses, TTS, masking, additional energy expenditure and stress, the duration and scope of the proposed activities expected to result in such impacts, the expected behavioral state of the animals at the time of exposure, and the expected condition of those animals. Instances of North Atlantic right whale exposure to acoustic stressors are expected to be short-term, with the animal returning to its previous behavioral state shortly thereafter. As described previously, information is not available to conduct a quantitative analysis to determine the likely fitness consequences of these exposures and associated responses because we do not have information from wild cetaceans that links short-term behavioral responses to vital rates and animal health. Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for North Atlantic right whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Maryland Wind project; therefore, we do not expect this harassment to reduce the likelihood of successful migration, breeding, calving, or nursing.

In summary, while we expect the proposed action to result in the ESA take by harassment of 6 right whales (i.e., short term significant disruption of behavioral patterns creating the likelihood of injury), we do not expect any actual harm, injury (auditory or otherwise), serious injury, or mortality of any right whale to result from the proposed action. We do not expect effects of the action to affect the health of any right whale. We also do not anticipate fitness consequences to any individual North Atlantic right whales; that is, we do not expect any effects on any individual's ability to reproduce or generate viable offspring. Because we do not anticipate any reduction in fitness, we do not anticipate any future effects on reproductive success to result from the proposed action. While many right whales in the action area are in a stressed state that is thought to contribute to a decreased calving interval, the short-term (no more than 2 hours) exposure to pile driving noise experienced by a single individual is not anticipated to have any lingering effects and is not expected to have any effect on future reproductive output. As such, we do not expect any reductions in reproduction. Any effects to distribution will be limited to short-term alterations to normal movements by individuals to avoid disturbing levels of noise. Based on the information provided here, the proposed action will not appreciably reduce the likelihood of survival of the North Atlantic right whale (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment).

The proposed action is not likely to affect the recovery potential of North Atlantic right whales (i.e. affect the likelihood that North Atlantic right whales can rebuild to a point where it is downlisted and ultimately listing is no longer appropriate). In making this determination we have considered generalized needs for species recovery and the goals and criteria identified in the 2005 Recovery Plan for North Atlantic right whales. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In general, mortality rates must be low enough to allow for recruitment to all age classes so that successful calving can continue over time and over generations. The 2005 Recovery Plan (NMFS 2005) states that North Atlantic right whales may be considered for reclassifying to threatened when all of the following have been met: 1) The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population; 2) The population has increased for a period of 35 years at an average rate of increase equal to or greater than 2% per year; 3) None of the known threats to Northern right whales (summarized in the five listing factors) are known to limit the population's growth rate; and, 4) Given current and projected threats and environmental conditions, the right whale population has no more than a 1% chance of quasi-extinction in 100 years. The proposed action will not result in any condition that impacts the time it will take to reach these goals or the likelihood that these goals will be met. This is because the proposed action will not result in any mortality or have any effect on the health or reproductive success of any individuals; therefore, it will not affect the trend of the species or prevent or delay it from achieving an increasing population or otherwise affect its growth rate and will not affect the chance of quasi-extinction. That is, the proposed action will not appreciably reduce the likelihood of recovery of North Atlantic right whales.

The proposed action will not affect the abundance of right whales; because no serious injury or mortality is anticipated, the project will not cause there to be fewer right whales. The only effects to distribution of right whales will be minor changes in the movements of up to 6 individuals exposed to pile driving noise above the MMPA Level B harassment threshold resulting in ESA take by harassment; there will be no changes in the distribution of the species in the action area or throughout its range. The proposed action will have no effect on reproduction because it will not affect the health of any potential mothers or the potential for successful breeding or calving;

the project will not cause any reduction in reproduction. As explained above, the proposed action will not affect the recovery potential of the species.

For the reasons presented herein, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of North Atlantic right whales in the wild. These conclusions were made in consideration of the endangered status of North Atlantic right whales, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects* section of this Opinion, and any anticipated effects of climate change on the abundance, reproduction, and distribution of right whales in the action area.

9.6.2 Fin Whales

The best available current abundance estimate for fin whales in the North Atlantic stock is 6,802 (CV=0.24), sum of the 2016 NOAA shipboard and aerial surveys and the 2016 NEFSC and Department of Fisheries and Oceans Canada (DFO) surveys; the minimum population estimate for the western North Atlantic fin whale is 5,573 (Hayes et al. 2022). Fin whales in the North Atlantic compromise one of the three to seven stocks in the North Atlantic. According to the latest NMFS stock assessment report for fin whales in the Western North Atlantic, information is not available to conduct a trend analysis for this population (Hayes et al. 2022). Rangewide, there are over 100,000 fin whales occurring primarily in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere.

Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the *Status of the Species* and *Environmental Baseline* sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of fin whales in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

The distribution of fin whales overlaps with some parts of the vessel transit routes that will be used through the 35-year life of the project. A number of measures designed to reduce the risk of vessel strike, including deploying lookouts and traveling at reduced speeds in areas where fin whales are most likely to occur, are part of the proposed action. As explained in section 7.2, we have determined that a strike of a fin whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a fin whale and any associated injury or mortality is not an expected outcome of the Maryland Wind project.

Based on the type of survey gear that will be deployed, we determined that effects to fin whales from the surveys of marine resources planned by US Wind and considered as part of the proposed action are extremely unlikely to occur. As such, capture or entanglement of a fin whale and any associated injury or mortality is not an expected outcome of the Maryland Wind project. As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with other project activities (e.g., HRG surveys, vessels) are expected to be insignificant. We also determined that effects of construction, operation, and decommissioning, inclusive of project noise, will have insignificant effects on fin whale prey. As fin whales do not echolocate, there is no potential for noise or other project effects to affect echolocation. The area around operating WTGs where operational noise may be above ambient noise is expected to be very small (up to 50-100 m) and any effects to fin whales from avoiding that very small area would be insignificant. For HRG surveys, the best available data (Crocker and Fratantonio 2016) indicates that the area with noise above the level that would be disturbing to fin whales is very small (no more than 500 m from the sound source). Given the small area, the shutdown and clearance requirements, and that we only expect a whale exposed to that noise to swim just far enough way to avoid it (less than 500 m), effects are insignificant.

A number of measures that are part of the proposed action, including a seasonal restriction on impact pile driving, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during pile driving monitored by PSOs on multiple platforms, reduce the potential for exposure of fin whales to noise during pile driving. With these measures in place, we do not anticipate the exposure of any fin whales to noise that could result in PTS, other injury, or mortality. However, even with these minimization measures in place, we expect up to 37 fin whales to experience TTS, temporary behavioral disturbance and associated temporary physiological stress during the construction period due to exposure to impact pile driving noise.

For the up to 37 fin whales that are exposed to noise loud enough to result in TTS and disruption of behavior, but not loud enough to result in PTS, we expect normal behaviors to resume quickly after the noise ends (see Goldbogen et al. 2013a; Melcon et al. 2012). Any TTS will resolve within a week of exposure (that is, hearing sensitivity will return to normal within one week of exposure) and is not expected to affect the longterm health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

We would not expect the TTS to span the entire communication or hearing range of fin whales given the frequencies produced by pile driving do not span entire hearing ranges for fin whales. Additionally, though the frequency range of TTS that fin whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from US Wind’s pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. Before the TTS resolves, individual fin whales could be less efficient at locating conspecifics or have decreased ability to detect threats at long distances, but these animals are still expected to be able to locate conspecifics to socialize and reproduce, and will still be able to detect threats with enough time to avoid injury, including vessel strike.

The risks of TTS or masking affecting communication or threat avoidance are lowered even further by the short duration of TTS (resolving within a week) and masking (limited only to the time that the whale is exposed to the pile driving noise). Also, as explained in section 7.1, we do not expect that avoidance of pile driving noise would result in fin whales moving to areas with higher risk of vessel strike or entanglement in fishing gear; increased risk of vessel strike or entanglement in fishing gear as a result of exposure to pile driving noise is extremely unlikely to occur. This determination was made in consideration of the distance a whale is expected to travel to avoid disturbing levels of noise and the distribution of vessel traffic and fishing activity in the

WDA and surrounding waters (i.e. no meaningful difference in vessel traffic or fishing effort between the two and thus no increased risk)

We have considered if pile driving noise may mask fin whale calls and could have effects on mother-calf communication and behavior. If a mother-calf pair was exposed to pile driving noise, we do not anticipate that masking would result in fitness consequences given their short-term nature. Any masking of communications or any delays in nursing due to swimming away from the pile driving noise would only last for the duration of the exposure to pile driving noise, which in all cases would be less than 2 hours and likely far shorter (as explained in section 7.1). This temporary disruption is not expected to have any health consequences to the calf or mother due to its short-term duration and the ability to resume normal behaviors as soon as they are out of range of the disturbance.

Fin whales in the WDA are migrating and may also forage. Based on the best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that the up to 37 fin whales exposed to harassing levels of noise will return to normal behavioral patterns after the exposure ends. As such, even if a fin whale exposed to pile driving noise was foraging, this disruption would be short term and impact no more than one foraging event on a single day.
A single pile driving event will take approximately 2 hours; therefore, even in the event that the 37 fin whales expected to be exposed to impact pile driving noise were exposed to disturbing levels of noise for the entirety of a pile driving event, that disturbance would last no longer than 2 hours. An animal exhibiting the anticipated avoidance response to foundation installation noise would experience a cost in terms of the energy associated with traveling away from the acoustic source. Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the Level B harassment threshold would take a direct path to get outside of the noisy area.
There would likely be an energetic cost associated with any temporary displacement or change in migratory route, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (see Southall et al. 2007a). The energetic consequences of the evasive behavior and delay in resting are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in future breeding or calving. Stress responses are also anticipated with each of these instances of disruption. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase in stress that could result in physiological consequences to the animal (Southall et al. 2007). Given the short period of time during which individuals will be exposed to elevated noise, we do not anticipate long duration exposures to occur, and we do not anticipate the associated stress of exposure to result in significant costs to affected individuals.
As explained in section 7 of this Opinion, we determined that the adverse effects expected to result from the exposure of the 37 fin whales to noise below the Level A harassment threshold but above the Level B harassment threshold meet NMFS interim ESA definition of take by harassment. The proposed action will result in ESA take by harassment, but not harm, of 37

individual fin whales. No other injury, and no harm, serious injury, or mortality is expected due to exposure to any aspect of the proposed action during the construction, operations, or decommissioning phases of the project.

Our analysis considered the overall number of exposures to acoustic stressors that are expected to result in harassment, inclusive of behavioral responses, TTS, and stress, the duration and scope of the proposed activities expected to result in such impacts, the expected behavioral state of the animals at the time of exposure, and the expected condition of those animals. Instances of fin whale exposure to acoustic stressors are expected to be short-term, with the animal returning to its previous behavioral state shortly thereafter. As described previously, information is not available to conduct a quantitative analysis to determine the likely fitness consequences of these exposures and associated responses because we do not have information from wild cetaceans that links short-term behavioral responses to vital rates and animal health. Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for fin whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Maryland Wind project. Because we do not anticipate fitness consequences to individual fin whales to result from instances of TTS and behavioral disturbance due to acoustic stressors that we have determined meets the ESA definition of harassment but not harm, we do not expect reductions in overall reproduction, abundance, or distribution of the fin whale population in the North Atlantic or rangewide.

The proposed action will not result in any reduction in the abundance or reproduction of fin whales. Any effects to distribution will be limited to short-term alterations to normal movements by individuals to avoid disturbing levels of noise. There will be no change to the overall distribution of fin whales in the action area or throughout their range. Based on the information provided here, the proposed action will not appreciably reduce the likelihood of survival of the fin whale (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment).
The proposed action is not likely to affect the recovery potential of fin whales. In making this determination we have considered generalized needs for species recovery and the goals and criteria identified in the 2010 Recovery Plan for fin whales. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In general, mortality rates must be low enough to allow for recruitment to all age classes so that successful calving can continue over time and over generations. The 2010 Recovery Plan for fin whales included two criteria for consideration for reclassifying the species from endangered to threatened:

1. Given current and projected threats and environmental conditions, the fin whale population in each ocean basin in which it occurs (North Atlantic, North Pacific and Southern Hemisphere) satisfies the risk analysis standard for threatened status (has no more than a 1% chance of extinction in 100 years) and has at least 500 mature, reproductive individuals (consisting of at least 250 mature females and at least 250 mature males) in each ocean basin. Mature is defined as the number of individuals known, estimated, or inferred to be capable of reproduction. Any factors or circumstances that are thought to substantially contribute to a real risk of extinction that cannot be incorporated into a Population Viability Analysis will be carefully considered before downlisting takes place; and,
2. None of the known threats to fin whales are known to limit the continued growth of populations. Specifically, the factors in 4(a)(l) of the ESA are being or have been addressed: A) the present or threatened destruction, modification or curtailment of a species' habitat or range; B) overutilization for commercial, recreational or educational purposes; C) disease or predation; D) the inadequacy of existing regulatory mechanisms; and E) other natural or manmade factors.
3.

The proposed action will not result in any condition that impacts the time it will take to reach these goals or the likelihood that these goals will be met. This is because the proposed action will not affect the trend of the species or prevent or delay it from achieving an increasing population or otherwise affect the number of individuals or the species growth rate and will not affect the chance of extinction. The proposed action will not appreciably reduce the likelihood of recovery of fin whales.

The proposed action will not affect the abundance of fin whales; because no serious injury or mortality is anticipated, the project will not cause there to be fewer fin whales. The only effects to distribution of fin whales will be minor changes in the movements of up to 37 individuals exposed to pile driving noise above the Level B harassment threshold; there will be no changes in the distribution of the species throughout the action area or throughout its range. The proposed action will have no effect on reproduction because it will not affect the health of any potential mothers or the potential for successful breeding or calving; the project will not cause any reduction in reproduction. As explained above, the proposed action will not affect the recovery potential of the species.

Based on this analysis, the effects of the proposed action are not likely to appreciably reduce the likelihood of both the survival and recovery of fin whales in the wild by reducing the reproduction, numbers, or distribution of that species. These conclusions were made in consideration of the endangered status of fin whales, the effects of the action, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of fin whales in the action area.

9.6.3 Sei Whales

The average spring 2010–2013 abundance estimate of 6,292 (CV=1.015) is considered the best available for the Nova Scotia stock of sei whales because it was derived from surveys covering the largest proportion of the range (Halifax, Nova Scotia to Florida), during the season when they are the most prevalent in U.S. waters (in spring), using only recent data (2010–2013), and correcting aerial survey data for availability bias (Hayes et al. 2022). However, as described in Hayes et al. 2022 (the most recent stock assessment report), there is considerable uncertainty in this estimate and there are insufficient data to determine population trends for the Nova Scotia stock of sei whales. As described in the Status of the Species, a robust estimate of worldwide abundance is not available. The most recent abundance estimate for the North Atlantic is an estimate of 10,300 whales in 1989 (Cattanach et al. 1993 as cited in (NMFS 2011a). In the North Pacific, an abundance estimate for the entire North Pacific population of sei whales is not available. However, in the western North Pacific, it is estimated that there are 35,000 sei whales (Cooke 2018a). In the eastern North Pacific (considered east of longitude 180o), two stocks of sei whales occur in U.S. waters: Hawaii and Eastern North Pacific. Abundance estimates for the Hawaii stock are 391 sei whales (Nmin=204), and for Eastern North Pacific stock, 519 sei whales (Nmin=374) (Carretta et al. 2019a). In the Southern Hemisphere, recent abundance of sei whales is estimated at 9,800 to 12,000 whales.

Entanglement in fishing gear and vessel strikes as described in the *Environmental Baseline* may occur in the action area over the life of the proposed action. As noted in the *Cumulative Effects* section of this Opinion, we have not identified any cumulative effects different from those considered in the Status of the Species and Environmental Baseline sections of this Opinion, inclusive of how those activities may contribute to climate change. As described in section 7.10, climate change may result in changes in the distribution or abundance of sei whales in the action area over the life of this project; however, we have not identified any different or exacerbated effects of the action in the context of anticipated climate change.

The distribution of sei whales overlaps with some parts of the vessel transit routes that will be used through the 35-year life of the project. A number of measures designed to reduce the risk of vessel strike, including deploying lookouts and traveling at reduced speeds in areas where sei whales are most likely to occur, are part of the proposed action. As explained in section 7.2, we have determined that strike of a sei whale by a project vessel is extremely unlikely to occur. As such, vessel strike of a sei whale and any associated injury or mortality is not an expected outcome of the Maryland Wind project.

Based on the type of survey gear that will be deployed, we do not expect any effects to sei whales from the surveys of marine resources planned by US Wind and considered as part of the proposed action. As such, capture or entanglement of a sei whale and any associated injury or mortality is not an expected outcome of the Maryland Wind project.

As explained in section 7.1, the effects of exposure to WTG operational noise and noise associated with other project activities (e.g., HRG surveys, vessels) are expected to be insignificant. We also determined that effects of construction, operation, and decommissioning, inclusive of project noise, will have insignificant effects on sei whale prey. As sei whales do not echolocate, there is no potential for noise or other project effects to affect echolocation. The area around operating WTGs where operational noise may be above ambient noise is expected to be very small (50 m or less) and any effects to sei whales from avoiding that very small area would be insignificant. For HRG surveys, the best available data (Crocker and Fratantonio 2016) indicates that the area with noise above the level that would be disturbing to sei whales is very small (no more than 500 m from the sound source). Given the small area, the shutdown and clearance requirements, and that we only expect a whale exposed to that noise to swim just far enough away to avoid it (less than 500 m), effects are insignificant.

Up to 6 sei whales are expected to be exposed to pile driving noise that will be loud enough to result in TTS or behavioral disturbance, inclusive of masking and stress that would meet the NMFS interim definition of ESA take by harassment but not harm. A number of measures that are part of the proposed action, including a seasonal restriction on impact pile driving, requirements to use noise attenuation devices, minimum visibility requirements, and clearance and shutdown measures during pile driving monitored by PSOs on multiple platforms, reduce the potential for exposure of sei whales to pile driving noise. However, even with these minimization measures in place, we expect 6 sei whales to experience TTS, temporary behavioral disturbance (up to 2 hours but likely far shorter), and associated temporary physiological stress during the construction period due to exposure to impact pile driving noise. As explained in the *Effects of the Action* section, all of these impacts, including TTS, are expected to be temporary with normal behaviors resuming quickly after the noise ends (see Goldbogen et al. 2013a; Melcon et al. 2012). Any TTS will resolve within a week of exposure (that is, hearing sensitivity will return to normal within one week of exposure) and is not expected to affect the long-term health of any whale or its ability to migrate, forage, breed, or calve (Southall et al. 2007).

As explained in section 7.1, we have also considered whether TTS, masking, or avoidance behaviors experienced by the 6 sei whales exposed to noise above the MMPA Level B harassment threshold would be likely to increase the risk of vessel strike or entanglement in fishing gear. We would not expect the TTS to span the entire communication or hearing range of sei whales given the frequencies produced by pile driving do not span entire hearing ranges for sei whales. Additionally, though the frequency range of TTS that sei whales might sustain would overlap with some of the frequency ranges of their vocalization types, the frequency range of TTS from US Wind's pile driving activities would not span the entire frequency range of one vocalization type, much less span all types of vocalizations or other critical auditory cues for any given species. As such, we do not expect TTS to affect the ability of a sei whale to communicate with other sei whales or to detect audio cues to the extent they rely on audio cues to avoid vessels or other threats. As such, we do not expect masking to affect the ability of a sei whale to avoid a vessel. These risks are lowered even further by the short duration of TTS (resolving within a week) and masking (limited only to the time that the whale is exposed to the pile driving noise). Also, as explained in section 7.1, we do not expect that avoidance of pile driving noise would result in sei whales moving to areas with higher risk of vessel strike or entanglement in fishing gear; increased risk of vessel strike or entanglement in fishing gear as a result of exposure to pile driving noise is extremely unlikely to occur. This determination was made in consideration of the distance a whale is expected to travel to avoid disturbing levels of noise and the distribution of vessel traffic and fishing activity in the WDA and surrounding waters (i.e. no meaningful difference in vessel traffic or fishing effort between the two and thus no increased risk).

We have considered if pile driving noise may mask sei whale calls and could have effects on mother-calf communication and behavior. If a mother-calf pair was exposed to pile driving noise, we do not anticipate that masking would result in fitness consequences given their short-term nature. Any masking of communications or any delays in nursing due to swimming away from the pile driving noise would only last for the duration of the exposure to monopile driving noise, approximately 2 hours, but likely much less. This temporary disruption is not expected to have any health consequences to the calf or mother due to its short-term duration and the ability to resume normal behaviors as soon as they are out of range of the disturbance.

Sei whales in the WDA are migrating and may forage in the WDA. Based on the best available information that indicates whales resume normal behavior quickly after the cessation of sound exposure (e.g., Goldbogen et al. 2013a; Melcon et al. 2012), we anticipate that the up to 6 sei whales exposed to harassing levels of noise will return to normal behavioral patterns after the exposure ends. As such, even if a sei whale exposed to pile driving noise was foraging, this disruption would be short term and impact no more than one foraging event.

If an animal exhibits an avoidance response to pile driving noise, it would experience a cost in terms of the energy associated with traveling away from the acoustic source. Studies of marine mammal avoidance of sonar, which like pile driving is an impulsive sound source, demonstrate clear, strong, and pronounced behavioral changes, including sustained avoidance with associated energetic swimming and cessation of feeding behavior (Southall et al. 2016) suggesting that it is reasonable to assume that a whale exposed to noise above the Level B harassment threshold would take a direct path to get outside of the noisy area. As explained in section 7.1, during impact pile driving of foundations, the area with noise above the Level B harassment threshold extends approximately 0.1 to 5.25 km from the pile being driven. As such, a sei whale that was at the edge of the clearance zone when pile driving starts and that is swimming at maximum speed (55 kph) would swim out of the area with noise above 160 dB re 1uPa the noise in less than 15 minutes, at the normal cruising speed of 10 kph, it would take the animal up to an hour to move out of the noisy area.

There would likely be an energetic cost associated with any temporary displacement or change in migratory route, but unless disruptions occur over long durations or over subsequent days, which we do not expect, we do not anticipate this movement to be consequential to the animal over the long term (see Southall et al. 2007a). The energetic consequences of the evasive behavior and delay in resting are not expected to affect any individual's ability to successfully obtain enough food to maintain their health, or impact the ability of any individual to make seasonal migrations or participate in future breeding or calving. Stress responses are also anticipated with each of these instances of disruption. However, the available literature suggests these acoustically induced stress responses will be of short duration (similar to the duration of exposure), and not result in a chronic increase in stress that could result in physiological consequences to the animal (Southall et al. 2007). Given the short period of time during which individuals will be exposed to elevated noise, we do not anticipate long duration exposures to occur, and we do not anticipate the associated stress of exposure to result in significant costs to affected individuals.

As described in greater detail in Section 7.1, we do not anticipate these instances of TTS and/or behavioral disturbance that meet the ESA definition of take by harassment but not harm to result in fitness consequences to the individual sei whales to which this will occur. Our analysis considered the overall number of exposures to acoustic stressors that are expected to result in harassment, inclusive of behavioral responses, TTS, and stress, the duration and scope of the proposed activities expected to result in such impacts, the expected behavioral state of the animals at the time of exposure, and the expected condition of those animals. Instances of sei whale exposure to acoustic stressors are expected to be short-term, with the animal returning to its previous behavioral state shortly thereafter. As described previously, information is not available to conduct a quantitative analysis to determine the likely fitness consequences of these exposures and associated responses because we do not have information from wild cetaceans that links short-term behavioral responses to vital rates and animal health. Harris et al. (2017a) summarized the research efforts conducted to date that have attempted to understand the ways in which behavioral responses may result in long-term consequences to individuals and populations. Efforts have been made to try to quantify the potential consequences of such responses, and frameworks have been developed for this assessment (e.g., Population Consequences of Disturbance). However, models that have been developed to date to address this question require many input parameters and, for most species, there are insufficient data for parameterization (Harris et al. 2017a). Nearly all studies and experts agree that infrequent exposures of a single day or less are unlikely to impact an individual's overall energy budget (Farmer et al. 2018; Harris et al. 2017b; King et al. 2015b; NAS 2017; New et al. 2014; Southall et al. 2007d; Villegas-Amtmann et al. 2015). Based on best available information, we expect this to be the case for sei whales exposed to acoustic stressors associated with this project even for animals that may already be in a stressed or compromised state due to factors unrelated to the Maryland Wind project. Because we do not anticipate fitness consequences to individual sei whales to result from the ESA harassment resulting from TTS, behavioral disturbance, and associated stress, due to exposure to acoustic stressors, we do not expect any reductions in overall reproduction, abundance, or distribution of the sei whale population in the North Atlantic or rangewide. Based on the information provided here, the proposed action will not appreciably reduce the likelihood of survival of the sei whale (*i.e.*, it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment).

The proposed action will not result in any reduction in the abundance or reproduction of sei whales. Any effects to distribution will be limited to short-term alterations to normal movements by individuals to avoid disturbing levels of noise. There will be no change to the overall distribution of sei whales in the action area or throughout their range.

The proposed action is also not expected to affect recovery potential of the species. In the 2021 5-Year Review for sei whales, NMFS concluded that the recovery criteria outlined in the sei whale recovery plan (NMFS 2011) do not reflect the best available and most up-to-date information on the biology of the species. Therefore, we have not relied on the reclassification criteria specifically when considering the effects of the Maryland Wind action on the recovery of the species. We know that in general, to recover, a listed species must have a sustained positive trend of increasing population over time. In general, mortality rates must be low enough to allow for recruitment to all age classes so that successful calving can continue over time and over generations. The Maryland Wind project will not affect the status or trend of sei whales; this is because it will not result in the injury or mortality of any individuals or affect the ability of any individual to successfully reproduce or the ability of calves to grow to maturity. As such, the proposed action is not likely to affect the recovery potential of sei whales and is not likely to appreciably reduce the likelihood of recovery of sei whales.

The proposed action will not affect the abundance of sei whales; this is, because no serious injury or mortality is anticipated, the project will not cause there to be fewer sei whales. The only effects to distribution of sei whales will be minor changes in the movements of up to 6 individuals exposed to foundation installation noise; there will be no changes in the distribution of the species in the action area or throughout its range. The proposed action will have no effect on reproduction because it will not affect the health of any potential mothers or the potential for successful breeding or calving; the project will not cause any reduction in reproduction. As explained above, the proposed action will not affect the recovery potential of the species. Based on this analysis, the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of sei whales in the wild by reducing the reproduction, numbers, or distribution of that species. These conclusions were made in consideration of the endangered status of sei whales, other stressors that individuals are exposed to within the action area as described in the *Environmental Baseline* and *Cumulative Effects*, and any anticipated effects of climate change on the abundance, reproduction, and distribution of sei whales in the action area.

9.6.4 Sperm Whales

Sperm whales occur in the Atlantic Ocean portion of the action area. We have not identified any adverse effects from the proposed action or the Connected Action, inclusive of consideration of all activities that are anticipated to occur in the portion of the action area that overlaps with the distribution of sperm whales. As explained in section 7 of this Opinion, we expect any effects to sperm whales from exposure to project noise to be insignificant or discountable. We do not expect any sperm whales to be struck by project vessels. As all effects of the activities considered in this Opinion to sperm whales will be insignificant and/or discountable, the proposed action, inclusive of the Connected Action at the O&M facility, is not likely to adversely affect sperm whales. Because the proposed action is not likely to adversely affect sperm whales, and no take of individuals will occur, it is also, by definition, not likely to jeopardize the continued existence of the species.

10.0 CONCLUSION

After reviewing the current status of the ESA-listed species and critical habitat, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is our biological opinion that the proposed action is likely to adversely affect but is not likely to jeopardize the continued existence of fin, sei, or North Atlantic right whales or the Northwest Atlantic DPS of loggerhead sea turtles, North Atlantic DPS of green sea turtles, Kemp’s ridley or leatherback sea turtles, shortnose sturgeon, or any of the five DPSs of Atlantic sturgeon. The proposed action, specifically the transit of vessels to/from the NJWP, is likely to adversely affect but not likely to destroy or adversely modify critical habitat designated for the New York Bight DPS of Atlantic sturgeon; these effects are included in the Environmental Baseline of this Opinion and there are no additional effects caused by this action. The proposed action is not likely to adversely affect blue whales, sperm whales, Rice’s whales, oceanic whitetip sharks, giant manta rays, or hawksbill sea turtles. We have determined that the project will have no effect on gulf sturgeon, the Gulf of Maine DPS of Atlantic salmon, Nassau grouper, scalloped hammerhead sharks, smalltooth sawfish, any species of ESA listed corals, or critical habitat designated for the North Atlantic right whale, the Gulf of Maine DPS of Atlantic salmon, the Northwest Atlantic DPS of loggerhead sea turtles, or elkhorn, or staghorn corals.

11.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species of fish or wildlife, respectively, without a permit or exemption. In the case of threatened species, section 4(d) of the ESA directs the agency to issue regulations it considers necessary and advisable for the conservation of the species and leaves it to the Secretary's discretion whether and to what extent to extend the statutory 9(a)(1) ''take'' prohibitions to such species.

"Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm, as explained above, is further defined by regulation to include significant habitat modification or degradation that results in death or injury to ESA listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. NMFS, as we have explained, has not yet defined "harass" under the ESA in regulation, but has issued interim guidance on the term "harass," defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFS PD 02-110-19). We considered NMFS' interim definition of harassment in evaluating whether the proposed activities are likely to result in harassment of ESA listed species. Incidental take statements serve a number of functions, including providing reinitiation triggers for all anticipated take, providing exemptions from the Section 9 prohibitions against take for endangered species and from any prohibition on take extended to threatened species by 4(d) regulations, and identifying reasonable and prudent measures with implementing terms and conditions that will minimize the impact of anticipated incidental take and monitor incidental take that occurs.

When an action will result in incidental take of ESA listed marine mammals, ESA section 7(b)(4) requires that such taking be authorized under the MMPA section 101(a)(5) before the Secretary can issue an Incidental Take Statement (ITS) for ESA listed marine mammals and that an ITS specify those measures that are necessary to comply with Section 101(a)(5) of the MMPA. Section 7(b)(4), section 7(o)(2), and ESA regulations provide that taking that is incidental to an otherwise lawful activity conducted by an action agency or applicant is not considered to be prohibited taking under the ESA if that activity is performed in compliance with the terms and conditions of this ITS, including those specified as necessary to comply with the MMPA, Section 101(a)(5). Accordingly, the terms of this ITS and the exemption from Section 9(a)(1) of the ES, and any 4(d) rule extending the Section 9(a)(1) prohibition on take to threatened species, become effective only upon the issuance of a final MMPA authorization to take the ESA-listed marine mammals identified here and the incorporation of its mitigation measures in this ITS. Absent such authorization and incorporation of its mitigation measures, this ITS's take exemption is inoperative for ESA listed marine mammals. As described in this Opinion, US Wind, Inc. has applied for an MMPA ITA; a decision regarding issuance of the ITA (i.e., final Incidental Take Regulations and a Letter of Authorization) is expected in Fall 2024 following issuance of the Record of Decision for the project. Once a final authorization is issued, we will review this ITS to ensure it includes all measures necessary to comply with the authorization, and if necessary, make appropriate modifications.

The measures described below must be undertaken by the action agencies and the applicant so that they become binding conditions for the exemption in section 7(o)(2) to apply. BOEM and other action agencies have a continuing duty to regulate the activity covered by this ITS. If one or more of them: (1) fails to assume and implement the terms and conditions, or (2) fails to require the project sponsor or their contractors to adhere to the terms and conditions of the ITS through enforceable terms and conditions that are included in any COP approval, grants, permits, authorizations and/or contracts, the protective coverage of section 7(o)(2) may lapse. The protective coverage of section 7(o)(2) also may lapse if the project sponsor fails to comply with the terms and conditions and the minimization and mitigation measures included in the ITS as well as those described in the proposed action and set forth in Section 3 of this opinion as we consider those measures necessary and appropriate to minimize take but have not restated them here for efficiency. In order to monitor the impact of incidental take, BOEM, other action agencies, and US Wind must report the progress of the action and its impact on the species to us as specified in the ITS [50 CFR §402.14(i)(3)] (See U.S. Fish and Wildlife Service and National Marine Fisheries Service's Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

11.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent of such incidental taking on the species (50 C.F.R. §402.14(i)(1)(i)). As explained in the *Effects of the Action* section, we anticipate pile driving to result in the harassment of an identified number of North Atlantic right, fin, sperm, and sei whales and NWA DPS loggerhead, NA DPS green, Kemp's ridley, and leatherback sea turtles. We anticipate the serious injury or mortality of an identified number of NWA DPS loggerhead, NA DPS green, Kemp's ridley, and leatherback sea turtles due to vessel strikes during construction, operation, and decommissioning phases of the project. With the exception of vessel strikes of up to 2 shortnose sturgeon and up to 8 Atlantic sturgeon (see DPS breakdown in table below) from vessels transiting to/from the NJWP, Paulsboro Marine Terminal, and identified ports in MD and VA, no other sources of incidental take of sturgeon are anticipated. There is no incidental take anticipated to result from the USCG's proposed issuance of a Private Aids to Navigation (PATON) authorization. We anticipate no more than the amount and type of take described below to result from the construction, operation, and decommissioning of the Maryland Wind project as proposed for approval by BOEM and pursuant to other permits, authorizations, and approvals by BSEE, USACE, and NMFS OPR. No take of sperm whales or Giant manta rays is anticipated or exempted.

Vessel Strike

No take of any species of ESA listed whales resulting from vessel strike of any project vessels is anticipated or exempted.

We calculated the number of sea turtles likely to be struck by project vessels based on the anticipated increase in vessel traffic during the construction, operations, and decommissioning phases of the project. The following amount of incidental take is exempted over the 35-year life of the project, inclusive of construction, operations, and decommissioning of Maryland Wind the Mar Win Construction Campaign, Momentum Wind Construction Campaign, and Future Development Construction Campaign:

Species/DPS	Vessel Strike Mortality
Kemp's ridley sea turtle	20
Leatherback sea turtle	6
North Atlantic DPS green sea turtle	4
Northwest Atlantic DPS Loggerhead sea turtle	116

The anticipated lethal take of Atlantic and shortnose sturgeon from vessels operating in the Chesapeake Bay entrance area (to/from ports in MD and VA) and in the Delaware River transiting to/from the Paulsboro Marine Terminal and NJWP, is anticipated as follows:

Port	Species/DPS	Vessel Strike Mortality
MD and VA (transiting in Chesapeake Bay Entrance)	NYB DPS Atlantic Sturgeon	2
	Chesapeake Bay DPS Atlantic sturgeon	1
New Jersey Wind Port	NYB DPS Atlantic Sturgeon	2
	Chesapeake Bay, South Atlantic, OR Gulf of Maine DPS	2
	Shortnose sturgeon	1
Paulsboro Marine Terminal	NYB DPS Atlantic Sturgeon	1
	Shortnose sturgeon	1

Incidental take of Atlantic sturgeon from vessels operating in the Delaware River transiting to/from the Paulsboro Marine Terminal and NJWP is exempted in those project's Biological Opinions and is included in the *Environmental Baseline* for this Opinion; the take identified above for vessel strike resulting from vessels transiting to/from ports in MD and VA is exempted here. No take of any other shortnose or Atlantic sturgeon as a result of vessel strike is anticipated or exempted.

Pile Driving

We calculated the number of whales and sea turtles expected to be harassed (Temporary Threshold Shift and/or Behavioral Disturbance) due to exposure to pile driving noise during foundation installation based on the proposed construction scenario (i.e., 114 total WTG foundations, 1 Met-Tower, and up to 4 OSS foundations, meeting the isopleth distances identified for 10 dB attenuation). For ESA listed whales, this is consistent with the amount of incidental take from exposure to impact pile driving noise during foundation installation that NMFS OPR is proposing to authorize through the MMPA ITA.

Species/DPS	Take due to Exposure to Noise during Foundation Installation	
	Harm/Injury (PTS)	**Harassment (TTS and/or Behavior)**
Fin whale	None	37
North Atlantic right whale	None	6
Sei whale	None	6
Sperm whale	None	None
Kemp's ridley sea turtle	None	1
Leatherback sea turtle	None	12
North Atlantic DPS green sea turtle	None	22
Northwest Atlantic DPS Loggerhead sea turtle	None	374
Atlantic sturgeon – all five DPSs	None	None
Giant manta ray	None	None

11.2 Effects of the Take

In this opinion, we determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to jeopardize the continued existence of any ESA listed species under NMFS' jurisdiction.

11.3 Reasonable and Prudent Measures and Terms and Conditions

Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action is likely to incidentally take individuals of ESA listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, necessary or appropriate reasonable and prudent measures, and terms and conditions to implement the measures, must be provided. Only incidental take specified in this ITS that would not occur but for the agency actions described in this Opinion, and any specified reasonable and prudent measures and terms and conditions identified in the ITS, are exempt from the taking prohibition of section 9(a), provided that, pursuant to section 7(o) of the ESA, such taking is in compliance with the terms and conditions of the ITS. This ITS for sea turtles and sturgeon is effective upon issuance, and the action agencies and applicant may receive the benefit of the sea turtle and sturgeon take exemption as long as they are complying with the applicable terms and conditions. This ITS's take exemption for ESA listed marine mammals is not effective unless and until a final MMPA ITA is effective and the final mitigation measures in the ITA are determined to be consistent with the RPMs and terms and conditions in this ITS; the action agencies and applicant may receive the benefit of the ESA listed marine mammal take exemption as long as they are complying with the applicable terms and conditions in this ITS and the MMPA ITA.

Reasonable and prudent measures (RPMs) are measures necessary or appropriate to minimize the impact (i.e., amount or extent) of the incidental take on the listed species(50 C.F.R. §402.02). The RPMs determined to be necessary and appropriate and implementing terms and conditions are specified as required by 50 CFR 402.14 (i)(1) to minimize the impact of incidental take of ESA listed species by the proposed action, to monitor document and report that incidental take, and to specify the procedures to be used to handle or dispose of any individuals of a species actually taken. The RPMs and their terms and conditions are nondiscretionary for the action agencies and applicant. In addition to the minimization measures specified in Section 3, the RPMs and terms and conditions must be undertaken by the appropriate Federal agency so that they become binding conditions of any COP approval, permit, other authorization, or other agency approval for the exemption in section 7(o)(2) to apply.

NMFS has determined that the RPMs identified here are necessary and appropriate to minimize impacts of incidental take that might otherwise result from the proposed action, to monitor, document, and report incidental take that does occur, to specify the procedures to be used to handle or dispose of any individual listed species taken.

Please note that these reasonable and prudent measures and terms and conditions are in addition to the minimization and avoidance measures that US Wind has included in its COP, the additional measures that BOEM has proposed to require as conditions of COP approval, and the mitigation measures identified in the proposed ITA issued by NMFS OPR, as all of these sources are considered part of the proposed action (see Section 3 above). All of the minimization measures identified in Section 3 of this Opinion, including Appendix A and B, are considered part of the proposed action, many of which are necessary and appropriate to minimize take, and not repeated here; yet must be complied with for the conclusions of this Opinion and for the take exemption to apply as the measures specified here rely on, supplement and clarify those measures and are necessary to minimize the impacts of incidental take. For example, the prohibition on impact pile driving from December 1 – April 30 is considered part of the proposed action, and it is not repeated here as an RPM or term and condition; yet it is critical to minimizing take of North Atlantic right whale. In some cases, the RPMs and Terms and Conditions provide additional detail or clarity to measures that are part of the proposed action. A failure to implement the proposed action as identified in Section 3 of this Opinion would be a change in the action that may render the conclusions of this Opinion and the take exemption inapplicable to the activities carried out, and may necessitate reinitiation of consultation.
All of the RPMs and Terms and Conditions are reasonable and prudent and necessary and appropriate to minimize, monitor, document, and report the level of incidental take associated with the proposed action. None of the RPMs or the terms and conditions that implement them alter the basic design, location, scope, duration, or timing of the action and all of them involve only minor changes (50 CFR§ 402.14(i)(2)). A copy of this ITS must be on board all survey vessels and PSO platforms at all times.

Reasonable and Prudent Measures

We have determined the following RPMs are necessary and appropriate to minimize, monitor, document, and report the impacts of incidental take of threatened and endangered species that occurs during implementation of the proposed action:

1. Effects to ESA listed species must be minimized and monitored during WTG, OSS, and Met Tower foundation installation.
2. Effects to ESA listed sturgeon resulting from project vessel operations must be monitored and reported.
3. Effects to, or interactions with, ESA listed species must be properly documented during all phases of the proposed action, and all incidental take must be reported to NMFS GARFO.
4. Plans must be prepared that describe the implementation of activities or monitoring protocols for which the details were not available at the time this consultation was completed. All required plans must be submitted to NMFS GARFO in advance of the applicable activity with sufficient time for review, comment, and any required concurrence.
5. BOEM, BSEE, NMFS OPR, and USACE must exercise their authorities to assess and ensure compliance with the implementation of measures to avoid, minimize, monitor, and report incidental take of ESA listed species during activities described in this Opinion. On-site observation and inspection by appropriate agency personnel must be allowed to gather information on the implementation of measures, and the effectiveness of those measures, to minimize and monitor incidental take during activities described in this Opinion, including its Incidental Take Statement.

Terms and Conditions
To be exempt from the prohibitions of Section 9 of the ESA, the federal action agencies (BOEM, BSEE, USACE, and NMFS OPR, each consistent with their own legal authority) and US Wind, Inc. (the lessee and applicant), must comply with the following terms and conditions (T&C), which implement the RPMs above. These include the take minimization, monitoring, and reporting measures required by the Section 7 regulations (50 C.F.R. §402.14(i)). These terms and conditions are non-discretionary; that is, if the Federal agencies and/or US Wind fail to ensure compliance with these terms and conditions and the RPMs they implement, the protective coverage of Section 7(o)(2) may lapse. Note that throughout these Terms and Conditions we have identified a number of places where we direct reporting to BOEM, BSEE, USACE, and/or NMFS OPR in addition to NMFS GARFO. These additions have been made at the request of the action agencies; reporting to the action agencies in addition to NMFS GARFO aids in monitoring incidental take and monitoring implementation of these measures.

1. To implement the requirements of RPM 1, for ESA listed whales, US Wind must comply with the measures specified in the proposed MMPA ITA (which are incorporated into the proposed action) as modified or supplemented in the final MMPA ITA, to minimize effects of foundation installation and other activities on ESA listed whales. To facilitate implementation of this requirement:
    a. BOEM must require, through an enforceable condition of their approval of US Wind's Construction and Operations Plan for the Maryland Wind Project, US Wind to comply with any measures for ESA-listed species included in the proposed ITA, which already have been incorporated into the proposed action, as modified or supplemented by the final MMPA ITA.

b. NMFS OPR must ensure the applicant's compliance with all mitigation measures as prescribed in the final ITA. We expect this will be carried out through NMFS OPR's review of plans and monitoring reports, including interim and final SFV reports, submitted by US Wind over the life of the MMPA ITA and taking any responsive action within its statutory and regulatory authority it deems necessary to ensure compliance with all final ITA mitigation measures based on the foregoing review.
c. The USACE must require, through an enforceable conditions of their individual permit authorizations, that US Wind comply with any measures in the proposed MMPA ITA regarding ESA-listed marine mammals, which have already been incorporated into the proposed action, and as modified or supplemented by the final MMPA ITA.

2. To implement the requirements of RPM 1, the following measures related to sound field verification (SFV) for pile driving carried out for WTG, OSS, and Met Tower foundation installation must be required by BOEM, BSEE, USACE, and implemented by US Wind. The purpose of SFV and the steps outlined here are to ensure that US Wind does not exceed the distances to the auditory injury (i.e., harm) or behavioral harassment threshold (Level A and Level B harassment respectively) for ESA listed marine mammals, the harm or behavioral harassment thresholds for sea turtles, or the harm or behavioral disturbance thresholds for Atlantic sturgeon as analyzed in the Opinion. These thresholds and the distances to them, identified and described in this Opinion, underpin the effects analysis, exposure analysis, and our determination of the amount and extent of incidental take anticipated and exempted in this ITS, including any determination that no incidental take is anticipated (e.g., for Atlantic sturgeon). The measures outlined here are based on the requirement that the initial pile driving methodology and sound attenuation measures will result in noise levels that do not exceed the identified distances (as modeled assuming 10 dB attenuation; see Tables 7.1.7, 7.1.17, 7.1.24) but, if that is not the case, provide a step-wise approach for modifying operations and/or modifying or adding sound attenuation measures that can reasonably be expected to avoid exceeding those thresholds for the next pile being driven.
    a. BOEM, BSEE, and USACE must require, and US Wind must develop, a Sound Field Verification Plan, addressing Thorough and Abbreviated SFV, consistent with the requirements in T&C 10.d below. Thorough SFV consists of: SFV measurements made at a minimum of four distances from the pile(s) being driven, along a single transect, in the direction of lowest transmission loss (i.e., projected lowest transmission loss coefficient), including, but not limited to, 750 m and three additional ranges selected such that measurement of identified isopleths are accurate, feasible, and avoid extrapolation. At least one additional measurement at an azimuth 90 degrees from the array at approximately 750 m must be made. At each measurement location, there must be a near-bottom and mid-water column hydrophone (measurement systems); the recordings must be continuous throughout the duration of all pile driving of each foundation. Abbreviated SFV consists of: SFV measurements made at a single acoustic recorder, consisting of a near-bottom and mid-water hydrophone, at approximately 750 m from the pile, in

the direction of lowest transmission loss, to record sounds throughout the duration of all pile driving of each foundation.

b. BOEM, BSEE, and USACE must require, and US Wind must implement Thorough SFV, as detailed in 2c below, for at least the following foundations:
    - Each construction year: the first 3 monopiles; the first three full jacket foundations (inclusive of all pin/skirt piles for a specific jacket foundation); and, the first foundation for any foundation scenarios that were modeled for the exposure analysis (e.g., rated hammer energy, number of strikes, representative location) that does not fall into one of the previously listed categories.

c. During Thorough SFV, installation of the next foundation (of the same type/foundation method) may not proceed until US Wind has reviewed the initial results from the Thorough SFV and determined that there were no exceedances of any distances to the identified thresholds based on modeling assuming 10 dB attenuation. US Wind must notify NMFS by email (nmfs.gar.incidental-take@noaa.gov) when they intend to proceed to the next pile.

d. If any of the Thorough SFV measurements from any pile indicate that the distance to any isopleth of concern for any species is greater than those modeled assuming 10 dB attenuation, US Wind must notify BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO within 24 hours of reviewing the Thorough SFV measurements and must implement the following measures for the next pile of the same type/installation methodology, as applicable. These requirements are in place for monopiles and jacket foundations and repeat until the criteria in 2.d.ii.1 or 2.d.ii.2 are met.

    i. Clearance and Shutdown Zones. If any of the Thorough SFV measurements indicate that the distances to level A thresholds for ESA listed whales (peak or cumulative) or PTS peak or cumulative thresholds for sea turtles are greater than the modeled distances (assuming 10 dB attenuation, see Tables 7.1.7, 7.1.17, 7.1.24), the clearance and shutdown zones (see Table 11.1) for subsequent piles of the same type (e.g., if triggered by SFV results for a monopile, for the next monopile) must be increased so that they are at least the size of the distances to those thresholds as indicated by SFV. For every 1,500 m that a marine mammal clearance or shutdown zone is expanded, additional PSOs must be deployed from additional platforms/vessels to ensure adequate and complete monitoring of the expanded shutdown and/or clearance zone; US Wind must deploy any additional PSOs consistent with the approved Pile Driving Monitoring Plan (see 10.a below) in consideration of the size of the new zones and the species that must be monitored (i.e., sea turtles and/or whales). Use of the expanded clearance and shutdown zones must continue for additional piles until US Wind requests and receives concurrence from NMFS GARFO to revert to the original clearance and shutdown zones.

    ii. Attenuation Measures/Pile Driving Operations. US Wind must identify one or more additional, modified, and/or alternative noise attenuation measure(s) and/or operational change(s) to the noise attenuation system or pile driving operations (to be described in the approved SFV plan (see T&C 10.d)) that is expected to result in sound levels meeting the modeled distances for which there was an exceedance and must implement that measure/change for the next pile of the same type of pile that is installed. Attenuation measures/operational changes include but are not limited to adding a noise attenuation device, adjusting hammer operations, and adjusting or otherwise modifying the noise mitigation system. US Wind must provide written notification to BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO of the changes implemented within 24 hours of their implementation.

1. If no additional, modified, and/or alternative measures or operational changes are identified for implementation, or if Thorough SFV carried out for the third pile (of the same type and installation method; i.e., the pile installed with a second round of additional/modified noise attenuation or pile driving operations) indicates that the distance to any of the identified thresholds for ESA listed species are still greater than those modeled (assuming 10 dB attenuation), installation of that foundation type/installation methodology must be paused until there is concurrence from NMFS, BOEM, and BSEE to proceed. NMFS GARFO, NMFS OPR, BOEM, BSEE, and USACE will meet within three business days to discuss: the results of the Thorough SFV monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR 402.16), including consideration of whether the Thorough SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation. Implementation of additional measures to reduce noise and additional Thorough SFV may also be required as a result of this meeting.
2. Following installation of a pile with additional, alternative, or modified noise attenuation measures/operational changes required by 2.d, if Thorough SFV results indicate that all isopleths of concern are within distances to isopleths of concern modeled assuming 10 dB attenuation, implementation of those measures must continue and Thorough SFV must be carried out for a total of at least three piles of the same type/installation method with consistent noise attenuation measures. If the Thorough SFV results from all three of those piles are within the distances to isopleths of concern modeled assuming 10 dB attenuation, then BOEM, BSEE, and USACE must require, and US Wind must continue to implement the additional, alternative, or modified sound attenuation measures/operational changes. US Wind can request concurrence from NMFS GARFO and NMFS OPR to return to the original clearance and shutdown zones (Table 11.1).

e. BOEM, BSEE, and USACE must require, and US Wind must implement Abbreviated SFV for all piles for which the Thorough SFV monitoring outlined above is not carried out. The transition to Abbreviated SFV requires concurrence from NMFS GARFO that the requirements outlined in Term and Condition 2 b-d have been met. Abbreviated SFV consists of: SFV measurements made at a single acoustic recorder, consisting of a near-bottom and mid-water hydrophone, at approximately 750 m from the pile, in the direction of lowest transmission loss, to record sounds throughout the duration of all pile driving for each foundation. The Abbreviated SFV data collected will be used to compare to the noise levels defined as a result of Thorough SFV.
   i. US Wind must review Abbreviated SFV results for each pile within 24 hours of completion of the foundation installation. If measured levels at 750 m did not exceed the expected levels defined during Thorough SFV, US Wind does not need to take any additional action. Results of Abbreviated SFV must be submitted with the weekly pile driving report.
   ii. If measured levels from Abbreviated SFV for any pile are greater than expected levels (as defined by Thorough SFV), US Wind must evaluate the available information from the pile installation to determine if there is an identifiable cause of the greater than expected sound levels (i.e., a failure of the noise attenuation system), identify and implement corrective action, and report this information (inclusive of an explanation of the suspected or identified cause) to BOEM, BSEE, USACE, and NMFS GARFO within 48 hours of completion of the installation of the pile, during which the greater than expected sound levels occurred.
   iii. If US Wind can demonstrate that this greater than expected sound level was the result of a failure of the noise attenuation system (e.g., loss of a generator supporting a bubble curtain such that one bubble curtain failed during pile driving) that can be remedied in a way that returns the noise attenuation system to pre-failure conditions, or there is another satisfactory explanation for the increase in sound that is not expected to be repeated for subsequent piles, US Wind can request concurrence from BOEM, BSEE, NMFS OPR, and NMFS GARFO to proceed without Thorough SFV monitoring that would otherwise be required within 72 hours. US Wind is required to remedy any such failure of the noise attenuation system prior to carrying out any additional pile driving.
   iv. If results of Abbreviated SFV monitoring for any pile exceed the expected noise levels at 750 m established during the initial Thorough SFV, US Wind must resume Thorough SFV monitoring (as described in 2a above, subject to the exception in 2.e.ii above) for installation of the same foundation type and installation method within 72 hours after the completion of the pile driving with an exceedance.
      1. US Wind can request concurrence from BOEM, BSEE, NMFS OPR, and NMFS GARFO to resume Abbreviated SFV monitoring following submission of an interim report from Thorough SFV that demonstrates ranges to the identified thresholds within expected values (i.e., distances to thresholds modeled assuming 10 dB

attenuation). US Wind may automatically resume Abbreviated SFV monitoring if three consecutive Thorough SFV reports indicate ranges to the identified thresholds within modeled distances (assuming 10 dB attenuation). Interim Thorough SFV monitoring reports must be submitted to BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO within 48 hours of completion of the monitored pile.

2. If results from any Thorough SFV monitoring triggered by results from Abbreviated SFV indicate that ranges to the identified thresholds (i.e., distances to thresholds modeled assuming 10 dB attenuation) are larger than expected values, the requirements for Thorough SFV outlined in 2.a, c, and d above apply (i.e., continuing Thorough SFV and implementing requirements for additional/modified attenuation measures). Additionally, BOEM, BSEE, USACE, NMFS OPR, and NMFS GARFO will meet within three business days to discuss: the results of SFV monitoring, the severity of exceedance of distances to identified isopleths of concern, the species affected, modeling assumptions, and whether any triggers for reinitiation of consultation are met (50 CFR 402.16), including consideration of whether the available SFV results constitute new information revealing effects of the action that may affect listed species in a manner or to an extent not previously considered in the consultation. Implementation of additional measures to reduce pile driving noise and/or additional Thorough SFV may also be required as a result of this meeting.

3. To implement the requirements of RPMs 1 and 2, BOEM, BSEE, and/or USACE must require that US Wind inspect and carry out appropriate maintenance on the noise attenuation system prior to every foundation installation event (i.e., for each pile driven foundation) and prepare and submit a Noise Attenuation System (NAS) inspection/performance report to NMFS GARFO and NMFS OPR. For piles for which Thorough SFV is carried out, this report must be submitted as soon as it is available, but no later than when the interim Thorough SFV report is submitted for the respective pile. Performance reports for piles with Abbreviated SFV must be submitted with the weekly pile driving reports. All reports must be submitted by email to nmfs.gar.incidental-take@noaa.gov and submitted to BSEE through TIMSWeb.
    a. US Wind must develop and implement a maintenance plan that identifies the frequency of hose inspection, flushing, pressure tests, and re-drilling and that is designed to minimize the potential for sediment clogging to affect bubble curtain performance. Adjustments to the frequency of these maintenance steps must be made as necessary to ensure optimal performance of the bubble curtain system.
    b. Performance reports for each bubble curtain deployed must include water depth, current speed and direction, wind speed and direction, bubble curtain deployment/retrieval date and time, bubble curtain hose length, bubble curtain radius (distance from pile), diameter of holes and hole spacing, air supply hose length, compressor type (including rated Cubic Feet per Minute (CFM) and model number), number of operational compressors, performance data from each

compressor (including Revolutions Per Minute (RPM), pressure, start times, and stop times), free air delivery (m^3/min), total hose air volume (m^3/(min m)), schematic of GPS waypoints during hose laying, maintenance procedures performed (pressure tests, inspections, flushing, re-drilling, and any other hose or system maintenance) before and after installation and the time and date of each of these procedures, and the length of time the bubble curtain was on the seafloor prior to foundation installation. Additionally, the report must include any important observations regarding performance (before, during, and after pile installation), such as any observed weak areas of low pressure. The report may also include any relevant video and/or photographs of the bubble curtain(s) operating during pile driving.

4. To implement the requirements of RPM 3, the following conditions must be implemented:
    a. BOEM, BSEE, and/or USACE must require that US Wind document and report project vessel trips to/from ports in the Chesapeake Bay and the Delaware River, including the number of vessel calls to Sparrows Point, Hampton Roads, New Jersey Wind Port, and Paulsboro Marine Terminal. This must be included in the monthly project reports submitted to NMFS GARFO over the life of the project (see T&C 7.f. below). An annual summary of project vessel calls to Paulsboro must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and the USACE Philadelphia District (NAPRegulatory@usace.army.mil).
    b. BOEM, BSEE, and/or USACE must require that US Wind implement the following reporting requirements for all project vessels transiting to/from ports in the Delaware River and the Chesapeake Bay:
        i. Report any sturgeon observed with injuries or mortalities along the transit route in the Chesapeake Bay, Chesapeake-Delaware Canal, Delaware Bay, Delaware River, or in the vicinity of the port that the vessel is calling on to NMFS within 24 hours by submitting the form available at: https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null to nmfs.gar.incidental-take@noaa.gov.
        ii. Collect any dead sturgeon observed in the vicinity of the port that the vessel is calling on and hold in cold storage until proper disposal procedures are discussed with NMFS GARFO.
        iii. Complete procedures for genetic sampling of any collected dead Atlantic sturgeon that are over 75 cm. More information on submitting genetic samples is included in Term and Condition 6a below.

These requirements and instructions are consistent with the requirements of the RPMs and Terms and Conditions of the 2023 Paulsboro Opinion and 2022 New Jersey Wind Port Opinion.

5. To implement the requirements of RPM 4, BOEM, BSEE, and/or USACE must require that US Wind prepare and submit interim and final SFV reports to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BSEE (via TIMSWeb) as outlined here:
    a. *Thorough SFV Interim Reports - Foundation Installation*. BOEM, BSEE, and USACE must require US Wind to provide the initial results of the Thorough SFV measurements to NMFS GARFO and NMFS OPR in an interim report as soon as

it is available but no later than 48 hours after the installation of each pile for which thorough SFV is carried out. If technical or other issues prevent submission within 48 hours, US Wind must notify BOEM, BSEE, and NMFS GARFO within that 48-hour period with the reasons for delay and provide an anticipated schedule for submission of the report. The interim report must include data from hydrophones identified for interim reporting in the SFV Plan and include a summary of pile installation activities (pile diameter, pile weight, pile length, water depth, sediment type, hammer type, total strikes, total installation time [start time, end time], duration of pile driving, max single strike energy, NAS deployments), pile location, recorder locations, modeled and measured distances to thresholds, received levels (rms, peak, and SEL) results from Conductivity, Temperature, and Depth (CTD) casts/sound velocity profiles, signal and kurtosis rise times, pile driving plots, activity logs, weather conditions. Additionally, any important sound attenuation device malfunctions (suspected or definite), must be summarized and substantiated with data (e.g. photos, positions, environmental data, directions, etc.). Such malfunctions include gaps in the bubble curtain, significant drifting of the bubble curtain, and any other issues which may indicate sub-optimal mitigation performance or are used by US Wind to explain performance issues. Requirements for actions to be taken based on the results of the SFV are identified above.

b. Prior to transitioning to Abbreviated SFV, US Wind must prepare and submit a table with levels expected at 750 m for subsequent piles for which that Thorough SFV is intended to represent to be compared against measurements from Abbreviated SFV monitoring. Expected single strike metrics are the maxima of the 95th-percentile of measured unweighted SPL, SEL, and Peak. The expected cumulative metric of unweighted SEL for all impact pile-driving strikes must also be reported and compared. These tables must include the highest levels from Thorough SFVs for which isopleths were calculated to be within modeled ranges, assuming 10 dB attenuation rounded up to the next integer decibel, both actual measurements at 750 m, and fits based on measurements from recorders at other ranges. The highest levels in these tables, rounded to the next whole decibel, will be the "expected levels" to which Abbreviated SFV results must be compared.
c. All Abbreviated SFV reports must include the results from the hydrophones at 750m and a comparison to the expected levels at 750 m based on the previously completed thorough SFV for comparable pile type and installation method. Abbreviated SFV reports must be submitted with the weekly pile driving report.
d. *Thorough SFV Final Reports* - The final results of Thorough SFV for monopile and jacket foundation installations must be submitted as soon as possible, but no later than within 90 days following completion of pile driving for the foundations for which that seasons Thorough SFV was carried out (i.e., if the last Thorough SFV was complete on June 15, the final report is due by September 15). Within 60 days of the end of each construction season, US Wind must compile and submit all final Abbreviated SFV reports.

6. To implement the requirements of RPM 4, BOEM, BSEE, and/or USACE must require that US Wind file a report with NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BSEE (via TIMSWeb and notification email to protectedspecies@bsee.gov) in the event

that any ESA listed species is observed within the identified shutdown zone during active pile driving. This report must be filed within 48 hours of the incident and include the following: description of the activity and duration of pile driving prior to the detection of the animal(s), location of PSOs and any factors that impaired visibility or detection ability, time of first and last detection of the animal(s), distance of animal at first detection, closest point of approach of animal to pile, behavioral observations of the animal(s), time the PSO called for shutdown, hammer log (number of strikes, hammer energy), time the pile driving began and stopped, and any measures implemented (e.g., reduced hammer energy) prior to shutdown. If shutdown was determined not to be feasible, the report must include an explanation for that determination and the measures that were implemented (e.g., reduced hammer energy).

7. To implement the requirements of RPM 4, BOEM, BSEE, USACE, must require US Wind to implement the following reporting requirements necessary to document the amount or extent of incidental take that occurs during all phases of the proposed action. Unless otherwise specified all reports must be submitted to NMFS GARFO via e-mail (nmfs.gar.incidental-take@Noaa.gov) and BSEE via TIMSWeb.
    a. While unexpected, any observations or interactions with sea turtles or sturgeon that occur during the fisheries monitoring surveys must be reported within 48 hours to NMFS GARFO Protected Resources Division by email (nmfs.gar.incidental-take@noaa.gov). Take reports should reference the Maryland Wind project and include the Take Report Form available on NMFS webpage (https://media.fisheries.noaa.gov/2021-07/Take%20Report%20Form%2007162021.pdf?null).
    b. All sightings or acoustic detections of North Atlantic right whales must be reported immediately (no later than 24 hours). PAM detections and sightings of right whales with no visible injuries or entanglement must be reported as described in (i) below. Reporting requirements for suspected vessel strikes and injured/dead right whales are in (c) and (d) below.
        1. If a NARW is sighted with no visible injuries or entanglement or is detected via PAM at any time by project PSOs/PAM Operators or project personnel, US Wind must immediately report the sighting or acoustic detection to NMFS; if immediate reporting is not possible, the report must be submitted as soon as possible but no later than 24 hours after the initial sighting or acoustic detection.
            - To report the sighting or acoustic detection, download and complete the Real-Time North Atlantic Right Whale Reporting Template spreadsheet found here: https://www.fisheries.noaa.gov/resource/document/template-datasheet-real-time-north-atlantic-right-whale-acoustic-and-visual. Save the spreadsheet as a .csv file and email it to NMFS NEFSC-PSD (ne.rw.survey@noaa.gov), NMFS GARFO-PRD (nmfs.gar.incidental-take@noaa.gov), and NMFS OPR (PR.ITP.MonitoringReports@noaa.gov).
            - If unable to report a sighting through the spreadsheet within 24 hours, call the relevant regional hotline (Greater Atlantic Region [Maine through Virginia] Hotline 866-755-6622; Southeast

Hotline 877-WHALE-HELP) with the observation information provided below (PAM detections are not reported to the Hotline).

- Observation information: Report the following information: the time (note time format), date (MM/DD/YYYY), location (latitude/longitude in decimal degrees; coordinate system used) of the observation, number of whales, animal description/certainty of observation (follow up with photos/video if taken), reporter's contact information, and lease area number/project name, PSO/personnel name who made the observation, and PSO provider company (if applicable) (PAM detections are not reported to the Hotline).
- If unable to report via the template or the regional hotline, enter the sighting via the WhaleAlert app (http://www.whalealert.org/). If this is not possible, report the sighting to the U.S. Coast Guard via channel 16. The report to the Coast Guard must include the same information as would be reported to the Hotline (see above). PAM detections are not reported to WhaleAlert or the U.S. Coast Guard.

c. In the event of a suspected or confirmed vessel strike of any ESA listed species (e.g. marine mammal, sea turtle, listed fish) by any vessel associated with the Project or other means by which project activities caused a non-auditory injury or death of a ESA listed species, US Wind must immediately report the incident to NMFS (at the phone numbers and email addresses identified below) and BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov). Reports to NMFS must be made by phone and email:

- Phone: If in the Greater Atlantic Region (ME-VA): the NMFS Greater Atlantic Stranding Hotline (866-755-6622); in the Southeast Region (NC-FL): the NMFS Southeast Stranding Hotline (877-942-5343).
- Email: GARFO (*nmfs.gar.incidental-take@noaa.gov*), and if in the Southeast region (NC-FL), also to NMFS SERO (*secmammalreports@noaa.gov*) The report must include: (A) Time, date, and location (coordinates) of the incident; (B) Species identification (if known) or description of the animal(s) involved (i.e., identifiable features including animal color, presence of dorsal fin, body shape and size); (C) Vessel strike reporter information (name, affiliation, email for person completing the report); (D) Vessel strike witness (if different than reporter) information (name, affiliation, phone number, platform for person witnessing the event); (E) Vessel name and/or MMSI number; (F) Vessel size and motor configuration (inboard, outboard, jet propulsion); (G) Vessel's speed leading up to and during the incident; (H) Vessel's course/heading and what operations were being conducted (if applicable); (I) Part of vessel that struck whale (if known); (J) Vessel damage notes; (K) Status of all sound sources in use; (L) If animal was seen before strike event; (M) behavior of animal before strike event; (N) 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; (O) Environmental conditions (*e.g.*, wind speed and direction,

Beaufort sea state, cloud cover, visibility) immediately preceding the strike; (P) Estimated (or actual, if known) size and length of animal that was struck; (Q) Description of the behavior of the marine mammal immediately preceding and following the strike; (R) If available, description of the presence and behavior of any other marine mammals immediately preceding the strike; (S) Other animal details if known (e.g., length, sex, age class); (T) Behavior or estimated fate of the animal post-strike (*e.g.*, dead, injured but alive, injured and moving, external visible wounds (linear wounds, propeller wounds, non-cutting blunt-force trauma wounds), blood or tissue observed in the water, status unknown, disappeared); (U) To the extent practicable, photographs or video footage of the animal(s); and (V) Any additional notes the witness may have from the interaction. For any numerical values provided (i.e., location, animal length, vessel length etc.), please provide if values are actual or estimated.

d. In the event that any PSO or other project personnel, including any project vessel operator or crew, observe or identify a stranded, entangled, injured, or dead ESA listed species (e.g. marine mammal, sea turtle, listed fish), US Wind must immediately report the observation to NMFS (by phone (marine mammals and turtles only) and email (marine mammal, sea turtle, listed fish) and BSEE (via TIMSWeb and notification email to (protectedspecies@bsee.gov):
    - Phone: If in the Greater Atlantic Region (ME-VA):e NMFS Greater Atlantic Stranding Hotline (866-755-6622); in the Southeast Region (NC-FL) call the NMFS Southeast Stranding Hotline (877-942-5343). Note, the stranding hotline may request the report be sent to the local stranding network response team.
    - Email: if in the Greater Atlantic region (ME to VA) to GARFO (nmfs.gar.incidental-take@noaa.gov) or if in the Southeast region (NC-FL) to NMFS SERO (secmammalreports@noaa.gov). . The report must include: (A) Contact information (name, phone number, etc.), time, date, and location (coordinates) 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. Staff responding to the hotline call will provide any instructions for handling or disposing of any injured or dead animals, which may include coordination of transport to shore, particularly for injured sea turtles.

e. US Wind must compile and submit weekly reports during each month that foundation installation occurs that document: the foundation/pile ID, type of pile, pile diameter, start and finish time of each pile driving event, hammer log (number of strikes, max hammer energy, duration of piling) per pile, any changes to noise attenuation systems and/or hammer schedule, details on the deployment of PSOs and PAM operators, including the start and stop time of associated observation periods by the PSOs and PAM Operators, and a record of all observations/detections of marine mammals and sea turtles including time (UTC) of sighting/detection, species ID, behavior, distance (meters) from vessel to animal at time of sighting/detection (meters), animal distance (meters) from pile installation vessel, vessel/project activity at time of sighting/detection, platform/vessel name, and mitigation measures taken (if any) and reason. Sightings/detections during pile driving activities (clearance, active pile driving, post-pile driving) and all other (transit, opportunistic, etc.) sightings/detection must be reported and identified as such. The weekly reports must also confirm that the required SFV was carried out for each pile and that results were reviewed on the required timelines. Abbreviated SFV reports must be appended to the weekly report. These weekly reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov), BOEM, and BSEE by US Wind or the PSO providers and can consist of QA/QC'd raw data. Weekly reports are due on Wednesday for the activities occurring the previous week (Sunday – Saturday, local time).

f. Starting in the first month that in-water activities occur (e.g., cable installation, fisheries surveys), US Wind must compile and submit monthly reports that include a summary of all project activities carried out in the previous month, including dates and location of any fisheries surveys carried out, vessel transits (name, type of vessel, number of transits, vessel activity, and route (origin and destination, including transits from all ports, foreign and domestic)), cable installation activities (including sea to shore transition), number of foundations installed and pile IDs, and all sightings/detections of ESA listed whales, sea turtles, and sturgeon. Sightings/detections must include species ID, time, date, initial detection distance, vessel/platform name, vessel activity, vessel speed, bearing to animal, project activity, and any mitigation measures taken as a result of those observations. These reports must be submitted to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) and BSEE (TIMSWeb and protectedspecies@bsee.gov) and are due on the 15th of the month for the previous month.

g. US Wind must submit to NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) an annual report describing all activities carried out to implement their Fisheries Research and Monitoring Plan. This report must include a summary of all activities conducted, the dates and locations of all fisheries surveys, number of vessel transits inclusive of port of origin and destination, and a summary table of any observations and captures of ESA listed species during these surveys. The report must also summarize all acoustic telemetry and benthic monitoring activities that occurred, inclusive of vessel transits. Each annual report is due by February 15 (i.e., the report for 2025 activities is due by February 15, 2026).

h. BOEM and BSEE must require US Wind to submit full detection data, metadata, and location of recorders (or GPS tracks, if applicable) from all real-time hydrophones used for monitoring during construction within 90 calendar days after the completion of foundation installation have ended for the calendar year (i.e., if the last foundation of construction year 1 is installed on November 30, the report is due by March 1 of the following year). Reporting must use the webform templates on the NMFS Passive Acoustic Reporting System website at https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates. BOEM and BSEE, must require US Wind to submit the full acoustic recordings from all the real-time hydrophones to the National Centers for Environmental Information (NCEI) for archiving within 90 calendar days after pile-driving has ended and instruments have been pulled from the water. Archiving guidelines outlined here (https://www.ncei.noaa.gov/products/passive-acoustic-data#tab-3561) must be followed. Confirmation of both submittals must be sent to NMFS GARFO via email.

8. To implement the requirements of RPM 4 and to facilitate monitoring of the incidental take exemption for sea turtles, BOEM, BSEE, USACE, and NMFS must meet twice annually to review sea turtle observation records. These meetings/conference calls will be held in September (to review observations through August of that year) and December (to review observations from September to November) and will use the best available information on sea turtle presence, distribution, and abundance, project vessel activity, and observations to estimate the total number of sea turtle vessel strikes in the action area that are attributable to project operations.
9. To implement the requirements of RPM 4, within 10 business days of BOEM, BSEE, and/or USACE obtaining updated information on project plans (e.g., as obtained through a relevant Facility Design Report (FDR) and/or Fabrication and Installation Report (FIR), or other submission), BOEM, BSEE, and/or USACE must provide NMFS GARFO (nmfs.gar.incidental-take@noaa.gov) with the following information: number, size, and type of foundations to be installed to support wind turbine generators and electrical service platforms for each project; the proposed construction schedule (i.e., months when pile driving is planned) for each project, and any available updates on anticipated vessel transit routes (e.g., any changes to the ports identified for use by project vessels, confirmation of location of O&M facility) that will be used by project vessels. This information may be provided in separate submissions for each of the three project phases. NMFS GARFO will review this information and, to the maximum extent practicable, within 10 business days of receipt will request a meeting with BOEM, BSEE, and USACE if there is any indication that there are changes to the proposed action that would cause an effect to listed species or critical habitat that was not considered in this Opinion, including the amount or extent of predicted take, such that any potential trigger for reinitiation of consultation can be discussed with the relevant action agencies.
10. To implement RPM 5, BOEM, BSEE, and/or USACE must require, and US Wind must prepare and submit the plans identified below in sufficient time to allow for review and any required approval prior to the planned start date for the associated activities. All plans must be submitted to NMFS GARFO at nmfs.gar.incidental-take@noaa.gov as well as to BOEM (renewable_reporting@boem.gov), BSEE (via TIMSWeb with a notification email to protectedspecies@bsee.gov), and USACE (cenae-r-@usace.army.mil).
    - Any of the identified plans can be combined such that a single submitted plan addresses multiple requirements provided that the plan clearly identifies which requirements it is addressing.
    - Within 60 days of issuance of this Biological Opinion, BOEM must schedule a meeting between US Wind and NMFS GARFO to: review the plan

requirements, discuss the review/approval process, and develop a schedule for when plans can be expected to be submitted for review.

- Between 30 and 90 days before the planned start of foundation installation each year, US Wind must meet with NMFS GARFO, BOEM, BSEE, USACE, and NMFS OPR to review the construction plans and schedule for the upcoming construction season, and review requirements for reporting and notification protocols, and Thorough and Abbreviated SFV requirements.
- All plans must be submitted at least 180 days in advance of the planned start of relevant activities (e.g., the foundation installation monitoring plan must be submitted at least 180 days before the planned date for installation of the first pile). For each plan, within 45 calendar days of receipt of the plan, NMFS GARFO will provide comments to BOEM, BSEE, and US Wind, including a determination as to whether the plan is consistent with the requirements outlined in this ITS and/or in Section 3 of this Opinion. If the plan is complete and is determined to be consistent with the identified requirements, NMFS GARFO will provide concurrence with the plan. If the plan is determined to be inconsistent with these requirements (e.g., if required information is missing), US Wind must resubmit a modified plan that addresses the identified issues within 30 days of the receipt of the comments. For all subsequent drafts, US Wind must provide for at least 10 day calendar days for review and comment. BOEM must work with US Wind to ensure that subsequent drafts of each plan are provided to NMFS with adequate time to carry out a thorough review, and any necessary approvals, prior to the associated activity taking place.

a. **Marine Mammal and Sea Turtle Monitoring Plan – Foundation Installation (Pile Driving Monitoring Plan).** BOEM, BSEE, and/or US Wind must submit this Plan to NMFS GARFO at least 180 calendar days before the respective activity is planned to begin (i.e., if foundation installation is planned for May 1, the plan must be submitted no later than November 1 of the preceding year). BOEM, BSEE, and US Wind must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of any pile driving for foundation installation.
    - The Plan(s) must include: a description of how all relevant mitigation and monitoring requirements contained in the incidental take statement and those included as part of the proposed action will be implemented; a pile driving installation summary and sequence of events; a description of all monitoring equipment and evidence (i.e., manufacturer's specifications, reports, testing) that it can be used to effectively monitor and detect ESA listed marine mammals and sea turtles in the identified clearance and shutdown zones (i.e., field data demonstrating reliable and consistent ability to detect ESA listed large whales and sea turtles at the relevant distances in the conditions planned for use); communications and reporting details; and PSO monitoring and mitigation protocols (including number and location of PSOs) for effective observation and documentation of sea turtles and ESA listed marine mammals during all foundation installation events.
    - The Plan(s) must demonstrate sufficient PSO and PAM Operator staffing (in accordance with watch shifts), PSO and PAM Operator schedules, and

contingency plans for instances if additional PSOs and PAM Operators are required including any expansion of clearance and/or shutdown zones that may be required as a result of SFV.

- The Plan(s) must contain a thorough description of how US Wind will monitor foundation installation activities during reduced visibility conditions (e.g. rain, fog) and in other low visibility conditions, including proof of the efficacy of monitoring devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable night vision devices NVDs, spotlights) in detecting ESA listed marine mammals and sea turtles over the full extent of the required clearance and shutdown zones, including demonstration that the full extent of the minimum visibility zones can be effectively and reliably monitored. The Plan must identify the efficacy of the technology at detecting marine mammals and sea turtles in the clearance and shutdown zones under all the various conditions anticipated during construction, including varying weather conditions, sea states, and in consideration of the use of artificial lighting.
- The Plan must contain a thorough description of how US Wind will monitor foundation installation activities during daytime when unexpected changes to lighting or weather occur during pile driving that prevent visual monitoring of the full extent of the clearance and shutdown zones.
- The plan must describe how US Wind would determine the number of sea turtles exposed to noise above the 175 dB harassment threshold during foundation installation and how US Wind would determine the number of ESA listed whales exposed to noise above the Level B harassment threshold during foundation installation (in consideration of modeling that indicates that distances to the level B harassment threshold may extend beyond the clearance and shutdown zones being monitored by PSOs).

b. **Nighttime Monitoring Plan – Foundation Installation**. If US Wind seeks to obtain approval for pile driving initiated after dark, BOEM, BSEE, and/or US Wind must submit this Plan to NMFS GARFO at least 180 calendar days before night time foundation installation is planned to begin. BOEM, BSEE, and US Wind must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of any night time pile driving for foundation installation. This plan can be included as a sub-section of the Marine Mammal and Sea Turtle Monitoring Plan addressed above or as a stand-alone plan.

- This Plan(s) must contain a thorough description of how US Wind will monitor foundation installation activities at night, including proof of the efficacy of monitoring devices (e.g., mounted thermal/infrared camera systems, hand-held or wearable night vision devices NVDs, spotlights) in detecting ESA listed marine mammals and sea turtles over the full extent of the required clearance and shutdown zones, including demonstration that the full extent of the minimum visibility zones can be effectively and reliably monitored.
- The Plan must identify the efficacy of the technology at detecting marine mammals and sea turtles in the clearance and shutdown zones under all the various conditions anticipated during construction,

including varying weather conditions, sea states, and in consideration of the use of artificial lighting.

- If the plan does not include a full description of the proposed technology, monitoring methodology, and data demonstrating to NMFS GARFO's satisfaction that marine mammals and sea turtles can reliably and effectively be detected within the clearance and shutdown zones for monopiles and jacket foundations before and during foundation installation, nighttime foundation installation may not occur; the only exception would be if safety necessitates continuing pile installation after dark for a foundation that was initiated 1.5 hours prior to civil sunset, in which case the Low Visibility components of the Pile Driving Monitoring Plan would be implemented.

c. **Passive Acoustic Monitoring Plan for Pile Driving**. BOEM, BSEE, and/or US Wind must submit this Plan to NMFS GARFO at least 180 calendar days before Pile Driving is planned. This plan can be included as a sub-section of the Marine Mammal and Sea Turtle Monitoring Plan addressed above. BOEM, BSEE, and US Wind must obtain NMFS GARFO's concurrence with this Plan prior to the start of any foundation installation.

- The Plan must include a description of all proposed PAM equipment and hardware, the calibration data, bandwidth capability and sensitivity of hydrophones, and address how the proposed passive acoustic monitoring will follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind (Van Parijs *et al.,* 2021).
- The Plan must describe and include all procedures, documentation, and protocols including information (i.e., testing, reports, equipment specifications) to support that it will be able to detect vocalizing whales within the clearance and shutdown zones, including deployment locations, procedures, detection review methodology, and protocols; hydrophone detection ranges with and without foundation installation activities and data supporting those ranges; communication time between call and detection, and data transmission rates between PAM Operator and PSOs on the pile driving vessel; where PAM Operators will be stationed relative to hydrophones and PSOs on pile driving vessel calling for delay/shutdowns; and a full description of all proposed software, call detectors, and filters.
- The Plan must also incorporate the requirements relative to North Atlantic right whale reporting in T&C 7.
- The Plan must include a description of planned maintenance procedures to ensure effective operations of the PAM system during the pile driving period. Additionally, the plan must describe steps that will be taken if any system component fails during the pile driving period.

d. **Sound Field Verification Plan - Foundation Installation**. BOEM, BSEE, and USACE must require US Wind to submit this Plan to NMFS GARFO at least 180 calendar days before pile driving for foundations is planned to begin. BOEM, BSEE, and US Wind must obtain NMFS GARFO's concurrence with this Plan(s) prior to the start of foundation installation.

- The Plan must detail all plans and procedures for sound attenuation, including procedures for adjusting and optimizing the noise attenuation system(s), deployment procedures and timelines, maintenance procedures and timelines, and detail the available contingency noise attenuation measures/systems and operational changes to be implemented if distances to modeled isopleths of concern are exceeded (as documented during SFV). This must include consideration for addressing battery life, sediment build up in bubble curtain hoses, and ensuring adequate back up equipment is available.
- The plan must describe how US Wind will conduct the required Thorough SFV (T&C 2) for each of the required foundation types, installation methodologies, and locations. This must include an explanation of how the foundation sites planned for Thorough SFV are representative of all other foundation installation sites for a scenario or, if they are not, how US Wind will select additional foundation locations for Thorough SFV. US Wind must provide justification for why the foundation locations selected for Thorough SFV are representative of the scenario modeled.
- The plan must describe how US Wind will conduct the required Abbreviated SFV, inclusive of requirements to review results within 24 hours and triggers for Thorough SFV.
- The Plan must provide a table of the identification number and coordinates of each foundation location, and specify the underwater acoustics analysis model scenario against which each foundation location's SFV results will be compared.
- The Plan(s) must also include the piling schedule and sequence of events, communication and reporting protocols, and methodology for collecting, analyzing, and preparing SFV data for submission to NMFS, including instrument deployment, locations of all hydrophones (including direction and distance from the pile), hydrophone sensitivity, recorder/measurement layout, and analysis methods. The Plan must also identify the number and distance of relative location of hydrophones for Thorough and Abbreviated SFV.
- The plan must include a template of the interim report to be submitted and describe the all the information that will be reported in the SFV Interim Reports including the number, location, depth, distance, and predicted and actual isopleth distances that will be included in the final report(s).
- The Plan must describe how the interim SFV report results will be evaluated against the modeled results, including which modeled scenario the results will be reported against, and include a decision tree of what happens if measured values exceed predicted values.
- The Plan must address how US Wind will implement the measures associated with the required SFV which includes, but is not limited to,

identifying additional or modified noise attenuation measures (e.g., additional noise attenuation device, adjust hammer operations, adjust or modify the noise mitigation system) or operational changes that will be applied if measured distances are greater than those modeled as well as implementation of any expanded clearance or shutdown zones, including deployment of additional PSOs.

e. **Vessel Strike Avoidance Plan.** US Wind must submit this plan to NMFS GARFO as soon as possible after issuance of this Biological Opinion but no later than 180 days prior to the planned mobilization of any vessels operated by or under contract to US Wind for the Maryland Wind project (i.e., any vessel associated with construction, operations and maintenance, or decommissioning activities described in this Opinion). The Plan must include: an acknowledgement of the vessels that are subject to the plan; all relevant mitigation and monitoring measures for listed species inclusive of a summary of all applicable vessel speed and approach restrictions in different operational areas; vessel-based observer protocols for transiting vessels; communication and reporting plans; and a description of proposed alternative monitoring equipment to allow lookouts/PSOs to observe vessel strike avoidance zones in varying weather conditions, sea states, darkness, and in consideration of the use of artificial lighting. The plan must also address procedures to be implemented when navigational or crew safety prevent adherence to vessel speed restrictions that would otherwise apply. NMFS GARFO will review this plan and identify any inconsistencies with the requirements for vessel strike avoidance required by regulation or otherwise incorporated into the proposed action considered in the Biological Opinion. With the exceptions noted below, NMFS GARFO's concurrence with this plan is not required prior to vessel mobilization.
    i. Consistent with the requirements in the proposed MMPA ITA, if US Wind plans to implement PAM in any transit corridor to allow vessel transit above 10 knots, US Wind must prepare a plan (a standalone plan or supplement to the Vessel Strike Avoidance Plan) that describes: the location of each transit corridor (with a map); how PAM, in combination with visual observations, will be conducted to ensure highly effective monitoring for the presence of right whales in the transit corridor; and, the protocols that will be in place for vessel speed restrictions following detection of a right whale via PAM or visual observation. This plan must be provided to NMFS GARFO for review at least 180 days in advance of planned deployment of the PAM system. PAM information should follow what is required to be submitted for the PAM Plan in T&C 10.c. BOEM, BSEE, and US Wind must receive NMFS GARFO's concurrence with this plan prior to implementation of the PAM-monitored transit corridor. This plan will be reviewed in consideration of issues related to navigational and crew safety.
    ii. If a separate Vessel Strike Avoidance Plan will be implemented after the expiration of the 5-year effective period of the MMPA ITA, it must be submitted to NMFS GARFO for review and concurrence that operation of

project vessels pursuant to the proposed plan would not result in effects to any listed species not considered in this Opinion.

11. To implement the requirements of RPM 6, BOEM, BSEE, NMFS OPR, and USACE must exercise their authorities to assess the implementation of measures to avoid, minimize, monitor, and report incidental take of ESA listed species during activities described in this Opinion. These agencies shall immediately exercise their respective authorities to take effective action to ensure prompt implementation and compliance if US Wind is not complying with: any avoidance, minimization, and monitoring measures incorporated into the proposed action or any term and condition(s) specified in this statement, as currently drafted or otherwise amended in agreement between these agencies and NMFS; if agencies fail to do so, the protective coverage of Section 7(o)(2) may lapse and reinitiation of consultation may be required.
12. To implement the requirements of RPM 6, US Wind must consent to on-site observation and inspections by Federal agency personnel (including NOAA personnel) during activities described in the Biological Opinion, for the purposes of evaluating the effectiveness and implementation of measures designed to minimize or monitor incidental take.
13. To implement the requirements of RPM 6, US Wind, BOEM, BSEE, NMFS OPR, and USACE must immediately notify NMFS GARFO of any identified or suspected non-compliance with any measure outlined in this Incidental Take Statement or in any measure incorporated into the proposed action, including measures included in the Final MMPA authorization. This includes the suspected or identified failure in effectiveness of any such measure. This notification must be submitted as soon as the issue is identified to nmfs.gar.incidental-take@noaa.gov and must include a description of the non-compliance or failure of effectiveness of the measure, the date the issue was identified, and, any corrective actions that were taken. The report of non-compliance must be followed within 48 hours with a request to meet with NMFS GARFO to discuss the report and seek concurrence from NMFS GARFO on the corrective measures. Neither the lessee nor any action agency may interfere with any reporting to NMFS by a PSO or other personnel of any identified or suspected non-compliance with any such measures or any identified or suspected incidental take.

Table 11.1. Clearance and Shutdown Zones for ESA Listed Species - Impact Pile Driving
These are the PAM detection, minimal visibility, clearance and shutdown zones incorporated into the proposed action; the zones for marine mammals reflect the proposed conditions of the MMPA ITA, and the zones for sea turtles reflect the zone sizes proposed by BOEM. Pile driving will not proceed unless the visual PSOs can effectively monitor the full extent of the minimum visibility zones. Detection of an animal within the clearance zone triggers a delay of initiation of pile driving; detection of an animal in the shutdown zone triggers the identified shutdown requirements.

Species	Clearance Zone (m)	Shutdown Zone (m)
Impact Pile Driving		
Minimum visibility zone from each PSO platform (pile driving vessel and at least one PSO vessels): Monopiles - 2,900 m; 3-m pin piles - 1,400 m; 1.8-m pin piles - 200 m		

PAM monitoring out to 10,000 m		
North Atlantic right whale – visual and PAM monitoring	At any distance (Minimum visibility zone (2,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM	At any distance (Minimum visibility zone (2,900 m) plus any additional distance observable by the visual PSOs on all PSO platforms); At any distance within the 10,000 m monitoring zone monitored by PAM
Other large whales (visual and PAM monitoring)	Monopiles - 5,250 m 3-m pin piles - 1,400 m 1.8-m pin piles - 200 m (visual or PAM detection)	Monopiles - 2,900 m 3-m pin piles - 1,400 m 1.8-m pin piles - 100 m (visual or PAM detection)
Sea Turtles	250 m (visual detection)	250 m (visual detection)

As explained above, reasonable and prudent measures are measures to minimize the amount or extent of incidental take (50 C.F.R. §402.02) that must be implemented in order for the incidental take exemption to be effective. The reasonable and prudent measures and terms and conditions are specified as required by 50 CFR 402.14 (i)(1)(ii), (iii) and (iv) to document the incidental take by the proposed action, minimize the impact of that take on ESA-listed species and, in the case of marine mammals, specify those measures that are necessary to comply with section 101(a)(5) of the Marine Mammal Protection Act of 1972 and applicable regulations with regard to such taking. We document our consideration of these requirements for reasonable and prudent measures and terms and conditions here. We have determined that all of these RPMs and associated terms and conditions are reasonable and necessary or appropriate, to minimize or document take and that they all comply with the minor change rule. That is, none of these RPMs or their implementing terms and conditions alter the basic design, location, scope, duration, or timing of the action, and all involve no more than minor changes.

RPM 1/Term and Condition 1
The proposed ITA includes a number of general conditions and specific mitigation measures that are considered part of the proposed action. The final ITA issued under the MMPA may have modified or additional measures that clarify or enhance the measures identified in the proposed ITA. Compliance with those measures is necessary and appropriate to minimize and document incidental take of North Atlantic right, sperm, sei, and fin whales. As such, the terms and conditions that require BOEM, BSEE, USACE, and NMFS OPR to ensure compliance with the conditions and mitigation measures of the final ITA are necessary and appropriate to minimize the extent of take of these species and to ensure that take is documented.

RPM 1/Term and Condition 2 and 3
The proposed action incorporates requirements for sound field verification (SFV) and outlines general measures to be implemented as a result of SFV. Term and Condition 2 is necessary and appropriate to provide clarification of the required steps related to sound field verification and measures to be implemented as a result of sound field verification. Additionally, this measure

requires abbreviated SFV monitoring, using a single hydrophone, during all foundation pile driving where full SFV monitoring is not carried out. This requirement implements one of the recommendations included in BOEM's August 2023 *Recommendations for Offshore Wind Project Pile Driving Sound Exposure Modeling and Sound Field Measurement*[51]. This measure is necessary and appropriate to monitor take; the exposure estimates and amount and extent of incidental take exempted in this ITS are based on the size of the area that will experience noise above the identified thresholds during pile driving. While the initial, full SFV monitoring, and the associated steps to require any changes to the noise attenuation system, are designed to ensure that pile driving will proceed in a way that is not expected to exceed the modeled distances, there is likely to be variability in pile driving and there may be issues with the sound attenuation systems (e.g., poor bubble curtain performance) that would be undetected without at least minimal SFV monitoring. We expect that the required abbreviated SFV will both allow a continuous check on noise levels and the attenuation system which will allow us to monitor take in a way that supplements detections of sea turtles and whales by the PSOs, but also allow for expeditious detection of any issues with the noise attenuation system or unanticipated variations in noise produced during pile driving so that adjustments can be made and US Wind can avoid exceeding the amount and extent of take exempted herein. Additionally, we have determined in this Opinion that take of Atlantic sturgeon as a result of exposure to pile driving noise is not expected and no take has been exempted; because PSOs cannot see sturgeon, this abbreviated SFV monitoring will allow for monitoring of noise levels to compare to the modeled distances to the injury and behavioral disturbance thresholds for sturgeon and ensure that these distances are not exceeded.

RPM 2/Term and Condition 4
As explained above, take that may occur of Atlantic and shortnose sturgeon as a result of vessel strike is expected to occur from US Wind's vessels transiting in the Delaware River/Bay as they move to/from the New Jersey Wind Port and Paulsboro Marine Terminal. In this Opinion, we have identified the portion of the take identified in the New Jersey Wind Port and Paulsboro Biological Opinions that will be attributable to US Wind's vessels. That take is exempted through the Incidental Take Statement issued with NMFS' Biological Opinions for those projects. Here, we identify the relevant RPMs and Terms and Conditions from those ITSs that must be complied with in order for the relevant take exemption included in the New Jersey Wind Port and Paulsboro Opinion to apply. Similar measures are necessary and appropriate to monitor incidental take (injury/mortality due to vessel strike) for project vessels transiting in the lower Chesapeake Bay to/from ports in MD and VA where we expect Atlantic sturgeon may be struck and killed.

RPM 3/Term and Conditions 5, 6, and 7
Documenting take that occurs is essential to ensure that reinitiation of consultation occurs if the amount or extent of take identified in the ITS is exceeded. Some measures for documenting and reporting take are included in the proposed action. The requirements of Term and Conditions 5, 6, and 7 enhance or clarify those requirements. Documentation and timely reporting of observations of whales, sea turtles, and Atlantic sturgeon is important to monitoring the amount or extent of actual take compared to the amount or extent of take exempted. The reporting

[51] https://www.boem.gov/sites/default/files/documents/renewable-energy/BOEMOffshoreWindPileDrivingSoundModelingGuidance.pdf; last accessed June 10, 2024.

requirements included here will allow us to track the progress of the action and associated take. While we note that it is unexpected, in the event that any interactions with sturgeon or ESA listed fish occur in the fisheries surveys, proper identification and handling is essential for documenting take and to minimize the extent of that take (i.e., reducing the potential for further stress, injury, or mortality). The measures identified here are consistent with established best practices for proper handling and documentation of these species. Identifying existing tags helps to monitor take by identifying individual animals. Requiring genetic samples (fin clips) from any Atlantic sturgeon struck by project vessels or suspected to be struck by project vessels and ensuring that those samples be analyzed to determine the DPS of origin is essential for monitoring actual take as genetic analysis is the only way to identify the DPS of origin for subadult and adult Atlantic sturgeon captured in the ocean. Taking fin clips is not expected to increase stress or result in any injury of Atlantic sturgeon because fin clips will only be taken from already dead animals; as such, there are no additional effects of taking the fin clips.

RPM 3/Term and Condition 8
We recognize that documenting sea turtles that were struck by project vessels may be difficult given their small size and the factors that contribute to cryptic mortality addressed in the *Effects of the Action* section of this Opinion. Therefore, we are requiring that BOEM, BSEE, and US Wind document any and all observations of dead or injured sea turtles over the course of the project and that we meet twice annually to review that data and determine which, if any, of those sea turtles have a cause of death that is attributable to project operations. We expect that we will consider the factors reported with the particular turtle (i.e., did the lookout suspect the vessel struck the turtle), the state of decomposition, any observable injuries, and the extent to which project vessel traffic contributed to overall traffic in the area at the time of detection.

RPM 4/Term and Condition 9
Term and Condition 9 requires BOEM, BSEE, and/or USACE to provide updates on certain project information (listed in the condition) to us following BSEE's review of the Facility Design Report (FDR) and/or Fabrication and Installation Report or whenever the identified information is available. Because US Wind used a project design envelope for environmental permitting, a number of the project parameters have not been finalized. Receipt of this information from BOEM, BSEE, or USACE is necessary for us to ensure that the project to be constructed is consistent with the description of the proposed action in the Opinion and allows us an opportunity to identify if any changes to the ITS would be appropriate. For example, if the project described in the FDR includes significantly fewer pile driven WTG foundations than described in the Opinion, adjustments to the amount of exempted take may be appropriate. Requiring the submission of information on how the project will be implemented is necessary and appropriate to allow us to determine if the amount or extent of take is likely to be exceeded (or alternatively, if it would be an overestimate), and allows for us to accurately monitor the proposed action and associated incidental take.

RPM 4/Term and Condition 10
A number of plans are proposed for development and submission by US Wind and/or required for submission by BOEM, BSEE, or NMFS OPR. Term and Condition 10 identifies all of the plans that must be submitted to NMFS GARFO, identifies timeline for submission, and clarifies any relevant requirements. This will minimize confusion over submission of plans and facilitate

efficient review of the plans. Implementation of these plans will minimize or monitor take, dependent on the plan. Obtaining NMFS concurrence with these plans prior to implementation of the associated activity is necessary and appropriate to ensure that the activities are carried out in a way that is consistent with the proposed action described herein, including compliance with the avoidance, minimization, or monitoring measures built into the proposed action, or to ensure that the measures outlined in this ITS are implemented as intended. Preparation, review, and concurrence with these plans is necessary because the relevant details were not available at the time this consultation was initiated or completed.

RPM 5/Term and Condition 11-13
RPM 5 and its associated terms and conditions are reasonable and necessary or appropriate to minimize and monitor incidental take. Measures to minimize and monitor incidental take, whether part of the proposed action or this ITS, first must be implemented in order to achieve the beneficial results anticipated in this Opinion for ESA listed species. The action agencies exercising their authorities to assess and ensure compliance with the measures to avoid, minimize, monitor, and report incidental take of ESA listed species, including the measures that were incorporated into the description of the proposed action is an essential component of ensuring that incidental take is minimized and monitored. Likewise, such measures once implemented must be effective at minimizing and monitoring incidental take consistent with the analysis. While the measures described as part of the proposed action and in the ITS are consistent with best practices in other industries, and are anticipated to be practicable and functional, gathering information in situ through observation, inspection, and assessment may confirm expectations or reveal room for improvement in a measure's design or performance, or in US Wind's implementation and compliance. While the ITS states that action agencies must adopt the RPMs and terms and conditions as enforceable conditions in their own actions, and while each agency is responsible for oversight regarding its own actions taken, specifying that US Wind must consent to NOAA (or other enforcement related) personnel's attendance during offshore wind activities clarifies its role as well. Given the nascence of the U.S. offshore wind industry information gathering on the implementation and effectiveness of these measures will help ensure that effects to listed species and their habitat are minimized and monitored. Term and Condition 13 requires prompt notification of any non-compliance with measures that are designed to avoid, minimize, or monitor effects to ESA listed species; this is necessary not only to monitor incidental take and the implementation of this ITS but also to ensure that appropriate corrective actions are taken. This will also facilitate identification of any need to reinitiate this consultation.

12.0 CONSERVATION RECOMMENDATIONS

In addition to Section 7(a)(2), which requires agencies to ensure that all projects will not jeopardize the continued existence of listed species, Section 7(a)(1) of the ESA places a responsibility on all federal agencies to "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species." Conservation Recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information in furtherance of these identified purposes. As such, NMFS recommends that the BOEM, BSEE, USACE, and the other action agencies implement the following Conservation Recommendations consistent with their authorities:

1. Work with the lessee to develop a construction schedule that further reduces potential exposure of North Atlantic right whales to noise from pile driving including avoiding impact pile driving in May.

2. Collect data to add to the limited information we have on underwater noise generated during operations of the direct drive wind turbines in the action area.
    i. A study to document operational noise of WTGs during a variety of wind and weather conditions should be carried out.

3. Support research and development of technology to aid in the minimization of risk of vessel strikes on marine mammals, sea turtles, and Atlantic sturgeon.

4. Support development of regional monitoring of project and cumulative effects through the Regional Wildlife Science Collaborative for Offshore Wind (RWSC).

5. Work with the NEFSC to support robust monitoring and study design with adequate sample sizes, appropriate spatial and temporal coverage, and proper design allowing the detection of potential impacts of offshore wind projects on a wide range of ecological and oceanographic conditions including protected species distribution, prey distribution, pelagic habitat, and habitat usage.

6. Support research into understanding the effects of offshore wind on regional oceanic and atmospheric conditions through modeling and data collection, and assessment of potential impacts on protected species, their habitats, and distribution of zooplankton and other prey.

7. Support the continuation of aerial surveys for post-construction monitoring of listed species in the Maryland Wind WFA and surrounding waters, and methods for survey adaptation to the presence of wind turbines.

8. Support research on construction and operational impacts to protected species distribution, particularly the North Atlantic right whale and other listed whales. Conduct monitoring pre/during/post construction, including long-term monitoring during the operational phase, including sound sources associated with turbine maintenance (e.g., service vessels), to understand any changes in protected species distribution and habitat use in the Mid-and Central Atlantic.

9. Support the deployment of acoustic tags on sea turtles and sturgeon and the continued maintenance of the receiver array in the Maryland Wind WDA.

10. Support research regarding the abundance and distribution of Atlantic sturgeon in the Maryland Wind WDA and surrounding region in order to understand the distribution and habitat use and aid in density modeling efforts, including the continued use of acoustic telemetry networks to monitor for tagged fish.

11. Require the lessee to send all acoustic telemetry metadata and detections to the Mid-Atlantic Acoustic Telemetry Observation System (MATOS) database via https://matos.asascience.com/ for coordinated tracking of marine species over broader spatial scales in US Animal Tracking Network and Ocean Tracking Network.

12. Conduct or support long-term ecological monitoring to document the changes to the ecological communities on, around, and between foundations and other benthic areas disturbed by the proposed Project.

13. Develop or support the development of a PAM array in the Maryland Wind WDA to monitor changes in ambient noise and use of the area by baleen whales (and other marine mammals) during the life of the Project, including construction, and to detect small-scale changes at the scale of the Maryland Wind WDA. Bottom mounted recorders should be deployed at a maximum of 20 km distance from each other throughout the given study area in order to ensure near to complete coverage of the area over which North Atlantic right whales and other baleen whales can be heard. See Van Parijs et al. 2021 for specific details. Resulting data products should be provided according to https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates.

14. Support the development of a regional PAM network across lease areas to monitor long-term changes in baleen whale distribution and habitat use. A regional PAM network should consider adequate array/hydrophone design, equipment, and data evaluation to understand changes over the spatial scales that are relevant to these species for the duration of these projects, as well as the storage and dissemination of these data.

15. Monitor changes in commercial fishing activity to detect changes in bycatch or entanglement rates of protected species, particularly the North Atlantic right whale, and support the adaptation of ropeless fishing practices where necessary. Conduct regular surveys and removal of marine debris from project infrastructure.

16. Provide support to groups that participate in regional stranding networks.

13.0 REINITIATION NOTICE

This concludes formal consultation for the proposed authorizations associated listed herein for the Maryland Wind offshore energy project. As 50 C.F.R. §402.16 states, reinitiation of formal consultation is required and shall be requested by the Federal action agency where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(1) If the amount or extent of taking specified in the incidental take statement is exceeded;
(2) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
(3) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion or written concurrence; or,
(4) If a new species is listed or critical habitat designated that may be affected by the identified action.

14.0 LITERATURE CITED

Note: citations are organized by section of the Biological Opinion in the heading below; citations that appear in more than one section may appear more than once in this list.

1.0 Introduction, 2.0 Consultation History, and 3.0 Description of the Proposed Action

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5.0 Status of the Species

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7.5 Marine Resource Survey and Monitoring Activities

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7.6 Consideration of Potential Shifts or Displacement of Fishing Activity, 7.7 Repair and Maintenance Activities, 7.8 Unexpected/Unanticipated Events, 7.9 Project Decommissioning, 7.10 Consideration of the Effects of the Action in the Context of Predicted Climate Change due to Past, Present, and Future Activities

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11.0 Incidental Take Statement

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APPENDICES

APPENDIX A

Measures Included in BOEM's BA that are Part of the Proposed Action for the ESA Consultation

BA Table 3-20. Environmental Protection Measures Proposed by US Wind and Measures Modified or Additionally Proposed by BOEM to be Included in the BA as Part of the Proposed Action (with further minor modifications made during the consultation period)

Measure	Applicant Proposed Measures	BOEM Proposed or Modified Measures	Project Phase
Mitigation measure alignment with Letter of Authorization (LOA) and other permit conditions	1) US Wind will adhere to any additional requirements for the Proposed Action set forth by MMPA and ESA consultations, BOEM project design criteria (PDC) and best management practices (BMPs), and Record of Decision conditions.	2) The measures required by the final MMPA LOA will be incorporated by reference as appropriate into COP approval and Record of Decision conditions, and BOEM or BSEE will monitor compliance with these measures. 3) US Wind must comply with any special conditions and required mitigation associated with work authorized or permitted through Section 10 of the Rivers and Harbors Act of 1899, Section 404 of the Clean Water Act, and ESA terms and conditions landward of the Submerged Lands Act boundary. 4) US Wind must comply with all published BOEM BMPs and PDC that are applicable to the activities when not superseded by LOA, COP, or Record of Decision conditions. The following measure will be included as stated below or as modified by the Biological Opinion 5) US Wind must prepare and submit a Pile Driving Monitoring Plan to BOEM, BSEE, and NMFS for review and concurrence by all agencies at least 120 days before the start of pile driving. Pile driving will not commence without an approved plan. The plan will detail all plans and procedures for sound attenuation and monitoring for ESA-listed whales and sea turtles during all impact pile driving. The plan will also describe how BOEM and US Wind would determine the number of whales exposed to noise above the Level B harassment threshold during pile driving. US Wind must obtain concurrence with this plan prior to starting any pile driving. 6) US Wind must resolve all agency comments on the Pile Driving Monitoring Plan before operations can begin, and operations must be conducted according to the plan. A copy of the approved Pile Driving Monitoring Plan must be in the possession of the US Wind representative, protected species observers (PSOs), impact-hammer operators, and any other relevant designees operating under the authority of the approved COP and carrying out the requirements on site. The Pile Driving Monitoring Plan must:	C, O&M, D

		• Provide detailed information on all visual and passive acoustic monitoring (PAM) components of the monitoring, describing all equipment, procedures, and protocols, including staffing levels. • Ensure the full extent of the harassment distances from piles are monitored for marine mammals and sea turtles to document all potential take. Include a PAM plan, detailing all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. • Include an Alternative Monitoring Plan (AMP), detailing measures for enhanced monitoring capabilities in the event that poor-visibility conditions unexpectedly arise, and pile driving cannot be stopped. • Include a Communication Plan, detailing the chain of command, mode of communication, and decision authority. • Include a Vessel Plan, detailing how vessel strike avoidance will be maintained and monitored. • Include the number of PSOs or Native American monitors, or both, that will be used, the platforms or vessels upon which they will be deployed, and contact information for the PSO providers. • Include seasonal and species-specific clearance and shutdown zones including time-of-year requirements for North Atlantic right whales (NARWs).	
General PSO standards	1) PSOs will be provided by a third-party provider. 2) PSO and PAM operators will have completed NMFS-approved PSO training and will undergo Project-specific operations and safety training prior to the start of Project activities.	In addition to the Applicant-proposed measures: 1) All PSOs must have completed a NMFS-approved PSO training program and received NMFS approval to act as a PSO for geophysical surveys. 2) Upon request, US Wind must provide BOEM with documentation of NMFS approval as PSOs for geophysical activities in the Atlantic and copies of the most recent training certificates of PSOs' successful completion of a commercial PSO training course with an overall examination score of 80 percent or higher.	C, O&M, D
General PSO roles and responsibilities	1) A Lead PSO will be designated every shift and responsible for communication with the vessel team, PSO onshore support team, and US Wind compliance personnel. 2) The Lead PSO will monitor the NOAA Fisheries NARW Reporting Systems for the presence of NARWs at the start of each shift. This includes checking the Early Warning System, Sighting Advisory System, and Mandatory Ship Reporting System.	In addition to the Applicant-proposed measures, PSO data must be collected in accordance with standard data reporting, software tools, and electronic data submission standards approved by BOEM and BSEE for the particular activity.	C, O&M, D

	3) PSOs will be responsible for informing the captain, or designated personnel, if a protected species is heading toward or enters the clearance or shutdown zone around the sound-producing activity to minimize or reduce the chance of injuring a protected species. 4) PSOs will summarize daily monitoring efforts and submit data forms to the appropriate staff or database. 5) It will be the responsibility of the PSO team to report any visual or acoustic detections via the appropriate communication channels.		
Foundation installation: PSO visual monitoring protocols	1) PSOs will visually monitor 360 degrees as far as the eye can see, including the clearance and shutdown zones around the vessel (provided below in this table for each foundation type and HRG surveys), at all times for the presence of marine mammals and all other protected species. 2) No individual PSO will conduct more than 4 consecutive hours on watch as a visual observer. Break times of no less than 2 hours will be required before a PSO begins another visual monitoring watch rotation. 3) A team of six to eight dual-role PAM operators/PSOs supplied by a third-party PSO provider will be on board the construction vessel and the secondary support vessel, the locations of which will be determined in the final Pile Driving Monitoring Plan. These PAM operators/PSOs will be on duty throughout the 24-hour construction operations (impact piling of foundations) to undertake visual and acoustic watches, implement mitigation, and conduct data collection and reporting.	In addition to the Applicant-proposed measures: 1) US Wind must demonstrate to BOEM, BSEE, and the USACE that PSO coverage is sufficient to reliably detect marine mammals and sea turtles at the surface in the identified clearance and shutdown zones to execute any pile driving delays or shutdown requirements. This will include a PSO/PAM team on the construction vessel and at least a visual monitoring team on two additional PSO vessels for monopile installation and on one additional PSO vessel for skirt pile installation (no additional PSO vessels are required for pin pile installation). 2) If, at any point prior to or during construction, the PSO coverage included in the Proposed Action is determined to be insufficient to reliably detect ESA-listed whales and sea turtles within the clearance and shutdown zones, additional PSOs, platforms, or both will be deployed. Determinations prior to construction will be based on review of the Pile Driving Monitoring Plan. Determinations during construction will be based on review of the weekly pile driving reports and other information, as appropriate. 3) The following equipment and personnel will be on each associated vessel: Construction vessel: At least two visual PSOs on watch during foundation installation 2 (7× or 10×) reticle binoculars calibrated for observer height off the water 2 (25× or similar) "big eye" binoculars mounted 180 degrees apart 1 PAM operator on duty 1 mounted thermal/IR camera system 1 monitoring station for a real-time PAM system 2 handheld or wearable night vision devices (NVDs) with IR spotlights 1 data-collection software system 2 PSO-dedicated very high-frequency (VHF) radios	C

	4) During pile driving, at least two PSOs will be on duty on the foundation-installation vessel. 5) PSOs will be equipped with binoculars with a minimum of 8× or 10× magnification, reticule binoculars that allow for range estimations to be made, and a single lens reflex (SLR) camera with a zoom lens during daytime operations. During nighttime operations, PSOs will be equipped with high-performance night vision goggles, (i.e., PVS-7 Generation 3 Pinnacle) and Nivisys Thermal Acquisition Clip-on System in addition to handheld infrared (IR) light-emitting diode (LED) spotlights. Due to the potential for reflectivity from bridge windows that could interfere with the use of the night vision optics, PSOs will be required to make nighttime observations from a platform with no visual barriers. 6) Because technology for visual monitoring is advancing rapidly, if new equipment becomes available during the LOA, US Wind will submit the equipment specifications and plans for use to BOEM, BSEE, and NMFS for review and concurrence that it is as protective or an improvement to equipment described in the Pile Driving Monitoring Plan.	1 digital single lens reflex camera equipped with a 300-millimeter lens Each additional PSO vessel: 2 visual PSOs on watch 2 (7× or 10×) reticle binoculars calibrated for observer height off the water 1 (25× or similar) mounted "big eye" binoculars if vessel is deemed appropriate to provide a platform in which they would be effective 1 mounted thermal/IR camera system 1 handheld or wearable NVD with IR spotlight 1 data collection software system 2 PSO-dedicated VHF radios 1 digital single lens reflex camera equipped with a 300-mm lens	
High-resolution geophysical (HRG) survey: PSO visual monitoring protocols	1) A team of four to six PSOs supplied by a third-party PSO Provider will be on board each vessel conducting 24-hour survey operations to undertake visual watches, implement mitigation, and conduct data collection and reporting during geophysical operations. 2) A team of two to three PSOs supplied by a third-party PSO Provider will be on board each vessel conducting 12-hour, daylight-	In addition to the Applicant-proposed measures: US Wind must comply with all PDC and BMPs for protected species that are in effect at the time of the activity. US Wind must implement all PDC and BMPs incorporated in the Atlantic Data Collection Consultation for Offshore Wind Activities (BOEM 2021) to activities associated with the construction and O&M of the Project, as applicable.	C, O&M

	only survey operations to undertake visual watches, implement mitigation, and conduct data collection and reporting. 3) PSOs will be equipped with binoculars with a minimum of 8× or 10× magnification, reticule binoculars that allow for range estimations to be made, and an SLR camera with a zoom lens during daytime operations. During nighttime operations, PSOs will be equipped with high-performance night vision goggles, (i.e., PVS-7 Generation 3 Pinnacle) and Nivisys Thermal Acquisition Clip-on System in addition to handheld IR LED spotlights. Due to the potential for reflectivity from bridge windows that could interfere with the use of the night vision optics, PSOs will be required to make nighttime observations from a platform with no visual barriers.		
PAM protocols	1) US Wind anticipates using PAM during Project construction and installation activities. PAM Operators will use equipment that can detect all known species in the region. 2) Specifications of the PAM equipment to be used will be provided to NMFS for review prior to the start of Project activities. 3) The PAM system will operate in accordance with the pre-piling clearance timing. Deployment of the PAM system will be around the perimeter of the clearance zone prior to pile driving and sufficient to create an acoustic monitoring field around the installation sites. 4) PAM operators will monitor hydrophone signals visually (screen display of sound analysis software) and aurally (using headphones). PAM operators may be	In addition to the Applicant-proposed measures: 1) US Wind must prepare a PAM Plan describing all proposed equipment, deployment locations, detection review methodology and other procedures, and protocols related to the proposed uses of PAM for mitigation and long-term monitoring. 2) The PAM Plan will be submitted to BOEM, BSEE, and NMFS for review and concurrence at least 120 days prior to the planned start of activities requiring PAM. Pile driving may not commence until the PAM plan is approved by all agencies.	C

	located onshore or on a separate vessel than the installation vessel.		
Project reporting requirements	1) PSO documentation throughout Project operations would be consistent with data required for PSO data in Appendix B to Addendum C of the Lease, pending confirmation by NMFS and BOEM. 2) US Wind will provide NMFS with an annual report on April 1 every calendar year following commencement of Project construction and installation activities. A final report will be provided 90 days following the conclusion of Project activities. 3) PSO reports will include a summary of the raw data pertaining to Project activities, PSO sighting data, any incident reports, and an estimate of the number of ESA-listed marine mammals observed or taken during the Project activities for the preceding year. 4) US Wind will notify BOEM and NMFS at least 24 hours prior to commencement of Project activities and within 24 hours following completion of the activity.	In addition to the Applicant-proposed measures: 1) US Wind must submit data that is consistent with the most current permitting documents, and all reporting will meet the metadata standards established by BOEM, BSEE, and NMFS. 2) All PSO data will also be shared with BOEM and BSEE to ensure compliance with requirements. 3) During the construction phase and for the first year of operations, US Wind will compile and submit monthly reports that include a summary of all Project activities carried out in the previous month, including vessel transits (number, type of vessel, and route), piles installed, and all observations of ESA-listed species. Monthly reports are due on the 15th of the month for the previous month. 4) Beginning in year 2 of operations, US Wind will compile and submit annual reports that include a summary of all Project activities carried out in the previous year, including vessel transits (number, type of vessel, and route), repair and maintenance activities, survey activities, and all observations of ESA-listed species. These reports are due by April 1 of each year (e.g., the 2026 report is due by April 1, 2027). Upon mutual agreement of NMFS and BOEM, the frequency of reports can be changed. 5) By January 31 of each year, US Wind will submit to BSEE an annual report that describes its marine trash and debris awareness training process and certifies the training process has been followed for the previous calendar year.	C, O&M
Dead or injured animal reporting requirements	US Wind will ensure any sightings of injured or dead marine mammals are reported to BOEM, NMFS, and the NMFS Greater Atlantic (Northeast) Region Fisheries Office (GARFO) Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-NOAA [6622] or current). Sightings will be reported within 24 hours, regardless of whether the injury or death was caused by a vessel. In addition, if the injury or death was caused by a collision with a US Wind vessel, US Wind will notify BOEM and NMFS within 24 hours of the strike.	In addition to the Applicant-proposed measures: Any potential takes, strikes, strandings, entanglements, or occurrences of dead/injured protected species regardless of cause, will be reported by the vessel captain or the PSO onboard to the NMFS GARFO Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-NOAA [6622] or current) and BSEE within 24 hours of a sighting. In addition, if the injury or death was caused by a collision with a Project-related vessel, US Wind will ensure NMFS GARFO and BSEE are notified of the strike within 24 hours. The notification will include date and location (latitude and longitude) of the strike, name of the vessel involved, and the species identification or a description of the animal, if possible. If the Project activity is responsible for the injury or death, US Wind will supply a vessel to assist in any salvage effort as requested by NMFS or BSEE.	C, O&M

NARW reporting	Any sighting of a NARW will be reported to NMFS within 24 hours of the observation and reported on the WhaleAlert application.	In addition to the Applicant-proposed measures: If an NARW is observed at any time by a PSO or project personnel during surveys or vessel transit, US Wind or the PSO must report sighting within 2 hours of occurrence, when practicable, and no later than 24 hours after occurrence. In the event of a sighting of an NARW that is dead, injured, or entangled, efforts must be made to report as quickly as possible to the appropriate regional NOAA stranding hotline (from Maine to Virginia, report sightings to 866-755-6622; from North Carolina to Florida to 877-942-5343). NARW sightings in any location may also be reported to the USCG via channel 16, to BSEE, and through the WhaleAlert application (http://www.whalealert.org/). Further information on reporting an NARW sighting can be found at: https://appsnefsc.fisheries.noaa.gov/psb/surveys/documents/20120919_Report_a_Right_Whale.pdf The following information should also be reported with the NARW sighting: 1) The name of the project and lease associated with the sighting. 2) The activity occurring at the time of the sighting (e.g., HRG survey, cable installation, etc.). 3) Name of the person who made the sighting and initial report. 4) Name of the vessel from which the sighting was made. 5) The closest point of approach of the NARW to the vessel. 6) Any vessel strike avoidance maneuvers that were made in response to the sighting. 7) Was the sighting reported to the proper channels within the designated window or as soon as practicable? 8) Was the NARW sighting communicated to other project vessels operating in the area?	C, O&M
Vessel strike avoidance measures	1) Vessel operators and crews engaged in all Project activities will abide by all applicable regulations and US Wind's vessel strike avoidance measures to protect marine mammals from vessel strike. 2) Vessel operators and crews will maintain vigilant watch for marine mammals and will slow down or stop the vessel to avoid striking protected species. Vessel operators and crews will be briefed during vessel mobilization and crew changes regarding US Wind's vessel strike avoidance procedures.	In addition to the Applicant-proposed measures: 1) As part of vessel strike avoidance, a vessel crew training program will be implemented. The training program will be provided to NMFS for review and approval prior to the start of surveys. Confirmation of the training and understanding of the requirements will be documented on a training course log sheet. Signing the log sheet will certify the crew members understand and will comply with the necessary requirements throughout the survey event. 2) Vessel operators and crews must maintain vigilant watch for marine mammals and sea turtles by slowing down or stopping the vessels to avoid striking protected species. Vessel crew members responsible for navigation duties will receive site-specific training on marine mammal sighting/reporting and vessel strike avoidance measures.	C, O&M, D

	3) Vessel strike avoidance measures will be in effect during all activities, except under extraordinary circumstances when complying with these requirements would risk the safety of the vessel or crew. 4) Trained observers will be present on crew vessels and other Project vessels without PSOs.	3) Vessel operators will use all available sources of information of NARW presence, including daily monitoring of the Right Whale Sightings Advisory System, WhaleAlert application, and monitoring of USCG VHF channel 16 to receive notifications of NARW detections, Special Management Areas (SMAs), Dynamic Management Areas (DMAs), and Slow Zones to plan vessel routes to minimize the potential for co-occurrence with NARWs. 4) For all vessels operating north of the Virginia/North Carolina border; and year-round for all vessels operating south of the Virginia/North Carolina border, US Wind will have a trained lookout posted on all vessel transits during all phases of the Project to observe for sea turtles. a. The trained lookout will communicate any sightings, in real time, to the captain so that vessel strike and minimum separation distances can be achieved. The trained lookout would monitor https://seaturtlesightings.org/ prior to each trip and report any observations of sea turtles in the vicinity of the planned transit to all vessel operators/captains and lookouts on duty that day. b. The trained lookout will maintain a vigilant watch and monitor a Vessel Strike Avoidance Zone (1,640 feet [500 meters]) at all times to maintain minimize potential vessel strikes of ESA-listed sea turtle species. Alternative monitoring technology (e.g., night vision, thermal cameras) would be available to ensure effective watch at night and in any other low-visibility conditions. c. If the trained lookout is a vessel crew member, this would be their designated role and primary responsibility while the vessel is transiting. d. Any designated crew lookouts will receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. 5) If a vessel is carrying a PSO or trained lookout for the purposes of maintaining watch for NARWs, an additional lookout (as described in item 4, above) is not required; the PSO or trained lookout would maintain watch for marine mammals and sea turtles. 6) Vessel transits to and from the Project area that require PSOs will maintain a speed commensurate with weather conditions and effectively detecting sea turtles prior to reaching the 1,640-feet (500-meters) avoidance measure.	
Minimum separation distances	Vessels will maintain, to the extent practicable, separation distances of: ○ >1,640 feet (500 meters) from an NARW	In addition to the Applicant-proposed measures: 1) If a NARW, or unidentified whale, is sighted within its designated separation distance (see below) while under way, the vessel will steer a course away from the whale at 10 knots (5.1 m/s) or less until the 1,640 feet (500 meters) minimum separation distance has been established.	C, O&M, D

	o >328 feet (100 meters) from non-delphinid cetaceans other than NARWs o >164 feet (50 meters) from delphinid cetaceans and pinnipeds, except if a marine mammal approaches the vessel Vessels will observe NMFS collision avoidance guidance, such as establishing minimum separation distances from sea turtles. If an animal is sighted within its respective separation distance, vessels must steer a course away from the animal at 10 knots (5.1 m/s) or slower until the minimum separation distance is established.	a. If a NARW is sighted within 328 feet (100 meters) of an underway vessel, the vessel operator will immediately reduce speed and promptly shift the engine to neutral. If the vessel is stationary, the operator will not engage engines until the NARW has moved beyond 328 feet (100 meters). 2) If a non-delphinid cetacean is sighted within 328 feet (100 meters) of an underway vessel, the vessel operator will immediately reduce speed and promptly shift the engine to neutral. The vessel operator will not engage the engines until the non-delphinid cetacean has moved beyond 328 feet (100 meters). If a vessel is stationary, the operator will not engage engines until the non-delphinid cetacean has moved beyond 328 feet (100 meters) 3) If a delphinid cetacean or pinniped approaches an underway vessel, the vessel will avoid excessive speed or abrupt changes in direction to avoid injury to these organisms. Additionally, vessels underway may not divert to approach any delphinid cetacean or pinniped. 4) If a sea turtle is sighted within 328 feet (100 meters) or less of the operating vessel's forward path, the vessel operator will slow down to a maximum of 4 knots (2.1 m/s) (unless unsafe to do so) and then proceed away from the turtle at a speed of 4 knots (2.1 m/s) or less until there is a separation distance of at least 328 feet (100 meters), at which time the vessel may resume normal operations. a. If a sea turtle is sighted within 164 feet (50 meters) of the forward path of the operating vessel, the vessel operator will shift to neutral when safe to do so and then proceed away from the turtle at a speed of 4 knots (2.1 m/s) or less. The vessel may resume normal operations once it has passed the turtle. 5) The only exception to these actions is when the safety of the vessel or crew necessitates deviation from these requirements on an emergency basis. If any such incidents occur, they would be reported to NMFS and BSEE within 24 hours.	
Vessel speed restrictions	1) Vessels 65 feet (19.8 meters) in length or greater would operate at speeds of 10 knots (5.1 m/s) or slower in NARW Special Management Areas (SMAs). Additionally, all vessels would operate at speed of 10 knots (5.1 m/s) or slower in Right Whale Slow Zones (i.e., DMAs) to protect visually or acoustically detected NARWs. US Wind will incorporate the proposed revision to the NARW vessel speed rule	In addition to the Applicant-proposed measures: 1) Vessel captains/operators will avoid transiting through areas of visible jellyfish aggregations or floating *Sargassum* lines or mats. In the event that operational safety prevents avoidance of such areas, vessels would slow to 4 knots (2.1 m/s) while transiting through such areas. 2) All project vessels of 65 feet (19.8 meters) in length or greater will abide to speed restrictions.	C, O&M, D

	for vessels 35 to 65 ft (10.6 to 19.8 m) in length upon implementation. 2) All vessels will comply with NMFS regulations and speed restrictions as well as state regulations, as applicable for NARW. 3) All Project-related vessels of 65 feet (19.8 meters) in length or greater will comply with 10 knots (5.1 m/s) speed restrictions in any SMA, DMA, or Slow Zone. 4) All Project-related vessels of 65 feet (19.8 meters) in length or greater will reduce vessel speed to 10 knots (5.1 m/s) or slower when mother/calf pairs, pods, or larger assemblages of whales are observed near an underway vessel.		
Crew training requirements	US Wind would defer to any crew training requirements set forth by agencies resulting from this consultation, MMPA ITA, and COP conditions of approval.	All vessel crew members will be briefed in the identification of sea turtles and in regulations and best practices for avoiding vessel collisions. Reference materials will be available aboard all Project vessels for identification of sea turtles. The expectation and process for reporting of sea turtles (including live, entangled, and dead individuals) will 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 (i.e., the lookout or the vessel captain) as well as a communication channel and process for crew members to do so.	C, O&M, D
Communication protocols	1) At first detection of a protected species in the vessel's path, the PSO notifies the bridge of the animal's presence and distance from the vessel, in person, via VHF radio, or by phone and requests a Vessel Strike Avoidance. 2) During the sighting, the PSO continues to monitor the protected species to continue advising the bridge as to the effectiveness of the Vessel Strike Avoidance. The vessel operator must respond to the requested mitigation if it is safe for the vessel to do so, and the PSO team will document the decision of the vessel operator.	In addition to the Applicant-proposed measures: US Wind must submit a Communication Plan that details the responsible parties and when/how communications are made during pre-clearance monitoring, noise attenuation system deployment and testing, PAM monitoring, detection events, shutdowns, and vessel operations.	C, O&M, D

	3) At first detection of a protected species inside its respective shutdown zone, the PSO or PAM Operator immediately notifies the onboard Party Chief/Project Manager via VHF radio/WhatsApp that a shutdown of operations is required. 4) The Party Chief/Project Manager will assess the ability to safely shutdown and communicate the decision to the PSO/PAM Operator. 5) During the detection, the PSO/PAM Operator will continue to monitor and record ongoing behavior of the detected animal(s). 6) From the time that the protected species is last detected inside the shutdown zone and the proper amount of time has passed, the PSO/PAM Operator informs the onboard Party Chief/Project Manager that it is safe to restart operations. 7) It will be the responsibility of the Lead PSO to report any visual sightings of NARWs as well as injured, dead, or entangled protected species using the designated reporting forms. The report will immediately be sent to the PSO Project Manager for review and submission to the appropriate regulatory agencies within the required time frame. 8) The vessel captain will call the USCG on channel 16 to report the detection.		
Foundation pile driving time-of-year/day restrictions and Alternative Monitoring Plan (AMP)	1) Pile driving for any Project foundations would occur only between May and November of any construction phase. 2) No more than one monopile will be driven per day. 3) No simultaneous pile driving of Project foundations will occur. 4) Pile driving would occur during daylight hours only unless pile driving that started	1) US Wind will submit an AMP to BOEM, BSEE and NMFS for review and approval at least 6 months prior to the planned start of all pile driving. The AMP may include deploying additional observers; alternative monitoring technologies such as night vision, thermal, and infrared technologies; or PAM, and it must demonstrate the ability to effectively maintain all clearance and shutdown zones during daytime. 2) US Wind must not conduct pile driving operations at any time when lighting or weather conditions (e.g., darkness, rain, fog, sea state) prevent visual monitoring	C

	during daylight hours must be completed at night for safety or feasibility considerations. 5) Initiation of impact pile driving would not begin within 1.5 hours of civil sunset or in times of low visibility when the clearance and shutdown zones cannot be visually monitored, as determined by the Lead PSO on duty.	of the full extent of the clearance and shutdown zones unless an acceptable AMP is submitted to and approved by BOEM, BSEE, and NMFS. 3) The AMP must include enhanced monitoring capabilities that will be utilized in the event that poor visibility conditions unexpectedly arise and pile driving cannot be stopped. The AMP must also include measures for deploying additional observers, using night vision devices or PAM, with the goal of ensuring the ability to maintain all clearance and shutdown zones in the event of unexpected poor-visibility conditions. 4) The AMP must include the following two standalone components: Part 1 – Daytime: When lighting or weather (e.g., fog, rain, sea state) conditions prevent visual monitoring of the full extent of the clearance and shutdown zones. Daytime being defined as 1 hour after civil sunrise to 1.5 hours before civil sunset. Part 2 – Nighttime: Inclusive of weather conditions (e.g., fog, rain, sea state). Nighttime being defined as 1.5 hours before civil sunset to 1 hour after civil sunrise. 5) The AMP must include, at a minimum, the following information: Identification of NVDs (e.g., mounted thermal/IR camera systems, hand-held or wearable NVDs, IR spotlights), if proposed for use to detect protected marine mammal and sea turtle species. The AMP must demonstrate (through empirical evidence) the capability of the proposed monitoring methodology to detect marine mammals and sea turtles within the full extent of the established clearance and shutdown zones (i.e., species can be detected at the same distances and with similar confidence) with the same effectiveness as daytime visual monitoring (i.e., same detection probability). Only devices and methods demonstrated as capable of detecting marine mammals and sea turtles to the maximum extent of the clearance and shutdown zones will be acceptable. Evidence and discussion of the efficacy (range and accuracy) of each device proposed for low-visibility monitoring must include an assessment of the results of field studies (e.g., Thayer Mahan demonstration) as well as supporting documentation regarding the efficacy of all proposed alternative monitoring methods (e.g., best scientific data available). Reporting procedures, contacts, and time frames. BOEM may request additional information, when appropriate, to assess the efficacy of the AMP.	
Noise mitigation systems	1) US Wind will employ noise attenuation through deployment of near- and far-field sound attenuation technologies:	In addition to the Applicant-proposed measures: 1) US Wind must implement noise attenuation device(s) during all pile driving of foundations.	C

	a. Near-field technologies could include AdBm Technologies Noise Mitigation System and using a damper between the hammer and sleeve to prolong the impact pulse. b. Far-field technologies could include a large double bubble curtain, deployed by a separate vessel mobilized to the installation location. 2) US Wind will implement sound attenuation technologies such as double bubble curtains and near-field sound attenuation devices to reduce underwater pile driving noise by 10 decibels, with a target of 20 decibels at the source.	2) If bubble curtains are used, construction contractors must submit an inspection/performance report for approval by US Wind within 72 hours following the performance test. Corrections to the bubble ring(s) to meet the performance standards must occur prior to impact pile driving of monopiles. 3) If sound field verification (SFV) measurements indicate the ranges to Level A and B harassment isopleths are larger than those permitted, US Wind must modify or apply additional noise attenuation measures (e.g., improve efficacy of bubble curtain, modify the piling schedule to reduce the source sound, install an additional noise attenuation device) before another pile is installed. Until SFV confirms the ranges to Level A and B harassment isopleths are less than or equal to those permitted, the shutdown and clearance zones must be expanded to match the measured ranges to the Level A and B harassment isopleths. 4) If the use of additional noise attenuation measures does not achieve ranges less than or equal to those permitted and no other actions can further reduce sound levels, US Wind must expand the clearance and shutdown zones according to those identified through SFV, in consultation with NMFS. 5) If the harassment zones are expanded beyond an additional 4,921 feet (1,500 meters), additional PSOs must be deployed on additional platforms, with each PSO responsible for maintaining watch in no more than 180 degrees and of an area with a radius no greater than 4,921 feet (1,500 meters).	
SFV measurement plan	US Wind would defer to any SFV requirements set forth by agencies resulting from this consultation, MMPA ITA, and COP conditions of approval.	1) US Wind must develop an impact pile driving SFV plan to confirm noise generated by foundation installation is below modeled ensonification levels used for estimating environmental impacts. 2) The plan must be reviewed and approved by BOEM, BSEE and NMFS. 3) The plan will include measurement procedures and results reporting that meet ISO standard 18406:2017 (Underwater acoustics – Measurement of radiated underwater sound from impact pile driving). 4) The submission of raw acoustic data or data products associated with SFV to BOEM may be required.	C
Adaptive mitigation zones	US Wind would defer to any adaptive mitigation zone requirements set forth by agencies resulting from this consultation, MMPA ITA, and COP conditions of approval.	1) US Wind must ensure that if the clearance and shutdown zones are expanded due to the results of the SFV from Project activities, PSO coverage is sufficient to reliably monitor the expanded clearance and shutdown zones. Additional observers will be deployed on additional platforms for every 4,921 feet (1,500 meters) that a clearance or shutdown zone is expanded beyond the distances modeled prior to verification. 2) BOEM, BSEE, and the USACE may consider reductions in the shutdown zones for sei, fin, or sperm whales based on SFV of a minimum of three piles. Sound field verification of additional piles may be required based on results of actual measurements. However, the shutdown zone for sei, fin, and sperm whales will not be reduced to less than 3,281 feet (1,000 meters) or 1,640 feet (500 meters)	C

<table>
<tr><td></td><td></td><td>for sea turtles. No reductions in the clearance or shutdown zones for NARWs will be considered regardless of the results of SFV of a minimum of three piles.</td><td></td></tr>
<tr><td>Clearance and shutdown zones for monopile-installation pile driving</td><td>Clearance and shutdown zones for monopile installation:
<table>
<tr><th>Marine Mammal Hearing Group</th><th>Clearance Zone</th><th>Shutdown Zone</th></tr>
<tr><td>Low Frequency Cetaceans</td><td rowspan="4">5,250 m</td><td>2,900 m</td></tr>
<tr><td>Mid-frequency Cetaceans</td><td><50 m</td></tr>
<tr><td>High Frequency Cetaceans</td><td>250 m</td></tr>
<tr><td>Pinnipeds in Water</td><td>100 m</td></tr>
</table></td><td>In addition to the Applicant-proposed measures:

1) Shutdown of pile driving would occur for NARWs visually detected at any distance or acoustically detected within 5 km of the piling location.
2) BOEM and the USACE would ensure US Wind monitors the following zones for sea turtles in addition to those proposed by the Applicant for marine mammals:
a. A clearance zone of 820 feet (250 meters), which encompasses maximum the area in which noise would exceed the SPL of 175 dB re 1 μPa behavioral disturbance threshold for sea turtles, to be monitored for the duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and records all observations in order to ensure all take is documented. This clearance zone would encompass a portion of the TTS ranges.
b. A shutdown zone of 1,640 feet (500 meters), which covers the extent of the modeled range to the PTS threshold for the WTG monopile foundation will be implemented for sea turtles.</td><td>C</td></tr>
<tr><td>Clearance and shutdown zones for skirt pile driving</td><td>Clearance and shutdown zones for skirt pile installation:
<table>
<tr><th>Marine Mammal Hearing Group</th><th>Clearance Zone</th><th>Shutdown Zone</th></tr>
<tr><td>Low Frequency Cetaceans</td><td rowspan="4">5,250 m</td><td>1,400 m</td></tr>
<tr><td>Mid-frequency Cetaceans</td><td><50 m</td></tr>
<tr><td>High Frequency Cetaceans</td><td>100 m</td></tr>
<tr><td>Pinnipeds in Water</td><td>50 m</td></tr>
</table></td><td>In addition to the Applicant-proposed measures:

1) Shutdown of pile driving would occur for NARWs visually detected at any distance or acoustically detected within 5 km of the piling location.
2) BOEM and the USACE would ensure US Wind monitors the following zones for sea turtles in addition to those proposed by the Applicant for marine mammals:
a. A clearance zone of 820 feet (250 meters), which encompasses the area in which noise would exceed the SPL of 175 dB re 1 μPa behavioral disturbance threshold for sea turtles, to be monitored for the duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and records all observations in order to ensure all take is documented. This clearance zone would encompass a portion of the TTS ranges.
b. A shutdown zone of 1,640 feet (500 meters), which covers the extent of the modeled range to the PTS threshold for the OSS skirt pile foundation will be implemented for sea turtles.</td><td>C</td></tr>
</table>

<table>
<tr><td>Clearance and shutdown zones for pin pile driving</td><td>Clearance and shutdown zones for pin pile installation:
<table><tr><th>Marine Mammal Hearing Group</th><th>Clearance Zone</th><th>Shutdown Zone</th></tr><tr><td>Low Frequency Cetaceans</td><td rowspan="3">100 m</td><td>50 m</td></tr><tr><td>Mid-frequency Cetaceans</td><td><50 m</td></tr><tr><td>High Frequency Cetaceans</td><td><50 m</td></tr><tr><td>Pinnipeds in Water</td><td></td><td><50 m</td></tr></table></td><td>In addition to the Applicant-proposed measures:

1) Shutdown of pile driving would occur for NARWs visually detected at any distance or acoustically detected within 5 km of the piling location.
3) BOEM and the USACE would ensure US Wind monitors the following zones for sea turtles in addition to those proposed by the Applicant for marine mammals:
a. A clearance zone of 820 feet (250 meters), which encompasses the area in which noise would exceed the SPL of 175 dB re 1 µPa behavioral disturbance threshold for sea turtles, to be monitored for the duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and records all observations in order to ensure all take is documented. This clearance zone would encompass a portion of the TTS ranges.
b. A shutdown zone of 1,640 feet (500 meters), which covers the maximum extent of the modeled range to the PTS threshold for the Met Tower pin pile foundation will be implemented for sea turtles.</td><td>C</td></tr>
<tr><td>Clearance and shutdown zones for inshore pile driving for the O&M facility</td><td>US Wind will defer to measures required by agencies through ESA and MMPA consultations and any COP conditions of approval.</td><td>US Wind must implement a minimum 328-foot (100-meter) clearance zone for all marine mammals; a 164-foot (50-meter) shutdown zone for low-frequency cetaceans; and a <164-foot (50-meter) shutdown zone for all other marine mammals, based on the anticipated ranges to the PTS and behavioral disturbance thresholds for these pile types.

Additionally, US Wind must monitor the full extent of the area where noise is estimated (by modeling or calculations) to exceed the SPL of 175 dB re 1 µPa behavioral disturbance threshold for sea turtles for the duration of all pile driving activities and for 30 minutes following the cessation of pile driving activities and records all observations in order to ensure all take is documented. Additionally, a 164-foot (50 meter) shutdown zone will be implemented for sea turtles to cover the extent of the anticipated ranges to the PTS and behavioral disturbance thresholds for these pile types.</td><td>C</td></tr>
<tr><td>HRG survey clearance and shutdown zones</td><td>Clearance zones:
○ NARWs: 1,640 feet (500 meters); All other marine mammals: 328 feet (100 meters)

Shutdown zones:
○ NARWs: 1,640 feet (500 meters)
All other marine mammals: 328 feet (100 meters)</td><td>In addition to the Applicant-proposed measures:

BOEM will require US Wind to comply with all the PDC and BMPs for protected species in effect at the time of the activity. BOEM would ensure all PDC and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (BOEM and NMFS 2022) shall be applied to activities associated with Project construction and O&M, as applicable, including the following measure:
Before any noise-producing survey equipment that operates at frequencies below 180 kHz is deployed, the monitoring zones (1,640 feet [500 meters] for</td><td>C, O&M</td></tr>
</table>

		ESA-listed species and 656 feet [200 meters] for non-ESA-listed marine mammals) must be monitored for 30 minutes of pre-clearance observation. A 328-foot (100-meter) shutdown zone will also be implemented for sea turtles. The clearance ranges for marine mammals will cover the area for PTS thresholds clearance zones for sea turtles.	
Monitoring of clearance zones	1) Pile driving would be attempted only when sufficient visual and acoustic monitoring of the relevant clearance zone for that activity is feasible. 2) The clearance zone would be monitored for a minimum of 60 minutes, and the zone must be clear for 30 minutes before initiating soft-start procedures. 3) If a marine mammal or sea turtle is detected within the clearance zone prior to the soft-start procedure, pile driving would be delayed until the marine mammal exits the clearance zone or is no longer observed after 30 minutes.	In addition to the Applicant-proposed measures: Acceptable visibility will be determined by the Lead PSO, and monitoring of the clearance zone will be required following cessation of impact pile driving for 30 minutes or longer.	C
Soft start for impact pile driving	Once the clearance zone is confirmed clear of marine mammals and sea turtles, pile driving would begin with minimum hammering at low energy for no less than 30 minutes.	Applicant proposed measures modified to: US Wind must implement soft-start techniques for impact pile driving. The soft start must include a minimum of 20 minutes of 4 to 6 strikes per minute at 10 to 20 percent of the maximum hammer energy. Soft start is required at the beginning of driving a new pile and any time following the cessation of impact pile driving for 30 minutes or longer.	C
Shutdowns for impact pile driving	1) Pile driving would halt if the shutdown zones cannot be effectively monitored visually or if the minimum visibility of 4,921 feet (1,500 meters) cannot be visually and acoustically monitored. 2) If a marine mammal is detected in the shutdown zone at any time during pile driving, the Lead PSO would call for an immediate shutdown of pile driving unless it is determined not feasible due to safety or technical reasons. 3) The offshore construction manager on duty would assess the safety of crew during a shutdown, whether the pile would be	In addition to the Applicant-proposed measures: 1) Within 24 hours, the Lessee must report to BOEM (renewable_reporting@boem.gov) and BSEE (protectedspecies@bsee.gov) all marine mammals and sea turtles observed in the shutdown zone. In the report, the Lessee must include a detailed description of any instance where a shutdown was requested by the PSO but not implemented due to safety concerns, including a clear description of the safety concerns that prevented the pile driving hammer from shutting down and the reduction of hammer energy that occurred. In addition, the PSO Provider must submit the data report (raw data collected in the field), including the daily form with the date, time, species, pile identification number, GPS coordinates, time and distance of the animal when sighted, time the shutdown occurred, behavior of the animal, direction of travel, time the	C

	structurally compromised, and whether pile driving could not be successfully completed after shutdown and the process is restarted (clearance zone monitoring and soft-start implementation). If any of these conditions cannot be met safely, the offshore construction manager may call for a continuation of pile driving. 4) Following a shutdown, monitoring of the shutdown zone would continue and pile driving would resume after 30 minutes if the sighted animal has exited the shutdown zone or 30 minutes elapses with no marine mammal or sea turtle observed in the shutdown zone.	animal left the shutdown zone, time the pile driver was restarted or powered back up, and any photographs that may have been taken. 2) To ensure impact pile driving operations are carried out in a way that minimizes the exposure of ESA-listed sea turtles to noise that may result in injury or behavioral disturbance, PSOs will establish a 1,640-ft (500-m) shutdown zone for all pile driving activities. Adherence to the 1,640-ft (500-m) shutdown zone must be reflected in the PSO reports. Any visual detection of sea turtles in the shutdown zone must trigger the required shutdown of pile installation. Upon visual detection of a sea turtle entering or within the shutdown zone during pile driving, US Wind must shut down the pile driving hammer unless activities must proceed for human safety or for concerns of structural failure. 3) Visual detection of an NARW at any distance will result in a shutdown. 4) Acoustic detection of an NARW within 9,514 feet (2,900 meters) will result in a shutdown.	
Post-construction noise and species monitoring	US Wind has partnered with the University of Maryland Center for Environmental Science to perform a PAM study to detect large whales (e.g., NARWs) and dolphins. Utilizing a before-during-after gradient design, deployed devices will be used to characterize ambient noise levels and evaluate how marine mammals and other tagged species using receivers on the PAM array (i.e., fishes, sharks, rays, and turtles) respond to construction and installation of the Project. This study will help distinguish changes in marine mammal behavior due to Project activities versus natural interannual variation in the region.	In addition to the Applicant-proposed measures: To facilitate monitoring of the incidental take exemption for sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records. These meetings/conference calls would use the best available information on sea turtle presence, distribution, and abundance; project vessel activity; and observations to estimate the total number of sea turtle vessel strikes in the Action Area that are attributable to Project operations. These meetings would continue annually following year 1 of operations. Upon mutual agreement of NMFS and BOEM, the frequency of these meetings can be changed.	O&M
	US Wind would defer to any post-construction noise and species monitoring requirements set forth by agencies resulting from this consultation, MMPA ITA, and COP conditions of approval.	The Lessee must conduct long-term monitoring of ambient noise, baleen whale, and marine fish vocalizations in the Lease Area before, during, and following construction. The Lessee must conduct continuous recording at least 30 days before conducting pile driving, during foundation pile driving, initial operation, and for at least 3 but no more than 10 full calendar years of operation to monitor for potential impacts. The Lessee must meet with BOEM and BSEE at least 60 days prior to conclusion of the third full calendar year of operation monitoring (and at least 60 days prior to the conclusion of each subsequent year until monitoring is concluded) to discuss: 1) monitoring conducted to-date, 2) the need for continued monitoring, and 3) if monitoring is continued, whether adjustments to the monitoring are warranted. Following this meeting, BOEM will make a determination as to continued	O&M

		monitoring requirements and inform the Lessee of any changes to monitoring requirements. The Lessee must independently deploy at least three devices within the Lease Area to maximize spatial coverage of the Lease Area based on 10- kilometer spacing between deployment locations or as otherwise agreed between BOEM and the Lessee. The devices(s) must be configured to identify the specific locations of vocalizing NARW within the Lease Area. The Lessee must coordinate the locations of the buoys with the Regional Wildlife Science Collaborative prior to the plan being submitted to BOEM and BSEE. The Lessee may move devices to new locations during the recording period, if existing PAM devices will be present in the Lease Area providing continuous recording. The archival recorders must have a minimum capability of continuously detecting and storing acoustic data on vessel noise, pile-driving, WTG operation, baleen whale vocalizations, and marine fish vocalizations in the Lease Area.	
Post-construction noise and species monitoring (cont'd)		No later than 180 days before buoy deployment, the Lessee must submit to BOEM and BSEE the long-term PAM plan, which must describe all proposed equipment, deployment locations, detection review methodology, and other procedures and protocols related to the required use of PAM for monitoring. The PAM plan must detail mooring best practices, data management, storage, measurement, and data processing best practices that are required by BOEM for long-term PAM monitoring. Refer to Regional Wildlife Science Collaborative for Offshore Wind Data Management & Storage Best Practices for Long-term and Archival PAM Data. The Lessee should detail other best practices consistent with COP approval in the plan. The long-term PAM Plan must include the proposed equipment, sample rate (the sampling rate (minimum 10 kHz) of the recorders should prioritize baleen whale detections but must also have a minimum capability to record noise from vessels, pile-driving, and WTG operation in the Lease Area), mooring design, deployment locations, methods for baleen whale and marine fish detections, and metrics for ambient noise analysis. The Lessee must submit the long-term PAM plan to BOEM and BSEE for review and concurrence. BOEM and BSEE will review the long-term PAM Plan and provide comments, if any, on the plan to the Lessee within 45 days, but no later than 90 days of its submittal. The Lessee's plan must satisfy all outstanding comments to BOEM's and BSEE's satisfaction. The Lessee will receive written concurrence from BOEM and BSEE upon acceptance of the final long-term PAM plan. If BOEM and BSEE do not provide comments on the long-term PAM Plan within 90 days of its submittal, the Lessee may conclusively presume BOEM and BSEE's concurrence with the long-term PAM Plan. The Lessee must provide long-term PAM monitoring results to BOEM and BSEE within 180 days of buoy collection and again within 180 days of the annual anniversaries of each the PAM device deployments. The Lessee must send all raw data to NCEI for archiving no later than 6 months following the date of each recorder recovery.	

		As an alternative to conducting long-term PAM in the Lease Area, the Lessee may opt to meet the monitoring requirement described above each year monitoring remains required through an annual economic contribution to BOEM's Environmental Studies Program in support of its Partnership for an Offshore Wind Energy Regional Observation Network (POWERON) initiative, the terms of which will be specified in a separate agreement between BOEM and the Lessee. At the Lessee's request, BOEM's Environmental Studies Program will estimate the amount of the economic contribution to be included in the separate agreement based on a share of the expected costs of the POWERON program. Under this option, the Lessee will be expected to cooperate with the POWERON team to facilitate deployment and retrieval of instruments within the Lease Area. If necessary, the Lessee may request temporary withholding of the public release of acoustic data that has been collected within its Lease Area.	
Ramp-up of HRG survey equipment	1) When technically feasible, electromechanical survey equipment will be ramped up at the start (or restart) of HRG survey activities. These procedures will allow marine mammals in the vicinity of survey activities time to vacate the area prior to the generation of maximum sound source levels due to equipment use. 2) Ramp-up will begin with the power of the smallest acoustic equipment for the HRG survey at its lowest power output. When technically possible, power output will be gradually increased and other acoustic sources added in such a way that the source level would increase in steps not exceeding 6 decibel per 5-minute period. 3) If a marine mammal enters the shutdown zone during ramp-up, the procedure will be delayed until the animal exits the shutdown zone or no further sightings are reported for 60 minutes.	In addition to the Applicant-proposed measures: US Wind must comply with all PDC and BMPs for protected species in effect at the time of the activity. BOEM would ensure all PDC and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (BOEM and NMFS 2022) shall be applied to activities associated with Project construction and O&M, as applicable.	C, O&M
Monitoring of HRG survey clearance zones	Prior to the initiation of ramp-up procedures described above, the clearance zone will be assessed to be clear of marine mammals for 60 minutes by PSOs.	In addition to the Applicant-proposed measures: US Wind must monitor the clearance zone for the presence of sea turtles for 30 minutes prior to the initiation of ramp-up procedures.	

Shutdowns for HRG surveys	1) Immediate shutdown of HRG survey equipment will occur if a non-delphinoid cetacean is sighted in the shutdown zone. The vessel operator will comply immediately with such a call by the Lead PSO. Any disagreement or discussion between the Lead PSO and vessel operator will occur only after shutdown. Subsequent restart of the electromechanical survey equipment may only occur following clearance of the shutdown zone and implementation of ramp-up procedures. 2) If a delphinoid cetacean or pinniped is sighted in the shutdown zone, HRG survey equipment will be powered down to the lowest power output that is technically feasible. The vessel operator will comply immediately with such a call by the Lead PSO, with any disagreement or discussion occurring only after power-down. Subsequent power-up of the electromechanical survey equipment will use ramp-up procedures and may occur after: a. The shutdown zone is clear of delphinoid cetaceans and pinnipeds; or b. A determination by the Lead PSO after a minimum of 10 minutes of observation that the delphinoid cetacean or pinniped is approaching the vessel or towed equipment at a speed and vector that indicates voluntary approach to bow-ride or chase towed equipment. 3) If the HRG sound sources shut down for reasons other than encroachment into the shutdown zone by a non-delphinoid cetacean (e.g., mechanical or electronic	In addition to the Applicant-proposed measures: US Wind must comply with all PDC and BMPs for protected species in effect at the time of the activity. BOEM would ensure all PDC and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (BOEM and NMFS 2022) shall be applied to activities associated with Project construction and O&M, as applicable.	C, O&M

	failure) for more than 20 minutes, restart of the HRG survey equipment will proceed following ramp-up procedures after clearance of the shutdown zone. 4) If the shutdown is less than 20 minutes in duration, the HRG equipment may be restarted as soon as practicable at its operational level as long as visual surveys were continued throughout the silent period and the shutdown zone remained clear of marine mammals. 5) If visual surveys were not continued during a pause of 20 minutes or less, restart of the HRG survey equipment will follow ramp-up procedures after clearance of the shutdown zone.		
Injured and dead protected species reporting	US Wind will ensure any sightings of injured or dead marine mammals are reported to BOEM, NMFS OPR, and the NMFS GARFO Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (866-755-NOAA [6622] or current). Sightings will be reported within 24 hours, regardless of whether the injury or death was caused by a vessel. In addition, if the injury or death was caused by a collision with a Project vessel, US Wind will notify NMFS OPR, NMFS GARFO, and BOEM within 24 hours of the strike. US Wind will use the form provided in Appendix A to Addendum C of the Lease to report the sighting or incident. If Project activities are responsible for the injury or death, US Wind will supply a vessel to assist in any salvage effort requested by NMFS.	In addition to the Applicant-proposed measures: US Wind will also ensure any sighting of injured or dead marine mammals are reported to BSEE at ProtectedSpecies@BSEE.gov within 24 hours of the sighting.	C, O&M, D
Take notification for ESA-listed species during construction, O&M, and decommissioning	US Wind will ensure the PSOs report any observations concerning impacts on ESA-listed marine mammals to BOEM and NMFS within 48 hours. US Wind will report any injuries or mortalities using the Incident Report provided in the Lease. Any observed takes of ESA-listed marine mammals resulting in injury or	In addition to the Applicant-proposed measures: US Wind must ensure sea turtle and ESA-listed fish observations are reported in the same manner as ESA-listed marine mammal observations. To facilitate monitoring of the incidental take exemption for sea turtles, through the first year of operations, BOEM and NMFS would meet twice annually to review sea turtle observation records. These meetings/conference calls would use the best available information on	C, O&M, D

	mortality will be reported within 24 hours to BOEM and NMFS.	sea turtle presence, distribution, and abundance; project vessel activity; and observations to estimate the total number of sea turtle vessel strikes in the Action Area that are attributable to Project operations. These meetings would continue on an annual basis following year 1 of operations. Upon mutual agreement of NMFS and BOEM, the frequency of these meetings can be changed.	
Take notification for ESA-listed species during fisheries surveys	US Wind will defer to measures required by agencies through ESA and MMPA consultations and any COP conditions of approval.	1) NMFS GARFO Protected Resources Division (PRD) would be notified as soon as possible of all observed takes of sea turtles and ESA-listed fish species occurring as a result of any fisheries survey. Specifically: 2) GARFO PRD would be notified within 24 hours of any interaction with a sea turtle or ESA-listed fish (nmfs.gar.incidental-take@noaa.gov). The report will include at a minimum: Survey name and applicable information (e.g., vessel name, station number) GPS coordinates describing the location of the interaction (in decimal degrees) Gear type involved (e.g., bottom trawl, gillnet, longline) Soak time, gear configuration, and any other pertinent gear information Time and date of the interaction Identification of the animal to the species level Additionally, the email will transmit a copy of the NMFS Take Report Form and a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes). 3) If reporting within 24 hours is not possible due to distance from shore or lack of ability to communicate via phone, fax, or email, reports will be submitted as soon as possible; late reports will be submitted with an explanation for the delay. 4) At the end of each survey season, a report will be sent to NMFS that compiles all information on any observations and interactions with ESA-listed species. This report will also contain information on all survey activities that occurred during the season, including location of gear set, duration of soak/trawl, and total effort. The report on survey activities will be comprehensive of all activities, regardless of whether ESA-listed species were observed.	Fisheries surveys
Marine debris awareness training	US Wind will defer to measures required by agencies through the ESA and MMPA consultations and any COP conditions of approval.	1) US Wind must ensure that vessel operators, employees, and contractors engaged in offshore activities pursuant to the approved COP complete marine trash and debris awareness training annually. 2) The training consists of two parts: a. Viewing a marine trash and debris training video or slide show (described below); and b. 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	All phases

		or by contacting BSEE. Operators engaged in marine survey activities will continue to develop and use a marine trash and debris awareness training and certification process that reasonably assures their employees and contractors are trained. The training process will include the following elements: Viewing of either a video or slide show by the personnel specified above; An explanation from management personnel that emphasizes their commitment to the requirements; Attendance measures (initial and annual); and Record keeping.	
EMF mitigation	US Wind will defer to measures required by agencies through the ESA and MMPA consultations and any COP conditions of approval.	US Wind must comply with all PDC and BMPs for protected species in effect at the time of the activity. BOEM would ensure all PDC and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (BOEM and NMFS 2022) shall be applied to activities associated with Project construction and O&M, as applicable, including: Use of standard underwater cables that have electrical shielding to control the intensity of electromagnetic fields.	C, O&M
Project design envelope evaluation	US Wind will defer to measures required by agencies through the ESA and MMPA consultations and any COP conditions of approval.	US Wind should evaluate marine mammal use of the proposed Action Area and design the project to minimize and mitigate the potential for mortality or disturbance. The amount and extent of ecological baseline data required should be determined on a project basis.	Pre-construction
Gear utilization mitigation and monitoring	US Wind will utilize ropeless EdgetTech devices for all their commercial pot survey gear.	In addition to the Applicant-proposed measures: US Wind must comply with all PDC and BMPs for protected species in effect at the time of the activity. BOEM would ensure all PDC and BMPs incorporated in the Atlantic Data Collection consultation for Offshore Wind Activities (BOEM and NMFS 2022) shall be applied to activities associated with Project construction and O&M, as applicable.	Fisheries surveys
Handling of sea turtle and sturgeon species	US Wind will defer to measures required by agencies through the ESA and MMPA consultations and any COP conditions of approval.	US Wind must ensure that any sea turtle or sturgeon species taken incidentally during the course of fishing or scientific research activities will be handled with due care to prevent injury, observed for activity, resuscitated if comatose or inactive, and returned to the water according to the procedures provided in NOAA's sea turtle and Atlantic and shortnose sturgeon handling and resuscitation guidelines.	Fisheries surveys
Navigational traffic mitigation	A 1 nautical mile (1.8-kilometers) setback from the Traffic Separation Scheme from Delaware Bay would remove seven WTG locations along the eastern edge of the Lease Area.	BOEM-proposed mitigation for navigational safety is consistent with that proposed by US Wind.	Operations

APPENDIX B. MITIGATION, MONITORING, AND REPORTING REQUIREMENTS INCLUDED IN THE PROPOSED MMPA ITA (89 FR 504).

MITIGATION REQUIREMENTS

(a) *General conditions.* LOA Holder must comply with the following general measures:

(1) A copy of any issued LOA must be in the possession of LOA Holder and its designees, all vessel operators, visual protected species observers (PSOs), passive acoustic monitoring (PAM) operators, pile driver operators, and any other relevant designees operating under the authority of the issued LOA;

(2) LOA Holder must conduct training for construction, survey, and vessel personnel and the marine mammal monitoring team (PSO and PAM operators) prior to the start of all in-water construction activities in order to explain responsibilities, communication procedures, marine mammal detection and identification, mitigation, monitoring, and reporting requirements, safety and operational procedures, and authorities of the marine mammal monitoring team(s). This training must be repeated for new personnel who join the work during the project. A description of the training program must be provided to NMFS at least 60 days prior to the initial training before in-water activities begin. Confirmation of all required training must be documented on a training course log sheet and reported to NMFS Office of Protected Resources prior to initiating project activities;

(3) Prior to and when conducting any in-water activities and vessel operations, LOA Holder personnel and contractors (*e.g.*, vessel operators, PSOs) must use available sources of information on North Atlantic right whale presence in or near the Project Area including daily monitoring of the Right Whale Sightings Advisory System, and monitoring of U.S. Coast Guard VHF Channel 16 throughout the day to receive notification of any sightings and/or information associated with any Slow Zones (*i.e.*, Dynamic Management Areas (DMAs) and/or acoustically-triggered slow zones) to provide situational awareness for both vessel operators, PSO(s), and PAM operator(s); The marine mammal monitoring team must monitor these systems no less than every 4 hours;

(4) Any marine mammal observed by project personnel must be immediately communicated to any on-duty PSOs, PAM operator(s), and all vessel captains. Any large whale observation or acoustic detection by PSOs or PAM operators must be conveyed to all vessel captains;

(5) For North Atlantic right whales, any visual detection or acoustic detection within the PAM monitoring zone must trigger a delay to the commencement of pile driving. Any visual detection within 500 m must trigger a delay to the commencement of HRG surveys;

(6) In the event that a large whale is sighted or acoustically detected that cannot be confirmed as a non-North Atlantic right whale, it must be treated as if it were a North Atlantic right whale for purposes of mitigation;

(7) If a delay to commencing an activity is called for by the Lead PSO or PAM operator, LOA Holder must take the required mitigative action. If a delay or shutdown of an activity is called for by the Lead PSO or PAM operator, LOA Holder must take the required mitigative action unless shutdown would result in imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. Any disagreements between the Lead PSO, PAM operator, and the activity operator regarding delays or shutdowns would only be discussed after the mitigative action has occurred;

(8) If an individual from a species for which authorization has not been granted, or a species for which authorization has been granted but the authorized take number has been met, is observed entering or within the relevant Level B harassment zone prior to beginning a specified activity, the activity must be delayed. If the activity is ongoing, it must be shut down immediately, unless shutdown would result in imminent risk of injury or loss of life to an individual, pile refusal, or pile instability. The activity must not commence or resume until the animal(s) has been confirmed to have left and is on a path away from the Level B harassment zone or after 15 minutes for small odontocetes and pinnipeds, and 30 minutes for all other species with no further sightings;

(9) For in-water construction heavy machinery activities listed in § 217.340(c), if a marine mammal is on a path towards or comes within 10 meters (m) (32.8 feet (ft)) of equipment, LOA Holder must cease operations until the marine mammal has moved more than 10 m on a path away from the activity to avoid direct interaction with equipment;

(10) All vessels must be equipped with a properly installed, operational Automatic Identification System (AIS) device and LOA Holder must report all Maritime Mobile Service Identity (MMSI) numbers to NMFS Office of Protected Resources;

(11) By accepting the issued LOA, LOA Holder consents to on-site observation and inspections by Federal agency personnel (including NOAA personnel) during activities described in this subpart, for the purposes of evaluating the implementation and effectiveness of measures contained within the LOA and this subpart;

(12) It is prohibited to assault, harm, harass (including sexually harass), oppose, impede, intimidate, impair, or in any way influence or interfere with a PSO, PAM Operator, or vessel crew member acting as an observer, or attempt the same. This prohibition includes, but is not limited to, any action that interferes with an observer's responsibilities, or that creates an intimidating, hostile, or offensive environment. Personnel may report any violations to the NMFS Office of Law Enforcement; and

(13) The LOA Holder must also abide by the reasonable and prudent measures and terms and conditions of the Biological Opinion and Incidental Take Statement, as issued by NMFS, pursuant to section 7 of the Endangered Species Act.

(b) *Vessel strike avoidance measures.* LOA Holder must comply with the following vessel strike avoidance measures, unless a situation presents a threat to the health, safety, or life of a person or when a vessel, actively engaged in emergency rescue or response duties, including vessel-in-distress or environmental crisis response, requires speeds in excess of 10 kn to fulfill those responsibilities, while in the specified geographical region:

(1) Prior to the start of the Project's activities involving vessels, all vessel personnel must receive a protected species training that covers, at a minimum, identification of marine mammals that have the potential to occur where vessels would be operating; detection observation methods in both good weather conditions (*i.e.*, clear visibility, low winds, low sea states) and bad weather conditions (*i.e.*, fog, high winds, high sea states, with glare); sighting communication protocols; all vessel speed and approach limit mitigation requirements (*e.g.*, vessel strike avoidance measures); and information and resources available to the project personnel regarding the applicability of Federal laws and regulations for protected species. This training must be repeated for any new vessel personnel who join the Project. Confirmation of the observers' training and understanding of the Incidental Take Authorization (ITA) requirements must be documented on a training course log sheet and reported to NMFS;

(2) LOA Holder, regardless of their vessel's size, must maintain a vigilant watch for all marine mammals and slow down, stop their vessel, or alter course to avoid striking any marine mammal;

(3) LOA Holder's underway vessels (*e.g.*, transiting, surveying) operating at any speed must have a dedicated visual observer on duty at all times to monitor for marine mammals within a 180° direction of the forward path of the vessel (90° port to 90° starboard) located at an appropriate vantage point for ensuring vessels are maintaining appropriate separation distances. Visual observers must be equipped with alternative monitoring technology (*e.g.*, night vision devices, infrared cameras) for periods of low visibility (*e.g.*, darkness, rain, fog, *etc.*). The dedicated visual observer must receive prior training on protected species detection and identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements in this subpart. Visual observers may be third-party observers (*i.e.*, NMFS-approved PSOs) or trained crew members, as defined in paragraph (b)(1) of this section;

(4) LOA Holder must continuously monitor the U.S. Coast Guard VHF Channel 16 at the onset of transiting through the duration of transiting, over which North Atlantic right whale sightings are broadcasted. At the onset of transiting and at least once every 4 hours, vessel operators and/or trained crew member(s) must also monitor the project's Situational Awareness System, WhaleAlert, and relevant NOAA information systems such as the Right Whale Sighting Advisory System (RWSAS) for the presence of North Atlantic right whales;

(5) All LOA Holder's vessels must transit at 10 kn or less within any active North Atlantic right whale Slow Zone (*i.e.*, Dynamic Management Areas (DMAs) or acoustically-triggered slow zone);

(6) LOA Holder's vessels, regardless of size, must immediately reduce speed to 10 kn or less for at least 24 hours when a North Atlantic right whale is sighted at any distance by any project-related personnel or acoustically detected by any project-related PAM system. Each subsequent observation or acoustic detection in the Project area shall trigger an additional 24-hour period. If a North Atlantic right whale is reported via any of the monitoring systems (refer back to (b)(4) of this section) within 10 kilometers (km; 6.2 miles (mi)) of a transiting vessel(s), that vessel must operate at 10 knots (kn; 11.5 miles per hour (mph)) or less for 24 hours following the reported detection;

(7) LOA Holder's vessels, regardless of size, must immediately reduce speed to 10 kn or less when any large whale (other than a North Atlantic right whale) is observed within 500 m (1,640 ft) of an underway vessel;

(8) If LOA Holder's vessel(s) are traveling at speeds greater than 10 kn (*i.e.*, no speed restrictions are enacted) in a transit corridor from a port to the Lease Area, in addition to the required dedicated visual observer, LOA Holder must monitor the transit corridor in real-time with PAM prior to and during transits. If a North Atlantic right whale is detected via visual observation or PAM within or approaching the transit corridor, all crew transfer vessels must travel at 10 kn or less for 24 hours following the detection. Each subsequent detection shall trigger a 24-hour reset. A slowdown in the transit corridor expires when there has been no further visual or acoustic detection in the transit corridor in the past 24 hours;

(9) LOA Holder's vessels must maintain a minimum separation distance of 500 m from North Atlantic right whales. If underway, all vessels must steer a course away from any sighted North Atlantic right whale at 10 kn or less such that the 500-m minimum separation distance requirement is not violated. If a North Atlantic right whale is sighted within 500 m of an

underway vessel, that vessel 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 a whale is observed but cannot be confirmed as a species other than a North Atlantic right whale, the vessel operator must assume that it is a North Atlantic right whale and take the vessel strike avoidance measures described in this paragraph (b)(9);

(10) LOA Holder's vessels must maintain a minimum separation distance of 100 m (328 ft) from sperm whales and non-North Atlantic right whale baleen whales. If one of these species is sighted within 100 m of a transiting vessel, LOA Holder's vessel 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 100 m;

(11) LOA Holder's vessels must maintain a minimum separation distance of 50 m (164 ft) from all delphinoid cetaceans and pinnipeds with an exception made for those that approach the vessel (*i.e.*, bow-riding dolphins). If a delphinid cetacean or pinniped is sighted within 50 m of a transiting vessel, LOA Holder's vessel must shift the engine to neutral, with an exception made for those that approach the vessel (*e.g.*, bow-riding dolphins). Engines must not be engaged until the animal(s) has moved outside of the vessel's path and beyond 50 m;

(12) When a marine mammal(s) is sighted while LOA Holder's vessel(s) is transiting, the vessel must take action as necessary to avoid violating the relevant separation distances (*e.g.*, attempt to remain parallel to the animal's course, slow down, and avoid abrupt changes in direction until the animal has left the area). This measure does not apply to any vessel towing gear or any situation where respecting the relevant separation distance would be unsafe (*i.e.*, any situation where the vessel is navigationally constrained);

(13) LOA Holder's vessels underway must not divert or alter course to approach any marine mammal;

(14) LOA Holder is required to abide by other speed and approach regulations. Nothing in this subpart exempts vessels from any other applicable marine mammal speed and approach regulations;

(15) LOA Holder must check, daily, for information regarding the establishment of mandatory or voluntary vessel strike avoidance areas (*i.e.*, DMAs, SMAs, Slow Zones) and any information regarding North Atlantic right whale sighting locations;

(16) LOA Holder must submit a North Atlantic Right Whale Vessel Strike Avoidance Plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to the planned start of vessel activity. The plan must provide details on the vessel-based observer and PAM protocols for transiting vessels. If a plan is not submitted or approved by NMFS prior to vessel operations, all project vessels transiting, year-round, must travel at speeds of 10 kn or less. LOA Holder must comply with any approved North Atlantic Right Whale Vessel Strike Avoidance Plan; and

(17) Speed over ground will be used to measure all vessel speed restrictions.

(c) *WTG, OSS, Met tower foundation installation*. The following requirements apply to impact pile driving activities associated with the installation of WTG, OSS, and Met tower foundations:

(1) Impact pile driving must not occur December 1 through April 30.

(2) Monopiles must be no larger than 11 m in diameter. Hammer energies must not exceed 4,400 kilojoules (kJ) for monopile installation. No more than one monopile may be installed per day, unless otherwise approved by NMFS. Pin piles for the OSSs must be no larger than 3 m in diameter. Hammer energies must not exceed 1,500 kJ for 3-m pin pile installation.

No more than four 3-m pin piles may be installed per day. Met tower pin piles must be no larger than 1.8 m in diameter, and hammer energies must not exceed 500 kJ for Met tower pin pile installation. No more than two 1.8-m pin piles may be installed per day.

(3) LOA Holder must not initiate pile driving earlier than 1 hour prior to civil sunrise or later than 1.5 hours prior to civil sunset, unless the LOA Holder submits, and NMFS approves, an Alternative Monitoring Plan as part of the Pile Driving and Marine Mammal Monitoring Plan that reliably demonstrates the efficacy of their night vision devices.

(4) Soft-start must occur at the beginning of impact driving and at any time following a cessation of impact pile driving of 30 minutes or longer. Soft-start would involve initiating hammer operation at a reduced energy level (relative to full operating capacity) followed by a waiting period. For impact pile driving of monopiles and pin piles, the LOA Holder must utilize a soft-start protocol by performing four to six strikes per minute at 10 to 20 percent of the maximum hammer energy, for a minimum of 20 minutes.

(5) LOA Holder must establish clearance and shutdown zones, which must be measured using the radial distance around the pile being driven. If a marine mammal is detected within or about to enter the applicable clearance zones, prior to the beginning of soft-start procedures, impact pile driving must be delayed until the animal has been visually observed exiting the clearance zone or until a specific time period has elapsed with no further sightings. The specific time periods are 15 minutes for small odontocetes and pinnipeds, and 30 minutes for all other species.

(6) For North Atlantic right whales, any visual observation or acoustic detection within the PAM monitoring zone must trigger a delay to the commencement of pile driving. The clearance zone may only be declared clear if no North Atlantic right whale acoustic or visual detections have occurred within the clearance zone during the 60-minute monitoring period.

(7) LOA Holder must deploy at least two functional noise abatement systems that reduce noise levels to the modeled harassment isopleths, assuming 10-dB attenuation, during all impact pile driving and comply with the following measures:

(i) A single bubble curtain must not be used;

(ii) Any bubble curtain(s) must distribute air bubbles using an air flow rate of at least 0.5 m^3/(minute*m). The bubble curtain(s) must surround 100 percent of the piling perimeter throughout the full depth of the water column. In the unforeseen event of a single compressor malfunction, the offshore personnel operating the bubble curtain(s) must adjust the air supply and operating pressure such that the maximum possible sound attenuation performance of the bubble curtain(s) is achieved;

(iii) The lowest bubble ring must be in contact with the seafloor for the full circumference of the ring, and the weights attached to the bottom ring must ensure 100-percent seafloor contact;

(iv) No parts of the ring or other objects may prevent full seafloor contact with a bubble curtain ring;

(v) Construction contractors must train personnel in the proper balancing of airflow to the bubble curtain ring. LOA Holder must provide NMFS Office of Protected Resources with a bubble curtain performance test and maintenance report to review within 72 hours after each pile using a bubble curtain is installed. Additionally, a full maintenance check (*e.g.*, manually clearing holes) must occur prior to each pile being installed; and

(vi) Corrections to the bubble ring(s) to meet the performance standards in this paragraph (c)(8) must occur prior to impact pile driving of monopiles, 3-m pin piles, and 1.8-m pin piles. If

LOA Holder uses a noise mitigation device in addition to the bubble curtain, LOA Holder must maintain similar quality control measures as described in this paragraph (c)(7).

(8) LOA Holder must utilize NMFS-approved PAM systems, as described in paragraph(c)(16) of this section. The PAM system components (*i.e.*, acoustic buoys) must not be placed closer than 1 km to the pile being driven so that the activities do not mask the PAM system. LOA Holder must provide a demonstration of and justification for the detection range of the system they plan to deploy while considering potential masking from concurrent pile driving and vessel noise. The PAM system must be able to detect a vocalization of North Atlantic right whales up to 10 km (6.2 mi).

(9) LOA Holder must utilize PSO(s) and PAM operator(s), as described in § 217.345(c), to monitor the clearance and shutdown zones. At least three on-duty PSOs must be on the pile driving platform and any additional platforms used.

(10) If a marine mammal is detected (visually or acoustically) entering or within the respective shutdown zone after pile driving has begun, the PSO or PAM operator must call for a shutdown of pile driving and LOA Holder must stop pile driving immediately, unless shutdown is not practicable due to imminent risk of injury or loss of life to an individual or risk of damage to a vessel that creates risk of injury or loss of life for individuals, or the lead engineer determines there is pile refusal or pile instability. If pile driving is not shut down in one of these situations, LOA Holder must reduce hammer energy to the lowest level practicable and the reason(s) for not shutting down must be documented and reported to NMFS Office of Protected Resources within the applicable monitoring reports (*e.g.*, weekly, monthly).

(11) A visual observation by PSOs at any distance or acoustic detection within the PAM monitoring zone of a North Atlantic right whale triggers shutdown requirements as per paragraph 10 of this section. If pile driving has been shut down due to the presence of a North Atlantic right whale, pile driving may not restart until the North Atlantic right whale has neither been visually or acoustically detected for 30 minutes.

(12) If pile driving has been shut down due to the presence of a marine mammal other than a North Atlantic right whale, pile driving must not restart until either the marine mammal(s) has voluntarily left the specific clearance zones and has been visually or acoustically confirmed beyond that clearance zone, or, when specific time periods have elapsed with no further sightings or acoustic detections have occurred. The specific time periods are 15 minutes for small odontocetes and pinnipeds and 30 minutes for all other marine mammal species. In cases where these criteria are not met, pile driving may restart only if necessary to maintain pile stability at which time LOA Holder must use the lowest hammer energy practicable to maintain stability.

(13) Pile driving sound levels must not exceed modeled distances to NMFS marine mammal Level A harassment and Level B harassment thresholds assuming 10-dB attenuation.

(14) LOA Holder must conduct sound field verification (SFV) measurements during pile driving activities associated with the installation of, at minimum, the first three monopile foundations and the first three full jacket foundations (inclusive of all pin piles for a specific jacket foundation) for each of the three construction campaigns. SFV measurements must continue until at least three consecutive monopiles and three entire jacket foundations demonstrate noise levels are at or below those modeled, assuming 10-decibels (dB) of attenuation. Subsequent SFV measurements are also required should larger piles be installed or if additional piles are driven that may produce louder sound fields than those previously measured (*e.g.*, higher hammer energy, greater number of strikes, *etc.*). SFV measurements must be conducted as follows:

(i) Measurements must be made at a minimum of four distances from the pile(s) being driven, along a single transect, in the direction of lowest transmission loss (*i.e.*, projected lowest transmission loss coefficient), including, but not limited to, 750 m (2,460 ft) and three additional ranges selected such that measurement of Level A harassment and Level B harassment isopleths are accurate, feasible, and avoids extrapolation. At least one additional measurement at an azimuth 90 degrees from the array at 750 m must be made. At each location, there must be a near bottom and mid-water column hydrophone (measurement systems);

(ii) The recordings must be continuous throughout the duration of all pile driving of each foundation;

(iii) The SFV measurement systems must have a sensitivity appropriate for the expected sound levels from pile driving received at the nominal ranges throughout the installation of the pile. The frequency range of SFV measurement systems must cover the range of at least 20 hertz (Hz) to 20 kilohertz (kHz). The SFV measurement systems must be designed to have omnidirectional sensitivity so that the broadband received level of all pile driving exceeds the system noise floor by at least 10 dB. The dynamic range of the SFV measurement system must be sufficient such that at each location, the signals prevent poor signal-to-noise ratios for low amplitude signals and avoid clipping, nonlinearity, and saturation for high amplitude signals;

(iv) All hydrophones used in SFV measurements systems are required to have undergone a full system, traceable laboratory calibration conforming to International Electrotechnical Commission (IEC) 60565, or an equivalent standard procedure, from a factory or accredited source to ensure the hydrophone receives accurate sound levels, at a date not to exceed 2 years before deployment. Additional in-situ calibration checks using a pistonphone are required to be performed before and after each hydrophone deployment. If the measurement system employs filters via hardware or software (*e.g.*, high-pass, low-pass, *etc.*), which is not already accounted for by the calibration, the filter performance (*i.e.*, the filter's frequency response) must be known, reported, and the data corrected before analysis;

(v) LOA Holder must be prepared with additional equipment (hydrophones, recording devices, hydrophone calibrators, cables, batteries, *etc.*), which exceeds the amount of equipment necessary to perform the measurements, such that technical issues can be mitigated before measurement;

(vi) LOA Holder must submit interim SFV reports within 48 hours after each foundation is measured (see § 217.345(g) for interim and final reporting requirements);

(vii) If any of the interim SFV measurement reports submitted for the first three monopiles exceed the modeled distances to NMFS marine mammal Level A harassment and Level B harassment thresholds assuming 10-dB attenuation, then LOA Holder must implement additional sound attenuation measures on all subsequent foundations. LOA Holder must also increase clearance and shutdown zone sizes to those identified by NMFS until SFV measurements on at least three additional foundations demonstrate acoustic distances to harassment thresholds meet or are less than those modeled assuming 10 dB of attenuation. LOA Holder must optimize the sound attenuation systems (*e.g.*, ensure hose maintenance, pressure testing, *etc.*) to meet noise levels modeled, assuming 10-dB attenuation, within three piles or else foundation installation activities must cease until NMFS and LOA Holder can evaluate the situation and ensure future piles do not exceed noise levels modeled assuming 10-dB attenuation;

(viii) If, after additional measurements conducted pursuant to requirements of paragraph (14)(vii) of this section, acoustic measurements indicate that ranges to isopleths corresponding to the Level A harassment and Level B harassment thresholds are less than the ranges predicted by modeling (assuming 10-dB attenuation), LOA Holder may request a modification of the clearance and shutdown zones from the NMFS Office of Protected Resources. For NMFS Office of Protected Resources to consider a modification request for reduced zone sizes, LOA Holder must have conducted SFV measurements on an additional three foundations (for either/or monopile and jackets) and ensure that subsequent foundations would be installed under conditions that are predicted to produce smaller harassment zones than those modeled assuming 10 dB of attenuation;

(ix) LOA Holder must conduct SFV measurements as described in c(14) upon commencement of turbine operations to estimate turbine operational source levels, in accordance with a NMFS-approved Foundation Installation Pile Driving SFV Plan. SFV must be conducted in the same manner as previously described in § 217.304(c)(14), with appropriate adjustments to measurement distances, number of hydrophones, and hydrophone sensitivities being made, as necessary; and

(x) LOA Holder must submit a SFV Plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to planned start of foundation installation activities and abide by the Plan if approved. At minimum, the SFV Plan must describe how LOA Holder would ensure that the first three monopile foundation/entire jacket foundation (inclusive of all pin piles for a jacket foundation) installation sites selected for SFV measurements are representative of the rest of the monopile and/or jacket foundation installation sites such that future pile installation events are anticipated to produce similar sound levels to those piles measured. In the case that these sites/scenarios are not determined to be representative of all other pile installation sites, LOA Holder must include information in the SFV Plan on how additional sites/scenarios would be selected for SFV measurements. The SFV Plan must also include methodology for collecting, analyzing, and preparing SFV measurement data for submission to NMFS Office of Protected Resources and describe how the effectiveness of the sound attenuation methodology would be evaluated based on the results. SFV for pile driving may not occur until NMFS approves the SFV Plan for this activity.

(15) LOA Holder must submit a Foundation Installation Pile Driving Marine Mammal Monitoring Plan to NMFS Office of Protected Resources for review and approval at least 180 days prior to planned start of pile driving and abide by the Plan if approved. LOA Holder must obtain both NMFS Office of Protected Resources and NMFS Greater Atlantic Regional Fisheries Office Protected Resources Division's concurrence with this Plan prior to the start of any pile driving. The Plan must include a description of all monitoring equipment and PAM and PSO protocols (including number and location of PSOs) for all pile driving. No foundation pile installation can occur without NMFS' approval of the Plan.

(16) LOA Holder must submit a Passive Acoustic Monitoring Plan (PAM Plan) to NMFS Office of Protected Resources for review and approval at least 180 days prior to the planned start of foundation installation activities (impact pile driving) and abide by the Plan if approved. The PAM Plan must include a description of all proposed PAM equipment, address how the proposed passive acoustic monitoring must follow standardized measurement, processing methods, reporting metrics, and metadata standards for offshore wind as described in "NOAA and BOEM Minimum Recommendations for Use of Passive Acoustic Listening Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs" (2021). The Plan must describe all proposed PAM equipment, procedures, and protocols including proof that vocalizing North Atlantic right whales will be detected within the clearance and shutdown zones. No pile installation can occur if LOA Holder's PAM Plan does not receive approval from NMFS Office

of Protected Resources and NMFS Greater Atlantic Regional Fisheries Office Protected Resources Division.

(d) *HRG surveys*. The following requirements apply to HRG surveys operating sub-bottom profilers (SBPs) (*i.e.*, boomers, sparkers, and Compressed High Intensity Radiated Pulse (CHIRPS)):

(1) LOA Holder must establish and implement clearance and shutdown zones for HRG surveys using visual monitoring, as described in paragraph (d) of this section;

(2) LOA Holder must utilize PSO(s), as described in § 217.345(f);

(3) SBPs (hereinafter referred to as "acoustic sources") must be deactivated when not acquiring data or preparing to acquire data, except as necessary for testing. Acoustic sources must be used at the lowest practicable source level to meet the survey objective, when in use, and must be turned off when they are not necessary for the survey;

(4) LOA Holder is required to ramp-up acoustic sources prior to commencing full power, unless the equipment operates on a binary on/off switch, and ensure visual clearance zones are observable (*e.g.*, not obscured from observation by darkness, rain, fog, *etc.*) and clear of marine mammals, as determined by the Lead PSO, for at least 30 minutes immediately prior to the initiation of survey activities using acoustic sources specified in the LOA. Ramp-up and activation must be delayed if a marine mammal(s) enters its respective shutdown zone. Ramp-up and activation may only be reinitiated if the animal(s) has been observed exiting its respective shutdown zone or until 15 minutes for small odontocetes and pinnipeds, and 30 minutes for all other species, has elapsed with no further sightings;

(5) Prior to a ramp-up procedure starting or activating acoustic sources, the acoustic source operator (operator) must notify a designated PSO of the planned start of ramp-up as agreed upon with the Lead PSO. The notification time should not be less than 60 minutes prior to the planned ramp-up or activation in order to allow the PSOs time to monitor the clearance zone(s) for 30 minutes prior to the initiation of ramp-up or activation (pre-start clearance). During this 30-minute pre-start clearance period, the entire applicable clearance zones must be visible, except as indicated in paragraph (d)(11) of this section;

(6) Ramp-ups must be scheduled so as to minimize the time spent with the source activated;

(7) A PSO conducting pre-start clearance observations must be notified again immediately prior to reinitiating ramp-up procedures and the operator must receive confirmation from the PSO to proceed;

(8) LOA Holder must implement a 30-minute clearance period of the clearance zones immediately prior to the commencing of the survey or when there is more than a 30-minute break in survey activities or PSO monitoring. A clearance period is a period when no marine mammals are detected in the relevant zone;

(9) If a marine mammal is observed within a clearance zone during the clearance period, ramp-up or acoustic surveys may not begin until the animal(s) has been observed voluntarily exiting its respective clearance zone or until a specific time period has elapsed with no further sighting. The specific time period is 15 minutes for small odontocetes and pinnipeds, and 30 minutes for all other species;

(10) In any case when the clearance process has begun in conditions with good visibility, including via the use of night vision equipment (infrared (IR)/thermal camera), and the Lead PSO has determined that the clearance zones are clear of marine mammals, survey operations would be allowed to commence (*i.e.*, no delay is required) despite periods of inclement weather

and/or loss of daylight. Ramp-up may occur at times of poor visibility, including nighttime, if appropriate visual monitoring has occurred with no detections of marine mammals in the 30 minutes prior to beginning ramp-up;

(11) Once the survey has commenced, LOA Holder must shut down acoustic sources if a marine mammal enters a respective shutdown zone, except in cases when the shutdown zones become obscured for brief periods due to inclement weather, survey operations would be allowed to continue (*i.e.*, no shutdown is required) so long as no marine mammals have been detected. The shutdown requirement does not apply to small delphinids of the following genera: *Delphinus*, *Stenella*, *Lagenorhynchus*, and *Tursiops*. If there is uncertainty regarding the identification of a marine mammal species (*i.e.*, whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a delphinid that belongs to a genus other than those specified in this paragraph (d)(11) is detected in the shutdown zone;

(12) If an acoustic source has been shut down due to the presence of a marine mammal, the use of an acoustic source may not commence or resume until the animal(s) has been confirmed to have left the Level B harassment zone or until a full 15 minutes (for small odontocetes and seals) or 30 minutes (for all other marine mammals) have elapsed with no further sighting;

(13) LOA Holder must immediately shut down any acoustic source if a marine mammal is sighted entering or within its respective shutdown zones. If there is uncertainty regarding the identification of a marine mammal species (*i.e.*, whether the observed marine mammal belongs to one of the delphinid genera for which shutdown is waived), the PSOs must use their best professional judgment in making the decision to call for a shutdown. Shutdown is required if a delphinid that belongs to a genus other than those specified in paragraph (d)(11) of this section is detected in the shutdown zone; and

(14) If an acoustic source is shut down for a period longer than 30 minutes, all clearance and ramp-up procedures must be initiated. If an acoustic source is shut down for reasons other than mitigation (*e.g.*, mechanical difficulty) for less than 30 minutes, acoustic sources may be activated again without ramp-up only if PSOs have maintained constant observation and no additional detections of any marine mammal occurred within the respective shutdown zones.

(e) *Fisheries monitoring surveys*. The following measures apply to fishery monitoring surveys:

(1) Survey gear must be deployed as soon as possible once the vessel arrives on station. Gear must not be deployed if there is a risk of interaction with marine mammals. Gear may be deployed after 15 minutes of no marine mammal sightings within 1 nautical mile (nmi; 1,852 m) of the sampling station;

(2) LOA Holder and its cooperating institutions, contracted vessels, or commercially hired captains must implement the following "move-on" rule: If marine mammals are sighted within 1 nmi of the planned location and 15 minutes before gear deployment, then LOA Holder and its cooperating institutions, contracted vessels, or commercially hired captains, as appropriate, must move the vessel away from the marine mammal to a different section of the sampling area. If, after moving on, marine mammals are still visible from the vessel, LOA Holder and its cooperating institutions, contracted vessels, or commercially hired captains must move again or skip the station;

(3) If a marine mammal is at risk of interacting with or becoming entangled in the gear after the gear is deployed or set, all gear must be immediately removed from the water. If marine mammals are sighted before the gear is fully removed from the water, the vessel must slow its speed and maneuver the vessel away from the animals to minimize potential interactions with the observed animal;

(4) LOA Holder must maintain visual marine mammal monitoring effort during the entire period of time that gear is in the water (*i.e.*, throughout gear deployment, fishing, and retrieval);

(5) All fisheries monitoring gear must be fully cleaned and repaired (if damaged) before each use/deployment;

(6) LOA Holder's fixed gear must comply with the Atlantic Large Whale Take Reduction Plan regulations at 50 CFR 229.32 during fisheries monitoring surveys;

(7) All gear must be emptied as close to the deck/sorting area and as quickly as possible after retrieval;

(8) During any survey that uses vertical lines, buoy lines must be weighted and must not float at the surface of the water and all groundlines must consist of sinking lines. All groundlines must be composed entirely of sinking lines. Buoy lines must utilize weak links. Weak links must break cleanly leaving behind the bitter end of the line. The bitter end of the line must be free of any knots when the weak link breaks. Splices are not considered to be knots. The attachment of buoys, toggles, or other floatation devices to groundlines is prohibited;

(9) All in-water survey gear, including buoys, must be properly labeled with the scientific permit number or identification as LOA Holder's research gear. All labels and markings on the gear, buoys, and buoy lines must also be compliant with the Atlantic Large Whale Take Reduction Plan regulations at 50 CFR 229.32, and all buoy markings must comply with instructions received by the NOAA Greater Atlantic Regional Fisheries Office Protected Resources Division;

(10) All survey gear must be removed from the water whenever not in active survey use (*i.e.*, no wet storage); and

(11) All reasonable efforts, that do not compromise human safety, must be undertaken to recover gear.

MONITORING AND REPORTING REQUIREMENTS.

(a) *Protected species observer (PSO) and passive acoustic monitoring (PAM) operator qualifications.* LOA Holder must implement the following measures applicable to PSOs and PAM operators:

(1) LOA Holder must use independent, NMFS-approved PSOs and PAM operators, meaning that the PSOs and PAM operators must be employed by a third-party observer provider, must have no tasks other than to conduct observational effort, collect data, and communicate with and instruct relevant crew with regard to the presence of protected species and mitigation requirements;

(2) All PSOs and PAM operators must have successfully attained a bachelor's degree from an accredited college or university with a major in one of the natural sciences, a minimum of 30 semester hours or equivalent in the biological sciences, and at least one undergraduate course in math or statistics. The educational requirements may be waived if the PSO or PAM operator has acquired the relevant skills through a suitable amount of alternate experience. Requests for such a waiver must be submitted to NMFS Office of Protected Resources and must

include written justification containing alternative experience. Alternate experience that may be considered includes, but is not limited to previous work experience conducting academic, commercial, or government-sponsored marine mammal visual and/or acoustic surveys, or previous work experience as a PSO/PAM operator;

(3) PSOs must have visual acuity in both eyes (with correction of vision being permissible) sufficient enough to discern moving targets on the water's surface with the ability to estimate the target size and distance (binocular use is allowable); ability to conduct field observations and collect data according to the assigned protocols; sufficient training, orientation, or experience with the construction operation to provide for personal safety during observations; writing skills sufficient to document observations, including but not limited to, the number and species of marine mammals observed, the dates and times when in-water construction activities were conducted, the dates and time when in-water construction activities were suspended to avoid potential incidental take of marine mammals from construction noise within a defined shutdown zone, and marine mammal behavior; and the ability to communicate orally, by radio, or in-person, with project personnel to provide real-time information on marine mammals observed in the area;

(4) All PSOs must be trained in northwestern Atlantic Ocean marine mammal identification and behaviors and must be able to conduct field observations and collect data according to assigned protocols. Additionally, PSOs must have the ability to work with all required and relevant software and equipment necessary during observations (as described in paragraphs (b)(6) and (7) of this section;

(5) All PSOs and PAM operators must successfully complete a relevant training course within the last 5 years, including obtaining a certificate of course completion;

(6) PSOs and PAM operators are responsible for obtaining NMFS' approval. NMFS may approve PSOs and PAM operators as conditional or unconditional. A conditionally approved PSO or PAM operator may be one who has completed training in the last 5 years but has not yet attained the requisite field experience. An unconditionally approved PSO or PAM operator is one who has completed training within the last 5 years and attained the necessary experience (*i.e.*, demonstrate experience with monitoring for marine mammals at clearance and shutdown zone sizes similar to those produced during the respective activity). Lead PSO or PAM operators must be unconditionally approved and have a minimum of 90 days in a northwestern Atlantic Ocean offshore environment performing the role (either visual or acoustic), with the conclusion of the most recent relevant experience not more than 18 months previous. A conditionally approved PSO or PAM operator must be paired with an unconditionally approved PSO or PAM operator;

(7) PSOs for HRG surveys may be unconditionally or conditionally approved. PSOs and PAM operators for foundation installation activities must be unconditionally approved;

(8) At least one on-duty PSO and PAM operator, where applicable, for each activity (*e.g.*, impact pile driving, vibratory pile driving, and HRG surveys) must be designated as the Lead PSO or Lead PAM operator;

(9) LOA Holder must submit NMFS previously approved PSOs and PAM operators to NMFS Office of Protected Resources for review and confirmation of their approval for specific roles at least 30 days prior to commencement of the activities requiring PSOs/PAM operators or 15 days prior to when new PSOs/PAM operators are required after activities have commenced;

(10) For prospective PSOs and PAM operators not previously approved, or for PSOs and PAM operators whose approval is not current, LOA Holder must submit resumes for approval at

least 60 days prior to PSO and PAM operator use. Resumes must include information related to relevant education, experience, and training, including dates, duration, location, and description of prior PSO or PAM operator experience. Resumes must be accompanied by relevant documentation of successful completion of necessary training;

(11) PAM operators are responsible for obtaining NMFS approval. To be approved as a PAM operator, the person must meet the following qualifications: The PAM operator must demonstrate that they have prior experience with real-time acoustic detection systems and/or have completed specialized training for operating PAM systems and detecting and identifying Atlantic Ocean marine mammals sounds, in particular: North Atlantic right whale sounds, humpback whale sounds, and how to deconflict them from similar North Atlantic right whale sounds, and other co-occurring species' sounds in the area including sperm whales; must be able to distinguish between whether a marine mammal or other species sound is detected, possibly detected, or not detected, and similar terminology must be used across companies/projects; Where localization of sounds or deriving bearings and distance are possible, the PAM operators need to have demonstrated experience in using this technique; PAM operators must be independent observers (*i.e.*, not construction personnel); PAM operators must demonstrate experience with relevant acoustic software and equipment; PAM operators must have the qualifications and relevant experience/training to safely deploy and retrieve equipment and program the software, as necessary; PAM operators must be able to test software and hardware functionality prior to operation; and PAM operators must have evaluated their acoustic detection software using the PAM Atlantic baleen whale annotated data set available at National Centers for Environmental Information (NCEI) and provide evaluation/performance metric;

(12) PAM operators must be able to review and classify acoustic detections in real-time (prioritizing North Atlantic right whales and noting detection of other cetaceans) during the real-time monitoring periods;

(13) PSOs may work as PAM operators and vice versa, pending NMFS-approval; however, they may only perform one role at any time and must not exceed work time restrictions, which must be tallied cumulatively; and

(14) All PSOs and PAM operators must complete a Permits and Environmental Compliance Plan training and a 2-day refresher session that must be held with the PSO provider and Project compliance representative(s) prior to the start of in-water project activities (*e.g.*, HRG survey, foundation installation, *etc*.).

(b) *General PSO and PAM operator requirements*. The following measures apply to PSOs and PAM operators and must be implemented by LOA Holder:

(1) PSOs must monitor for marine mammals prior to, during, and following impact pile driving and HRG surveys that use sub-bottom profilers (with specific monitoring durations and needs described in paragraphs (c) through (f) of this section, respectively). Monitoring must be done while free from distractions and in a consistent, systematic, and diligent manner;

(2) For foundation installation, PSOs must visually clear (*i.e.*, confirm no observations of marine mammals) the entire minimum visibility zone for a full 30 minutes immediately prior to commencing activities. For HRG surveys, which do not have a minimum visibility zone, the entire clearance zone must be visually cleared and as much of the Level B harassment zone as possible;

(3) All PSOs must be located at the best vantage point(s) on any platform, as determined by the Lead PSO, in order to obtain 360-degree visual coverage of the entire clearance and shutdown zones around the activity area, and as much of the Level B harassment zone as

possible. PAM operators may be located on a vessel or remotely on-shore, the PAM operator(s) must assist PSOs in ensuring full coverage of the clearance and shutdown zones. The PAM operator must monitor to and past the clearance zone for large whales;

(4) All on-duty PSOs must remain in real-time contact with the on-duty PAM operator(s), PAM operators must immediately communicate all acoustic detections of marine mammals to PSOs, including any determination regarding species identification, distance, and bearing (where relevant) relative to the pile being driven and the degree of confidence (*e.g.*, possible, probable detection) in the determination. All on-duty PSOs and PAM operator(s) must remain in contact with the on-duty construction personnel responsible for implementing mitigations (*e.g*., delay to pile driving) to ensure communication on marine mammal observations can easily, quickly, and consistently occur between all on-duty PSOs, PAM operator(s), and on-water Project personnel;

(5) The PAM operator must inform the Lead PSO(s) on duty of animal detections approaching or within applicable ranges of interest to the activity occurring via the data collection software system (*i.e.*, Mysticetus or similar system) who must be responsible for requesting that the designated crewmember implement the necessary mitigation procedures (*i.e.*, delay);

(6) PSOs must use high magnification (25x) binoculars, standard handheld (7x) binoculars, and the naked eye to search continuously for marine mammals. During foundation installation, at least two PSOs on the pile driving vessel must be equipped with functional Big Eye binoculars (*e.g.*, 25 * 150; 2.7 view angle; individual ocular focus; height control); these must be pedestal mounted on the deck at the best vantage point that provides for optimal sea surface observation and PSO safety. PAM operators must have the appropriate equipment (*i.e.*, a computer station equipped with a data collection software system available wherever they are stationed) and use a NMFS-approved PAM system to conduct monitoring. PAM systems are approved through the PAM Plan as described in § 217.344(c)(17); and

(7) PSOs and PAM operators must not exceed 4 consecutive watch hours on duty at any time, must have a 2-hour (minimum) break between watches, and must not exceed a combined watch schedule of more than 12 hours in a 24-hour period. If the schedule includes PSOs and PAM operators on-duty for 2-hour shifts, a minimum 1-hour break between watches must be allowed.

(c) *PSO and PAM operator requirements during WTG, OSS, and Met Tower foundation installation*. The following measures apply to PSOs and PAM operators during WTG, OSS, and Met tower foundation installation and must be implemented by LOA Holder:

(1) PSOs and PAM operator(s), using a NMFS-approved PAM system, must monitor for marine mammals 60 minutes prior to, during, and 30 minutes following all pile driving activities. If PSOs cannot visually monitor the minimum visibility zone prior to impact pile driving at all times using the equipment described in paragraphs (b)(6) and (7) of this section, pile driving operations must not commence or must shutdown if they are currently active;

(2) At least three on-duty PSOs must be stationed and observing from the activity platform during impact pile driving and at least three on-duty PSOs must be stationed on each dedicated PSO vessel. Concurrently, at least one PAM operator per acoustic data stream (equivalent to the number of acoustic buoys) must be actively monitoring for marine mammals 60 minutes before, during, and 30 minutes after impact pile driving in accordance with a NMFS-approved PAM Plan; and

(3) LOA Holder must conduct PAM for at least 24 hours immediately prior to pile driving activities. The PAM operator must review all detections from the previous 24-hour period immediately prior to pile driving activities.

(d) *PSO requirements during HRG surveys*. The following measures apply to PSOs during HRG surveys using acoustic sources that have the potential to result in harassment and must be implemented by LOA Holder:

(1) At least one PSO must be on active duty monitoring during HRG surveys conducted during daylight (*i.e.*, from 30 minutes prior to civil sunrise through 30 minutes following civil sunset) and two PSOs during nighttime surveying (if it occurs);

(2) PSOs on HRG vessels must begin monitoring 30 minutes prior to activating acoustic sources, during the use of these acoustic sources, and for 30 minutes after use of these acoustic sources has ceased;

(3) Any observations of marine mammals must be communicated to PSOs on all nearby survey vessels during concurrent HRG surveys; and

(4) During daylight hours when survey equipment is not operating, LOA Holder must ensure that visual PSOs conduct, as rotation schedules allow, observations for comparison of sighting rates and behavior with and without use of the specified acoustic sources.

(e) *Monitoring requirements during fisheries monitoring surveys*. The following measures apply during fisheries monitoring surveys and must be implemented by LOA Holder:

(1) All captains and crew conducting fishery surveys must be trained in marine mammal detection and identification; and

(2) Marine mammal monitoring must be conducted within 1 nmi from the planned survey location by the trained captain and/or a member of the scientific crew for 15 minutes prior to deploying gear, throughout gear deployment and use, and for 15 minutes after haul back.

(f) *Reporting*. LOA Holder must comply with the following reporting measures:

(1) Prior to initiation of any on-water project activities, LOA Holder must demonstrate in a report submitted to NMFS Office of Protected Resources that all required training for LOA Holder personnel (including the vessel crews, vessel captains, PSOs, and PAM operators) has been completed.

(2) LOA Holder must use a standardized reporting system during the effective period of the LOA. All data collected related to the Project must be recorded using industry-standard software that is installed on field laptops and/or tablets. Unless stated otherwise, all reports must be submitted to NMFS Office of Protected Resources (*PR.ITP.MonitoringReports@noaa.gov*), dates must be in MM/DD/YYYY format, and location information must be provided in Decimal Degrees and with the coordinate system information (*e.g.*, NAD83, WGS84, *etc*.).

(3) For all visual monitoring efforts and marine mammal sightings, the following information must be collected and reported to NMFS Office of Protected Resources: the date and time that monitored activity begins or ends; the construction activities occurring during each observation period; the watch status (*i.e.*, sighting made by PSO on/off effort, opportunistic, crew, alternate vessel/platform); the PSO who sighted the animal; the time of sighting; the weather parameters (*e.g.*, wind speed, percent cloud cover, visibility); the water conditions (*e.g.*, Beaufort sea state, tide state, water depth); all marine mammal sightings, regardless of distance from the construction activity; species (or lowest possible taxonomic level possible); the pace of the animal(s); the estimated number of animals (minimum/maximum/high/low/best); the estimated number of animals by cohort (*e.g.*, adults, yearlings, juveniles, calves, group composition, *etc*.); the description (*i.e.*, 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); the description of any marine mammal behavioral observations (*e.g.*, observed behaviors such as feeding or traveling) and observed changes in behavior, including an assessment of behavioral responses thought to have resulted from the specific activity; the animal's closest distance and bearing from the pile being driven or specified HRG equipment and estimated time entered or spent within the Level A harassment and/or Level B harassment zone(s); the activity at time of sighting (*e.g.*, impact pile driving, construction survey), use of any noise attenuation device(s), and specific phase of activity (*e.g.*, ramp-up of HRG equipment, HRG acoustic source on/off, soft-start for pile driving, active pile driving, *etc*.); the marine mammal occurrence in Level A harassment or Level B harassment zones; the description of any mitigation-related action implemented, or mitigation-related actions called for but not implemented, in response to the sighting (*e.g.*, delay, shutdown, *etc*.) and time and location of the action; other human activity in the area, and; other applicable information, as required in any LOAs issued under § 217.346.

(4) LOA Holder must compile and submit weekly reports during foundation installation to NMFS Office of Protected Resources that document the daily start and stop of all pile driving associated with the Project; the start and stop of associated observation periods by PSOs; details on the deployment of PSOs; a record of all detections of marine mammals (acoustic and visual); any mitigation actions (or if mitigation actions could not be taken, provide reasons why); and details on the noise attenuation system(s) used and its performance. Weekly reports are due on Wednesday for the previous week (Sunday to Saturday) and must include the information required under this section. The weekly report must also identify which turbines become operational and when (a map must be provided). Once all foundation pile installation is completed, weekly reports are no longer required by LOA Holder.

(5) LOA Holder must compile and submit monthly reports to NMFS Office of Protected Resources during foundation installation that include a summary of all information in the weekly reports, including project activities carried out in the previous month, vessel transits (number, type of vessel, MMIS number, and route), number of piles installed, all detections of marine mammals, and any mitigative action taken. Monthly reports are due on the 15th of the month for the previous month. The monthly report must also identify which turbines become operational and when (a map must be provided). Full PAM detection data and metadata must also be submitted monthly on the 15th of every month for the previous month via the webform on the NMFS North Atlantic Right Whale Passive Acoustic Reporting System website at *https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*.

(6) LOA Holder must submit a draft annual report to NMFS Office of Protected Resources no later than 90 days following the end of a given calendar year. LOA Holder must provide a final report within 30 days following resolution of NMFS' comments on the draft report. The draft and final reports must detail the following: the total number of marine mammals of each species/stock detected and how many were within the designated Level A harassment and Level B harassment zone(s) with comparison to authorized take of marine mammals for the associated activity type; marine mammal detections and behavioral observations before, during, and after each activity; what mitigation measures were implemented (*i.e.*, number of shutdowns or clearance zone delays, *etc*.) or, if no mitigative actions was taken, why not; operational details (*i.e.*, days and duration of impact and vibratory pile driving, days, and amount of HRG survey effort, *etc*.); any PAM systems used; the results, effectiveness, and which noise attenuation systems were used during relevant activities (*i.e.*, impact pile driving); summarized information

related to situational reporting; and any other important information relevant to the Project, including additional information that may be identified through the adaptive management process.

(7) LOA Holder must submit its draft 5-year report to NMFS Office of Protected Resources on all visual and acoustic monitoring conducted within 90 calendar days of the completion of activities occurring under the LOA. At a minimum, the draft and final 5-year report must include: the total number (annually and across all 5 years) of marine mammals of each species/stock detected and how many were detected within the designated Level A harassment and Level B harassment zone(s) with comparison to authorized take of marine mammals for the associated activity type; a summary table(s) indicating the amount of each activity type (*e.g.*, pile installation, HRG) completed in each of the 5 years and total; GIS shapefile(s) of the final location of all piles, cable routes, and other permanent structures including an indication of what year installed and began operating; GIS shapefile of all North Atlantic right whale sightings, including dates and group sizes; a 5-year summary and evaluation of all SFV data collected; a 5-year summary and evaluation of all PAM data collected; a 5-year summary and evaluation of marine mammal behavioral observations; a 5-year summary and evaluation of mitigation and monitoring implementation and effectiveness; a list of recommendations to inform environmental compliance assessments for future offshore wind actions. A 5-year report must be prepared and submitted within 60 calendar days following receipt of any NMFS Office of Protected Resources comments on the draft report. If no comments are received from NMFS Office of Protected Resources within 60 calendar days of NMFS Office of Protected Resources receipt of the draft report, the report shall be considered final.

(8) For those foundation piles requiring SFV measurements, LOA Holder must provide the initial results of the SFV measurements to NMFS Office of Protected Resources in an interim report after each foundation installation event as soon as they are available and prior to a subsequent foundation installation, but no later than 48 hours after each completed foundation installation event. The report must include, at minimum: hammer energies/schedule used during pile driving, including, the total number of strikes and the maximum hammer energy; the model-estimated acoustic ranges ($R_{95\%}$) to compare with the real-world sound field measurements; peak sound pressure level (SPL_{pk}), root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), and sound exposure level (SEL, in single strike for pile driving, $SEL_{ss,}$), for each hydrophone, including at least the maximum, arithmetic mean, minimum, median (L50) and L5 (95 percent exceedance) statistics for each metric; estimated marine mammal Level A harassment and Level B harassment isopleths, calculated using the maximum-over-depth L5 (95 percent exceedance level, maximum of both hydrophones) of the associated sound metric; comparison of modeled results assuming 10-dB attenuation against the measured marine mammal Level A harassment and Level B harassment acoustic isopleths; estimated transmission loss coefficients; pile identifier name, location of the pile and each hydrophone array in latitude/longitude; depths of each hydrophone; one-third-octave band single strike SEL spectra; if filtering is applied, full filter characteristics must be reported; and hydrophone specifications including the type, model, and sensitivity. LOA Holder must also report any immediate observations which are suspected to have a significant impact on the results including but not limited to: observed noise mitigation system issues, obstructions along the measurement transect, and technical issues with hydrophones or recording devices. If any in-situ calibration checks for hydrophones reveal a calibration drift greater than 0.75 dB, pistonphone calibration

checks are inconclusive, or calibration checks are otherwise not effectively performed, LOA Holder must indicate full details of the calibration procedure, results, and any associated issues in the 48-hour interim reports.

(9) The final results of SFV measurements from each foundation installation must be submitted as soon as possible, but no later than 90 days following completion of each event's SFV measurements. The final reports must include all details prescribed above for the interim report as well as, at minimum, the following: the peak sound pressure level (SPL_{pk}), the root-mean-square sound pressure level that contains 90 percent of the acoustic energy (SPL_{rms}), the single strike sound exposure level (SEL_{ss}), the integration time for SPL_{rms}, the spectrum, and the 24-hour cumulative SEL extrapolated from measurements at all hydrophones. The final report must also include at least the maximum, mean, minimum, median (L_{50}) and L_5 (95 percent exceedance) statistics for each metric; the SEL and SPL power spectral density and/or one-third octave band levels (usually calculated as decidecade band levels) at the receiver locations should be reported; the sound levels reported must be in median, arithmetic mean, and L_5 (95 percent exceedance) (*i.e.*, average in linear space), and in dB; range of transmission loss coefficients; the local environmental conditions, such as wind speed, transmission loss data collected on-site (or the sound velocity profile); baseline pre- and post-activity ambient sound levels (broadband and/or within frequencies of concern); a description of depth and sediment type, as documented in the Construction and Operation Plan (COP), at the recording and foundation installation locations; the extents of the measured Level A harassment and Level B harassment zone(s); hammer energies required for pile installation and the number of strikes per pile; the hydrophone equipment and methods (*i.e.*, recording device, bandwidth/sampling rate; distance from the pile where recordings were made; the depth of recording device(s)); a description of the SFV measurement hardware and software, including software version used, calibration data, bandwidth capability and sensitivity of hydrophone(s), any filters used in hardware or software, any limitations with the equipment, and other relevant information; the spatial configuration of the noise attenuation device(s) relative to the pile; a description of the noise abatement system and operational parameters (*e.g.*, bubble flow rate, distance deployed from the pile, *etc.*), and any action taken to adjust the noise abatement system. A discussion which includes any observations which are suspected to have a significant impact on the results including but not limited to: observed noise mitigation system issues, obstructions along the measurement transect, and technical issues with hydrophones or recording devices.

(10) If at any time during the project LOA Holder becomes aware of any issue or issues which may (to any reasonable subject-matter expert, including the persons performing the measurements and analysis) call into question the validity of any measured Level A harassment or Level B harassment isopleths to a significant degree, which were previously transmitted or communicated to NMFS Office of Protected Resources, LOA Holder must inform NMFS Office of Protected Resources within 1 business day of becoming aware of this issue or before the next pile is driven, whichever comes first.

(11) If a North Atlantic right whale is acoustic detected at any time by a project-related PAM system, LOA Holder must ensure the detection is reported as soon as possible to NMFS, but no longer than 24 hours after the detection via the "24-hour North Atlantic right whale Detection Template" (*https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*). Calling the hotline is not necessary when reporting PAM detections via the template.

(12) Full detection data, metadata, and location of recorders (or GPS tracks, if applicable) from all real-time hydrophones used for monitoring during construction must be submitted within 90 calendar days after pile driving has ended and instruments have been pulled from the water. Reporting must use the webform templates on the NMFS Passive Acoustic Reporting System website at *https://www.fisheries.noaa.gov/resource/document/passive-acoustic-reporting-system-templates*. Submit the completed data templates to *nmfs.nec.pacmdata@noaa.gov.* The full acoustic recordings from all real-time hydrophones must also be sent to the National Centers for Environmental Information (NCEI) for archiving within 90 calendar days following completion of activities requiring PAM for mitigation. Submission details can be found at: *https://www.ncei.noaa.gov/products/passive-acoustic-data.*

(13) LOA Holder must submit situational reports if the following circumstances occur (including all instances wherein an exemption is taken must be reported to NMFS Office of Protected Resources within 24 hours):

(i) If a North Atlantic right whale is observed at any time by PSOs or project personnel, LOA Holder must ensure the sighting is immediately (if not feasible, as soon as possible, and no longer than 24 hours after the sighting) reported to NMFS and the Right Whale Sightings Advisory System (RWSAS). If in the Northeast Region (Maine to Virginia/North Carolina border) call (866-755-6622). If in the Southeast Region (North Carolina to Florida) call (877-WHALE-HELP or 877-942-5343). If calling NMFS is not possible, reports can also be made to the U.S. Coast Guard via channel 16 or through the WhaleAlert app (*https://www.whalealert.org*). The sighting report must include the time, date, and location of the sighting, number of whales, animal description/certainty of sighting (provide photos/video if taken), Lease Area/project name, PSO/personnel name, PSO provider company (if applicable), and reporter's contact information.

(ii) If a North Atlantic right whale is observed at any time by PSOs or project personnel, LOA Holder must submit a summary report to NMFS GARFO (*nmfs.gar.incidental-take@noaa.gov*) and NMFS Office of Protected Resources, and NMFS Northeast Fisheries Science Center (NEFSC; *ne.rw.survey@noaa.gov*) within 24 hours with the above information and the vessel/platform from which the sighting was made, activity the vessel/platform was engaged in at time of sighting, project construction and/or survey activity at the time of the sighting (*e.g*., pile driving, cable installation, HRG survey), distance from vessel/platform to sighting at time of detection, and any mitigation actions taken in response to the sighting.

(iii) If an observation of a large whale occurs during vessel transit, LOA Holder must report the time, date, and location of the sighting; the vessel's activity, heading, and speed (knots); Beaufort sea state, water depth (meters), and visibility conditions; marine mammal species identification to the best of the observer's ability and any distinguishing characteristics; initial distance and bearing to marine mammal from vessel and closest point of approach; and any avoidance measures taken in response to the marine mammal sighting.

(iv) In the event that personnel involved in the Project discover a stranded, entangled, injured, or dead marine mammal, LOA Holder must immediately report the observation to NMFS. If in the Greater Atlantic Region (Maine to Virginia) call the NMFS Greater Atlantic Stranding Hotline (866-755-6622); if in the Southeast Region (North Carolina to Florida), call the NMFS Southeast Stranding Hotline (877-942-5343). Separately, LOA Holder must report the incident to NMFS Office of Protected Resources (*PR.ITP.MonitoringReports@noaa.gov*) and, if in the Greater Atlantic region (Maine to Virginia), NMFS GARFO (*nmfs.gar.incidental-take@noaa.gov*, *nmfs.gar.stranding@noaa.gov*) or, if in the Southeast region (North Carolina to

Florida), NMFS Southeast Regional Office (SERO; *secmammalreports@noaa.gov*) as soon as feasible. The report (via phone or email) must include contact (name, phone number, *etc.*), the time, date, and location of the first discovery (and updated location information if known and applicable); species identification (if known) or description of the animal(s) involved; condition of the animal(s) (including carcass condition if the animal is dead); observed behaviors of the animal(s), if alive; if available, photographs or video footage of the animal(s); and general circumstances under which the animal was discovered.

(v) In the event of a vessel strike of a marine mammal by any vessel associated with the Project or if other project activities cause a non-auditory injury or death of a marine mammal, LOA Holder must immediately report the incident to NMFS. If in the Greater Atlantic Region (Maine to Virginia) call the NMFS Greater Atlantic Stranding Hotline (866-755-6622) and if in the Southeast Region (North Carolina to Florida) call the NMFS Southeast Stranding Hotline (877-942-5343). Separately, LOA Holder must immediately report the incident to NMFS Office of Protected Resources (*PR.ITP.MonitoringReports@noaa.gov*) and, if in the Greater Atlantic region (Maine to Virginia), NMFS GARFO (*nmfs.gar.incidental-take@noaa.gov*, *nmfs.gar.stranding@noaa.gov*) or, if in the Southeast region (North Carolina to Florida), NMFS SERO (*secmammalreports@noaa.gov*). The report must include the time, date, and location of the incident; species identification (if known) or description of the animal(s) involved; vessel size and motor configuration (inboard, outboard, jet propulsion); vessel's speed leading up to and during the incident; vessel's course/heading and what operations were being conducted (if applicable); status of all sound sources in use; 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; environmental conditions (*e.g.*, wind speed and direction, Beaufort sea state, cloud cover, visibility) immediately preceding the strike; estimated size and length of animal that was struck; description of the behavior of the marine mammal immediately preceding and following the strike; if available, description of the presence and behavior of any other marine mammals immediately preceding the strike; estimated fate of the animal (*e.g.*, dead, injured but alive, injured and moving, blood or tissue observed in the water, status unknown, disappeared); and to the extent practicable, photographs or video footage of the animal(s). LOA Holder must immediately cease all on-water activities until the NMFS Office of Protected Resources is able to review the circumstances of the incident and determine what, if any, additional measures are appropriate to ensure compliance with the terms of the LOA. NMFS Office of Protected Resources may impose additional measures to minimize the likelihood of further prohibited take and ensure MMPA compliance. LOA Holder may not resume their activities until notified by NMFS Office of Protected Resources.

(14) LOA Holder must report any lost gear associated with the fishery surveys to the NOAA GARFO Protected Resources Division (*nmfs.gar.incidental-take@noaa.gov*) as soon as possible or within 24 hours of the documented time of missing or lost gear. This report must include information on any markings on the gear and any efforts undertaken or planned to recover the gear.

APPENDIX C

June 29, 2021

James F. Bennett
Program Manager, Office of Renewable Energy Programs

Dear Mr. Bennett:

We have completed consultation pursuant to section 7 of the Endangered Species Act (ESA) of 1973, as amended, concerning the effects of certain site assessment and site characterization activities to be carried out to support the siting of offshore wind energy development projects off the U.S. Atlantic coast. The Bureau of Ocean Energy Management (BOEM) is the lead federal agency for this consultation. BOEM's request for consultation included a biological assessment (BA) that was finalized in February 2021 and was supplemented with modified Project Design Criteria (PDC) and supplemental information through June 11, 2021. The activities considered in this consultation may occur in the three Atlantic Renewable Energy Regions (North Atlantic Planning Area, Mid-Atlantic Planning Area, and South Atlantic Planning Area; see Figure 1 in Appendix A) and adjacent coastal waters over the next 10 years (i.e., June 2021 – June 2031). Other action agencies include the U.S. Army Corps of Engineers (USACE), the U.S. Department of Energy (DOE), the U.S. Environmental Protection Agency (EPA), and the National Marine Fisheries Service's (NMFS) Office of Protected Resources (OPR).

ACTION AREA AND PROPOSED ACTIONS

As defined in 50 CFR 402.02, "programmatic consultation is a consultation addressing an agency's multiple actions on a program, region, or other basis. Programmatic consultations allow NMFS to consult on the effects of programmatic actions such as: (1) Multiple similar, frequently occurring, or routine actions expected to be implemented in particular geographic areas; and, (2) A proposed program, plan, policy, or regulation providing a framework for future proposed actions." This programmatic consultation considers category 1--multiple similar, frequently occurring, or routine actions expected to be implemented in particular geographic areas.

The survey activities considered in this consultation are geophysical and geotechnical surveys and the deployment, operation, and retrieval of environmental data collection buoys. These frequent, similar activities are expected to be implemented along the U.S. Atlantic coast in the three Atlantic Renewable Energy Regions (North Atlantic Planning Area, Mid-Atlantic Planning Area, and South Atlantic Planning Area). The meteorological buoys and geophysical and geotechnical surveys are expected to occur to support the potential future siting of offshore wind turbines, cables, and associated offshore facilities such as substations or service platforms.

Action Agencies
As noted above, the activities considered here may be authorized, funded, or carried out by BOEM, the DOE, the EPA, the USACE, and NMFS. The roles of these action agencies are described here.

BOEM
The Outer Continental Shelf Lands Act (OCSLA), as amended, mandates the Secretary of the Interior (Secretary), through BOEM, to manage the siting and development of the Outer Continental Shelf (OCS) for renewable energy facilities. BOEM is delegated the responsibility for overseeing offshore renewable energy development in Federal waters (30 C.F.R. Part 585). Through these regulations, BOEM oversees responsible offshore renewable energy development, including the issuance of leases for offshore wind development. This consultation considers the effects of certain data collection activities (geophysical and geotechnical surveys and deployment of meteorological buoys) that may be undertaken to support offshore wind development. BOEM regulations require that a lessee provide the results of shallow hazard, geological, geotechnical, biological, and archaeological surveys with its Site Assessment Plan and Construction and Operations Plan (see 30 C.F.R. 585.610(b) and 30 C.F.R. 585.626(a)). BOEM also funds data collection projects, such as seafloor mapping through the Environmental Studies Program (ESP). The activities considered here may or may not occur in association with a BOEM lease. This consultation does not obviate the need for an appropriate consultation to occur on lease issuance or the approval of a Site Assessment Plan or Construction and Operations Plan.

DOE
The 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. EERE's Water Power Technologies Office enables research, development, and testing of emerging technologies to advance marine energy. DOE's financial assistance in support of renewable energy projects could have consequences for listed species in federal or state waters. Data collection activities that may be supported by DOE and are considered in this programmatic consultation include deployment of meteorological buoys and geotechnical and geophysical surveys.

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),[1] in order to attain and maintain Federal and State ambient air quality standards and comply with the provisions of part C of title I of the Act.[2] 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

[1] 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."
[2] Part C of title I contains the Prevention of Significant Deterioration of Air Quality (PSD) requirements.

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.

As described in the BA, where activities considered in this consultation 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 activities may be subject to the 40 C.F.R. part 55 requirements, including the 40 C.F.R. § 55.6 permitting requirements. Such activities are expected to be limited to vessel operations and some meteorological buoys.

USACE

Of the activities considered in this consultation, the deployment of meteorological buoys and carrying out geotechnical surveys may require authorization from the 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 USACE Nationwide Permit (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).

Consideration of Potential Issuance of Incidental Harassment Authorizations for Survey Activities

The Marine Mammal Protection Act (MMPA), and its implementing regulations, allows, upon request, the incidental take of small numbers of marine mammals by U.S. citizens who engage in a specified activity (other than commercial fishing) within a specified geographic region. Incidental take is an unintentional, but not unexpected, "take." Upon receipt and review of an adequate and complete application, NMFS OPR may authorize the incidental take of marine mammals incidental to the marine site characterization surveys pursuant to the MMPA, if the required findings are made. Proponents of some survey activities considered here may be required to obtain Incidental Take Authorizations (ITAs) under the MMPA. Therefore, the Federal actions considered in this consultation include the issuance of ITAs for survey activities described herein. Those ITAs may or may not provide MMPA take authorization for marine mammal species that are also listed under the ESA. As noted above, we have determined that all activities considered (inclusive of all PDC and BMPs) in this consultation will have no effect or are not likely to adversely affect any species listed under the ESA. By definition, that means that no take, as defined in the ESA, is anticipated. However, given the differences in the definitions of "harassment" under the MMPA and ESA, it is possible the site characterization surveys could result in harassment, as defined under the MMPA, but meet the ESA definition of "not likely to adversely affect." This consultation addresses such situations.

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

Under the ESA, take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." Harm is defined by regulation (50 C.F.R. §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding, or sheltering." NMFS does not have a regulatory definition of "harass." However, on December 21, 2016, NMFS issued interim guidance[3] on the term "harass," under the ESA, defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering." The NMFS interim ESA definition of "harass" is not equivalent to MMPA Level B harassment. Due to the differences in the definition of "harass" under the MMPA and ESA, there may be activities that result in effects to a marine mammal that would meet the threshold for harassment under both the MMPA and the ESA, while other activities may result in effects that would meet the threshold for harassment under the MMPA but not under the ESA. This issue is addressed further in the Marine Mammals section of this letter.

For this consultation, we considered NMFS' interim guidance on the term "harass" under the ESA when evaluating whether the proposed activities are likely to harass ESA-listed species, and we considered the available scientific evidence to determine the likely nature of the behavioral responses and their potential fitness consequences. As explained below, we determined that the effects to ESA-listed marine mammals resulting from the survey activities considered here would be insignificant and not result in harassment per NMFS' interim guidance on harassment under the ESA.

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

Activities Considered in this Programmatic Consultation
The survey activities that are considered here consist of high resolution geophysical (HRG) and geotechnical surveys designed to characterize benthic and subsurface conditions and deployment, operation, and retrieval of environmental data collection buoys. A complete description of representative survey equipment to be used is included in Appendix A (Tables A.1 and A.2). Additionally, this consultation considers effects of deploying, operating, and retrieving buoys equipped with scientific instrumentation to collect oceanographic, meteorological, and biological data. All activities considered here will comply with a set of PDC (see Appendix B). We also consider the effects of vessel traffic associated with these activities. All vessels carrying out these activities, including during transits, will comply with measures outlined in Appendix B regardless of the equipment used or the sound levels/frequency at which equipment is operating. This consultation does not consider the effects of any survey activities that have the potential to result in directed or incidental capture or collection of any ESA-listed species (e.g., trawl surveys in areas where ESA-listed sea turtles occur).

This consultation does not evaluate the construction of any commercial electricity generating facilities or transmission cables with the potential to export electricity. Consistent with our understanding of the relevant regulations, BOEM has indicated that any such proposals for installation of electricity generating facilities (i.e., installation of wind turbines) or transmission cables would be a separate federal action (including authorization from BOEM) requiring a separate section 7 consultation. "Effects of the action are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action" (50 CFR §402.02; see also 50 CFR §402.17). The construction, operation, and/or decommissioning of any offshore wind facility or appurtenant facilities (e.g., cables, substations, etc.) are not consequences of the proposed survey activities considered here as they are not reasonably certain to occur. As such, this consultation does not consider these activities.

Action Area
The action area is defined by regulation as "all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action" (50 CFR 402.02). The Action Area for this consultation includes the areas to be surveyed and where buoys will be deployed, areas where increased levels of noise will be experienced as well as the vessel transit routes between existing Atlantic coast ports and the survey area. This area encompasses all effects of the proposed action considered here.

Surveys considered in this programmatic consultation will take place at depths 100-meters (m) or less within the three Atlantic Renewable Energy Regions (North Atlantic Planning Area, Mid-Atlantic Planning Area, and South Atlantic Planning Area) located on the Atlantic Outer Continental Shelf (OCS) and may also occur along potential cable corridor routes in nearshore waters of Atlantic coast states. The three planning areas extend from the US/Canada border in the north to Palm Bay, Florida in the south. The North, Mid-Atlantic, and South Atlantic planning areas together extend seaward from the U.S./Canadian border in the North to Palm Bay, Florida in the South. For the purposes of this consultation, the action area includes the 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 and the adjacent coastal waters to the Atlantic coast (see Figure 1 in Appendix A for map of the action area). The offshore extent of the action area is defined by the anticipated maximum water depth where potential offshore wind facilities could be constructed. The seaward limit for siting a wind energy facility on the OCS is approximately 25 nautical miles (nm) (46.3 kilometers [km]) from shore or 100 m (328 feet [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 foundations for wind turbine generators, floating foundations may be used in water depths >60 m in the future.

IMPLEMENTATION, TRACKING, AND REPORTING FOR THIS PROGRAMMATIC CONSULTATION

As noted above, activities considered in this consultation may be authorized, funded, or carried out by one or more action agencies. When one of these action agencies identifies a proposed activity that they believe falls within the scope of this programmatic consultation, they will first identify a lead action agency for the review (we anticipate that in most cases this will be BOEM). They will then review the activity to confirm that it is consistent with the activities covered by this consultation, including a review to confirm that all relevant PDCs (as outlined in Appendix B) will be implemented. The lead action agency for the activity will send written correspondence to the NMFS Greater Atlantic Regional Fisheries Office (GARFO) (nmfs.gar.esa.section7@noaa.gov) providing a brief summary of the proposed activity, including location and duration, and the agency's determination that the proposed activity is consistent with the scope of activities considered in this consultation. The action agency will also confirm in writing that all relevant PDCs will be implemented. If NMFS GARFO has any questions about the activity or determines it is not within the scope of this consultation, a written reply will be provided to the action agency within 15 calendar days. Activities that are determined to not be within the scope of this consultation can be modified by the action agency to bring them within the scope of this consultation or the action agency can request a stand-alone ESA section 7 consultation outside of this programmatic consultation.

To provide flexibility while maintaining the intent of this programmatic consultation, if an action agency proposes use of an equipment type different than described in this consultation, but can demonstrate that the acoustic characteristics are similar to the representative equipment described in Table A.2 and that implementation of the PDCs will result in the same effects considered here, this can be described when the survey plan is transmitted to us. Similarly, it is possible to consider modifications to the PDCs for a particular survey plan when the lead action agency can demonstrate that the same conservation benefit or risk reduction can be achieved with an alternate proposal.

In order to track activities carried out under this programmatic consultation, by February 15 of each year, BOEM, as the lead agency for this programmatic consultation, will provide a written report to NMFS documenting the activities that occurred under the scope of this consultation in the previous year (e.g., the report for 2021 activities will be due by February 15, 2022). This annual report will also transmit any monitoring reports and any reports of instances where PDCs were not implemented (e.g., where human safety prevented implementation of an otherwise required speed reduction). Following the receipt of the annual report, a meeting will be held if necessary to review and update any PDCs and to update the list of representative equipment.

ESA-LISTED SPECIES AND CRITICAL HABITAT CONSIDERED IN THIS CONSULTATION

In their BA, BOEM described the ESA-listed species and critical habitats that occur along the U.S. Atlantic coast. Of the species listed in the BA, we have determined that oceanic whitetip shark (*Carcharhinus longimanus*), Nassau grouper (*Epinephelus striatus*)[4], 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*) do not occur in the action area.

ESA-Listed Species in the Action Area

The following listed species occur in the action area and are considered in this consultation:

Table 1. ESA-listed species that may be affected by the proposed action.

Common Name	Scientific Name	ESA Status
Marine Mammals – Cetaceans		
North Atlantic right whale	*Eubalaena glacialis*	Endangered
Fin Whale	*Balaenoptera physalus*	Endangered
Sei Whale	*Balaenoptera borealis*	Endangered
Sperm Whale	*Physeter macrocephalus*	Endangered
Blue whale	*Balaenoptera musculus*	Endangered
Sea Turtles		
Loggerhead turtle - Northwest Atlantic DPS	*Caretta*	Threatened
Green turtle - North Atlantic DPS and South Atlantic DPS	*Chelonia mydas*	Threatened
Kemp’s ridley turtle	*Lepidochelys kempii*	Endangered

[4] Nassau grouper may occur in nearshore and offshore waters in the Florida Straits Planning Area but are not known to occur in nearshore or offshore waters of the South Atlantic Planning Area (NMFS 2013)

Leatherback turtle	*Dermochelys coriacea*	Endangered
Hawksbill turtle	*Eretmochelys imbricata*	Endangered
Fishes		
Atlantic salmon	*Salmo salar*	Endangered
Atlantic sturgeon	*Acipenser oxyrinchus*	Endangered
New York Bight DPS		Endangered
Chesapeake Bay DPS		Endangered
Carolina DPS		Endangered
South Atlantic DPS		Endangered
Gulf of Maine DPS		Threatened
Giant Manta Ray	*Manta birostris*	Threatened
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Smalltooth sawfish	*Pristis pectinate*	Endangered

BOEM has determined the proposed action is not likely to adversely affect any of these species. We concur with this determination based on the rationale presented below. More information on the status of the species and critical habitat considered in this consultation, as well as relevant listing documents, status reviews, and recovery plans, can be found within the BA and on NMFS webpages accessible at: *https://www.greateratlantic.fisheries.noaa.gov/protected/section7/listing/index.html*, *https://sero.nmfs.noaa.gov/protected_resources/section_7/threatened_endangered/index.html*, and *https://www.fisheries.noaa.gov/species-directory*.

Critical Habitat in the Action Area

The action area overlaps, at least in part, with critical habitat designated for all five DPSs of Atlantic sturgeon, North Atlantic right whales, and the Northwest Atlantic Ocean DPS of loggerhead sea turtles. While critical habitat is designated for some of the other species considered in this consultation, that critical habitat does not occur in the action area. Critical habitat for the Gulf of Maine DPS of Atlantic salmon is limited to certain mainstem rivers in the State of Maine. At this time, we do not know of any geotechnical or geophysical survey activities that are likely to occur in those waters. As such, the proposed action will not overlap with critical habitat designated for the Gulf of Maine DPS of Atlantic salmon. BOEM determined that the activities considered here may affect, but are not likely to adversely affect critical habitat designated for the five DPSs of Atlantic sturgeon or the Northwest Atlantic DPS of loggerhead sea turtles. We concur with these determinations based on the rationale presented in the Effects of the Action section below.

BOEM determined that the activities considered here would have no effect on critical habitat designated for North Atlantic right whales. We agree with this determination as described briefly below.

Critical Habitat designated for the North Atlantic Right Whale

On January 27, 2016, NMFS issued a final rule designating critical habitat for North Atlantic right whales (81 FR 4837). Critical habitat includes two areas (Units) located in the Gulf of Maine and Georges Bank Region (Unit 1) and off the coast of North Carolina, South Carolina, Georgia and Florida (Unit 2). Geophysical and geotechnical surveys and met buoy deployment may occur in Unit 1 and Unit 2. Note that there are seasonal restrictions on certain acoustic survey equipment in Unit 1 and Unit 2 (PDC 4); however, these seasonal restrictions are in place to further reduce the potential for effects to right whales in these areas and are not related to effects on the features of that critical habitat.

Consideration of Potential Effects to Unit 1

As identified in the final rule (81 FR 4837), the physical and biological features essential to the conservation of the North Atlantic right whale that provide foraging area functions in Unit 1 are: 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; 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; late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region.

The activities considered here will not affect the physical oceanographic conditions and structures of the region that distribute and aggregate *C. finmarchicus* for foraging. This is because the activities considered here have no potential to affect currents and circulation patterns, flow velocities, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, or temperature regimes. Therefore, we have determined that the activities considered in this programmatic consultation will have no effect on Unit 1 of right whale critical habitat.

Consideration of Potential Effects to Unit 2

As identified in the final rule (81 FR 4837), the physical and biological features essential to the conservation of the North Atlantic right whale, which provide calving area functions in Unit 2, are: (i) Sea surface conditions associated with Force 4 or less on the Beaufort Scale; (ii) Sea surface temperatures of 7 °C to 17 °C; and, (iii) Water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 nmi^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.

The activities considered here will have no effect on the features of Unit 2; this is because geophysical and geotechnical surveys, met buoys, and vessel operations do not affect sea surface state, water temperature, or water depth. Therefore, we have determined that the activities considered in this programmatic consultation will have no effect on Unit 2 of right whale critical habitat

EFFECTS OF THE ACTION ON NMFS LISTED SPECIES AND CRITICAL HABITAT

Potential effects of the proposed action on listed species can be broadly categorized into the following categories: (1) effects to individual animals of exposure to noise associated with the survey activities (HRG, geotechnical), (2) effects of buoy deployment, operation, and retrieval; (3) effects to habitat from survey activities (including consideration of effects to Atlantic sturgeon and loggerhead critical habitat), and (4) effects of vessel use.

Effects of Exposure to Noise Associated With Survey Activities

Here we consider effects of noise associated with HRG and geotechnical surveys on ESA-listed species. Noise associated with meteorological buoys and vessel operations is discussed in those sections of this consultation.

Acoustic Thresholds

Due to the different hearing sensitivities of different species groups, NMFS uses different sets of acoustic thresholds to consider effects of noise on ESA-listed species. Below, we present information on thresholds considered for ESA-listed whales, sea turtles, and fish considered in this consultation.

ESA-listed Whales

NMFS *Technical Guidance for Assessing the Effects of Anthropogenic Noise on Marine Mammal Hearing* compiles, interprets, and synthesizes scientific literature to produce updated acoustic thresholds to assess how anthropogenic, or human-caused, sound affects the hearing of all marine mammals under NMFS jurisdiction (NMFS 2018[5]). Specifically, it identifies the received levels, or thresholds, at which individual marine mammals are predicted to experience temporary or permanent changes in their hearing sensitivity for acute, incidental exposure to underwater anthropogenic sound sources. As explained in the document, these thresholds represent the best available scientific information. These acoustic thresholds cover the onset of both temporary (TTS) and permanent hearing threshold shifts (PTS).

[5] See *https://www.fisheries.noaa.gov/national/marine-mammal-protection/marine-mammal-acoustic-technical-guidance* for more information.

Table 2. Impulsive acoustic thresholds identifying the onset of permanent threshold shift and temporary threshold shift for ESA-listed whales (NMFS 2018).

Hearing Group	Generalized Hearing Range[6]	Permanent Threshold Shift Onset[7]	Temporary Threshold Shift Onset
Low-Frequency Cetaceans (LF: baleen whales)	7 Hz to 35 kHz	Lpk,flat: 219 dB LE,LF,24h: 183 dB	Lpk,flat: 213 dB LE,LF,24h: 168 dB
Mid-Frequency Cetaceans (MF: sperm whales)	150 Hz to 160 kHz	Lpk,flat: 230 dB LE,MF,24h: 185 dB	Lpk,flat: 224 dB LE,MF,24h: 170 dB

These thresholds are a dual metric for impulsive sounds, with one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the duration of exposure, and another based on cumulative sound exposure level (SEL_{cum}) that does incorporate exposure duration. The two metrics also differ in regard to considering information on species hearing. The cumulative sound exposure criteria incorporate auditory weighting functions, which estimate a species group's hearing sensitivity, and thus susceptibility to TTS and PTS, over the exposed frequency range, whereas peak sound exposure level criteria do not incorporate any frequency dependent auditory weighting functions.

Additionally, NMFS considers exposure to impulsive/intermittent noise greater than 160 dB re 1uPa rms to have the potential to result in Level B harassment, as defined under the MMPA (which does not necessarily equate to ESA harassment). This value is based on observations of behavioral responses of baleen whales (Malme et al. 1983; Malme et al. 1984; Richardson et al. 1986; Richardson et al. 1990), but is used for all marine mammal species.

Sea Turtles
In order to evaluate the effects of exposure to the survey noise by sea turtles, we rely on the available scientific literature. Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Ridgway et al. 1969, Lenhardt 1994, Bartol et al. 1999, Lenhardt 2002, Bartol and Ketten 2006). Currently, the best available data regarding the potential for noise to cause behavioral disturbance come from studies by O'Hara and Wilcox (1990) and McCauley et al. (2000), who experimentally examined behavioral responses of sea turtles in response to seismic airguns. O'Hara and Wilcox

[6] Represents the generalized hearing range for the entire group as a composite (i.e., all species within the group), where individual species' hearing ranges are typically not as broad. Generalized hearing range chosen based on approximately 65 dB threshold from normalized composite audiogram, with the exception for lower limits for LF cetaceans (Southall et al. 2007).
[7] $L_{pk,flat}$: unweighted ($_{flat}$) peak sound pressure level (L_{pk}) with a reference value of 1 µPa; $L_{E,XF,24h}$: weighted (by species group; $_{LF}$: Low Frequency, or $_{MF}$: Mid-Frequency) cumulative sound exposure level (L_E) with a reference value of 1 μPa^2-s and a recommended accumulation period of 24 hours ($_{24h}$)

(1990) found that loggerhead turtles exhibited avoidance behavior at estimated sound levels of 175 to 176 dB re: 1 µPa (rms) (or slightly less) in a shallow canal. McCauley et al. (2000) reported a noticeable increase in swimming behavior for both green and loggerhead turtles at received levels of 166 dB re: 1 µPa (rms). At 175 dB re: 1 µPa (rms), both green and loggerhead turtles displayed increased swimming speed and increasingly erratic behavior (McCauley et al. 2000). Based on these data, we assume that sea turtles would exhibit a behavioral response when exposed to received levels of 175 dB re: 1 µPa (rms) and higher.

In order to evaluate the effects of exposure to the survey noise by sea turtles that could result in physical effects, we relied on the available literature related to the noise levels that would be expected to result in sound-induced hearing loss (i.e., temporary threshold shift (TTS) or permanent threshold shift (PTS)); we relied on acoustic thresholds for PTS and TTS for impulsive sounds developed by the U.S. Navy for Phase III of their programmatic approach to evaluating the environmental effects of their military readiness activities (U.S. Navy 2017). At the time of this consultation, we consider these the best available data since they rely on all available information on sea turtle hearing and employ the same statistical methodology to derive thresholds as in NMFS recently issued technical guidance for auditory injury of marine mammals (NMFS 2018). Below we briefly detail these thresholds and their derivation. More information can be found in the U.S. Navy's Technical report on the subject (U.S. Navy 2017).

To estimate received levels from airguns and other impulsive sources expected to produce TTS in sea turtles, the U.S. Navy compiled all sea turtle audiograms available in the literature in an effort to create a composite audiogram for sea turtles as a hearing group. Since these data were insufficient to successfully model a composite audiogram via a fitted curve as was done for marine mammals, median audiogram values were used in forming the hearing group's composite audiogram. Based on this composite audiogram and data on the onset of TTS in fishes, an auditory weighting function was created to estimate the susceptibility of sea turtles to TTS. Data from fishes were used since there are currently no data on TTS for sea turtles and fishes are considered to have hearing more similar to sea turtles than do marine mammals (Popper et al. 2014). Assuming a similar relationship between TTS onset and PTS onset as has been described for humans and the available data on marine mammals, an extrapolation to PTS susceptibility of sea turtles was made based on the methods proposed by (Southall et al. 2007). From these data and analyses, dual metric thresholds were established similar to those for marine mammals: one threshold based on peak sound pressure level (0-pk SPL) that does not incorporate the auditory weighting function nor the duration of exposure, and another based on cumulative sound exposure level (SEL_{cum}) that incorporates both the auditory weighting function and the exposure duration (Table 3).

Table 3. Acoustic thresholds identifying the onset of permanent threshold shift and temporary threshold shift for sea turtles exposed to impulsive sounds (U.S. Navy 2017, McCauley et al. 2000).

Hearing Group	Generalized Hearing Range	Permanent Threshold Shift Onset	Temporary Threshold Shift Onset	Behavioral Response
Sea Turtles	30 Hz to 2 kHz	204 dB re: 1 $\mu Pa^2 \cdot s$ SEL_{cum}	189 dB re: 1 $\mu Pa^2 \cdot s$ SEL_{cum}	175 dB re: 1 μPa (rms)
		232 dB re: 1 μPa SPL (0-pk)	226 dB re: 1 μPa SPL (0-pk)	

Marine Fish

There are no criteria developed for considering effects to ESA-listed fish specific to HRG equipment. However, all of the equipment that operates within a frequency that these fish species are expected to respond to, produces intermittent or impulsive sounds; therefore, it is reasonable to use the criteria developed for impact pile driving, seismic, and explosives when considering effects of exposure to this equipment (FHWG 2008). However, unlike impact pile driving, which produces repetitive impulsive noise in a single location, the geophysical survey sound sources are moving; therefore, the potential for repeated exposure to multiple pulses is much lower when compared to pile driving. We expect fish to react to noise that is disturbing by moving away from the sound source and avoiding further exposure. Injury and mortality is only known to occur when fish are very close to the noise source and the noise is very loud and typically associated with pressure changes (i.e., impact pile driving or blasting).

The Fisheries Hydroacoustic Working Group (FHWG) was formed in 2004 and consists of biologists from NMFS, United States Fish and Wildlife Service, Federal Highway Administration, USACE, and the California, Washington, and Oregon Department of Transportations, supported by national experts on underwater sound producing activities that affect fish and wildlife species of concern. In June 2008, the agencies signed an MOA documenting criteria for assessing physiological effects of impact pile driving on fish. The criteria were developed for the acoustic levels at which physiological effects to fish could be expected. It should be noted, that these are onset of physiological effects (Stadler and Woodbury, 2009), and not levels at which fish are necessarily mortally damaged. These criteria were developed to apply to all fish species. The interim criteria are:

- Peak SPL: 206 dB re 1 μPa
- SELcum: 187 B re 1μPa^2-s for fishes 2 grams or larger (0.07 ounces).
- SELcum: 183 dB re 1μPa^2-s for fishes less than 2 grams (0.07 ounces).

At this time, these criteria represent the best available information on the thresholds at which physiological effects to ESA-listed marine fish are likely to occur. It is important to note that physiological effects may range from minor injuries from which individuals are anticipated to completely recover with no impact to fitness to significant injuries that will lead to death. The severity of injury is related to the distance from the noise source and the duration of exposure. The closer to the source and the greater the duration of the exposure, the higher likelihood of significant injury. Use of the 183 dB re 1 μPa^2-s cSEL threshold, is not appropriate for this consultation because all sturgeon in the action area will be larger than 2 grams. Physiological effects could range from minor injuries that a fish is expected to completely recover from with no impairment to survival to major injuries that increase the potential for mortality, or result in death.

We use 150 dB re: 1 μPa RMS as a threshold for examining the potential for behavioral responses by individual listed fish to noise with frequency less than 1 kHz. This is supported by information provided in a number of studies (Andersson et al. 2007, Purser and Radford 2011, Wysocki et al. 2007). Responses to temporary exposure of noise of this level is expected to be a range of responses indicating that a fish detects the sound, these can be brief startle responses or in the worst case, we expect that listed fish would completely avoid the area ensonified above 150 dB re: 1 uPa rms. Popper et al. (2014) does not identify a behavioral threshold but notes that the potential for behavioral disturbance decreases with the distance from the source.

HRG Acoustic Sources

HRG surveys are used for a number of site characterization purposes: locating shallow hazards, cultural resources, and hard-bottom areas; evaluating installation feasibility; assisting in the selection of appropriate foundation system designs; and determining the variability of subsurface sediments. The equipment typically used for these surveys includes: Bathymetry/Depth Sounder; Magnetometer; Seafloor Imagery/Side-Scan Sonar; Shallow and Medium (Seismic) Penetration Sub-bottom Profilers (e.g., CHIRPs, boomers, bubble guns). This consultation does not consider the use of seismic airguns because this equipment is not required for site characterization activities to support offshore wind development (due to the shallow sediment depths that need to be examined, compared to the miles into the seabed that are examined for oil and gas exploration where airguns are used).

As described in the BA, BOEM completed a desktop analysis of nineteen HRG sources in Crocker and Fratantonio (2016) to evaluate the distance to thresholds of concern for listed species (see tables in Appendix A). Equipment types or frequency settings that would not be used for the survey purposes by the offshore wind industry were not included in this analysis. To provide the maximum impact scenario for these 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), which is the expected speed vessels will travel while towing equipment. 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.

Tables 4 and 5 describe the greatest distances to thresholds of concern for the various equipment types analyzed by BOEM. It is important to note that as different species groups have different hearing sensitivities, not all equipment operates within the hearing threshold of all species considered here. Complete tables are included in Appendix B of BOEM’s BA.

Table 1. Summary of greatest PTS Exposure Distances from mobile HRG Sources at Speeds of 4.5 knots.

HRG SOURCE	PTS DISTANCE (m)								
	Highest Source Level (dB re 1 µPa)	Sea Turtles		Fish[b]		Baleen Whales		Sperm Whales[c]	
Mobile, Impulsive, Intermittent Sources									
		Peak	*SEL*	*Peak*	*SEL*	*Peak*	*SEL*	*Peak*	*SEL*
Boomers, Bubble Guns	176 dB SEL 207 dB RMS 216 PEAK	0	0	3.2	0	0	0.3	0	0
Sparkers	188 dB SEL 214 dB RMS 225 PEAK	0	0	9	0	2	12.7	0	0.2
Chirp Sub-Bottom Profilers	193 dB SEL 209 dB RMS 214 PEAK	NA	NA	NA	NA	0	1.2	0	0.3
Mobile, Non-impulsive, Intermittent Sources									
Multi-beam echosounder (100 kHz)	185 dB SEL 224 dB RMS 228 PEAK	NA	NA	NA	NA	NA	NA	0	0.5
Multi-beam echosounder (>200 kHz) (mobile, non-impulsive, intermittent)	182 dB SEL 218 dB RMS 223 PEAK	NA	NA	NA	NA	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	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.

Using the same sound sources for the PTS analysis, BOEM calculated the 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 5). 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 do not consider the tow depth and directionality of the sources; therefore, these are likely overestimates of actual disturbance distances.

Table 5. Summary of greatest disturbance distances by equipment type.

HRG SOURCE	DISTURBANCE DISTANCE (m)			
	Sea Turtles (175 dB re 1uPa rms)	Fish (150 dB re 1uPa rms)	Baleen Whales (160 dB re 1uPa rms)	Sperm Whales (160 dB re 1uPa rms)
Boomers, Bubble Guns	40	708	224	224
Sparkers	90	1,996[a]	502	502
Chirp Sub-Bottom Profilers	2	32	10	10
Multi-beam Echosounder (100 kHz)	NA	NA	NA	<369[b]
Multi-beam Echosounder (>200 kHz)	NA	NA	NA	NA
Side-scan Sonar (>200 kHz)	NA	NA	NA	NA

a – the calculated distance to the 150 dB rms threshold for the Applied Acoustics Dura-Spark is 1,996m; however, the distances for other equipment in this category is significantly smaller
b – this distance was recalculated using the NMFS spreadsheet following receipt of the BA.
NA = not applicable due to the sound source being out of the hearing range for the group.

Marine Mammals
Considering peak noise levels, the equipment resulting in the greatest isopleth to the marine mammal PTS threshold is the sparker (2.0 m for baleen whales, 0 m for sperm whales; Table A.3). Considering the cumulative threshold (24 hour exposure), the greatest distance to the PTS threshold is 12.7 m for baleen whales and 0.5 m for sperm whales. Animals in the survey area during the HRG survey are unlikely to incur any hearing impairment due to the characteristics of the sound sources, considering the source levels (176 to 205 dB re 1 µPa-m) and generally very short pulses and duration of the sound. Individuals would have to make a very close approach and

also remain very close to vessels operating these sources (<13 m) in order to receive multiple exposures at relatively high levels, as would be necessary to have the potential to result in any hearing impairment. Kremser et al. (2005) noted that the probability of a whale swimming through the area of exposure when a sub-bottom profiler emits a pulse is small—because if the animal was in the area, it would have to pass the transducer at close range in order to be subjected to sound levels that could cause PTS and would likely exhibit avoidance behavior to the area near the transducer rather than swim through at such a close range. Further, the restricted beam shape of many of HRG survey devices planned for use makes it unlikely that an animal would be exposed more than briefly during the passage of the vessel. The potential for exposure to noise that could result in PTS is even further reduced by the clearance zone and the use of PSOs to all for a shutdown of equipment operating within the hearing range of ESA-listed whales should a right whale or unidentified large whale be detected within 500 m or 100 m for an identified sei, fin, or sperm whale, see PDC 4. Based on these considerations, it is extremely unlikely that any ESA-listed whale will be exposed to noise that could result in PTS.

Masking is the obscuring of sounds of interest to an animal by other sounds, typically at similar frequencies. Marine mammals are highly dependent on sound, and their ability to recognize sound signals amid other sounds is important in communication and detection of both predators and prey (Tyack 2000). Although masking is a phenomenon which may occur naturally, the introduction of loud anthropogenic sounds into the marine environment at frequencies important to marine mammals increases the severity and frequency of occurrence of masking. The components of background noise that are similar in frequency to the signal in question primarily determine the degree of masking of that signal. In general, little is known about the degree to which marine mammals rely upon detection of sounds from conspecifics, predators, prey, or other natural sources. In the absence of specific information about the importance of detecting these natural sounds, it is not possible to predict the impact of masking on marine mammals (Richardson et al., 1995). In general, masking effects are expected to be less severe when sounds are transient than when they are continuous. Masking is typically of greater concern for those marine mammals that utilize low-frequency communications, such as baleen whales, because of how far low-frequency sounds propagate. NMFS has previously concluded that marine mammal communications would not likely be masked appreciably by the sub-bottom profiler signals given the directionality of the signals for most HRG survey equipment types planned for use for the types of surveys considered here and the brief period when an individual mammal is likely to be within its beam (see for example, 86 FR 22160). Based on this, any effects of masking on ESA-listed whales will be insignificant.

For equipment that operates within the functional hearing range (7 Hz to 35 kHz) of baleen whales, the area ensonified by noise greater than 160 dB re: 1uPa rms will extend no further than 502 m from the source (sparkers; the distance for chirp (10 m) and boomers and bubble guns (224 m) is smaller (Table A.5)). For equipment that operates within the functional hearing range of sperm whales (150 Hz to 160 kHz), the area ensonified by noise greater than 160 dB re: 1uPa rms will extend no further than 369 m from the source (100 kHz Multi-beam echosounder; the distance for sparkers (502 m), boomers and bubble guns (224 m), and chirp (10 m) is smaller; Table A.5).

Given that the distance to the 160 dB re: 1 uPa rms threshold extends beyond the required Shutdown Zone, it is possible that ESA-listed whales will be exposed to potentially disturbing levels of noise during the surveys considered here. We have determined that, in this case, the exposure to noise above the MMPA Level B harassment threshold (160 dB re: 1uPa rms) will result in effects that are insignificant. We expect that the result of this exposure would be, at worst, temporary avoidance of the area with underwater noise louder than this threshold, which is a reaction that is considered to be of low severity and with no lasting biological consequences (e.g., Ellison et al. 2007). The noise source itself will be moving. This means that any co-occurrence between a whale, even if stationary, will be brief and temporary. Given that exposure will be short (no more than a few seconds, given that the noise signals themselves are short and intermittent and because the vessel towing the noise source is moving) and that the reaction to exposure is expected to be limited to changing course and swimming away from the noise source only far/long enough to get out of the ensonified area (502 m or less, depending on the noise source), the effect of this exposure and resulting response will be so small that it will not be able to be meaningfully detected, measured or evaluated and, therefore, is insignificant. Further, the potential for disruption to activities such as breeding, feeding (including nursing), resting, and migrating is extremely unlikely given the very brief exposure to any noise (given that the source is traveling and the area ensonified at any given moment is so small). Any brief interruptions of these behaviors are not anticipated to have any lasting effects. Because the effects of these temporary behavioral changes are so minor, it is not reasonable to expect that, under the NMFS' interim ESA definition of harassment, they are equivalent to an act that would "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering."

Sea Turtles

None of the equipment being operated for these surveys that overlaps with the hearing range (30 Hz to 2 kHz) for sea turtles has source levels loud enough to result in PTS or TTS based on the peak or cumulative exposure criteria (Table A.4). Therefore, physical effects are extremely unlikely to occur.

As explained above, we assume that sea turtles would exhibit a behavioral response when exposed to received levels of 175 dB re: 1 µPa (rms) and are within their hearing range (below 2 kHz). For boomers and bubble guns the distance to this threshold is 40 m, and is 90 m for sparkers and 2 m for chirps (Table A.5). Thus, a sea turtle would need to be within 90 m of the source to be exposed to potentially disturbing levels of noise. We expect that sea turtles would react to this exposure by swimming away from the sound source; this would limit exposure to a short time period, just the few seconds it would take an individual to swim away to avoid the noise.

The risk of exposure to potentially disturbing levels of noise is reduced by the use of PSOs to monitor for sea turtles. As required by the PDC 4, a Clearance Zone (500 m in all directions) for ESA-listed species must be monitored around all vessels operating equipment at a frequency of less than 180 kHz. At the start of a survey, equipment cannot be turned on until the Clearance Zone is clear for at least 30 minutes. This condition is expected to reduce the potential for sea turtles to be exposed to noise that may be disturbing. However, even in the event that a sea turtle is submerged and not seen by the PSO, in the worst case, we expect that sea turtles would avoid the area ensonified by the survey equipment that they can perceive. Because the area where increased underwater noise will be experienced is transient and increased underwater noise will only be experienced in a particular area for only seconds, we expect any effects to behavior to be minor and limited to a temporary disruption of normal behaviors, temporary avoidance of the ensonified area and minor additional energy expenditure spent while swimming away from the noisy area. If foraging or migrations are disrupted, we expect that they will quickly resume once the survey vessel has left the area. No sea turtles will be displaced from a particular area for more than a few minutes. While the movements of individual sea turtles will be affected by the sound associated with the survey, these effects will be temporary (seconds to minutes) and localized (avoiding an area no larger than 90 m) and there will be only a minor and temporary impact on foraging, migrating or resting sea turtles. For example, BOEM calculated that for a survey with equipment being towed at 3 knots, exposure of a turtle that was within 90 m of the source would last for less than two minutes. We also note that, to minimize disturbance to the Northwest Atlantic Ocean DPS of loggerhead sea turtles, a voluntary pause in sparker operation will be implemented for all vessels operating in nearshore critical habitat for loggerhead sea turtles if any loggerhead or other sea turtle is observed within a 100 m Clearance Zone during a survey. This will further reduce the potential for behavioral disturbance.

Given the intermittent and short duration of exposure to any potentially disturbing noise from HGR equipment, major shifts in habitat use or distribution or foraging success are not expected. Effects to individual sea turtles from brief exposure to potentially disturbing levels of noise are expected to be minor and limited to a brief startle, short increase in swimming speed and/or short displacement, and will be so small that they cannot be meaningfully measured, detected, or evaluated; therefore, effects are insignificant.

Marine Fish

Of the equipment that may be used for geophysical surveys, only equipment that operates at a frequency within the estimated hearing range of the ESA-listed fish that may occur in the action area (i.e., frequency less than 1 kHz; Lovell et al. 2005; Meyer et al. 2010) may affect these species. Generally, this includes sparkers, boomers, and bubble guns (see Table A.2). All other survey equipment operates at a frequency higher than the ESA-listed fish considered here are expected to hear; therefore, we do not expect any effects to ESA-listed fish exposed to increased underwater noise from the other higher frequency survey equipment. Due to their typically submerged nature, monitoring clearance or shutdown zones for marine fish is not expected to be effective. As required by PDC 4, the surveys will use a ramp up procedure; that is, noise producing equipment will not be used at full energy right away. This gives any fish in the immediate area a “warning” and an opportunity to leave the area before the full energy of the survey equipment is used.

As explained above, the available information suggests that for noise exposure to result in physiological impacts to the fish species considered here, received levels need to be at least 206 dB re: 1uPa peak sound pressure level (SPLpeak) or at least 187 dB re: u1Pa cumulative. The peak thresholds are exceeded only very close to the noise source (<3.2 m for the boomers/bubble guns and <9 m for the sparkers (see Table A.4); the cumulative threshold is not exceeded at any distance. As such, in order to be exposed to peak sound pressure levels of 206 dB re: 1uPa from any of these sources, an individual fish would need to be within 9 m of the source (Table A.4). This is extremely unlikely to occur given the dispersed nature of the distribution of ESA-listed fish in the action area, the use of a ramp up procedure, the moving and intermittent/pulsed characteristic of the noise source, and the expectation that ESA-listed fish will swim away, rather than towards the noise source. Based on this, no physical effects to any ESA-listed fish, including injury or mortality, are expected to result from exposure to noise from the geophysical surveys.

We use 150 dB re: 1 µPa root mean square (RMS) sound pressure level (SPL) as a threshold for examining the potential for behavioral responses to underwater noise by ESA-listed fish. This is supported by information provided in a number of studies (Andersson et al. 2007, Purser and Radford 2011, Wysocki et al. 2007). In the worst case, we expect that ESA-listed fish would completely avoid an area ensonified above 150 dB re: 1uPa rms for the period of time that noise in that area was elevated. The calculated distances to the 150 dB re: 1 uPa rms threshold for the boomers/bubble guns, sparkers, and sub-bottom profilers is 708 m, 1,996 m, and 32 m, respectively (Table A.5). It is important to note that BOEM has conservatively used the highest power levels for each sound source reported in Crocker and Fratantonio (2016) to calculate these distances; thus, they likely overestimate actual sound fields.

Because the area where increased underwater noise will be experienced is transient (because the survey vessel towing the equipment is moving), increased underwater noise will only be experienced in a particular area for a short period of time. Given the transient and temporary nature of the increased noise, we expect any effects to behavior to be minor and limited to a temporary disruption of normal behaviors, potential temporary avoidance of the ensonified area and minor additional energy expenditure spent while swimming away from the noisy area. If foraging, resting, or migrations are disrupted, we expect that these behaviors will quickly resume once the survey vessel has left the area (i.e., in seconds to minutes, given its traveling speed of 3 – 4.5 knots). Therefore, no fish will be displaced from a particular area for more than a few minutes. While the movements of individual fish will be affected by the sound associated with the survey, these effects will be temporary and localized and these fish are not expected to be excluded from any particular area and there will be only a minimal impact on foraging, migrating, or resting behaviors. Sustained shifts in habitat use or distribution or foraging success are not expected. Effects to individual fish from brief exposure to potentially disturbing levels of noise are expected to be limited to a brief startle or short displacement and will be so small that they cannot be meaningfully measured, detected, or evaluated; therefore, effects of exposure to survey noise are insignificant.

Acoustic Effects - Geotechnical Surveys

Geotechnical surveys generally do not use active acoustic sources, but may have some low-level ancillary sounds associated with them. As described in the BA, the loudest noises are from drilling associated with obtaining bore samples. 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).

Noise associated with geotechnical surveys is below the level that we expect may result in physiological or behavioral responses by any ESA-listed species considered here. As such, effects to listed whales, sea turtles, or fish from exposure to this noise source are extremely unlikely to occur.

Meteorological Buoys

A meteorological buoy (met buoy) is designed to collect meteorological data for a period of four-five years. During this time, data will be collected and transmitted to onshore facilities. The operation of the meteorological data collection instrumentation (i.e., light detection and ranging remote sensing technology (LIDAR) and Acoustic Doppler Current Profilers (ADCP)) will have no effect on any listed species as it does not operate in any way that could result in effects to listed species. Bathymetric LIDAR uses water-penetrating green light to also measure seafloor and riverbed elevations. ADCP uses extremely high frequency sound (well above the hearing frequency of any species considered in this consultation) to measure water currents. No other acoustic effects from the deployment of the met buoys are anticipated.

Buoys will be deployed and retrieved by vessels; maintenance will also be carried out from vessels. Potential effects of vessel traffic for all activities considered in this consultation is addressed below. PDCs for siting the buoy will result in avoidance of anchoring buoys on any sensitive habitats (i.e., placement will occur on unconsolidated and uncolonized areas only, avoiding eelgrass, corals, etc.) (see PDC 1). Buoys will be anchored to a clump weight anchor and attached to the anchor with heavy chain. We have considered the potential for any listed species, including whales and/or sea turtles, to interact with the buoy and to become entangled in the buoy or mooring system and have determined that this is extremely unlikely to occur for the reasons outlined below.

In order for an entanglement to occur, an animal must first encounter the gear, which has an extremely low likelihood based on the number of buoys and total area where buoys may be deployed (Atlantic OCS). BOEM predicts that up to two met buoys could be deployed in any potential lease area, for a maximum of 60 buoys deployed in the entirety of the Atlantic OCS. Given the small number of buoys and their dispersed locations on the OCS, the potential for encounter between an individual whale or sea turtle and a buoy is extremely low. However even if there is co-occurrence between an individual animal and one or more buoys, entanglement is extremely unlikely to occur. This is because the buoy will be attached to the anchor with heavy gauge chain, which reduces the risk of entanglement due to the tension that the buoy will be under and the gauge of the chain, which prevents any slack in the chain that could result in an entanglement (see PDC 6). There have been no documented incidences of any listed species, including whales or sea turtles, entangled in United States Coast Guard navigational buoys, which have a similar mooring configuration to these met buoys, but also far outnumber the potential number of deployed met buoys (there are 1000s of navigational buoys within the range of ESA-listed whales and sea turtles and no recorded entanglements). Based on the analysis herein, it is extremely unlikely that any ESA-listed species will interact with the buoy and anchor system such that it becomes entangled. As such, effects are extremely unlikely to occur.

Effects to Habitat

Vibracores and grab samples may be used to document habitat types during geophysical and geotechnical survey activities. Both of these survey methods will result in temporary disturbance of the benthos and a potential temporary loss of benthic resources. Additionally, bottom disturbance will occur in the area where a met buoy is anchored.

The vibracores and grab samples will affect an extremely small area (approximately 0.1 to 2.7 ft^2) at each sampling location, with sampling locations several hundred meters apart. While the vibracore and grab sampler will take a portion of the benthos that will be brought onto the ship, because of the small size of the sample and the nature of the removal, there is little to no sediment plume associated with the sampling. While there may be some loss of benthic species at the sample sites, including potential forage items for listed species that feed on benthic resources, the amount of benthic resources potentially lost will be extremely small and limited to immobile individuals that cannot escape capture during sampling. As such a small area will be disturbed and there will be a large distance between disturbed areas, recolonization is expected to be rapid. The amount of potential forage lost for any benthic feeding species is extremely small, localized, and temporary. While the area of the bottom impacted by the anchoring of the met buoy is larger (i.e., several meters in diameter), as stated above, there will be a small number of buoys deployed along the entire Atlantic OCS. Any loss of benthic resources will be small, temporary, and localized.

These temporary, isolated reductions in the amount of benthic resources are not likely to have a measurable effect on any foraging activity or any other behavior of listed species; this is due to the small size of the affected areas in relation to remaining available habitat in the OCS and the temporary nature of any disturbance. As effects to listed species will be so small that they cannot be meaningfully measured, detected, or evaluated, effects are insignificant.

Other Considerations – Geotechnical Surveys
The PDCs include a seasonal prohibition on any activities involving disturbance of the bottom in areas where early life stages of Atlantic or shortnose sturgeon may occur (see PDC 2). The seasonal prohibition is designed to avoid any activity that could disturb potential spawning or rearing substrate during the time of year that spawning or rearing may occur in that river. This PDC will also ensure that no bottom disturbing survey activities will occur at a time that eggs or other immobile or minimally mobile early life stages of sturgeon are present. This will ensure that sampling activities will not result in the disturbance, injury, or mortality of any sturgeon. Based on this, any effects to sturgeon spawning habitat or early life stages are extremely unlikely to occur.

Atlantic Sturgeon Critical Habitat
Critical habitat has been designated for all five DPSs of Atlantic sturgeon (82 FR 39160; effective date September 18, 2017). While there is no Atlantic sturgeon critical habitat in the three Atlantic Renewable Energy Regions located on the Atlantic OCS, survey activities along potential cable routes, including vessel transits, may occur within Atlantic sturgeon critical habitat. While BOEM anticipates that activities would be limited to overlapping with critical habitat designated in the Hudson, Delaware, and James rivers for the New York Bight and Chesapeake Bay DPSs respectively, the conclusions reached here apply to critical habitat designated for all five DPSs.

The PDCs include a seasonal prohibition on any geophysical and geotechnical survey activities involving disturbance of the bottom in freshwater (salinity less than 0.5 parts per thousand (ppt)) areas designated as critical habitat for any DPS of Atlantic sturgeon (see PDC # 2 for more detail). The PDCs also require operation of vessels in a way that ensures that vessel activities do not result in disturbance of bottom habitat.

In order to determine if the proposed action may affect critical habitat, we consider whether it would impact the habitat in a way that would affect its ability to support reproduction and recruitment. Specifically, we consider the effects of the action on the physical features of the proposed critical habitat. The Physical and Biological Features (PBFs) essential for Atlantic sturgeon conservation identified in the final rule (82 FR 39160) are:

(1) Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages;

(2) Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development;

(3) Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: (i) Unimpeded movement of adults to and from spawning sites; (ii) Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and, (iii) Staging, resting, or holding of subadults or spawning condition adults. Water depths in main river channels must also be deep enough (e.g., at least 1.2 m) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river.

(4) Water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: (i) Spawning; (ii) Annual and interannual adult, subadult, larval, and juvenile survival; and, (iii) Larval, juvenile, and subadult growth, development, and recruitment (e.g., 13 degrees Celsius [°C] to 26 °C for spawning habitat and no more than 30 °C for juvenile rearing habitat, and 6 milligrams per liter (mg/L) dissolved oxygen (DO) or greater for juvenile rearing habitat).

PBF 1: Hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0–0.5 ppt range) for settlement of fertilized eggs, refuge, growth, and development of early life stages

In considering effects to PBF 1, we consider whether the proposed action will have any effect on areas of hard substrate in low salinity waters that may be used for settlement of fertilized eggs, refuge, growth, and development of early life stages; therefore, we consider effects of the action on hard bottom substrate and any change in the value of this feature in the action area.

Vessel operations during transits or surveys would not affect hard bottom habitat in the part of the river with salinity less than 0.5 ppt, because they 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, geotechnical surveys, and any other activity that may affect hard bottom is prohibited in areas with salinity less than 0.5 ppt during the time of year that these areas may be used for spawning or rearing (PDC 2). Given the very small footprint of all survey activities that may affect the hard bottom (3-4 inch diameter area would be disturbed during sampling) and the spacing of sampling several hundred meters apart, any effects to hard bottom substrate from survey activities outside of the time of year when these areas may be used for spawning and rearing would be small, localized, and dispersed. Given the dynamic nature of river sediments and the small area that will be disturbed, we expect that substrate conditions will recover to pre-survey conditions within days to weeks of sampling occurring. As such, any effects to hard bottom substrate and the value of this feature in the action area or to any of the critical habitat units as a whole are temporary and so small that they cannot be meaningfully measured, evaluated, or detected and, therefore, are insignificant.

PBF 2: Aquatic habitat with a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud) between the river mouth and spawning sites for juvenile foraging and physiological development

In considering effects to PBF 2, we consider whether the proposed action will have any effect on areas of soft substrate within transitional salinity zones between the river mouth and spawning sites for juvenile foraging and physiological development; therefore, we consider effects of the action on soft substrate and salinity and any change in the value of this feature in the action area.

Project vessels (whether transiting or surveying) do not have the potential to effect salinity. Vessels are expected to maintain a minimum of 4-feet clearance with the river bottom (see PDC 2) and, therefore, effects to the soft substrate are extremely unlikely. 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 bottom, which would not affect any soft substrate that is present.

Grab samples and geotechnical surveys may impact soft substrate; however, given the very small footprint of any such activities (3-4 inch diameter area would be disturbed during sampling) and the spacing of sampling locations several hundred meters apart, any effects to soft substrate would be small, localized, and dispersed. Given the dynamic nature of river sediments and the small area that will be disturbed, we expect that substrate conditions will recover to pre-survey conditions within days to weeks of sampling occurring. As such, any effects to soft substrate and the value of this feature in the action area, are extremely unlikely or so small that they cannot be meaningfully measured, evaluated, or detected.

PBF 3: Water absent physical barriers to passage between the river mouth and spawning sites

In considering effects to PBF 3, we consider whether the proposed action will have any effect on water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, thermal plumes, turbidity, sound, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support: unimpeded movements of adults to and from spawning sites; seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and; staging, resting, or holding of subadults or spawning condition adults. We also consider whether the proposed action will affect water depth or water flow, as if water is too shallow it can be a barrier to sturgeon movements, and an alteration in water flow could similarly impact the movements of sturgeon in the river, particularly early life stages that are dependent on downstream drift. Therefore, we consider effects of the action on water depth and water flow and whether the action results in barriers to passage that impede the movements of Atlantic sturgeon.

Survey activities, including vessel transits, will have no effect on this feature as they will not have any effect on water depth or water flow and will not be physical barriers to passage for any life stage of Atlantic sturgeon that may occur in this portion of the action area. As explained above, noise associated with the geotechnical surveys is below the threshold that would be expected to result in any disturbance of sturgeon; therefore, noise associated with geotechnical surveys will not affect the habitat in any way that would affect the movement of Atlantic sturgeon. Similarly, while HRG surveys may affect the movement of individual sturgeon, the effects are short-term and transient; noise is not expected to result in a barrier to passage. Based on this analysis, any effects to PBF 3 will be insignificant.

PBF 4: Water with the temperature, salinity, and oxygen values that, combined, provide for DO values that support successful reproduction and recruitment and are within the temperature range that supports the habitat function

In considering effects to PBF 4, we consider whether the proposed action will have any effect on water, between the river mouth and spawning sites, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support: spawning; annual and interannual adult, subadult, larval, and juvenile survival; and larval, juvenile, and subadult growth, development, and recruitment. Therefore, we consider effects of the action on temperature, salinity and DO needs for Atlantic sturgeon spawning and recruitment. These water quality conditions are interactive and both temperature and salinity influence the DO saturation for a particular area. We also consider whether the action will have effects to access to this feature, temporarily or permanently and consider the effect of the action on the action area's ability to develop the feature over time. Survey activities, including vessel transit, will have no effect on this feature as they will not have any effect on temperature, salinity or dissolved oxygen.

Summary of effects to Atlantic sturgeon critical habitat
We have determined that the effects of the activities considered here will be insignificant on PBFs 1, 2, and 3, and will have no effects to PBF 4. As such, the activities considered here are not likely to adversely affect Atlantic sturgeon critical habitat designated for any of the five DPSs.

Critical Habitat Designated for the Northwest Atlantic Ocean DPS of Loggerhead Sea Turtles
Critical habitat for the Northwest Atlantic Ocean DPS of loggerhead sea turtles was designated in 2014 (79 FR 39855). Specific areas for designation include 38 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of habitat

types: Nearshore reproductive habitat, winter area, breeding areas, constricted migratory corridors, and/or *Sargassum* habitat. There is no critical habitat designated in the North Atlantic Renewable Energy Region. Winter, breeding, and migratory habitat occur in the Mid-Atlantic and South Atlantic regions of the action areas; there is also a small amount of overlap with *Sargassum* critical habitat on the outer edges of the action area near the 100-m isobaths. Geophysical and geotechnical surveys and met buoy deployment may take place within this critical habitat. As explained below, the activities considered in this programmatic consultation are not likely to adversely affect critical habitat designated for the Northwest Atlantic Ocean DPS of loggerheads.

Nearshore Reproductive
The PBF of nearshore reproductive habitat is described as a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season. The occurrence of designated nearshore reproductive habitat in the action area is limited to the area between the beach to 1 mile offshore along the Atlantic coast from Cape Hatteras, North Carolina to the southern extent of the South Atlantic planning area along the Florida coast.

As described in the final rule, the primary constituent elements (PCE) that support this habitat are the following: (1) Nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 CFR 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.

Met buoys will only be deployed in federal waters; therefore, no met buoys will be deployed in nearshore reproductive habitat. HRG and geotechnical surveys and associated vessel transits could occur in this nearshore habitat. The intermittent noise associated with these activities will not be an obstruction to turtles moving through the surf zone; this is because the noise that can be perceived by sea turtles would dissipate to non-disturbing levels within 90 m of the moving source (see further explanation above) and the area with potentially disturbing levels of noise would be limited to one area within 90 m of the source at any given time. Therefore, given the small geographic area affected by noise and that these effects will be temporary (experienced for no more than 2 minutes in any given area), the effects to habitat are insignificant. Any lighting associated with the surveys would be limited to lights on vessels in the ocean, this lighting would not disorient turtles the way that artificial lighting along land can. Additionally, there are no mechanisms by which the HRG and geotechnical surveys and vessel activities would promote predators or disrupt wave patterns necessary for orientation or create excessive longshore currents.

Winter
The PBF of winter habitat is described as warm water habitat south of Cape Hatteras, North Carolina near the western edge of the Gulf Stream used by a high concentration of juveniles and adults during the winter months. The one area of winter critical habitat identified in the final rule extends from Cape Hatteras at the 20 m depth contour straight across 35.27° N. lat. to the 100 m (328 ft.) depth contour, south to Cape Fear at the 20 m (66 ft.) depth contour (approximately

33.47° N. lat., 77.58° W. long.) extending in a diagonal line to the 100 m (328 ft.) depth contour (approximately 33.2° N. lat., 77.32° W. long.). This southern diagonal line (in lieu of a straight latitudinal line) was chosen to encompass the loggerhead concentration area (observed in satellite telemetry data) and identified habitat features, while excluding the less appropriate habitat (e.g., nearshore waters at 33.2° N. lat.). PCEs that support this habitat are the following: (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.

Met buoy deployment/operation, HRG and geotechnical surveys, and vessel transits that may occur within the designated winter habitat will have no effect on this habitat because they will not: affect or change water temperatures above 10° C from November through April; affect continental shelf waters in proximity to the western boundary of the Gulf Stream; or, affect or change water depths between 20 and 100 m.

Breeding

The PBFs of concentrated breeding habitat are sites with high densities of both male and female adult individuals during the breeding season. Two units of breeding critical habitat are identified in the final rule. One occurs in the action area – a concentrated breeding site located in the nearshore waters just south of Cape Canaveral, Florida. The PCEs that support this habitat are the following: (1) High densities of reproductive male and female loggerheads; (2) Proximity to primary Florida migratory corridor; and, (3) Proximity to Florida nesting grounds.

Met buoys, HRG and geotechnical surveys, and vessel transits will not affect the habitat in the breeding units in a way that would change the density of reproductive male or female loggerheads. This is because (as explained fully above), any effects to distribution of sea turtles will be limited to intermittent, temporary disturbance limited to avoidance of an area no more than 90m from the survey vessel. The impacts to habitat from temporary increases in noise will be so small that they will be insignificant.

Constricted Migratory Corridors

The PBF of constricted migratory habitat is high use migratory corridors that are constricted (limited in width) by land on one side and the edge of the continental shelf and Gulf Stream on the other side. The final rule describes two units of constricted migratory corridor habitat. The constricted migratory corridor off North Carolina serves as a concentrated migratory pathway for loggerheads transiting to neritic foraging areas in the north, and back to winter, foraging, and/or nesting areas in the south. The constricted migratory corridor in Florida stretches from the westernmost edge of the Marquesas Keys (82.17° W. long.) to the tip of Cape Canaveral (28.46° N. lat.) and partially overlaps with the action area (i.e., the designated habitat extends further south than the action area). PCEs that support this habitat are the following: (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.

Noise associated with the survey activities considered here will have minor and temporary effects on winter habitat; however, as explained fully above, any effects to sea turtles will be limited to intermittent, temporary disturbance or avoidance of an area no more than 90m from the survey vessel. These temporary and intermittent increases in underwater noise will have insignificant effects on the conditions of the habitat that will not result in any decreased ability or availability of habitat for passage of sea turtles. No other activities will affect passage of loggerhead sea turtles in the wintering habitat.

Sargassum
The PBF of loggerhead *Sargassum* habitat is developmental and foraging habitat for young loggerheads where surface waters form accumulations of floating material, especially *Sargassum*. Two areas are identified in the final rule – the Atlantic Ocean area and the Gulf of Mexico area. The Atlantic Ocean area extends from the Gulf of Mexico along the northern/western boundary of the Gulf Stream and east to the outer edge of the U.S. EEZ. There is a small amount of overlap between the action area and the Atlantic Ocean *Sargassum* critical habitat unit on the outer edges of the action area near the 100-m isobaths. PCEs that support this habitat are the following: (i) Convergence zones, surface-water downwelling 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; (ii) *Sargassum* in concentrations that support adequate prey abundance and cover; (iii) 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, (iv) 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.

Given the distance from shore, met buoy deployment is not anticipated in areas designated as *Sargassum* critical habitat. The occasional project vessel transits, HRG and geotechnical surveys that may occur within the designated *Sargassum* habitat will have no effect on: conditions that result in convergence zones, surface-water downwelling 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; the concentration of *Sargassum*; the availability of prey within *Sargassum*; or the depth of water in any area. This is because these activities do not affect hydrological or oceanographic processes, no *Sargassum* will be removed due to survey activities, and the intermittent noise associated with surveys will not affect the availability of prey within *Sargassum*.

Summary of effects to critical habitat
Any effects to designated critical habitat will be insignificant. Therefore, the survey activities considered in this programmatic consultation are not likely to adversely affect critical habitat designated for the Northwest Atlantic DPS of loggerhead sea turtles.

Vessel Traffic
The HRG and geotechnical surveys are carried out from vessels. Additionally, vessels will be used to transport met buoys to and from deployment sites and to carry out any necessary inspections. As described in BOEM's BA, survey operations involve slow moving vessels, traveling at no more than 3-4.5 knots. HRG and geotechnical surveys typically involve one to three survey vessels operating within the area to be surveyed; up to approximately 36 areas may be surveyed over the 10-year period considered here. During transits to or from survey locations,

these vessels would travel at a maximum speed of around 12 knots. Met buoy deployment, retrieval, and inspection will also involve one or two vessels at a time; a total of 60 buoys are considered in this consultation. These vessels will typically travel at speeds of 12 knots or less; however, service vessels (limited to one trip per month per buoy) may travel at speeds of up to 25 knots (BOEM 2021).

Marine Mammals

As detailed in Appendix B, a number of Best Management Practices (BMPs) (see PDC 5), designed to reduce the risk of vessel strike, will be implemented for all activities covered by this programmatic consultation, including the following requirements:

1. All vessel operators and crews will maintain a vigilant watch for marine mammals at all times, and slow down or stop their vessel to avoid any interaction.
2. PSOs monitoring a Vessel Strike Avoidance Zone during all vessel operations.
3. Complying with speed restrictions in North Atlantic right whale management areas including Seasonal Management Areas (SMAs), active Dynamic Management Areas (DMAs)/visually triggered Slow Zones.
4. Daily monitoring of the NMFS North Atlantic right whale reporting systems.
5. Reducing vessel speeds to ≤10 knots when mother/calf pairs, pods, or large assemblages of ESA-listed marine mammals are observed.
6. Maintaining >500 m separation distance from all ESA-listed whales or an unidentified large marine mammal; if a whale is sighted within 200 m of the forward path of the vessel, then reducing speed and shifting the engines into neutral, and must not be engaged until the whale has move outside of the vessel's path and beyond 500 m.

An examination of all known ship strikes from all shipping sources (civilian and military) indicates vessel speed is a principal factor in whether a vessel strike results in death of a whale (Kelley et al. 2020; Knowlton and Kraus 2001; Laist et al., 2001; Jensen and Silber 2003; Vanderlaan and Taggart 2007). In assessing records with known vessel speeds, Laist et al. (2001) found a direct relationship between the occurrence of a whale strike and the speed of the vessel involved in the collision. The authors concluded that most deaths occurred when a vessel was traveling in excess of 24.1 km/h (14.9 mph; 13 knots (kn)). Additionally, Kelley et al (2020) found that collisions that create stresses in excess of 0.241 megapascals were likely to cause lethal injuries to large whales and through biophysical modeling that vessels of all sizes can yield stresses higher than this critical level. Survey vessels will typically travel slowly (less than 4.5 knots) as necessary for data acquisition, will have PSOs monitoring for whales, and will adjust vessel operations as necessary to avoid striking whales during survey operations and transits. The only times that survey vessels will operate at speeds above 4 knots is during transit to and from the survey site where they may travel at speeds up to 12 knots (although several circumstances described below will restrict speed to 10 knots), a number of measures (see PDC 5) will be in place to minimize the risk of strike during these transits. Slow operating speeds mean that vessel operators have more time to react and steer the vessel away from a whale. The use of dedicated PSOs to keep a constant watch for whales and to alert vessel operators of any sightings also allows vessel operators to avoid striking any sighted whales.

As noted above, vessels used to inspect and maintain met buoys may travel at speeds up to 25 knots. This vessel traffic will be an extremely small increase in the amount of vessel traffic in the action area (i.e., if 60 buoys are deployed this would be a maximum of 60 trips per month spread out along the entire Atlantic OCS), which is transited by thousands of vessels each day. These vessels are subject to all of the vessel related BMPs (see PDC 5) noted above, including use of a dedicated lookout, vessel strike avoidance procedures, and requirements to slow down to 10 knots in areas where North Atlantic right whales have been documented (i.e., within SMAs, DMAs/visually triggered Slow Zones). Based on this analysis, it is extremely unlikely that a vessel associated with the survey activities considered here, when added to the environmental baseline, will strike an ESA-listed whale. We note that similar activities have taken place since at least 2012 in association with BOEM's renewable energy program and there have been no reports of any vessel strikes of marine mammals.

The frequency range for vessel noise (10 to 1000 Hz; MMS 2007) overlaps with the generalized hearing range for sei, fin, and right whales (7 Hz to 35 kHz) and sperm whales (150 Hz to 160 kHz) and would therefore be audible. Vessels without ducted propeller thrusters would produce levels of noise of 150 to 170 dB re 1 µPa-1 meter at frequencies below 1,000 Hz, while the expected sound-source level for vessels with ducted propeller thrusters level is 177 dB (RMS) at 1 meter (BOEM 2015, Rudd et al. 2015). For ROVs, source levels may be as high as 160 dB (BOEM 2021). Given that the noise associated with the operation of project vessels is below the thresholds that could result in injury, no injury is expected.

Marine mammals may experience masking due to vessel noises. For example, right whales were observed to shift the frequency content of their calls upward while reducing the rate of calling in areas of increased anthropogenic noise (Parks et al. 2007) as well as increasing the amplitude (intensity) of their calls (Parks et al. 2011a; Parks et al. 2009). Right whales also had their communication space reduced by up to 84 percent in the presence of vessels (Clark et al. 2009). Although humpback whales did not change the frequency or duration of their vocalizations in the presence of ship noise, their source levels were lower than expected, potentially indicating some signal masking (Dunlop 2016).

Vessel noise can potentially mask vocalizations and other biologically important sounds (e.g., sounds of prey or predators) that marine mammals may rely on. Potential masking can vary depending on the ambient noise level within the environment, the received level and frequency of the vessel noise, and the received level and frequency of the sound of biological interest. In the open ocean, ambient noise levels are between about 60 and 80 dB re 1 µPa in the band between 10 Hz and 10 kHz due to a combination of natural (e.g., wind) and anthropogenic sources (Urick 1983), while inshore noise levels, especially around busy ports, can exceed 120 dB re 1 µPa. When the noise level is above the sound of interest, and in a similar frequency band, masking could occur. This analysis assumes that any sound that is above ambient noise levels and within an animal's hearing range may potentially cause masking. However, the degree of masking increases with increasing noise levels; a noise that is just detectable over ambient levels is unlikely to cause any substantial masking.

Vessel noise has the potential to disturb marine mammals and elicit an alerting, avoidance, or other behavioral reaction. These reactions are anticipated to be short-term, likely lasting the amount of time the vessel and the whale are in close proximity (e.g., Magalhaes et al. 2002; Richardson et al. 1995; Watkins 1981), and not consequential to the animals. Additionally, short-term masking could occur. Masking by passing ships or other sound sources transiting the action area would be short term and intermittent, and therefore unlikely to result in any substantial costs or consequences to individual animals or populations. Areas with increased levels of ambient noise from anthropogenic noise sources such as areas around busy shipping lanes and near harbors and ports may cause sustained levels of masking for marine mammals, which could reduce an animal's ability to find prey, find mates, socialize, avoid predators, or navigate.

Based on the best available information, ESA-listed whales are either not likely to respond to vessel noise or are not likely to measurably respond in ways that would significantly disrupt normal behavior patterns that include, but are not limited to, breeding, feeding or sheltering. Therefore, the effects of vessel noise on ESA-listed whales are insignificant (i.e., so minor that the effect cannot be meaningfully evaluated or detected).

Sea Turtles

As detailed in Appendix B, a number of BMPs (see PDC 5), designed to reduce the risk of vessel strike, will be implemented for all activities covered by this programmatic consultation, including dedicated lookouts on board all transiting vessels, reduced speeds and avoidance of areas where sea turtles are likely to occur (e.g., Sargassum patches), and required separation distances from any observed sea turtles.

Sea turtles are vulnerable to vessel collisions because they regularly surface to breathe and often rest at or near the surface. Sea turtles often congregate close to shorelines during the breeding season, where boat traffic is denser (Schofield et al. 2007; Schofield et al. 2010) which can increase vulnerability to vessel strike in such areas, particularly by smaller, fast moving vessels. Sea turtles, with the exception of hatchlings and pre-recruitment juveniles, spend a majority of their time submerged (Renaud and Carpenter 1994; Sasso and Witzell 2006). Although, Hazel et al. (2007) demonstrated sea turtles preferred to stay within the three meters of the water's surface, despite deeper water being available. Any of the sea turtle species found in the action area can occur at or near the surface in open-ocean and coastal areas, whether resting, feeding or periodically surfacing to breathe.

While research is limited on the relationship between sea turtles, vessel strikes and vessel speeds, sea turtles are at risk of vessel strike where they co-occur with vessels. Sea turtle detection is likely based primarily on the animal's ability to see the oncoming vessel, which would provide less time to react to vessels traveling at speeds at or above 10 knots (Hazel et al. 2007). Hazel et al. (2007) examined vessel strike risk to green sea turtles and suggested that sea turtles may habituate to vessel sound and are more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in eliciting responses (Hazel et al. 2007). Regardless of what specific stressor associated with vessels turtles are responding, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel et al. 2007). This is a concern because faster vessel speeds also have the potential to result in more serious injuries (Work et al. 2010). Although sea turtles can move quickly, Hazel et al. (2007) concluded that at vessel speeds above 4 km/hour (2.1 knots) vessel operators cannot rely on turtles to actively avoid being struck. Thus, sea turtles are not considered reliably capable of moving out of the way of vessels moving at speeds greater than 2.1 knots.

While vessel struck sea turtles have been observed throughout their range, including in the action area, the regions of greatest concern for vessel strike are areas with high concentrations of recreational-boat traffic such as the eastern Florida coast, the Florida Keys, and the shallow coastal bays in the Gulf of Mexico (NRC 1990). In general, the risk of strike for sea turtles is considered to be greatest in areas with high densities of sea turtles and small, fast moving vessels such as recreational vessels or speed boats (NRC 1990). Similarly, Foley et al. (2019) concluded that in a study in Florida, vessel strike risk for sea turtles was highest at inlets and passes. Stetzar (2002) reports that 24 of 67 sea turtles stranded along the Atlantic Delaware coast from 1994-1999 had evidence of boat interactions (hull or propeller strike); however, it is unknown how many of these strikes occurred after the sea turtle died. There are no estimates of the total number of sea turtles struck by vessels in the Atlantic Ocean each year. Foley et al. (2019), estimated that strikes by motorized watercraft killed a mean of 1,326–4,334 sea turtles each year in Florida during 2000–2014 (considering the Atlantic and Gulf coasts of Florida). As described in NRC 1990, vessel strike risk for sea turtles in the Atlantic Ocean is highest in Florida.

The proposed survey activities will result in an increase in vessel traffic in the action area. Compared to baseline levels of vessel traffic in the action area (in its entirety and in any particular portion), the survey vessels, which will be likely two or three vessels operating in a particular survey area at a time (and spaced such that the sound fields of any noise producing equipment do not overlap), represent an extremely small fraction of total vessel traffic. For example, the U.S. Coast Guard's Atlantic Coast Port Access Route Study (ACPARS; USCG 2015), reports nearly 36,000 unique vessel transits through wind energy areas and lease areas along the Atlantic Coast. Those vessel transits represent only a fraction of the total coastal traffic as the wind energy areas and lease areas are located further offshore than most of the routes used by coastal tug traffic, for example. The U.S. Coast Guard's New Jersey PARS (USCG 2021) reports between 77,000 and 80,000 unique trips annual in the Atlantic Ocean off a portion of the coast of New Jersey in 2017-2019. This data is not wholly representative of all vessel traffic in this area as it only includes vessels carrying AIS systems, which is only required for vessels 65 feet in length or greater (although smaller vessels can utilize AIS and some do). Even if there were 3-boat surveys occurring in each of the four lease areas located in the New Jersey PARS study area, this would represent an increase of 12 vessels off New Jersey in a single year; this represents an approximately 0.01% increase in vessel traffic in that area. We expect that this increase is similar in other portions of the action area. If we assume that any increase in vessel traffic in the action area would increase the risk of vessel strike to sea turtles, then we could also assume that this would result in a corresponding increase in the number of sea turtles struck by vessels. However, it is unlikely that all vessels represent an equal increase in risk and the slow speeds (up to 4.5 knots) that the majority of vessels considered here will typically be moving, requirements to monitor for sea turtles during vessel transits, avoid or slowdown in areas where sea turtles are likely to occur, and to maintain distance from any sighted turtles, means that the risk to sea turtles from the survey vessels is considerably less than other vessels, particularly small, fast vessels operating in nearshore areas where sea turtle densities are high.

An analysis conducted by NMFS Southeast Regional Office (Barnette 2018) considered sea turtle vessel strike risk in Florida; the portion of the action area where risk is considered highest due to the concentration of sea turtles and vessels. Barnette (2018) concluded that, when using the conservative mean estimate of a sea turtle strike every 193 years (range of 135-250 years) per vessel, it would require approximately 200 new vessels introduced to an area to potentially result in a single sea turtle strike in any single year. Considering that the proposed action will introduce significantly fewer vessels in any particular area and that survey vessels will increase vessel traffic in the action area by less than 0.01%, and the measures that will be in place to reduce risk of vessel strike, as well as the slow speed of the survey vessels, we conclude that any increase in the number of sea turtles struck in the action area because of the increase in traffic resulting from survey vessels added to the environmental baseline is extremely unlikely. Therefore, effects of this increase in traffic are extremely unlikely.

The vessels used for the proposed project will produce low-frequency, broadband underwater sound below 1 kHz (for larger vessels), and higher-frequency sound between 1 kHz to 50 kHz (for smaller vessels), although the exact level of sound produced varies by vessel type.

ESA-listed turtles could be exposed to a range of vessel noises within their hearing abilities. Depending on the context of exposure, potential responses of green, Kemp’s ridley, leatherback, and loggerhead sea turtles to vessel noise disturbance, would include startle responses, avoidance, or other behavioral reactions, and physiological stress responses. Very little research exists on sea turtle responses to vessel noise disturbance. Currently, there is nothing in the available literature specifically aimed at studying and quantifying sea turtle response to vessel noise. However, a study examining vessel strike risk to green sea turtles suggested that sea turtles may habituate to vessel sound and may be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in prompting reactions (Hazel et al. 2007). Regardless of the specific stressor associated with vessels to which turtles are responding, they only appear to show responses (avoidance behavior) at approximately 10 m or closer (Hazel et al. 2007).

Therefore, the noise from vessels is not likely to affect sea turtles from further distances, and disturbance may only occur if a sea turtle hears a vessel nearby or sees it as it approaches. These responses appear limited to non-injurious, minor changes in behavior based on the limited information available on sea turtle response to vessel noise.

For these reasons, vessel noise is expected to cause minimal disturbance to sea turtles. If a sea turtle detects a vessel and avoids it or has a stress response from the noise disturbance, these responses are expected to be temporary and only endure while the vessel transits through the area where the sea turtle encountered it. Therefore, sea turtle responses to vessel noise disturbance are considered insignificant (i.e., so minor that the effect cannot be meaningfully evaluated), and a sea turtle would be expected to return to normal behaviors and stress levels shortly after the vessel passes by.

Marine Fish

The only listed fish in the action area that are known to be at risk of vessel strike are shortnose and Atlantic sturgeon and giant manta ray. Vessel activities will have no effect on Atlantic salmon or smalltooth sawfish. There is no information to indicate that Atlantic salmon are struck by vessels; therefore, we have concluded that strike is extremely unlikely to occur. A vessel strike to smalltooth sawfish is extremely unlikely; smalltooth sawfish are primarily demersal and rarely would be at risk from moving vessels. PDC 5 requires vessels to maintain sufficient clearance above the bottom and to reduce speeds to 5 knots or less in waters with less than 4 feet of clearance. These conditions, combined with the low likelihood of vessels operating in nearshore coastal waters of Florida where sawfish occur, is expected to eliminate risk of vessel strikes with smalltooth sawfish.

Giant Manta Ray
Giant manta rays can be frequently observed traveling just below the surface and will often approach or show little fear toward humans or vessels (Coles 1916), which may also make them vulnerable to vessel strikes (Deakos 2010); vessel strikes can injure or kill giant manta rays, decreasing fitness or contributing to non-natural mortality (Couturier et al. 2012; Deakos et al. 2011). However, information about interactions between vessels and giant manta rays is limited. We have at least some reports of vessel strike, including a report of five giant manta rays struck by vessels from 2016 through 2018; individuals had injuries (i.e., fresh or healed dorsal surface propeller scars) consistent with a vessel strike. These interactions were observed by researchers conducting surveys from Boynton Beach to Jupiter, Florida (J. Pate, Florida Manta Project, pers. comm. to M. Miller, NMFS OPR, 2018) and it is unknown where the manta was at the time of the vessel strike. The giant manta ray is frequently observed in nearshore coastal waters and feeding at inlets along the east coast of Florida. As recreational vessel traffic is concentrated in and around inlets and nearshore waters, this overlap exposes the giant manta ray in these locations to an increased likelihood of potential vessel strike injury especially from faster moving recreational vessels. Yet, few instances of confirmed or suspected strandings of giant manta rays are attributed to vessel strike injury. This lack of documented mortalities could also be the result of other factors that influence carcass detection (i.e., wind, currents, scavenging, decomposition etc.); however, giant manta rays appear to be able to be fast and agile enough to avoid most moving vessels, as anecdotally evidenced by videos showing rays avoiding interactions with high-speed vessels.

While there is limited available information on the giant manta ray, we expect the circumstances and factors resulting in vessel strike injury are similar between sea turtles and the giant manta ray because these species are both found in nearshore waters (including in the vicinity of inlets where vessel traffic may also be concentrated) and may spend significant time at or near the surface. Therefore, consistent with Barnette 2018, we will rely on the more robust available data on sea turtle vessel strike injury to serve as a proxy for the giant manta ray. Because the activities considered here will result in far fewer than 200 new vessels, it is extremely unlikely that any giant manta rays will be struck by new or increased vessel traffic.

Sturgeon
Here, we consider whether the increase in vessel traffic is likely to increase the risk of strike for Atlantic or shortnose sturgeon in any part of the action area. Because the increase in traffic will be limited to no more than two or three survey vessels operating in an area being surveyed at one time, the increase in vessel traffic in any portion of the action area, as well as the action area as a whole, will be extremely small.

We do not expect shortnose sturgeon to occur along the survey routes in the Atlantic Ocean because coastal migrations are extremely rare. However, Atlantic sturgeon are present in this part of the action area. Both shortnose and Atlantic sturgeon may occur in nearshore waters and rivers and bays that may be surveyed for potential cable corridors and/or may be used for survey vessel transits to or from ports.

While we know that vessels and sturgeon co-occur in many portions of their range, we have no reports of vessel strikes outside of rivers and coastal bays. The risk of strike is expected to be considerably less in the Atlantic Ocean than in rivers. This is because of the greater water depth, lack of obstructions or constrictions and the more disperse nature of vessel traffic and more disperse distribution of individual sturgeon. All of these factors are expected to decrease the likelihood of an encounter between an individual sturgeon and a vessel and also increase the likelihood that a sturgeon would be able to avoid any vessel. While we cannot quantify the risk of vessel strike in the portions of the Atlantic Ocean that overlap with the action area, we expect the risk to be considerably lower than it is within the Delaware River, which is considered one of the areas with the highest risk of vessel strike for Atlantic sturgeon.

As evidenced by reports and collections of Atlantic and shortnose sturgeon with injuries consistent with vessel strike (NMFS unpublished data[8]), both species are struck and killed by vessels in the Delaware River. Brown and Murphy (2010) reported that from 2005-2008, 28 Atlantic sturgeon carcasses were collected in the Delaware River; approximately 50% showed signs of vessel interactions. Delaware Division of Fish and Wildlife has been recording information on suspected vessel strikes since 2005. From May 2005 – March 2016, they recorded a total of 164 carcasses, 44 of which were presumed to have a cause of death attributable to vessel interaction. Estimates indicate that up to 25 Atlantic sturgeon may be struck and killed in the Delaware River annually (Fox, unpublished 2016). Information on the number of shortnose sturgeon struck and killed by vessels in the Delaware River is currently limited to reports provided to NMFS through our sturgeon salvage permit. A review of the database indicates that of the 53 records of salvaged shortnose sturgeon (2008-2016), 11 were detected in the Delaware River. Of these 11, 6 had injuries consistent with vessel strike. This is considerably less than the number of records of Atlantic sturgeon from the Delaware River with injuries consistent with vessel strike (15 out of 33 over the same time period). Based on this, we assume that more Atlantic sturgeon are struck by vessels in the Delaware River than shortnose sturgeon.

Several major ports are present along the Delaware River. In 2014, there were 42,398 one-way trips reported for commercial vessels in the Delaware River Federal navigation channel (USACE 2014). In 2020, 2,195 cargo ships visited Delaware River ports[9]. Neither of these numbers include any recreational or other non-commercial vessels, ferries, tug boats assisting other larger vessels or any Department of Defense vessels (i.e., Navy, USCG, etc.).

If we assume that any increase in vessel traffic in the Delaware River would increase the risk of vessel strike to shortnose or Atlantic sturgeon, then we could also assume that this would result in

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[8] The unpublished data are reports received by NMFS and recorded as part of the sturgeon salvage program authorized under ESA permit 17273.

[9] *https://ajot.com/news/maritime-exchange-reports-2020-ship-arrivals*; last accessed March 24, 2021

a corresponding increase in the number of sturgeon struck and killed in the Delaware River. However, it is unlikely that all vessels represent an equal increase in risk, the slow speeds (4.5 knots) and shallower drafts of the survey vessels may mean that the risk to sturgeon is not as greater as faster moving deep draft cargo or tanker vessels as sturgeon may be able to more readily avoid the survey vessels and may not even overlap in the same part of the water column. The survey activities considered here will involve up to three slow-moving (up to 4.5 knots) vessels operating in a similar area. Sets of survey vessels will be dispersed along the coast and not co-occur in time or space. Even if there were four surveys in a year that transited the Delaware River (equivalent to the number of BOEM leases that are proximal to the entrance of Delaware Bay), that would be an increase of 12 vessels annually. Considering only the number of commercial one way trips in a representative year (42,398), an increase of 12 vessels operating in the Delaware River represents an approximately 0.03% increase in vessel traffic in the Delaware River navigation channel in a particular year. The actual percent increase in vessel traffic is likely even less considering that commercial traffic is only a portion of the vessel traffic in the river. Even in a worst-case scenario that assumes that all 25 Atlantic sturgeon struck and killed in the Delaware River in an average year occurred in the portion of the Delaware River that will be transited by the survey vessels, and that any increase in vessel traffic results in a proportionate increase in vessel strikes, this increase in vessel traffic would result in a hypothetical additional 0.0075 Atlantic sturgeon struck and killed in the Delaware River in a given year. Assuming a maximum case that four, 3-boat surveys transit the Delaware River every year for the 10 years considered here, that would result in a hypothetical additional 0.075 Atlantic sturgeon struck and killed in the Delaware River. Because we expect fewer strikes of shortnose sturgeon, the hypothetical increase in the number of struck shortnose sturgeon would be even less. Given this very small increase in traffic and the similar very small potential increase in risk of strike and a calculated potential increase in the number of strikes that is very close to zero, we conclude that any increase in the number of sturgeon struck because of the increase in traffic resulting from survey vessels operating in the Delaware River or Delaware Bay is extremely unlikely. BOEM has indicated that survey vessels may also transit the lower Chesapeake Bay and New York Bight/lower Hudson River. The risk of vessel strike in these areas is considered to be lower than in the Delaware River; thus, any prediction of vessel strike for the Delaware River can be considered a conservative estimate of vessel strike risk in other areas. Even applying this hypothetical increased risk for all three areas, we would estimate that a hypothetical additional 0.2 Atlantic sturgeon would be killed coast-wide over a 10-year period. As noted above, this is likely an overestimate given the slower speed of survey vessels compared to other vessels which is anticipated to reduce risk. Based on this analysis, effects of this increase in traffic are extremely unlikely. In addition, given the very small increase in risk and the calculated increase in strikes is close to zero, the effect of adding the survey vessels to the baseline cannot be meaningfully measured, detected, or evaluated; therefore, effects are also insignificant.

Vessel Noise

The vessels used for the proposed project will produce low-frequency, broadband underwater sound below 1 kHz (for larger vessels), and higher-frequency sound between 1 kHz to 50 kHz (for smaller vessels), although the exact level of sound produced varies by vessel type. In general, information regarding the effects of vessel noise on fish hearing and behaviors is limited. Some TTS has been observed in fishes exposed to elevated background noise and other white noise, a continuous sound source similar to noise produced from vessels. Caged studies on sound pressure sensitive fishes show some TTS after several days or weeks of exposure to increased background sounds, although the hearing loss appeared to recover (e.g., Scholik and Yan 2002; Smith et al. 2006; Smith et al. 2004a). Smith et al. (2004b) and Smith et al. (2006) exposed goldfish (a fish with hearing specializations, unlike any of the ESA-listed species considered in this opinion) to noise with a sound pressure level of 170 dB re 1 μPa and found a clear relationship between the amount of TTS and duration of exposure, until maximum hearing loss occurred at about 24 hours of exposure. A short duration (e.g., 10-minute) exposure resulted in 5 dB of TTS, whereas a three-week exposure resulted in a 28 dB TTS that took over two weeks to return to pre-exposure baseline levels (Smith et al. 2004b). Recovery times were not measured by researchers for shorter exposure durations, so recovery time for lower levels of TTS was not documented.

Vessel noise may also affect fish behavior by causing them to startle, swim away from an occupied area, change swimming direction and speed, or alter schooling behavior (Engas et al. 1998; Engas et al. 1995; Mitson and Knudsen 2003). Physiological responses have also been documented for fish exposed to increased boat noise. Nichols et al. (2015) demonstrated physiological effects of increased noise (playback of boat noise) on coastal giant kelpfish. The fish exhibited acute stress responses when exposed to intermittent noise, but not to continuous noise. These results indicate variability in the acoustic environment may be more important than the period of noise exposure for inducing stress in fishes. However, other studies have also shown exposure to continuous or chronic vessel noise may elicit stress responses indicated by increased cortisol levels (Scholik and Yan 2001; Wysocki et al. 2006). These experiments demonstrate physiological and behavioral responses to various boat noises that have the potential to affect species' fitness and survival, but may also be influenced by the context and duration of exposure. It is important to note that most of these exposures were continuous, not intermittent, and the fish were unable to avoid the sound source for the duration of the experiment because this was a controlled study. In contrast, wild fish are not hindered from movement away from an irritating sound source, if detected, so are less likely to subjected to accumulation periods that lead to the onset of hearing damage as indicated in these studies. In other cases, fish may eventually become habituated to the changes in their soundscape and adjust to the ambient and background noises.

All fish species can detect vessel noise due to its low-frequency content and their hearing capabilities. Because of the characteristics of vessel noise, sound produced from vessels is unlikely to result in direct injury, hearing impairment, or other trauma to ESA-listed fish. Plus, in the near field, fish are able to detect water motion as well as visually locate an oncoming vessel. In these cases, most fishes located in close proximity that detect the vessel either visually, via sound and motion in the water would be capable of avoiding the vessel or move away from the area affected by vessel sound. Thus, fish are more likely to react to vessel noise at close range than to vessel noise emanating from a greater distance away. These reactions may include physiological stress responses, or avoidance behaviors. Auditory masking due to vessel noise can potentially mask biologically important sounds that fish may rely on. However, impacts from vessel noise would be intermittent, temporary, and localized, and such responses would not be expected to compromise the general health or condition of individual fish from continuous exposures. Instead, the only impacts expected from exposure to project vessel noise for Atlantic sturgeon may include temporary auditory masking, physiological stress, or minor changes in behavior.

Therefore, similar to marine mammals and sea turtles, exposure to vessel noise for fishes could result in short-term behavioral or physiological responses (e.g., avoidance, stress). Vessel noise would only result in brief periods of exposure for fishes and would not be expected to accumulate to the levels that would lead to any injury, hearing impairment or long-term masking of biologically relevant cues. For these reasons, any effects of vessel noise on ESA-listed fish is considered insignificant (i.e., so minor that the effect cannot be meaningfully measured, detected, or evaluated).

Consideration of Effects of the Actions on Air Quality

In order to issue an OCS Air Permit for an activity considered in this consultation, EPA must conclude that the activity will not cause or contribute to a violation of applicable national ambient air quality standards (NAAQS) or prevention of significant deterioration (PSD) increments. The NAAQS are health-based standards that the EPA sets to protect public health with an adequate margin of safety. The PSD increments are designed to ensure that air quality in an area that meets the NAAQS does not significantly deteriorate from baseline levels. At this time, there is no information on the effects of air quality on listed species that may occur in the action area. However, as the PSD increments are designed to ensure that air quality in the area regulated by any OCS Air Permit do not significantly deteriorate from baseline levels, we conclude that any effects to listed species from these emissions will be so small that they cannot be meaningfully measured, detected, or evaluated and therefore are insignificant.

CONCLUSIONS

As explained above, we have determined that the actions considered here are not likely to adversely affect any ESA-listed species or critical habitat. The requirements for reviewing survey activities as they are developed will ensure that surveys carried out under this programmatic consultation do not have effects that exceed those considered here.

Reinitiation of consultation is required and shall be requested by BOEM or by NMFS where discretionary federal involvement or control over the action has been retained or is authorized by law and "(a) If the amount or extent of taking specified in the incidental take statement is exceeded; (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or (d) If a new species is listed or critical habitat designated that may be affected by the identified action." For the activities considered here, no take is anticipated or exempted; take is defined in the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect or attempt to engage in any such conduct." If there is any incidental take of a listed species, reinitiation would be required. As required by the PDCs outlined in Appendix B, all observations of dead or injured listed species should be reported to us immediately.

Should you have any questions regarding this consultation, please contact Julie Crocker of my staff at (978) 282-8480 or by e-mail (*Julie.Crocker@noaa.gov*).

Sincerely,

Jennifer Anderson
Assistant Regional Administrator
for Protected Resources

ec: Hooker, Baker - BOEM
Burns - GARFO HSED
Bernhart - SERO
Harrison, Daly, Carduner - OPR
DOE
EPA
USACE

File Code: Sec 7 BOEM OSW site assessment programmatic (2021)
ECO ID: GARFO-2021-0999

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Appendix A – Tables and Figures

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Figure 1. Action Area for this programmatic consultation.

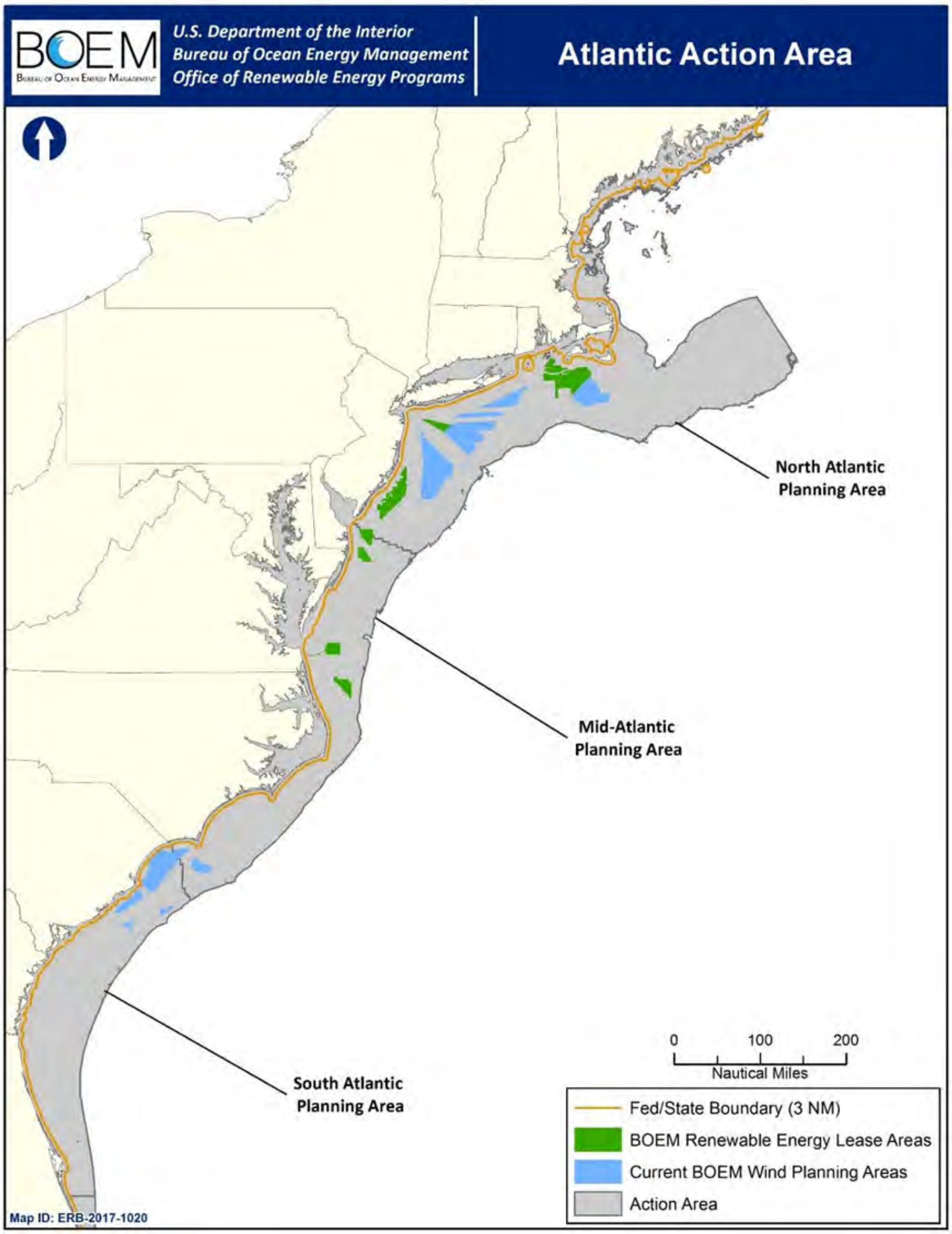

Table A.1 Description of Representative HRG Survey Equipment and Methods

Equipment Type	Data Collection and/or Survey Types	Description of the Equipment
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 Cone Penetration Testing.
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 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.
Shallow and Medium (Seismic) Penetration Profilers (i.e. Chirps, Sparkers, Boomers, Bubble Guns)	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.
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.

Table A.2. Acoustic Characteristics of Representative HRG Survey Equipment. Note list of equipment is representative and surveys may use similar equipment and actual source levels may be below those indicated.

	Highest Measured Source Level (Highest Power Setting)						
HRG Source	**Source Setting**	**PK**	**RMS**	**SEL**	**Pulse Width (s)**	**Main Pulse Frequency (kHz)**	**Inter-Pulse Interval (s) (1/PPS)**
Mobile, Impulsive, Intermittent Sources							
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 Acoustic Delta Sparker	2400 J at 1 m depth, 0.5 kHz	221	205	185	0.0095	0.5	.33333 (1-3 pps)
Applied Acoustic Dura-Spark	2400 J (high), 400 tips	225	214	188	0.0022	2.7	.33333 (1-3 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)
ELC820 Sparker	750 J (high) 1m depth	214	206	182	0.0039	1.2	1.0 (1 pps)
FSI HMS-620D Bubble Gun	Dual Channel 86 cm	204	198	173	0.0033	1.1	8.0 (1 per 8 s)
Mobile, Non-Impulsive, Intermittent Sources							
Bathyswath SWATHplus-M	100%, 234 kHz	223	218	180	0.00032	≥200 kHz	0.2000 pps (unknown)
Echotrac CV100 Single-Beam Echosounder	Power 12, 80 cycles, 200 kHz	196	193	159	0.00036	≥200 kHz	0.0500 (20 pps)
EdgeTech 424 with 3200-XS topside processor (Chirp)	100% power, 4-20 kHz	187	180	156	0.0046	7.2-11	.12500 (8 pps)

EdgeTech 512i Sub-bottom Profiler, 8.9 kHz (Chirp)	100% power, 2-12 kHz	186	180	159	0.0087	6.3-8.9	.12500 (8 pps)
EdgeTech 4200 Side-Scan	100%, 100 kHz (also a 400 kHz setting)	206	201	179	0.0072	100 kHz	.03333 (30 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
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	100 kHz	228	224	185	0.00015	100 kHz	0.0500 (20 pps)
Reson Seabat T20P Multibeam Echosounder	200, 300, or 400 kHz	221	218	182	0.00025	≥200 kHz	0.0200 (50 pps)

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

Table 1. Predicted isopleths for peak pressure (using 20 LogR) and cSEL using NOAA's general spreadsheet tool (December 2020 Revision) to predict cumulative exposure distances using the highest power levels were used for each sound source reported in Crocker and Fratantonio (2016).

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

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
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
Klein 3900 Side-Scan, 445 kHz	—	0	—	0	—	0	—	0

Table A.4. PTS distance for sea turtles and listed fish for impulsive HRG sound sources (60 minutes duration using the highest power levels were used for each sound source reported in Crocker and Fratantonio (2016)).

HRG SOURCE		Sea Turtles*, ESA-listed Fish			
		PTS INJURY DISTANCE (m) for Impulsive HRG Sources			
	SEL Source level	Fish cSEL[a] Distance to 187 dB (m)	Turtle cSEL[a] 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

HRG SOURCE		Sea Turtles*, ESA-listed Fish			
		PTS INJURY DISTANCE (m) for Impulsive HRG Sources			
	SEL Source level	Fish cSEL[a] Distance to 187 dB (m)	Turtle cSEL[a] Distance (m)	Peak Source Level	Fish Peak Distance to 206 dB (m)
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
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

[a] = 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 A.5. Disturbances distances for marine mammals (160 dB RMS), sea turtles (175 dB RMS), and fish (150 dB RMS) using 20LogR spherical spreading loss using the highest power levels were used for each sound source reported in Crocker and Fratantonio (2016).

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
Reson Seabat 7111 Multibeam Echosounder[1]	NA	NA	NA
Reson Seabat T20P Multibeam Echosounder[1]	NA	NA	NA
Bathyswath SWATHplus-M	NA	NA	NA
Echotrac CV100 Single-Beam Echosounder[1]	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.

APPENDIX B

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

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

PDC 1: Avoid Live Bottom Features

BMPs:

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

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

BMP:

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

PDC 3: Marine Trash and Debris Awareness and Prevention

"*Marine trash and debris*" is defined as any object or fragment of wood, metal, glass, rubber, plastic, cloth, paper or any other solid, man-made item or material that is lost or discarded in the marine environment by the Lessee or an authorized representative of the Lessee (collectively, the

[1] 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.

"Lessee") while conducting activities on the OCS in connection with a lease, grant, or approval issued by the Department of the Interior (DOI). To understand the type and amount of marine debris generated, and to minimize the risk of entanglement in and/or ingestion of marine debris by protected species, lessees must implement the following BMPS.

BMPs:

1. Training: All vessel operators, employees, and contractors performing OCS survey activities on behalf of the Lessee (collectively, "Lessee Representatives") must complete marine trash and 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. Reporting), the Lessee must submit a recovery plan to DOI explaining the recovery activities to recover the marine trash or debris ("Recovery Plan"). The Recovery Plan must be submitted no later than 10 calendar days from the date in which the incident occurred. Unless otherwise objected by DOI within 48 hours of the filing of the Recovery Plan, the Lessee can proceed with the activities described in the Recovery Plan. The Lessee must request and obtain approval of a time extension if recovery activities cannot be completed within 30 days from the date in which the incident occurred. The Lessee must enact steps to prevent similar incidents and must submit a description of these actions to BOEM and BSEE within 30 days from the date in which the incident occurred.

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

    a. Project identification and contact information for the lessee, operator, and/or contractor;
    b. The date and time of the incident;
    c. The lease number, OCS area and block, and coordinates of the object's location (latitude and longitude in decimal degrees);
    d. A detailed description of the dropped object to include dimensions (approximate length, width, height, and weight) and composition (e.g., plastic, aluminum, steel, wood, paper, hazardous substances, or defined pollutants);
    e. Pictures, data imagery, data streams, and/or a schematic/illustration of the object, if available;
    f. Indication of whether the lost or discarded item could be a magnetic anomaly of greater than 50 nanoTesla (nT), a seafloor target of greater than 0.5 meters (m), or a sub-bottom anomaly of greater than 0.5m when operating a magnetometer or gradiometer, side scan sonar, or sub-bottom profile in accordance with DOI's applicable guidance;
    g. An explanation of how the object was lost; and

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

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

PDC 4: Minimize Interactions with Listed Species during Geophysical Survey Operations
To avoid injury of ESA-listed species and minimize any potential disturbance, the following measures will be implemented for all vessels operating impulsive survey equipment that emits sound at frequency ranges <180 kHz (within the functional hearing range of marine mammals)[2] as well as CHIRP sub bottom profilers. The Clearance Zone is defined as the area around the sound source that needs to be visually cleared of listed species for 30 minutes before the sound source is turned on. The Clearance Zone is equivalent to a minimum visibility zone for survey operations to begin (*See* BMP 6). The Shutdown Zone is defined as the area around the sound source that must be monitored for possible shutdown upon detection of protected species within or entering that zone. For both the Clearance and Shutdown Zones, these are minimum visibility distances and for situational awareness PSOs should observe beyond this area when possible.

BMPs:

1. For situational awareness a Clearance Zone extending at least (500 m in all directions) must be established around all vessels operating sources <180 kHz.
    a. The Clearance Zone must be monitored by approved third-party PSOs at all times and any observed listed species must be recorded (see reporting requirements below).
    b. For monitoring around the autonomous surface vessel (ASV) where remote PSO monitoring must occur from the mother vessel, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. PSOs must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be installed in the bridge displaying the real-time images from the thermal/HD camera installed on

[2] Note that this requirement does not apply to Parametric Subbottom Profilers, Ultra Short Baseline, echosounders or side scan sonar; the acoustic characteristics (frequency, narrow beam width, rapid attenuation) are such that no effects to listed species are anticipated.

the front of the ASV itself, providing a further forward view of the craft. In addition, night-vision goggles with thermal clip-ons and a handheld spotlight must be provided and used such that PSOs can focus observations in any direction around the mother vessel and/or the ASV.

2. To minimize exposure to noise that could be disturbing, Shutdown Zone(s) (500 m for North Atlantic right whales and 100 m for other ESA-listed whales visible at the surface) must be established around the sources operating at <180 kHz being towed from the vessel .
    a. The Shutdown Zone(s) must be monitored by third-party PSOs at all times when noise-producing equipment (<180 kHz) is being operated and all observed listed species must be recorded (see reporting requirements below).
    b. If an ESA-listed species is detected within or entering the respective Shutdown Zone, any noise-producing equipment operating below 180 kHz must be shut off until the minimum separation distance from the source is re-established (500 m for North Atlantic right whales and 100 m for other ESA-listed species, including other ESA-listed marine mammals) and the measures in (5) are carried out.
        i. A PSO must notify the survey crew that a shutdown of all active boomer, sparker, and bubble gun acoustic sources below 180 kHz is immediately required. The vessel operator and crew must comply immediately with any call for a shutdown by the PSO. Any disagreement or discussion must occur only after shutdown.
    c. If the Shutdown Zone(s) cannot be adequately monitored for ESA-listed species presence (i.e., a PSO determines conditions, including at night or other low-visibility conditions, are such that listed species cannot be reliably sighted within the Shutdown Zone(s), no equipment operating at <180 kHz can be deployed until such time that the Shutdown Zone(s) can be reliably monitored.
3. Before any noise-producing survey equipment (operating at <180 kHz) is deployed, the Clearance Zone (500 m for all listed species) must be monitored for 30 minutes of pre-clearance observation.
    a. If any ESA-listed species is observed within the Clearance Zone during the 30-minute pre-clearance period, the 30-minute clock must be paused. If the PSO confirms the animal has exited the zone and headed away from the survey vessel, the 30-minute clock that was paused may resume. The pre-clearance clock will reset to 30 minutes if the animal dives or visual contact is otherwise lost.
4. When technically feasible, a “ramp up” of the electromechanical survey equipment must occur at the start or re-start of geophysical survey activities. A ramp up must begin with the power of the smallest acoustic equipment for the geophysical survey at its lowest power output. When technically feasible the power will then be gradually turned up and other acoustic sources added in a way such that the source level would increase gradually.
5. Following a shutdown for any reason, ramp up of the equipment may begin immediately only if: (a) the shutdown is less than 30 minutes, (b) visual monitoring of

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

6. In order for geophysical surveys to be conducted at night or during low-visibility conditions, PSOs must be able to effectively monitor the Clearance and Shutdown Zone(s). No may occur if the Clearance and Shutdown Zone(s) cannot be reliably monitored for the presence of ESA-listed species to ensure avoidance of injury to those species.
    a. An Alternative Monitoring Plan (AMP) must be submitted to BOEM (or the federal agency authorizing, funding, or permitting the survey) detailing the monitoring methodology that will be used during nighttime and low-visibility conditions and an explanation of how it will be effective at ensuring that the Shutdown Zone(s) can be maintained during nighttime and low-visibility survey operations. The plan must be submitted 60 days before survey operations are set to begin.
    b. The plan must include technologies that have the technical feasibility to detect all ESA-listed whales out to 500 m and sea turtles to 100 m.
    c. PSOs should be trained and experienced with the proposed alternative monitoring technology.
    d. The AMP must describe how calibration will be performed, for example, by including observations of known objects at set distances and under various lighting conditions. This calibration should be performed during mobilization and periodically throughout the survey operation.
    e. PSOs shall make nighttime observations from a platform with no visual barriers, due to the potential for the reflectivity from bridge windows or other structures to interfere with the use of the night vision optics.
7. To minimize risk to North Atlantic right whales, no surveys may occur in Cape Cod Bay from January 1 - May 15 of any year (in an area beginning at 42°04′56.5″ N-070°12′00.0″ W; thence north to 42°12′00.0″ N-070°12′00.0″ W; thence due west to charted mean high water line; thence along charted mean high water within Cape Cod Bay back to beginning point).
8. Sound sources used within the North Atlantic right whale Critical Habitat Southeastern U.S. Calving Area (i.e., Unit 2) during the calving and nursing season (December-March) shall operate at frequencies <7 kHz and >35 kHz (functional hearing range of right whales) at night or low visibility conditions.
9. At times when multiple survey vessels are operating within a lease area, adjacent lease areas, or exploratory cable routes, a minimum separation distance (to be determined on a survey specific basis, dependent on equipment being used) must be maintained between survey vessels to ensure that sound sources do not overlap.
10. To minimize disturbance to the Northwest Atlantic Ocean DPS of loggerhead sea turtles, a voluntary pause in sparker operation should be implemented for all vessels

operating in nearshore critical habitat for loggerhead sea turtles. These conditions apply to critical habitat boundaries for nearshore reproductive habitats LOGG N-3 through LOGG N-16 (79 FR 39855) from April 1 to September 30. Following pre-clearance procedures, if any loggerhead or other unidentified sea turtles is observed within a 100 m Clearance Zone during a survey, sparker operation should be paused by turning off the sparker until the sea turtle is beyond 100 m of the survey vessel. If the animal dives or visual contact is otherwise lost, sparker operation may resume after a minimum 2-minute pause following the last sighting of the animal.

11. Any visual observations of listed species by crew or project personnel must be communicated to PSOs on-duty.
12. During good conditions (e.g., daylight hours; Beaufort scale 3 or less) when survey equipment is not operating, to the maximum extent practicable, PSOs must conduct observations for protected species for comparison of sighting rates and behavior with and without use of active geophysical survey equipment. Any observed listed species must be recorded regardless of any mitigation actions required.

PDC 5: Minimize Vessel Interactions with Listed Species
All vessels associated with survey activities (transiting [i.e., travelling between a port and the survey site] or actively surveying) must comply with the vessel strike avoidance measures specified below. The only exception is when the safety of the vessel or crew necessitates deviation from these requirements. If any such incidents occur, they must be reported as outlined below under Reporting Requirements (PDC 8). The Vessel Strike Avoidance Zone is defined as 500 m or greater from any sighted ESA-listed species or other unidentified large marine mammal.

BMPs:

1. Vessel captain and crew must maintain a vigilant watch for all protected species and slow down, stop their vessel, or alter course, as appropriate and regardless of vessel size, to avoid striking any listed species. The presence of a single individual at the surface may indicate the presence of submerged animals in the vicinity; therefore, precautionary measures should always be exercised. If pinnipeds or small delphinids of the following genera: Delphinus, Lagenorhynchus, Stenella, and Tursiops are visually detected approaching the vessel (i.e., to bow ride) or towed equipment, vessel strike avoidance and shutdown is not required.
2. Anytime a survey vessel is underway (transiting or surveying), the vessel must maintain a 500 m minimum separation distance and a PSO must monitor a Vessel Strike Avoidance Zone (500 m or greater from any sighted ESA-listed species or other unidentified large marine mammal visible at the surface) to ensure detection of that animal in time to take necessary measures to avoid striking the animal. If the survey vessel does not require a PSO for the type of survey equipment used, a trained crew lookout may be used (see #3). For monitoring around the autonomous surface vessels, regardless of the equipment it may be operating, a dual thermal/HD camera must be installed on the mother vessel facing forward and angled in a direction so as to provide a field of view ahead of the vessel and around the ASV. A dedicated operator must be able to monitor the real-time output of the camera on hand-held computer tablets. Images from the cameras must be able to be captured and reviewed to assist in verifying species identification. A monitor must also be

installed in the bridge displaying the real-time images from the thermal/HD camera installed on the front of the ASV itself, providing a further forward view of the craft.

a. Survey plans must include identification of vessel strike avoidance measures, including procedures for equipment shut down and retrieval, communication between PSOs/crew lookouts, equipment operators, and the captain, and other measures necessary to avoid vessel strike while maintaining vessel and crew safety. If any circumstances are anticipated that may preclude the implementation of this PDC, they must be clearly identified in the survey plan and alternative procedures outlined in the plan to ensure minimum distances are maintained and vessel strikes can be avoided.
b. All vessel crew members must be briefed in the identification of protected species that may occur in the survey area and in regulations and best practices for avoiding vessel collisions. Reference materials must be available aboard all project vessels for identification of listed species. The expectation and process for reporting of protected species sighted during surveys must be clearly communicated and posted in highly visible locations aboard all project vessels, so that there is an expectation for reporting to the designated vessel contact (such as the lookout or the vessel captain), as well as a communication channel and process for crew members to do so.
c. The Vessel Strike Avoidance Zone(s) are a minimum and must be maintained around all surface vessels at all times.
d. If a large whale is identified within 500 m of the forward path of any vessel, the vessel operator must steer a course away from the whale at 10 knots (18.5 km/hr) or less until the 500 m minimum separation distance has been established. Vessels may also shift to idle if feasible.
e. If a large whale is sighted within 200 m of the forward path of a vessel, the vessel operator must reduce speed and shift the engine to neutral. Engines must not be engaged until the whale has moved outside of the vessel's path and beyond 500 m. If stationary, the vessel must not engage engines until the large whale has moved beyond 500 m.
f. If a sea turtle or manta ray is sighted within the operating vessel's forward path, the vessel operator must slow down to 4 knots (unless unsafe to do so) and steer away as possible. The vessel may resume normal operations once the vessel has passed the individual.
g. During times of year when sea turtles are known to occur in the survey area, vessels must avoid transiting through areas of visible jellyfish aggregations or floating vegetation (e.g., sargassum lines or mats). In the event that operational safety prevents avoidance of such areas, vessels must slow to 4 knots while transiting through such areas.
h. Vessels operating in water depths with less than 4 ft. clearance between the vessel and the bottom should maintain speeds no greater than 4 knots to minimize vessel strike risk to sturgeon and sawfish.

3. To monitor the Vessel Strike Avoidance Zone, a PSO (or crew lookout if PSOs are not required) must be posted during all times a vessel is underway (transiting or surveying) to monitor for listed species in all directions.

   a. Visual observers monitoring the vessel strike avoidance zone can be either PSOs or crew members (if PSOs are not required). If the trained lookout is a vessel crew member, this must be their designated role and primary responsibility while the vessel is transiting. Any designated crew lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements. All observations must be recorded per reporting requirements.
   b. Regardless of monitoring duties, all crew members responsible for navigation duties must receive site-specific training on ESA-listed species sighting/reporting and vessel strike avoidance measures.
4. Regardless of vessel size, vessel operators must reduce vessel speed to 10 knots (18.5 mph) or less while operating in any Seasonal Management Area (SMA), Dynamic Management Area (DMA)/Slow Zones triggered by visual detection of North Atlantic right whales. The only exception to this requirement is for vessels operating in areas within a DMA/visually triggered Slow Zone where it is not reasonable to expect the presence of North Atlantic right whales (e.g. Long Island Sound, shallow harbors). Reducing vessel speed to 10 knots or less while operating in Slow Zones triggered by acoustic detections of North Atlantic right whales is encouraged.
5. Vessels underway must not divert their course to approach any listed species.
6. All vessel operators must check for information regarding mandatory or voluntary ship strike avoidance (SMAs, DMAs, Slow Zones) and daily information regarding North Atlantic right whale sighting locations. These media may include, but are not limited to: NOAA weather radio, U.S. Coast Guard NAVTEX and channel 16 broadcasts, Notices to Mariners, the Whale Alert app, or WhaleMap website.
   a. North Atlantic right whale Sighting Advisory System info can be accessed at: https://apps-nefsc.fisheries.noaa.gov/psb/surveys/MapperiframeWithText.html
   b. Information about active SMAs, DMAs, and Slow Zones can be accessed at: https://www.fisheries.noaa.gov/national/endangered-species-conservation/reducing-vessel-strikes-north-atlantic-right-whales

PDC 6: Minimize Risk During Buoy Deployment, Operations, and Retrieval
Any mooring systems used during survey activities prevent any potential entanglement or entrainment of listed species, and in the unlikely event that entanglement does occur, ensure proper reporting of entanglement events according to the measures specified below.

BMPs:
1. Ensure that any buoys attached to the seafloor use the best available mooring systems. Buoys, lines (chains, cables, or coated rope systems), swivels, shackles, and anchor designs must prevent any potential entanglement of listed species while ensuring the safety and integrity of the structure or device.
2. All mooring lines and ancillary attachment lines must use one or more of the following measures to reduce entanglement risk: shortest practicable line length, rubber sleeves, weak-links, chains, cables or similar equipment types that prevent lines from looping, wrapping, or entrapping protected species.
3. Any equipment must be attached by a line within a rubber sleeve for rigidity. The length of the line must be as short as necessary to meet its intended purpose.

4. During all buoy deployment and retrieval operations, buoys should be lowered and raised slowly to minimize risk to listed species and benthic habitat. Additionally, PSOs or trained project personnel (if PSOs are not required) should monitor for listed species in the area prior to and during deployment and retrieval and work should be stopped if listed species are observed within 500 m of the vessel to minimize entanglement risk.
5. If a live or dead marine protected species becomes entangled, you must immediately contact the applicable NMFS stranding coordinator using the reporting contact details (see Reporting Requirements section) and provide any on-water assistance requested.
6. All buoys must be properly labeled with owner and contact information.

PDC 7: Protected Species Observers
Qualified third-party PSOs to observe Clearance and Shutdown Zones must be used as outlined in the conditions above.

BMPs:
1. All PSOs must have completed an approved PSO training program and must receive NMFS approval to act as a PSO for geophysical surveys. Documentation of NMFS approval for geophysical survey activities in the Atlantic and copies of the most recent training certificates of individual PSOs' successful completion of a commercial PSO training course with an overall examination score of 80% or greater must be provided upon request. Instructions and application requirements to become a NMFS-approved PSO can be found at: *www.fisheries.noaa.gov/national/endangered-species-conservation/protected-species-observers*.
2. In situations where third-party party PSOs are not required, crew members serving as lookouts must receive training on protected species identification, vessel strike minimization procedures, how and when to communicate with the vessel captain, and reporting requirements.
3. PSOs deployed for geophysical survey activities must be employed by a third-party observer provider. While the vessel is underway, they must have no other tasks than to conduct observational effort, record data, and communicate with and instruct relevant vessel crew to the presence of listed species and associated mitigation requirements. PSOs on duty must be clearly listed on daily data logs for each shift.
    a. Non-third-party observers may be approved by NMFS on a case-by-case basis for limited, specific duties in support of approved, third-party PSOs.
4. A minimum of one PSO (assuming condition 5 is met) must be on duty observing for listed species at all times that noise-producing equipment <180 kHz is operating, or the survey vessel is actively transiting during daylight hours (i.e. from 30 minutes prior to sunrise and through 30 minutes following sunset). Two PSOs must be on duty during nighttime operations. A PSO schedule showing that the number of PSOs used is sufficient to effectively monitor the affected area for the project (e.g., surveys) and record the required data must be included. PSOs must not be on watch for more than 4 consecutive hours, with at least a 2-hour break after a 4-hour watch. PSOs must not be on active duty observing for more than 12 hours in any 24-hour period.
5. Visual monitoring must occur from the most appropriate vantage point on the associated operational platform that allows for 360-degree visual coverage around the vessel. If

360-degree visual coverage is not possible from a single vantage point, multiple PSOs must be on watch to ensure such coverage.

6. Suitable equipment must be available to each PSO to adequately observe the full extent of the Clearance and Shutdown Zones during all vessel operations and meet all reporting requirements.
    a. Visual observations must be conducted using binoculars and the naked eye while free from distractions and in a consistent, systematic, and diligent manner.
    b. Rangefinders (at least one per PSO, plus backups) or reticle binoculars (e.g., 7 x 50) of appropriate quality (at least one per PSO, plus backups) to estimate distances to listed species located in proximity to the vessel and Clearance and Shutdown Zone(s).
    c. Digital full frame cameras with a telephoto lens that is at least 300 mm or equivalent. The camera or lens should also have an image stabilization system. Used to record sightings and verify species identification whenever possible.
    d. A laptop or tablet to collect and record data electronically.
    e. Global Positioning Units (GPS) if data collection/reporting software does not have built-in positioning functionality.
    f. PSO data must be collected in accordance with standard data reporting, software tools, and electronic data submission standards approved by BOEM and NMFS for the particular activity.
    g. Any other tools deemed necessary to adequately perform PSO tasks.

PDCs 8: Reporting Requirements

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

BMPs:

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

    Visual Effort:
    a. Vessel name;
    b. Dates of departures and returns to port with port name;
    c. Lease number;
    d. PSO names and affiliations;
    e. PSO ID (if applicable);
    f. PSO location on vessel;
    g. Height of observation deck above water surface (in meters);
    h. Visual monitoring equipment used;
    i. Dates and times (Greenwich Mean Time) of survey on/off effort and times corresponding with PSO on/off effort;
    j. Vessel location (latitude/longitude, decimal degrees) when survey effort begins and ends; vessel location at beginning and end of visual PSO duty shifts; recorded at 30 second intervals if obtainable from data collection software, otherwise at practical regular interval;

k. Vessel heading and speed at beginning and end of visual PSO duty shifts and upon any change;
l. Water depth (if obtainable from data collection software) (in meters);
m. Environmental conditions while on visual survey (at beginning and end of PSO shift and whenever conditions change significantly), including wind speed and direction, Beaufort scale, Beaufort wind force, swell height (in meters), swell angle, precipitation, cloud cover, sun glare, and overall visibility 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 (in meters);

v. Source frequency;
w. Animal's closest point of approach and/or closest distance from the center point of the acoustic source;
x. Time entered shutdown zone;
y. Time exited shutdown zone;
z. Time in shutdown zone;
aa. Photos/Video

2. The project proponent must submit a final monitoring report to BOEM and NMFS (to *renewable_reporting@boem.gov* and *nmfs.gar.incidental-take@noaa.gov*) within 90 days after completion of survey activities. The report must fully document the methods and monitoring protocols, summarizes the survey activities and the data recorded during monitoring, estimates of the number of listed species that may have been taken during survey activities, describes, assesses and compares the effectiveness of monitoring and mitigation measures. PSO sightings and effort data and trackline data in Excel spreadsheet format must also be provided with the final monitoring report.
3. Reporting sightings of North Atlantic right whales:
    a. If a North Atlantic right whale is observed at any time by a PSO or project personnel during surveys or vessel transit, sightings must be reported within two hours of occurrence when practicable and no later than 24 hours after occurrence. In the event of a sighting of a right whale that is dead, injured, or entangled, efforts must be made to make such reports as quickly as possible to the appropriate regional NOAA stranding hotline (from Maine-Virginia report sightings to 866-755-6622, and from North Carolina-Florida to 877-942-5343). Right whale sightings in any location may also be reported to the U.S. Coast Guard via channel 16 and through the WhaleAlert App (http://www.whalealert.org/).
    b. Further information on reporting a right whale sighting can be found at: *https://apps-nefsc.fisheries.noaa.gov/psb/surveys/documents/20120919_Report_a_Right_Whale.pdf*
4. In the event of a vessel strike of a protected species by any survey vessel, the project proponent must immediately report the incident to BOEM (*renewable_reporting@boem.gov*) and NMFS (*nmfs.gar.incidental-take@noaa.gov*) and for marine mammals to the NOAA stranding hotline: from Maine-Virginia, report to 866-755-6622, and from North Carolina-Florida to 877-942-5343 and for sea turtles from Maine-Virginia, report to 866-755-6622, and from North Caroline-Florida to 844-732-8785. The report must include the following information:
    a. Name, telephone, and email or the person providing the report;
    b. The vessel name;
    c. The Lease Number;
    d. Time, date, and location (latitude/longitude) of the incident;
    e. Species identification (if known) or description of the animal(s) involved;
    f. Vessel's speed during and leading up to the incident;
    g. Vessel's course/heading and what operations were being conducted (if applicable);
    h. Status of all sound sources in use;

   i. Description of avoidance measures/requirements that were in place at the time of the strike and what 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).
5. Sightings of any injured or dead listed species must be immediately reported, regardless of whether the injury or death is related to survey operations, to BOEM (*renewable_reporting@boem.gov*), NMFS (*nmfs.gar.incidental-take@noaa.gov*), and the appropriate regional NOAA stranding hotline (from Maine-Virginia report sightings to 866-755-6622, and from North Carolina-Florida to 877-942-5343 for marine mammals and 844-732-8785 for sea turtles). If the project proponent's activity is responsible for the injury or death, they must ensure that the vessel assist in any salvage effort as requested by NMFS. When reporting sightings of injured or dead listed species, the following information must be included:
   a. Time, date, and location (latitude/longitude) of the first discovery (and updated location information if known and applicable);
   b. Species identification (if known) or description of the animal(s) involved;
   c. Condition of the animal(s) (including carcass condition if the animal is dead);
   d. Observed behaviors of the animal(s), if alive;
   e. If available, photographs or video footage of the animal(s); and
   f. General circumstances under which the animal was discovered.
6. Reporting and Contact Information:
   a. Dead and/or Injured Protected Species:
      1. NMFS Greater Atlantic Region's Stranding Hotline: 866-755-6622
      2. NMFS Southeast Region's Stranding Hotline: 877-942-5343 (marine mammals), 844-732-8785 (sea turtles)
   ii. Injurious Takes of Endangered and Threatened Species:
      1. NMFS Greater Atlantic Regional Office, Protected Resources Division (*nmfs.gar.incidental-take@noaa.gov*)
      2. BOEM Environment Branch for Renewable Energy, Phone: 703-787-1340, Email: *renewable_reporting@boem.gov*