Strong Mitigation Measures Are Essential to Protect Large Whales and Sea Turtles During All Phases of Offshore Wind Energy Development

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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 any impacts to threatened and endangered marine species.[1] The seriously imperiled North Atlantic right whale – only 336 individuals were estimated remaining in 2020[2] – is in dire straits from vessel strikes, entanglement in fishing gear, underwater noise pollution, and climate change, and cannot withstand further losses or any additional stress.[3] Several other endangered and vulnerable large whale species inhabit the waters off the U.S. East Coast, including blue whales, fin whales, humpback whales, minke whales, and are under increasing pressure human activities and climate change.[4] All six species of sea turtles found in U.S. waters are protected under the Endangered Species Act and face a wide range of threats including bycatch in fishing gear, vessel strikes, direct harvest of turtles and eggs, loss and degradation of nesting and foraging habitat, ocean pollution and marine debris, and climate change.[5] To protect the future of marine wildlife, we must avoid additional threat to these species from offshore wind, and implement stringent measures to safeguard them during this industry's site assessment, construction, operations, and decommissioning.

Risks from vessel collision and direct and indirect noise impacts on large whales and sea turtles, including potential habitat displacement that may exacerbate existing threats, need to be fully addressed from the start. Strong protections are required to fulfill federal legal requirements for

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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, "Population of North Atlantic right whales continues its downward trajectory." Press release (Oct. 25, 2021). https://www.neaq.org/about-us/news-media/press-kit/press-releases/population-of-north-atlantic-right-whales-continues-its-downward-trajectory/.

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 See, e.g., NOAA Fisheries, "2016-2022 Humpback Whale Unusual Mortality Event Along the Atlantic Coast." https://www.fisheries.noaa.gov/national/marine-life-distress/2016-2022-humpback-whale-unusual-mortality-event-along-atlantic-coast; NOAA Fisheries, "2017-2022 Minke Whale Unusual Mortality Event along the Atlantic Coast." https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-minke-whale-unusual-mortality-event-along-atlantic-coast.

5 NOAA Fisheries, "Sea Turtles – Overview." https://www.fisheries.noaa.gov/sea-turtles.

protecting large whales and sea turtles[6] and will ensure we can achieve the administration's commitment to deploy 30 GW of offshore wind energy by 2030 while protecting biodiversity, cultural resources, and ocean uses.[7]

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 thus one of the most impactful offshore wind activities on whales and other marine life. 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 as the preferred alternative. If pile driving must occur, effective noise reduction and attenuation technologies are commercially available[8] 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.[9] 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 emit lower noise levels[10] and reduce the risk of behavioral disturbance or habitat displacement of North Atlantic right whales and other species during the operation phase of development.[11]

- *Vessels*: Science is unequivocal on the value of vessel speed restrictions in reducing mortalities of right whales, other large whale species, and sea turtles from vessel collisions.[12] 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.

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[6] All marine mammals are protected under the Marine Mammal Protection Act and strong protections for other 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 porpoise), are also essential.

[7] The White House, "Briefing Room FACT SHEET: Biden Administration Jumpstarts Offshore Wind Energy Projects to Create Jobs." https://www.whitehouse.gov/briefing-room/statements-releases/2021/03/29/fact-sheet-biden-administration-jumpstarts-offshore-wind-energy-projects-to-create-jobs/.

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

[9] *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." *The 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.

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

[11] 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.

[12] 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.

The mitigation measures presented in this document are based on best available scientific information and are needed to ensure offshore wind advances responsibly. These fundamental requirements are necessary to protect the critically endangered North Atlantic right whale from potential impacts posed by offshore wind energy development. Measures that offer co-benefits to other large whale species and sea turtles are also noted. 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.[13] Mitigation measures for the repowering and decommissioning phases of offshore wind energy development will be developed, as needed.

We present two sets of mitigation recommendations for the construction period: one set for pile-driven foundations that includes seasonal restrictions, a prohibition on pile driving at night, requirements for noise reduction technologies, and large monitoring zones (section 2), and a more limited set for quieter gravity-based and suction bucket foundations (section 3).

[13] 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 selecting sites that offer the least environmental impact.

Section 1. Mitigation recommendations during site assessment and characterization

i. Prohibit site assessment and site characterization activities during times of highest risk (*North Atlantic right whales only*):

1. Site assessment and characterization activities involving high resolution geophysical survey equipment with noise levels that could injure or harass large whales (defined throughout this section as: source levels at frequencies between 7 and 35 kHz) should not occur during periods of highest risk to North Atlantic right whales. These periods are defined as times of highest relative density of animals 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.
2. 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 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 pile driving would most likely be undertaken based on times of lower relative risk to North Atlantic right whales.

ii. Require diel restrictions on site assessment and characterization activities:

1. 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 zone" and "exclusion zone" (as defined below) cannot be visually monitored, as determined by the lead Protected Species Observer (PSO)[14] on duty.

iii. Require the following clearance zone and exclusion zone distances prior to activities known to injure or harass large whales (*large whales only*):

1. A visual clearance zone and exclusion zone of at least 500 m for all large whale species and 1,000 m for North Atlantic right whales must be established around each vessel conducting activities with noise levels that could result in injury or harassment to large whales.
2. An acoustic clearance zone and exclusion zone of at least 1,000 m must be established for North Atlantic right whales around each vessel conducting activities with noise levels that could result in injury or harassment to large whales.
3. If a large whale is detected within the 1000 m clearance zone but the species cannot be identified, it must be assumed to be a North Atlantic right whale.

iv. Require shutdown of activities if a large whale is detected visually or acoustically (*large whales only*):

1. If a North Atlantic right whale or other large whale species is visually or acoustically detected within the relevant clearance zone, site assessment and characterization activities with noise levels that could result in injury or harassment to large whales must not be initiated.

[14] The term "PSO" refers to an individual with a current NOAA Fisheries approval letter as a Protected Species Observer.

2. If a North Atlantic right whale or other large whale species is visually detected within the visual exclusion zone, site assessment and characterization activities with noise levels that could result in injury or harassment to large whales must be halted.
3. If a North Atlantic right whale is acoustically detected within the acoustic exclusion zone, site assessment and characterization activities with noise levels that could result in injury or harassment to large whales must be halted.
4. Once halted, site assessment and characterization activities may resume following the methods set forth in subsection (v) and after the lead PSO confirms no North Atlantic right whales or other large whale species have been detected within the relevant acoustic and visual clearance zones.

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

1. Monitoring of the acoustic clearance zone must be undertaken using near real-time passive acoustic monitoring (PAM)[15] 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.
2. 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 North Atlantic right whales, other large whale species, and sea turtles. 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 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.
3. Acoustic and visual monitoring must be required for North Atlantic right whales, and monitoring 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.

vi. Require mandatory vessel speed restrictions:

1. All Project-associated vessels must adhere to a 10-knot speed restriction at all times except for reasons of safety, and in all places except in limited circumstances where the best available scientific information demonstrates that whales do not occur in the area.
2. Slowing to 4 knots must be required while transiting through areas of visible jellyfish aggregations or floating vegetation lines or mats to improve protection for sea turtles. The speed must be reduced from an upper limit of 10 knots.
3. Project proponents may develop, in consultation with National Oceanic and Atmospheric Administration (NOAA) Fisheries, an "Adaptive Plan" that modifies these vessel speed restrictions. However, the monitoring methods that inform the Adaptive Plan must be proven effective using vessels traveling 10 knots or less and following a scientific study design. If the resulting Adaptive Plan is scientifically proven[16] to be equally or more effective than a 10-knot speed restriction, the Adaptive Plan could be used as an alternative to a 10-knot speed restriction.

[15] Throughout this document "PAM" refers to a real-time passive acoustic monitoring system, with equipment bandwidth sufficient to detect the presence of vocalizing North Atlantic right whales and/or if available at the time of construction other similar high performance sound monitoring systems and arrays).

[16] *I.e.*, *via* a peer-reviewed scientific study.

vii. Implement other vessel-related measures:

1. All personnel working offshore must receive training on observing and identifying North Atlantic right whales, other large whale species, and sea turtles.
2. Vessels must maintain a separation distances of 500 m for North Atlantic right whales, and 100 m for other large whale species, maintain a vigilant watch for North Atlantic right whales and other large whale species, and slow down or maneuver their vessels as appropriate to avoid a potential interaction with a North Atlantic right whale or other large whale species.
3. All vessels responsible for crew transport should use thermal detection systems to supplement visual monitoring of marine mammals.

viii. Require underwater noise reduction to the fullest extent feasible:

1. The impacts of underwater noise to 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.

ix. Require mandatory reporting of all North Atlantic right whale, other large whale species, and sea turtle detections:

1. Project proponents must report all visual observations and acoustic detections of North Atlantic right whales 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.
2. Project proponents must immediately report an entangled or dead North Atlantic right whale, other large whale species, or sea turtle to NOAA Fisheries, the Marine Animal Response Team (1-800-900-3622) or the United States Coast Guard immediately 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.
3. Quarterly reports of PSO sightings data must be made publicly available to inform marine mammal and sea turtle science and protection.

Section 2: Mitigation recommendations for pile-driven foundations

i. Prohibit pile driving during times of highest risk *(North Atlantic right whales only)*:

1. Pile driving must not occur during periods of highest risk to North Atlantic right whales, defined as times of highest relative density of animals 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.
2. 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.

ii. Restrict pile driving activity at night and during periods of low visibility *(all large whale species and sea turtles)*:

1. 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" (as hereinafter defined) cannot be visually monitored, as determined by the lead PSO on duty.
2. Pile driving may continue after dark only if the activity commenced during daylight hours and must proceed for human safety or installation feasibility reasons,[17] and if required night-time monitoring protocols are followed (see subsection (v)).

iii. Require underwater noise reduction levels based on best commercially available technology *(all large whale species)*:

1. A combination of near field[18] and far field noise mitigation,[19] and/or a combination system[20] expected to achieve at least 15dB (re: 1µPa^{2}s) reduction of Sound Exposure Level (SEL)[21]

[17] 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.

[18] E.g., reduced blow resonant panel noise abatement system (e.g., AdBm Noise Mitigation System. https://adbmtech.com/), hydrosound damper (e.g., OffNoise-Solutions Hydro-Sound-Damper-System (HSD-System). https://www.offnoise-solutions.com/), isolation casing (Noise Mitigation Screen (NMS)), and dewatered cofferdam (see Koschinski, S. and Lüdemann. K. (2020). "Noise mitigation for the construction of increasingly large offshore wind turbines: Technical options for complying with noise limits." Report commissioned by the Federal Agency for Nature Conservation, Isle of Vilm, Germany. https://tethys.pnnl.gov/publications/noisemitigation-construction-increasingly-large-offshore-wind-turbines).

[19] *E.g.*, single bubble curtain.

[20] *E.g.*, double bubble curtain.

[21] Sound Exposure Level (SEL) is defined following Bellmann et al. (2020) at 31-32. Bellmann M. A., Brinkmann J., May A., Wendt T., Gerlach S. & Remmers P. (2020) "Underwater noise during the impulse pile-driving procedure: Influencing factors on pile-

from pile driving operations, including pile strikes, compressors, and operations vessels engaged in construction, must be used.[22] At minimum, a 10 dB (re: re: 1µPa^{2}s) reduction of SEL must be attained.

2. Field measurements must be conducted on the first pile installed and data must be collected from a random sample of piles throughout the construction period. We do not support field testing using unmitigated piles.
3. Sound source validation reports of field measurements must be evaluated by both BOEM and NOAA Fisheries prior to additional piles being installed and be made publicly available.

iv. Require the following clearance zone distances prior to pile driving and exclusion zone distances during pile driving (for a minimum of 10-12 dB noise reduction *(see subsection (iii)); North Atlantic right whales only)*:

1. A visual clearance zone and exclusion zone must extend at minimum 5,000 m in all directions from the location of the driven pile.
2. An acoustic clearance zone must extend at minimum 5,000 m in all directions from the location of the driven pile.
3. An acoustic exclusion zone must extend at minimum 2,000 m in all directions from the location of the driven pile.
4. Clearance and exclusion zone distances for other large whale species must be designed in a manner that eliminates Level A take and minimizes behavioral harassment to the full extent practicable.

v. Require shutdown of activities if a large whale is detected visually or acoustically (for a minimum of 10-12 dB noise reduction *(see subsection (iii)); North Atlantic right whales only)*:

1. Pile driving must not be initiated when monitoring methods defined in subsection (vi) result in either an acoustic detection within the acoustic clearance zone or a visual detection within the visual clearance zone of one or more North Atlantic right whales.
2. 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 subsection (vi) result in acoustic detection within the acoustic exclusion zone or a visual detection within the visual exclusion zone of one or more North Atlantic right whales.
3. 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.
4. Once halted, pile driving may resume only after using the methods set forth in subsection (vi) and the lead PSO confirms no North Atlantic right whales or other large species have been detected within the relevant acoustic and visual clearance zones.

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driving noise and technical possibilities to comply with noise mitigation values." Supported by the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und nukleare Sicherheit (BMU)), FKZ UM16 881500. Commissioned and managed by the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie (BSH)), Order No. 10036866. Edited by the itap GmbH. https://www.itap.de/media/experience_report_underwater_era-report.pdf.

[22] Taking, as a baseline, projections from prior noise measurements of unmitigated piles from Europe and North America. We note that combination systems using best available technology have achieved noise reduction levels 20 dB or more in the field. The goal should be to achieve the greatest noise reduction level possible, in line with the principles of the mitigation hierarchy. Greater noise reduction levels could also provide more flexibility for developers. See Bellmann et al. (2020) at Table 4 (p. 106). https://www.itap.de/media/experience_report_underwater_era-report.pdf.

vi. Require robust near real-time monitoring protocols during pre-clearance and when pile driving activity is underway *(all large whale species)*:

1. Monitoring of the acoustic clearance and exclusion zone 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.
2. 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 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. Additional vessels must survey the clearance and exclusion zones at speeds of 10 knots or less.
3. 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.
4. Infrared technology must be used to support visual monitoring during any pile driving activities that extend into periods of darkness.
5. 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.

vii. Require mandatory vessel speed restrictions *(all large whale species and sea turtles)*:

1. All Project-associated vessels must adhere to a 10-knot speed restriction at all times except in limited circumstances where the best available scientific information demonstrates that whales do not use the area.
2. Slowing to 4 knots must be required while transiting through areas of visible jellyfish aggregations or floating vegetation lines or mats to improve protection for sea turtles. The speed must be reduced from an upper limit of 10 knots.
3. Project proponents may develop, in consultation with NOAA Fisheries, an "Adaptive Plan" that modifies these vessel speed restrictions. However, the monitoring methods that inform the Adaptive Plan must be proven effective using vessels traveling 10 knots or less and following a scientific study design. If the resulting Adaptive Plan is scientifically proven[23] to be equally or more effective than a 10-knot speed restriction, the Adaptive Plan could be used as an alternative to a 10-knot speed restriction.

viii. **Implement other vessel-related measures *(all large whale species and sea turtles)*:**

1. All personnel working offshore must receive training on observing and identifying North Atlantic right whales, other large whale species, and sea turtles.
2. Vessels must maintain a separation distance of 500 m for North Atlantic right whales and 100 m for other large whale species, maintain a vigilant watch for North Atlantic right whales and other large whale species, and slow down or maneuver their vessels as appropriate to avoid a potential interaction with a North Atlantic right whale or other large whale species.

[23] *I.e.*, *via* a peer-reviewed scientific study.

3. All vessels responsible for crew transport (i.e., service operating vessels) should use automated thermal detection systems to assist monitoring efforts while vessels are in transit, maintaining a speed of 10 knots.

ix. **Require mandatory reporting of all North Atlantic right whale, other large whale species, and sea turtle detections:**

1. Project proponents must report all visual observations and acoustic detections of North Atlantic right whales 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.
2. Projects must immediately report an entangled or dead North Atlantic right whale, other large whale species, or sea turtle to NOAA Fisheries, the Marine Animal Response Team (1-800-900-3622), or the United States Coast Guard immediately 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 BOEM should require projects to commit to supporting and participating in these efforts.
3. Quarterly reports of PSO sightings data must be made publicly available to inform marine mammal and sea turtle science and protection.

Section 3: Mitigation recommendations for gravity-based and suction bucket foundations

As stated above, quieter gravity-based and suction bucket foundations offer significant environmental benefits over pile driven foundations, 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 large whale species, and sea turtles and the risk of vessel strike remains. 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.

i. Require clearance zone and exclusion zone distances that will eliminate Level A take and minimize behavioral harassment (*large whale species only*):

1. Clearance and exclusion zone distances for North Atlantic right whales and other large whale species must be designed to eliminate Level A take and minimize behavioral harassment to the full extent practicable during the installation of gravity-based or suction bucket foundations, considering noise levels expected to be generated during installation.

ii. Require shutdown of activities if a large whale is detected visually or acoustically (*large whale species only*):

1. Installation of gravity-based and suction bucket foundations must not be initiated when the application of monitoring methods defined in subsection (iii) results in a detection of a North Atlantic right whale or other large whale species within the relevant clearance zone (as defined based on noise levels expected during installation; see subsection (i)).
2. Installation of gravity-based and suction bucket foundations 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 subsection (iii) results in a detection of a North Atlantic right whale or other large whale species within the relevant exclusion zone (as defined based on noise levels expected during installation; see subsection (i)).
3. Once halted, installation may resume after use of the methods set forth in subsection (iii) and the lead PSO confirms no North Atlantic right whales or other large species have been detected within the relevant clearance zones.

iii. Require robust near real-time monitoring protocols during clearance and installation:

1. Monitoring of the clearance and exclusion zones 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.
2. Monitoring of the clearance and exclusion zone must be undertaken by vessel based PSOs stationed at the installation site. 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 gravity-based or suction bucket foundation 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.
3. Acoustic and visual monitoring must be required, and monitoring must begin at least 60 minutes prior to the commencement or installation activity and must be conducted

throughout the duration of installation. Visual monitoring must continue until 30 minutes after installation.

4. 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.

iv. Require mandatory vessel speed restrictions:

1. All Project-associated vessels must adhere to a 10-knot speed restriction at all times except in limited circumstances where the best available scientific information demonstrates that whales do not occur in the area.
2. Slowing to 4 knots must be required while transiting through areas of visible jellyfish aggregations or floating vegetation lines or mats to improve protection for sea turtles. The speed must be reduced from an upper limit of 10 knots.
3. Project proponents may develop, in consultation with NOAA Fisheries, an "Adaptive Plan" that modifies these vessel speed restrictions. However, the monitoring methods that inform the Adaptive Plan must be proven effective using vessels traveling 10 knots or less and following a scientific study design. If the resulting Adaptive Plan is scientifically proven[24] to be equally or more effective than a 10-knot speed restriction, the Adaptive Plan could be used as an alternative to a 10-knot speed restriction.

v. Implement other vessel-related measures:

1. All personnel working offshore must receive training on observing and identifying North Atlantic right whales, other large whale species, and sea turtles.
2. Vessels must maintain a separation distances of at least 500 m for North Atlantic right whales and 100 m for other large whale species. They must maintain a vigilant watch for North Atlantic right whales and other large whale species, and slow down or maneuver their vessels as appropriate to avoid any potential interaction with them.
3. All vessels responsible for crew transport (i.e., service operating vessels) should use automated thermal detection systems to assist monitoring efforts while vessels are in transit, maintaining a speed of 10 knots.

vi. Require mandatory reporting of all North Atlantic right whale, other large whale, and sea turtle detections:

1. Project proponents must report all visual observations and acoustic detections of North Atlantic right whales 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 preset cycle.
2. Project proponents must immediately report an entangled or dead North Atlantic right whale, other large whale species, or sea turtle to NOAA Fisheries, the Marine Animal Response Team (1-800-900- 3622), or the United States Coast Guard immediately 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 agencies should require projects to commit to supporting and participating in these efforts.
3. Quarterly reports of PSO sightings data must be made publicly available to inform marine mammal and sea turtle science and protection.

[24] *I.e.*, *via* a peer-reviewed scientific study.