Strong Mitigation Measures Are Essential to Protect Marine Mammals and Sea Turtles During All Phases of Offshore Wind Energy Development on the Atlantic Coast

Table of Contents

Introduction

As we establish America's important new offshore wind energy industry to transition us away from harmful fossil fuels, we must follow the principles of the mitigation hierarchy and avoid, minimize, and mitigate impacts to protected marine species.[1] The seriously imperiled North Atlantic right whale – with approximately 350 individuals estimated remaining in 2022[2] – is in dire straits from vessel strikes, entanglement in fishing gear, underwater noise pollution, and climate change, and cannot withstand further losses or additional stress.[3] Other marine mammal species particularly vulnerable[4] to the potential impacts of offshore wind development in U.S. East Coast continental shelf waters include blue

[1] *See*, *e.g.*, CSBI (2015). "A cross-sector guide for implementing the mitigation hierarchy." Prepared by the Biodiversity Consultancy on behalf of IPIECA, ICMM and the Equator Principles Association: Cambridge UK. http://www.csbi.org.uk/wp-content/uploads/2017/10/CSBI-Mitigation-Hierarchy-Guide.pdf.

[2] New England Aquarium, "Scientists release annual population estimate for critically endangered North Atlantic right whale amid ongoing threats." Press release (Oct. 23, 2023). https://www.neaq.org/about-us/press-room/press-releases/2022-population-estimate-north-atlantic-right-whale/.

[3] NOAA Fisheries, "2017-2022 North Atlantic Right Whale Unusual Mortality Event." https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-north-atlantic-right-whale-unusual-mortality-event.

[4] Vulnerability level was determined based on several factors, including whether the species (and specific population stock) is listed under the Endangered Species Act, is currently experiencing or has recently experienced an Unusual Mortality Event, has a small population size and/or is range-restricted, or has outsized hearing sensitivity to noise.

whales, fin whales, humpback whales,[5] minke whales, sei whales, coastal bottlenose dolphins, harbor porpoises, and manatees. Five species of sea turtles (green, hawksbill, Kemp's ridley, leatherback, and loggerhead sea turtles) are found in U.S. East Coast waters and are protected under the Endangered Species Act. Marine mammals and sea turtles face a wide range of threats, including bycatch in fishing gear, vessel strikes, direct harvest of turtles and eggs, loss and degradation of turtle nesting and foraging habitat, pollution, including underwater noise for marine mammals and marine debris, and climate change.[6] To protect the future of marine mammals and sea turtles, we must avoid additional threats to these species from offshore wind, and implement stringent measures for each project to safeguard these species during site assessment, construction, operations, and decommissioning.

Risks from vessel collisions and noise impacts on marine mammals and sea turtles, including potential habitat displacement of marine mammals that may exacerbate existing threats, need to be fully addressed from the start of the offshore wind development process.[7] Strong protections are required to fulfill federal legal requirements for protecting marine mammals and sea turtles[8] and will ensure we can achieve the Biden administration's goals to deploy 30 gigawatts (GW) of offshore wind energy by 2030 and 15 additional GW of floating offshore wind by 2035, while protecting biodiversity, cultural resources, and ocean uses.[9]

Several science-based solutions and new technologies are now available to avoid or minimize the potential noise and vessel impacts stemming from offshore wind energy development:

- *Noise*: Quieter foundation technologies such as gravity-based or suction bucket (or "caisson") foundations eliminate the need for pile driving and are thus one of the most effective technologies available for mitigating noise risk to whales and other marine life during offshore wind development. We urge the use of quieter foundations during offshore wind energy project installation and stress the importance of providing full consideration to selecting these options

[5] *See, e.g.*, NOAA Fisheries, "2016-2024 Humpback Whale Unusual Mortality Event Along the Atlantic Coast." https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2024-humpback-whale-unusual-mortality-event-along-atlantic-coast.

[6] NOAA Fisheries, "Marine Mammal Protection: Conservation & Management." https://www.fisheries.noaa.gov/topic/marine-mammal-protection/conservation-and-management; NOAA Fisheries, "Understanding Vessel Strikes." https://www.fisheries.noaa.gov/insight/understanding-vessel-strikes; NOAA, "Marine Mammals: Underwater Noise." https://www.noaa.gov/marine-mammals-underwater-noise; NOAA Fisheries, "Sea Turtles – Overview." https://www.fisheries.noaa.gov/sea-turtles.

[7] Strong protections for endangered and at-risk marine mammal species, including those currently experiencing Unusual Mortality Events (including humpback whales and minke whales), as well as species highly sensitive to noise (e.g., harbor porpoises), are essential.

[8] All marine mammals are protected under the Marine Mammal Protection Act. The Endangered Species Act also provides protections to many species of marine mammals, as well as some species of sea turtles and other marine wildlife.

[9] The White House, "Briefing Room FACT SHEET: Biden Administration Announces New Actions to Expand U.S. Offshore Wind Energy." (Sept. 15, 2022). https://www.whitehouse.gov/briefing-room/statements-releases/2022/09/15/fact-sheet-biden-harris-administration-announces-new-actions-to-expand-u-s-offshore-wind-energy/.

as the preferred alternative.[10] If pile driving must occur, effective noise abatement systems are commercially available,[11] and near real-time monitoring technologies that can be used to trigger mitigation measures are being tested or are already being used by other sectors.[12] Pending further study, we also recommend the use of direct-drive turbines as opposed to turbines with a gear box, as direct-drive turbines may result in lower noise levels being emitted into the water column during operations.[13,]

- *Vessels*: Science is unequivocal on the value of vessel speed restrictions in reducing mortalities of North Atlantic right whales, other large whale species, and sea turtles from vessel collisions.[14] Service operating vessels that host construction workers and technicians for multiple days at sea reduce the pressure on limited transit times between the port and the lease area and can help developers meet speed requirements.

Entanglement risk must also proactively managed. Floating offshore wind platforms pose a unique risk of potential entanglement of marine wildlife due to their extensive underwater mooring and cable systems, which could ensnare marine debris.[15] Typical spacing of floating turbines is expected to be

[10] While gravity-based and suction bucket foundations avoid the impacts of pile-driving noise, their installation is not necessarily noise free, and the potential use of dynamic positioning systems and other noise related to installation vessels may still lead to some level of behavioral disturbance. As gravity-based and suction bucket foundations are new technologies in the U.S., it will be important to monitor the levels of noise emitted during installation at the source and model the level of potential noise exposure to large whales and other marine mammals, to inform the most appropriate mitigation approaches for future offshore wind energy projects for which these foundation types are used.

[11] *See, e.g.*, "AdBm Noise Mitigation System." AdBm Technologies. https://adbmtech.com/

[12] *See, e.g.*, Coutinho, R.W. and Boukerche, A. (2021). "North Atlantic Right Whales Preservation: A New Challenge for Internet of Underwater Things and Smart Ocean-Based Systems." *IEEE Instrumentation & Measurement Magazine*, 24(3), 61-67; Kowarski, K.A., Gaudet, B.J., Cole, A.J., Maxner, E.E., Turner, S.P., Martin, S.B., Johnson, H.D. and Moloney, J.E. (2020). "Near real-time marine mammal monitoring from gliders: Practical challenges, system development, and management implications." *Journal of the Acoustical Society of America*, 148(3), 1215-1230; Johnson, H., Morrison, D. and Taggart, C. (2021). "WhaleMap: a tool to collate and display whale survey results in near real-time." *Journal of Open Source Software*, 6(62), 3094; Vickers, W., Milner, B., Risch, D., & Lee, R. (2021). "Robust North Atlantic right whale detection using deep learning models for denoising." *Journal of the Acoustical Society of America*, 149, 3797.

[13] Stöber, U. and Thomsen, F. (2021). "How could operation sound from future offshore wind turbines impacts marine life?" *Journal of the Acoustical Society of America*, 149, 1791.

[14] A reduction in vessel speed has been successful in reducing collision risk and is the preferred measure to implement when vessels cannot be re-routed. Schoeman, R.P., Patterson-Abrolat, C. and Plön, S. (2020). "A global review of vessel collisions with marine animals." *Frontiers in Marine Science*, 7, 292; Redfern, J.V., Hodge, B.C., Pendleton, D.E., Knowlton, A.R., Adams, J., Patterson, E.M., Good, C.P. and Roberts, J.J., 2024. Estimating reductions in the risk of vessels striking whales achieved by management strategies. *Biological Conservation*, p.110427.

[15] Maxwell, Sara M., et al. "Potential impacts of floating wind turbine technology for marine species and habitats." *Journal of Environmental Management* 307 (2022): 114577. https://www.researchgate.net/profile/Sara-Maxwell-2/publication/358107242_Potential_impacts_of_floating_wind_turbine_technology_for_marine_species_and_habitats/links/61f05a65dafcdb25fd501ba7/Potential-impacts-of-floating-wind-turbine-technology-for-marine-species-and-habitats.pdf.

approximately 1 mile apart.[16] The mooring lines and dynamic array cables between the turbines therefore represent a sizable physical and ecological footprint, particularly for a utility-scale project. Marine mammals and sea turtles (and also sharks and diving birds) are at risk of becoming entangled on marine debris that becomes ensnared around floating offshore wind lines and cables. There is also a potential risk that large whales may become entangled in the offshore wind lines and cables themselves, or that materials already entangling whales may become ensnared on the infrastructure.
The mitigation measures presented in this document are based on the best available scientific information and are needed to ensure offshore wind advances responsibly.[17] These fundamental requirements are necessary to protect marine mammal and sea turtle species, including those particularly vulnerable to the potential impacts posed by offshore wind energy development. These recommendations may change as new scientific and/or technological advancements occur, and additional recommendations may be developed for these and other marine species. The measures are designed to first avoid, and then minimize and mitigate, potential impacts during the site assessment and characterization, construction, and operation phases.[18] Mitigation measures for the repowering and decommissioning phases of offshore wind energy development will be developed as needed.

We present recommendations for avoiding and reducing vessel strike risk at all stages of offshore wind development (Section I), recommendations for mitigating noise during site assessment and characterization (Section II) and operations (Section V), and two sets of mitigation recommendations for the construction period: one set for pile-driven foundations (Section III), and a more limited set for quieter gravity-based and suction bucket foundations and floating offshore wind platforms (Section IV). We also present recommendations for avoiding and mitigating entanglement risk for floating offshore wind platforms (Section VI).

Section I. Vessel strike mitigation recommendations during all stages of offshore wind development

1) **Require mandatory vessel speed restrictions:**
   a) All project-associated vessels must adhere to a 10-knot speed restriction at all times except for reasons of safety.
   b) When traveling in any area where one or more regulations establish a speed restriction,

[16] Typical spacing varies between 6x and 8x the diameter of the rotor. For example, a GE 12-MW Haliade-X turbine array with spacing 8x the diameter of the rotor would lead to turbines being spaced over 1 mile apart. Maxwell, Sara M., et al. 2022. *Id*.
[17] Responsible development of offshore wind energy: (i) avoids, minimizes, mitigates, and monitors for adverse impacts on wildlife and habitats, (ii) minimizes negative impacts on other ocean uses, (iii) includes robust consultation with Native American tribes and communities, (iv) meaningfully engages state and local governments and stakeholders from the outset, (v) includes comprehensive efforts to avoid impacts to underserved communities, and (vi) uses the best available scientific and technological data to ensure science-based stakeholder-informed decision making.
[18] This document should be considered together with other ENGO recommendations on how to advance offshore wind energy development in a responsible manner, including the importance of selecting sites that offer the least environmental impact.

either seasonally or dynamically, all project-associated vessels must adhere to the most stringent (i.e., the lowest speed) regulation applicable to that area. Vessels must also comply with all applicable speed restrictions established by permit.

c) All project-associated vessels must slow to 4 knots, except for reasons of safety, while transiting through areas of visible jellyfish aggregations or floating vegetation lines or mats to improve protection for sea turtles.

2) Future alternative for vessel strike risk reduction:

a) A 10-knot speed restriction is currently the only proven method for reducing the risk of lethal vessel strike of large whales. However, the development of near real-time monitoring technologies for North Atlantic right whales, and potentially other species of large whales, may provide alternative tools for mitigating vessel strike risk in the future. When the best available science demonstrates that vessel strike avoidance methods can provide comparable or greater vessel strike risk reduction than a 10-knot speed restriction, project proponents may develop an "Adaptive Plan" that modifies the 10-knot speed restriction. A determination that vessel strike avoidance methods can provide comparable or greater vessel strike risk reduction than a 10-knot speed restriction should be informed by the effectiveness criteria being developed by the joint Regional Wildlife Science Collaborative for Offshore Wind (RWSC) and Marine Technology Society Technology Workshop Series.[19] Any Adaptive Plan must be developed in consultation with the National Ocean and Atmospheric Administration (NOAA) Fisheries.

3) Implement other vessel-related measures:

a) Any designated crew lookouts must receive training on protected species identification, including distinguishing between large whale species and observing for the presence of small cetaceans, manatees, and sea turtles; vessel strike minimization procedures; how and when to communicate with the vessel captain; and reporting requirements.

b) All vessel crew members must be briefed on the identification of marine mammal and sea turtle species.

c) Vessels should maintain a separation distance of 500 meters (m) from North Atlantic right whales and other large whale species.
   i) Any time a large whale is within 200 m of an underway vessel, or the vessel encounters a feeding aggregation of large whales, a full stop is required if safety permits.
   ii) The vessel should remain stationary until large whales have moved at least 200 m away from the vessel, after which point the separation distance should again be maintained.

d) Vessels should maintain a separation distance of 100 m from all other marine mammal species and from sea turtles.

e) Vessels in transit must post at least one trained lookout or Protected Species Observer (PSO)[20] to search for marine mammals and sea turtles and notify the captain upon visual

[19] RWSC, "Technology Workshops," https://rwsc.org/technology-workshops/. This series is being funded by the Department of Energy, with contributions from NOAA and BOEM.

[20] Protected Species Observers are trained professionals who monitor for protected species so that the possibility of vessel strikes is minimized and to prevent or shut down any sound sources or other development activity causing harassment if protected species are detected within a certain distance. For the purposes of the recommendations set out in this document, lessees, operators, and developers should use trained, independent, third-party Protected Species Observers (e.g., not construction personnel) that are approved by NOAA Fisheries. Protected Species Observers should have no duties other than to effectively implement mitigation and monitoring measures during site assessment, construction, and/or operations.

detection.[21]

i) If the trained lookout is a vessel crew member, this must be their designated role and primary responsibility while the vessel is transiting.
ii) If a whale is observed that may be a North Atlantic right whale but its species cannot be confirmed, the vessel operator must assume that it is a North Atlantic right whale and take appropriate action for avoidance or stoppage.

f) All vessels responsible for crew transport should use thermal detection systems to supplement visual monitoring of marine mammals during transit, with at least one additional trained crew lookout or PSO monitoring the thermal detection system at all times.
g) All vessels (developer- and contractor-operated) must maintain a functioning Automatic Identification System (AIS) onboard and operate this system at all times.

4) **Additional vessel-related measures for the North Atlantic right whale:**
   a) Develop and implement the project's schedule to reduce vessel density during the times of year when North Atlantic right whales are most likely to occur in lease areas and along vessel routes. Coordinate across different offshore wind development projects to reduce cumulative vessel density within the region, to the extent practicable.
      i) Time periods of highest risk include, but are not limited to, during foraging and migration, and times when mother-calf pairs, pregnant females, surface active groups (indicative of breeding or social behavior), or aggregations of three or more whales (indicative of feeding or social behavior) are, or are expected to be, present. Time periods should be defined based on the best available scientific information.

Section II. Noise mitigation recommendations during site assessment and characterization

1) Prohibit site assessment and characterization activities during times of highest risk for North Atlantic right whales:

a) Site assessment and characterization activities involving high-resolution geophysical survey equipment with noise levels that could injure or harass marine mammals (at or below a frequency of 180 kHz) should not occur during periods of highest risk to North Atlantic right whales. Time periods of highest risk include, but are not limited to, during foraging and migration, and times when mother-calf pairs, pregnant females, surface active groups (indicative of breeding or social behavior), or aggregations of three or more whales (indicative of feeding or social behavior) are, or are expected to be, present. Time periods must be defined based on the best available scientific information.
b) If a near real-time monitoring system and mitigation protocol for North Atlantic right whales and other large whale species is developed and scientifically validated, the system and protocol may be used to dynamically manage the timing of site assessment and

[21] Additional PSO requirements for vessels conducting site assessment and construction activities are provided in Section II(5)(b) (site assessment and characterization activities), Section III(8)(b) (pile-driving activities), and Section IV(3)(b) (installation of quiet foundations).

characterization activities to ensure those activities are undertaken during times of lowest risk for all relevant large whale species. The development of such a protocol is particularly important where foraging aggregations of other large whale species are observed coincident with the times that noise-producing activities would most likely be undertaken based on times of lower relative risk to North Atlantic right whales.

2) Require diel restrictions on site assessment and characterization activities:

a) Site assessment and characterization activities must not be initiated within 1.5 hours of civil sunset or in times of low visibility when the visual clearance zones and exclusion zones (defined in Section II(3) below) cannot be visually monitored, as determined by the lead Protected Species Observer (PSO) on duty.

3) Require the following clearance zone and exclusion zone distances prior to site assessment and characterization activities with noise levels known to injure or harass marine mammals (defined throughout this section as source levels at or below a frequency of 180 kHz):

a) For North Atlantic right whales:
   i) A visual clearance zone and exclusion zone of at least 1,000 m must be established around each vessel or sound source.
   ii) An acoustic clearance zone and exclusion zone of at least 1,000 m must be established around each vessel or sound source.

b) If a large whale is detected visually or acoustically within the 1,000 m clearance or exclusion zone but the species cannot be identified, it must be assumed to be a North Atlantic right whale.

c) For other large whale species, coastal bottlenose dolphins, harbor porpoises, and manatees:
   i) A visual clearance zone and exclusion zone must extend at least 500 m in all directions from each vessel or sound source.

d) For all other marine mammal species:
   i) Clearance and exclusion zone distances for other marine mammal species must be designed in a manner that eliminates Level A take and minimizes behavioral harassment to the fullest extent practicable.

4) Delay initiation or require shutdown of site assessment and characterization activities with noise levels known to injure or harass marine mammals (defined throughout this section as source levels at or below a frequency of 180 kHz) if a marine mammal is detected visually or if a North Atlantic right whale is detected acoustically in clearance and exclusion zones (as defined in Section II(3)):

a) If a marine mammal species is visually detected within the relevant visual clearance zone for that species, as defined under Section II(3), site assessment and characterization activities must not be initiated.

b) If a marine mammal is visually detected within the relevant visual exclusion zone for that species, as defined under Section II(3), site assessment and characterization activities must be halted.

c) If a North Atlantic right whale is acoustically detected within the acoustic clearance zone, site assessment and characterization activities must not be initiated.
   i) If localization, as described in Section II(5)(a)(i) below, cannot be achieved by acoustic detection, site assessment and characterization activities should not be initiated upon detection of a North Atlantic right whale call, regardless of distance from sound source.

d) If a North Atlantic right whale is acoustically detected within the acoustic exclusion zone, site assessment and characterization activities must be halted.
    i) If localization, as described in Section II(5)(a)(i) below, cannot be achieved by acoustic detection, site assessment and characterization activities should be suspended upon detection of a North Atlantic right whale call, regardless of distance from sound source.
e) Once halted, site assessment and characterization activities may resume following the methods set forth in Section II(5) and after the lead PSO confirms no marine mammals have been detected within the relevant acoustic and visual clearance zones, as defined under Section II(3).

5) Require robust monitoring protocols during pre-clearance and when site assessment and characterization activities are underway:

a) Monitoring of the acoustic clearance zone must be undertaken using near real-time passive acoustic monitoring (PAM)[22] and must be undertaken from a vessel other than the survey vessel, or from a stationary unit, to avoid the hydrophone being masked by the survey vessel or development-related noise.
    i) The PAM system should be set up so that it is capable of localizing the position of vocalizing whales. A plan detailing any proposed localization system and analysis methods should be submitted to BOEM and other relevant permitting agencies in advance of deployment. The system should meet the following criteria:[23]
        (1) Stationary systems must have a minimum of three hydrophones (accuracy can be greatly improved by using four hydrophones), and mobile systems (e.g., towed arrays) must have a minimum of two hydrophones.
        (2) Simulations should be conducted prior to selecting the number and location of receivers to maximize accuracy (i.e., reduce confidence intervals) in the final configuration.[24]
        (3) Systems should be calibrated before deployment to ensure accurate detection capability.
        (4) For time-of-arrival based systems, synchronization of data streams from the multiple receivers is necessary for accurate calculations.
        (5) Irrespective of the system used, careful testing and documentation of localization errors should be undertaken.
b) During pre-clearance and when site assessment and characterization activities are underway, monitoring of the visual clearance zone must be undertaken by vessel-based PSOs stationed on the survey vessel to enable monitoring of the entire clearance zones for marine mammals. On each vessel, there must be a minimum of four PSOs following a two-on, two-off rotation, each responsible for scanning no more than 180° of the horizon. To effectively monitor the full exclusion zone, multiple PSOs must be stationed at several vantage points at the highest

[22] Throughout this document "PAM" refers to a real-time passive acoustic monitoring system. NOAA and BOEM have defined minimum recommendations for use of PAM in monitoring and mitigation for offshore wind development. Van Parijs SM et al. 2021. "NOAA and BOEM Recommendations for Use of Passive Acoustic Listening Systems in Offshore Wind Energy Development Monitoring and Mitigation Programs." *Front. Mar. Sci*. 8. Available at, https://www.frontiersin.org/articles/10.3389/fmars.2021.760840/full.

[23] *See, also*, recommendations in Van Parijs SM et al. 2021.

[24] There are several mathematical methods to improve the accuracy of localization estimates by reducing the confidence intervals for each parameter that should be follow. *See* Spiesberger J. 2022. Extremely reliable locations and calling abundance via passive acoustic monitoring. Oral Presentation. NYSERDA State of the Science Workshop. July 27, 2022. https://www.youtube.com/watch?v=-tV8ViBVQzg.

level to allow each to continuously scan a section of the exclusion zone. Ensure PSOs do not exceed two consecutive watch hours on duty at any time, have a two-hour (minimum) break between watches, and do not exceed a combined watch schedule of more than 12 hours in a 24-hour period. PSO schedules should be designed to minimize observer fatigue.

c) Acoustic monitoring for North Atlantic right whales and visual monitoring for marine mammal species must begin at least 30 minutes prior to the commencement or re-initiation of site assessment and characterization activity and must be conducted throughout the duration of activity.

6) Require underwater noise reduction to the fullest extent feasible:

a) The impacts of underwater noise must be minimized to the fullest extent feasible, including through the use of technically and commercially feasible and effective noise reduction and attenuation measures. For example, project proponents should select and operate sub-bottom profiling systems at power settings that achieve the lowest practicable source level for the objective. The site assessment plan submittal should provide detail as to how the operator has reduced noise output within the range of marine mammal audibility to the fullest extent feasible.

b) For deep-water site assessment and characterization surveys (floating wind only): Where water depth is greater than 100 m, survey equipment should be deployed using an autonomous underwater vehicle (AUV) operated a maximum of 40 m above the seafloor.

c) Project proponents should report the steps taken (including, for example, power settings used) to meet the recommendations in this subsection in the annual report of site assessment activities submitted to BOEM pursuant to 30 C.F.R. § 585.615.

7) Require mandatory reporting of marine mammals and sea turtles detected during pre-clearance and site assessment and characterization activities:

a) All visual observations and acoustic detections of North Atlantic right whales must be reported to NOAA Fisheries or the United States Coast Guard *as soon as possible and no later than the end of the PSO shift*. We note that, in some cases, such as with the use of near real-time autonomous buoy systems, the detections will be reported automatically on a pre-set cycle.

b) Observations of entangled, injured, or dead North Atlantic right whales, and other entangled, injured, and dead marine mammal species and sea turtles, must be immediately reported to NOAA Fisheries' Northeast Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (1-866-755-6622) for states from Maine to Virginia; NOAA Fisheries' Southeast Marine Mammal Stranding Hotline (1-877-942-5343) or Southeast Sea Turtle Stranding and Salvage Network (1-844-732-8785) for states from North Carolina to Florida;[25] or the United States Coast Guard via one of several available systems (e.g., phone, app, radio). Methods of reporting are expected to advance and streamline in the coming years, and projects should commit to supporting and participating in these efforts.

c) PSO sightings data must be submitted to BOEM as directed in any relevant guidance, site assessment plan (SAP) or construction and operations plan (COP) approval, or other agency protocol. Sightings data and reports provided to BOEM should be made publicly available by BOEM to inform marine mammal and sea turtle science and protection.

[25] NOAA Fisheries, "Report a Stranded or Injured Marine Animal," https://www.fisheries.noaa.gov/report.

Section III. Noise mitigation recommendations for construction of pile-driven foundations

Throughout this document, unless otherwise stated, "pile driving" refers to both impact and vibratory methods.

1) Use quiet foundations in construction.

a) Whenever possible, project proponents should use gravity-based and suction bucket foundations, which eliminate the need for pile driving and thereby significantly reduce underwater noise pollution and the risk of noise impacts to marine mammals and sea turtles.

2) Prohibit pile driving during times of highest risk to North Atlantic right whales:

a) Pile driving must not occur during periods of highest risk to North Atlantic right whales. Time periods of highest risk include, but are not limited to, during foraging and migration, and times when mother-calf pairs, pregnant females, surface active groups (indicative of breeding or social behavior), or aggregations of three or more whales (indicative of feeding or social behavior) are, or are expected to be, present. Time periods must be defined based on the best available scientific information.

b) If a near real-time monitoring system and mitigation protocol for North Atlantic right whales and other large whale species is developed and scientifically validated, the system and protocol may be used to dynamically manage the timing of pile driving and other construction activities to ensure those activities are undertaken during times of lowest risk for all relevant large whale species. The development of such a protocol is particularly important where foraging aggregations of other large whale species are observed coincident with the times that pile driving would most likely be undertaken based on times of lower relative risk to North Atlantic right whales.

3) Restrict pile-driving activity at night and during periods of low visibility:

a) Pile driving must not be initiated within 1.5 hours of civil sunset or in times of low visibility when the visual clearance zone and exclusion zone (defined in Section III(5) below) cannot be visually monitored, as determined by the lead PSO on duty.

b) Pile driving may continue after dark only if the activity commenced during daylight hours and must proceed for human safety or installation feasibility reasons,[26] and if required night-time monitoring protocols are followed (see Section III(8)).

[26] Throughout this document, "installation feasibility" refers to ensuring that the pile installation event results in a usable foundation for the wind turbine (i.e., foundation installed to the target penetration depth without refusal and with a horizontal foundation/tower interface flange). In the event that pile driving has already started and nightfall occurs, the lead engineer on duty will make a determination through the following evaluation: 1) Use the site-specific soil data on the pile location and the real-time hammer log information to judge whether a stoppage would risk causing piling refusal at re-start of piling; and 2) Check that the pile penetration is deep enough to secure pile stability in the interim situation, taking into account weather statistics for the relevant season and the current weather forecast. Such determinations by the lead engineer (or their alternate) on duty will be made for each pile location as the installation progresses and not for the site as a whole. This information will be included in the reporting for the project.

4) **Sound fields generated during impact pile driving must not exceed NOAA Fisheries' Level A permanent threshold shift (PTS) limits for low frequency cetaceans (LFC) by the specified date and at the distances below. Every attempt must be made to reach the Received Sound Level Limit (RSLL) at 100% of foundations.**
   a) Voluntary:
      i) May 1, 2025: After the first three foundations, no exceedance of RSLL beyond 4,921 feet (ft) (1,500 m) from the foundation for 90% of remaining piles.
   b) Required:
      i) May 1, 2026: After the first three foundations, no exceedance of RSLL beyond 4,921 ft (1,500 m) from the foundation for 90% of remaining piles.
      ii) May 1, 2028: After the first three foundations, no exceedance of RSLL beyond 3,280 ft (1,000 m) from the foundation for 90% of remaining piles.
      iii) May 1, 2030: After the first three foundations, no exceedance of RSLL beyond 2,460 ft (750 m) from the foundation for 90% of remaining piles.
   c) On a case-by-case basis, BOEM may consider an exception to the RSLL if the lessee provides sufficient written justification, as determined by BOEM, of why meeting the RSLL is not technically and commercially practicable. In these cases, compensatory mitigation may be considered, such as operator contributions to research and monitoring that reduce noise or contribute to a better understanding of noise reduction.
   d) Field measurements must be conducted as described in section 3 ("Offshore Wind Pile Driving Sound Field Measurement Recommendations") of the Nationwide Recommendations for Impact Pile Driving Sound Exposure Modeling and Sound Field Measurement for Offshore Wind Construction and Operations Plans.[27] As described in these recommendations, the "Thorough SFV Monitoring" procedure should be conducted for the first three foundations of a project and when a foundation is to be installed with substantially different foundation, construction, and environmental parameters. An "Abbreviated SFV Check" should be performed on any foundation installation for which "Thorough SFV Monitoring" is not planned.
   e) Sound source validation reports of field measurements must be evaluated by both BOEM and NOAA Fisheries prior to additional piles being installed. Reports must be made publicly available within one month after their submission to BOEM and other relevant agencies.

5) **Require the following clearance zone distances prior to pile driving and exclusion zone distances during pile driving:**
   a) For North Atlantic right whales:
      i) A visual clearance zone and exclusion zone must extend at minimum 5,000 m in all directions from the location of the driven pile.
      ii) An acoustic clearance zone must extend at minimum 10,000 m in all directions from the location of the driven pile.
      iii) An acoustic exclusion zone must extend at minimum 2,000 m in all directions from the location of the driven pile.
      iv) If a surface active group (indicative of breeding or social behavior), or an aggregation of three or more whales (indicative of feeding or social behavior) is

[27] BOEM, *Nationwide Recommendations for Impact Pile Driving Sound Exposure Modeling and Sound Field Measurement for Offshore Wind Construction and Operations Plans*, Aug. 2023, https://www.boem.gov/sites/default/files/documents/renewable-energy/state-activities/FINAL%20Nationwide%20Recommendations%20for%20Impact%20Pile%20Driving%20Sound%20Exposure%20Modeling%20and%20Sound%20Field%20Measurement%20%28Acoustic%20Modeling%20Guidance%29.pdf.

detected via regional or opportunistic detection methods (e.g., regional aerial surveys or WhaleAlert) within 20 kilometers of a pile installation site, then the start of pile driving should be delayed until the surface-active group or aggregation is no longer reported within that distance.

b) If a large whale is detected visually or acoustically within the clearance or exclusion zones defined in Section III(5)(a) for North Atlantic right whales, but the species cannot be identified, it must be assumed to be a North Atlantic right whale.
c) For all other marine mammals:
    i) Clearance and exclusion zone distances for other marine mammal species must be designed in a manner that eliminates Level A take and minimizes behavioral harassment to the fullest extent practicable.
d) For sea turtles:
    i) A visual clearance zone and exclusion zone must extend at minimum 500 m in all directions from the location of the driven pile.

6) Require a 24-hour pre-construction passive acoustic monitoring period for North Atlantic right whales prior to commencing pile-driving activities:

a) Monitoring for North Atlantic right whales must be undertaken using near real-time PAM, assuming a detection range of at least 10,000 m, for 24 hours prior to commencing pile-driving activities. PAM must be undertaken at the location of the pile-driving site in order to detect whales within a 10,000 m radius.
b) If a North Atlantic right whale vocalization is detected, the 24-hour monitoring period must be recommenced. Pile-driving activities must not commence until a 24-hour monitoring period has passed without any detection of North Atlantic right whale vocalizations.

7) Delay initiation or require shutdown of pile driving if a marine mammal or sea turtle is detected visually or if a North Atlantic right whale is detected acoustically in clearance and exclusion zones (as defined in Section III(5)):

a) Pile driving must not be initiated when monitoring methods defined in Section III(8) result in either an acoustic detection within the acoustic clearance zone of one or more North Atlantic right whales or a visual detection within the visual clearance zone of one or more marine mammals or sea turtles.
    i) If localization cannot be achieved by acoustic detection, as described in Section III(8)(a)(i) below, pile driving must not be initiated upon detection of a North Atlantic right whale call, regardless of distance from the sound source.
b) Pile driving must not be initiated or, if already underway, must be shut down, unless continued pile-driving activities are necessary for reasons of human safety or installation feasibility, when monitoring methods defined in Section III(8) result in acoustic detection within the acoustic exclusion zone of one or more North Atlantic right whales or a visual detection within the visual exclusion zone of one or more marine mammals or sea turtles.
    i) If localization cannot be achieved by acoustic detection, as described in Section III(8)(a)(i) below, pile driving must not be initiated or, if already underway, must be shut down upon detection of a North Atlantic right whale call, regardless of distance from the sound source.
c) Pile driving must be shut down, unless continued pile-driving activities are necessary for reasons of human safety or installation feasibility, if a North Atlantic right whale is visually detected by PSOs at any distance from the pile.
d) Once halted, pile driving may resume only after using the methods set forth in Section III(8)

and the lead PSO confirms no marine mammals or sea turtles have been detected within the relevant acoustic and visual clearance zones.

8) Require robust near real-time monitoring protocols during pre-clearance and when pile-driving activity is underway:

a) Monitoring of the acoustic clearance and exclusion zones must be undertaken using near real-time PAM, assuming a detection range of at least 10,000 m, and must be undertaken from a vessel other than the pile-driving vessel, or from a stationary unit, to avoid the hydrophone being masked by the pile-driving vessel or development-related noise.
   i) The PAM system should be set up so that it is capable of localizing the position of vocalizing whales. A plan detailing any proposed localization system and analysis methods should be submitted to BOEM and other relevant permitting agencies in advance of deployment. The system should meet the following criteria:[28]
      (1) Stationary systems must have a minimum of three hydrophones (accuracy can be greatly improved by using four hydrophones), and mobile systems (e.g., towed arrays) must have a minimum of two hydrophones.
      (2) Simulations should be conducted prior to selecting the number and location of receivers to maximize accuracy (i.e., reduce confidence intervals) in the final configuration.[29]
      (3) Systems should be calibrated before deployment to ensure accurate detection capability.
      (4) For time-of-arrival based systems, synchronization of data streams from the multiple receivers is necessary for accurate calculations.
      (5) Irrespective of the system used, careful testing and documentation of localization errors should be undertaken.

b) During pre-clearance and when pile-driving activity is underway, monitoring of the visual clearance and exclusion zones must be undertaken by vessel based PSOs stationed at the pile-driving site and on additional vessels circling the pile-driving site, as needed. On each vessel, there must be a minimum of four PSOs following a two-on, two-off rotation, each responsible for scanning no more than 180° of the horizon per pile-driving location. To effectively monitor the full exclusion zone, multiple PSOs must be stationed at several vantage points at the highest level to allow each to continuously scan a section of the exclusion zone. Additional vessels must survey the clearance and exclusion zones at speeds of 10 knots or less. Ensure PSOs do not exceed two consecutive watch hours on duty at any time, have a two-hour (minimum) break between watches, and do not exceed a combined watch schedule of more than 12 hours in a 24-hour period. PSO schedules should be designed to minimize observer fatigue.

c) Acoustic and visual monitoring must begin at least 60 minutes prior to the commencement or re-initiation of pile driving and must be conducted throughout the duration of pile-driving activity. Visual monitoring must continue until 30 minutes after cessation of pile driving.

d) Infrared technology must be used to support visual monitoring during any pile-driving activities that extend into periods of darkness.

e) Additional observers and monitoring technologies (e.g., infrared, drones, hydrophones) must be deployed, as needed, to ensure the ability to monitor the established clearance and

[28] *See, also*, recommendations in Van Parijs SM et al. 2021.

[29] There are several mathematical methods to improve the accuracy of localization estimates by reducing the confidence intervals for each parameter that should be follow. *See* Spiesberger J. 2022.

exclusion zones, including during periods of darkness or poor visibility.

9) **Require mandatory reporting of marine mammals and sea turtles detected during pre-clearance, when pile driving is underway, and for at least 30 minutes following pile driving:**
   a) All visual observations and acoustic detections of North Atlantic right whales must be reported to NOAA Fisheries or the United States Coast Guard *as soon as possible and no later than the end of the PSO shift*. We note that, in some cases, such as with the use of near real-time autonomous buoy systems, the detections will be reported automatically on a pre-set cycle.
   b) Observations of entangled, injured, or dead North Atlantic right whales, and other entangled, injured, and dead marine mammal species and sea turtles, must be immediately reported to NOAA Fisheries' Northeast Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (1-866-755-6622) for states from Maine to Virginia; NOAA Fisheries' Southeast Marine Mammal Stranding Hotline (1-877-942-5343) or Southeast Sea Turtle Stranding and Salvage Network (1-844-732-8785) for states from North Carolina to Florida;[30] or the United States Coast Guard via one of several available systems (e.g., phone, app, radio). Methods of reporting are expected to advance and streamline in the coming years, and projects should commit to supporting and participating in these efforts.
   c) PSO sightings data must be submitted to BOEM as directed in any relevant guidance, site assessment plan (SAP) or construction and operations plan (COP) approval, or other agency protocol. Sightings data and reports provided to BOEM should be made publicly available by BOEM to inform marine mammal and sea turtle science and protection.

Section IV. Noise mitigation recommendations for construction of gravity-based and suction bucket foundations and floating offshore wind platforms

Gravity-based and suction bucket foundations and floating offshore wind platforms eliminate the need for pile driving, require decreased noise mitigation and monitoring measures, and may enable flexibility in construction timing. The installation of quieter foundations may still pose some disruption to North Atlantic right whales, other marine mammal species, and sea turtles. We offer the following recommendations out of full precaution for these species, until we can monitor the installation process and better understand the potential risk.

1) **Require the following clearance zone distances prior to construction activities and exclusion zone distances during construction activities:**
   a) Clearance zone and exclusion zone distances for marine mammals must be designed that will eliminate Level A take and minimize behavioral harassment to the full extent practicable during the installation of gravity-based or suction bucket foundations, or floating offshore wind platforms, considering noise levels expected to be generated during installation.
   b) Clearance and exclusion zones of 100 m must be established for sea turtles.

2) **Delay initiation of or require shutdown of construction activities if a marine mammal or sea turtle is detected visually or if a North Atlantic right whale is detected acoustically in clearance or exclusion zones (as defined in Section IV(1)):**

[30] NOAA Fisheries, "Report a Stranded or Injured Marine Animal," https://www.fisheries.noaa.gov/report.

a) Installation of gravity-based and suction bucket foundations and floating offshore wind platforms must not be initiated when the application of monitoring methods defined in Section IV(3) results in a visual detection of a marine mammal or sea turtle or an acoustic detection of a North Atlantic right whale within the relevant clearance zone (as defined based on noise levels expected during installation; see Section IV(1)).
    i) If localization, as described in Section IV(3)(a)(i) below, cannot be achieved by acoustic detection, installation activities should not be initiated upon detection of a North Atlantic right whale call, regardless of distance from sound source.
b) Installation of gravity-based and suction bucket foundations and floating offshore wind platforms must be halted, unless continued installation activities are necessary for reasons of human safety or installation feasibility, when the application of monitoring methods defined in Section IV(3) results in a visual detection of a marine mammal or sea turtle or an acoustic detection of a North Atlantic right whale within the relevant exclusion zone (as defined based on noise levels expected during installation; see Section IV(1)).
    i) If localization, as described in Section IV(3) below, cannot be achieved by acoustic detection, installation activities should not be initiated upon detection of a North Atlantic right whale call, regardless of distance from sound source.
c) Once halted, installation may resume after use of the methods set forth in Section IV(3) and the lead PSO confirms no marine mammal or sea turtle species have been detected within the relevant clearance zones.

3) Require robust near real-time monitoring protocols during clearance and installation:

a) Monitoring of the acoustic clearance and exclusion zones for North Atlantic right whales must be undertaken using near real-time PAM from a vessel other than the installation vessel, or from a stationary unit, to avoid the hydrophone being masked by installation-related noise.
    i) The PAM system should be set up so that it is capable of localizing the position of vocalizing whales. A plan detailing any proposed localization system and analysis methods should be submitted to BOEM and other relevant permitting agencies in advance of deployment. The system should meet the following criteria:[31]
        (1) Stationary systems must have a minimum of three hydrophones (accuracy can be greatly improved by using four hydrophones), and mobile systems (e.g., towed arrays) must have a minimum of two hydrophones.
        (2) Simulations should be conducted prior to selecting the number and location of receivers to maximize accuracy (i.e., reduce confidence intervals) in the final configuration.[32]
        (3) Systems should be calibrated before deployment to ensure accurate detection capability.
        (4) For time-of-arrival based systems, synchronization of data streams from the multiple receivers is necessary for accurate calculations.
        (5) Irrespective of the system used, careful testing and documentation of localization errors should be undertaken.
b) During pre-clearance and installation, monitoring of the visual clearance and exclusion zones must be undertaken by vessel-based PSOs stationed at the installation site. On each vessel,

[31] *See, also*, recommendations in Van Parijs SM et al. 2021.

[32] There are several mathematical methods to improve the accuracy of localization estimates by reducing the confidence intervals for each parameter that should be follow. *See* Spiesberger J. 2022.

there must be a minimum of four PSOs following a two-on, two-off rotation, each responsible for scanning no more than 180° of the horizon per gravity-based or suction bucket foundation or floating offshore wind platform installation location. To effectively monitor the full exclusion zone for sea turtles, multiple PSOs must be stationed at several vantage points at the highest level to allow each to continuously scan a section of the exclusion zone. Ensure PSOs do not exceed two consecutive watch hours on duty at any time, have a two-hour (minimum) break between watches, and do not exceed a combined watch schedule of more than 12 hours in a 24-hour period. PSO schedules should be designed to minimize observer fatigue.

c) Acoustic and visual monitoring must be required, and monitoring must begin at least 60 minutes prior to the commencement of installation activity and must be conducted throughout the duration of installation. Visual monitoring must continue until 30 minutes after installation.

d) Additional observers and monitoring technologies (e.g., infrared, drones, hydrophones) must be deployed, as needed, to ensure the ability to monitor the established clearance and exclusion zones, including during periods of darkness or poor visibility.

4) Require mandatory reporting of marine mammals and sea turtles detected during pre-clearance, installation, and 30 minutes after installation:

a) All visual observations and acoustic detections of North Atlantic right whales must be reported to NOAA Fisheries or the United States Coast Guard *as soon as possible and no later than the end of the PSO shift*. We note that, in some cases, such as with the use of near real-time autonomous buoy systems, the detections will be reported automatically on a pre-set cycle.

b) Observations of entangled, injured, or dead North Atlantic right whales, and other entangled, injured, and dead marine mammal species and sea turtles, must be immediately reported to NOAA Fisheries' Northeast Marine Mammal and Sea Turtle Stranding and Entanglement Hotline (1-866-755-6622) for states from Maine to Virginia; NOAA Fisheries' Southeast Marine Mammal Stranding Hotline (1-877-942-5343) or Southeast Sea Turtle Stranding and Salvage Network (1-844-732-8785) for states from North Carolina to Florida;[33] or the United States Coast Guard via one of several available systems (e.g., phone, app, radio). Methods of reporting are expected to advance and streamline in the coming years, and projects should commit to supporting and participating in these efforts.

c) PSO sightings data must be submitted to BOEM as directed in any relevant guidance, site assessment plan (SAP) or construction and operations plan (COP) approval, or other agency protocol. Sightings data and reports provided to BOEM should be made publicly available by BOEM to inform marine mammal and sea turtle science and protection.

Section V. Noise mitigation recommendations for operations

1) Require operational noise reduction to the fullest extent practicable.

a) Operational noise should be reduced to the fullest extent practicable using best available technology and design principles. For example, direct-drive turbines should be used instead of

[33] NOAA Fisheries, "Report a Stranded or Injured Marine Animal," https://www.fisheries.noaa.gov/report.

gear-box turbines and engineering solutions should be used to acoustically decouple the turbine from the mast and platform whenever possible.

b) A detailed plan must be provided for how the operator will reduce operational noise output in the construction and operations plan submittal or in a separate plan submitted to BOEM and other relevant permitting agencies in advance of deployment.
c) Underwater sound source measurements must be conducted during operations. Plans for sound source measurements, including type and placement of equipment and frequency of measurements, must be fully described in construction and operations plan submittals. Sound source measurements should follow any available BOEM protocol.
d) Sound source measurements must be reported to BOEM as part of the annual certification required under 30 C.F.R. § 285.633(a).
e) Sound source measurement reports must be made available to the public within one month after the report is submitted to BOEM.

Section VI. Entanglement risk mitigation in construction and operations of floating platform wind turbines

This section provides mitigation recommendations to reduce the risk of entanglement for marine mammals and sea turtles, with co-benefits for sharks and diving or plunging marine birds, in the operation of floating offshore wind turbines. "Secondary" entanglement is presumed to be the main entanglement-related concern. This form of entanglement may occur if marine debris becomes ensnared around mooring lines and/or mid-water (i.e., inter-array) cables, or other infrastructure, and subsequently entangles marine wildlife. "Primary" entanglement, where an animal becomes directly entangled in floating offshore wind lines and cables, and "tertiary" entanglement, where marine debris or active fishing gear already entangling an animal becomes ensnared on infrastructure and anchors the animal, are additional potential concerns that warrant monitoring as offshore wind development proceeds.

1) Design floating offshore wind turbines to avoid entanglement risk:

a) Design and maintain mooring lines and inter-array cables in configurations that minimize the potential for entanglement of marine species by:
    i) Ensuring that lines and cables remain under tension and avoiding catenary moorings;[34]
    ii) Burying inter-array cables, or establishing a minimum depth of 200 m for free floating inter-array cables (where burial of cables is not possible);
    iii) Using large diameter (approximately 2 m) accessory buoys to stabilize catenary mooring lines and free-floating inter-array cables; and
    iv) Employing large diameter wire rope or cable, and avoiding chains and synthetic fiber ropes, due to higher snagging potential.
b) Design infrastructure to facilitate visual or acoustic detection of ensnared marine debris by monitoring equipment and personnel, for example, by using lighter coloration or, for acoustic detection, textures to contrast with marine debris at depths where light is limited.

[34] Marine species are more likely to become entangled in slack lines. "Taut mooring configurations are preferable because less slack in lines is likely to reduce entanglement potential (Benjamins et al. 2014). Highest relative risk may occur with catenary moorings given that the lines are not taut. Chains and nylon ropes are thought to have higher snagging potential, as do accessory buoys." Maxwell, Sara M., et al. 2022.

i) Infrastructure includes, for example, platforms, substations, mooring lines, inter-array cables, and anchors, as well as monitoring technology docking stations.

2) Conduct monitoring for entanglement that combines continuous and automated monitoring technologies with regular inspections and surveys of all floating offshore wind infrastructure throughout construction and operations:

a) Conduct continuous monitoring for strains on mooring lines and inter-array cables resulting from ensnarement of marine debris or entanglement of an animal.
   i) Outfit all mooring lines with load cells[35] with sufficient detection resolution to detect significant accumulations of secondary entanglement hazards and for entanglement events. Outfit all inter-array cables with vibration and fault sensors, as well as load cells at all floating offshore wind turbine attachment points, and potentially at accessory buoy attachment points if present.

b) Conduct monitoring underneath each floating offshore wind platform sufficient to detect accumulated secondary entanglement hazards and marine species presence in and around the array.
   i) Install multibeam systems with automatic detection capabilities, like the Biosonics Omnidirectional Marine Life Observer, installed facing down, underneath each individual floating offshore wind turbine.
   ii) Multibeam systems used should operate at peak frequencies above the range of marine mammal audibility and with no or minimal leakage of sound within the range of marine mammal audibility.

c) Conduct daily remote visual inspection of infrastructure for ensnarement of marine debris or entanglement of an animal[36] at depths where marine debris is most likely to occur, which is usually zero to five meters from the surface.
   i) Current suitable technologies for monitoring include cameras and remote aerial surveys.

d) Conduct monthly inspection of the full length of submerged infrastructure (including platforms, substations, mooring lines, inter-array cables, and anchors, as well as monitoring technology docking stations or other infrastructure, as appropriate) for ensnared marine debris or entanglement of an animal.
   i) Vessel deployed underwater autonomous vehicles (AUV) and remotely operated vehicles (ROV) can be outfitted with side-scan and multi-beam sonar transponders, and video cameras.[37]

---

[35] "…the Kincardine Floating Offshore Wind Farm in Scotland has integrated load cells with the mooring lines to periodically monitor line performance and potentially detect the entanglement of floating marine debris, including derelict fishing gear." SEER Educational Research Brief on Risk to Marine Life from Marine Debris & Floating Offshore Wind Cables Systems (p.5). https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Entanglement-Considerations.pdf.

[36] Visual inspection at least once during each 24-hour period may provide an alert of an entangled marine mammal or sea turtle or diving or plunging marine bird at an early enough point in time that rescue efforts can be made, and the animal can be released alive.

[37] ROVs may also be an important tool for marine debris removal at depth. The Kincardine Floating Offshore Wind Farm also "will use remotely operated vehicles and vessel-mounted sensors (such as multibeam sonar) to periodically survey floating cable systems, which could also monitor for the presence of derelict fishing gear." SEER Educational Research Brief on Risk to Marine Life from Marine Debris & Floating Offshore Wind Cables Systems (p.5). https://tethys.pnnl.gov/sites/default/files/summaries/SEER-Educational-Research-Brief-Entanglement-Considerations.pdf. *See, also*, Federal Energy Regulatory Commission (FERC) Environmental Assessment for

e) Outfit operations and maintenance vessels with equipment capable of locating and removing an entanglement hazard.
   i) Vessels should be of sufficient size (40 feet or greater in length), have winches or cranes with load capacities suitable for commercial fishing, have equipment necessary to support both SCUBA and surface-supply air diving, and be able to accommodate launching, operating, and retrieving a working-class ROV.

f) Integrate floating offshore wind arrays into reporting systems tracking lost fishing gear, in order to improve response time to remove entanglement risks.

3) Adaptive use of inspection results.

a) Project proponents may propose an adaptive approach to scheduling inspections in COP submittals. Monthly inspections should be used to validate continuous monitoring approaches by confirming the location of ensnarement or entanglement events detected by a continuous monitoring system, or identifying events that were missed by such a system, during early application of the technology. If marine debris ensnarements or marine life entanglements are observed during these monthly inspections within the first 12 months of an offshore wind project's operation, the frequency of full-infrastructure inspections should be increased. If monthly inspections detect no marine debris ensnarements or marine life entanglements during the first year of an offshore wind project's operation, the frequency of full-infrastructure inspections may be decreased.

4) Protocol when ensnarement and/or entanglements are identified:[38]

a) If monitoring shows that marine debris has become ensnared on any project structure, or that sharks and/or diving or plunging marine birds are entangled in marine debris ensnared on any project structure, the lessee must notify the National Marine Fisheries Service (NMFS) or U.S. Fish and Wildlife Service (USFWS), as appropriate, the U.S. Coast Guard, and the relevant state agency as soon as possible and within 6 hours of detection. If the appropriate federal and state agencies determine that the lessee should remove the marine debris and any entangled sharks or diving or plunging marine birds, or any other species, the lessee shall take such action as soon as is possible to do so, in a manner that does not jeopardize human safety, property, or the environment.

b) If monitoring shows that marine mammals or sea turtles are entangled in marine debris ensnared on any project structure, the lessee shall immediately follow the Reporting Protocol for Injured or Stranded Marine Mammals or the sea turtle reporting protocol developed by the Sea Turtle Disentanglement Network; and provide the federal and relevant state agencies with all available information on the incident.[39]

Hydropower License for the PacWave South Project (April 2020) at p. xvi. https://tethys.pnnl.gov/sites/default/files/publications/PacWave_South_Environmental_Assessment.pdf; and "The Atlantic Testing Platform for Maritime Robotics." https://www.atlantis-h2020.eu/.

[38] Protocol is adapted from the Federal Energy Regulatory Commission (FERC) Environmental Assessment for Hydropower License for the PacWave South Project (April 2020). https://tethys.pnnl.gov/sites/default/files/publications/PacWave_South_Environmental_Assessment.pdf.

[39] *See* National Marine Fisheries Service Large Whale Entanglement Response Program for whale entanglement reporting protocol, Greater Atlantic region: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/marine-mammal-entanglement-greater-atlantic-region; Sea Turtle Disentanglement Network for sea turtle reporting protocol: https://www.fisheries.noaa.gov/new-england-mid-atlantic/marine-life-distress/sea-turtle-disentanglement-network.

5) **Require reporting and appropriate disposition of recovered fishing gear.**
   a) Report recovered fishing gear to NMFS and the relevant state agency. Consult with those agencies to arrange for the return or disposal of the gear at a suitable location, prioritizing the physical recycling of materials (as opposed to incineration).

6) **Require transparent reporting of ensnarement and entanglement data.**
   a) All incidences of observed ensnarements of marine debris on floating offshore wind infrastructure and entanglements of marine life shall promptly be made publicly available.