Program Manager, Bureau of Ocean Energy Management
Office of Renewable Energy Programs
45600 Woodland Road (VAM-OREP)
Sterling, Virginia 20166

December 1, 2022

Re: Dear Sir or Madam,

In response to the Draft BOEM and NOAA North Atlantic Right Whale and Offshore Wind Strategy published by BOEM[1] and NOAA[2] and released October 2022, please accept this joint response by the following parties:

Ocean Conservation Society, Coastal Research and Education Society of Long Island, Inc., Ocean Conservation Research, Sea Life Conservation, Oceanic Preservation Society, American Cetacean Society, Save the Whales, Whales of Guerrero, the Great Whale Conservancy, and Gotham Whales.

[1] U.S. Bureau of Ocean Energy Management

[2] National Oceanic and Atmospheric Administration

Oceanic Preservation Society (OPS) documents humankind's formidable impact on the environment, inspiring action and motivating change. OPS harnesses the power of the camera to expose uncomfortable truths and crimes against nature and to illuminate solutions. Through compelling documentary films and imagery, OPS confronts climate change, species extinction, and other critical issues that affect the future of humankind and our fragile planet.

Ocean Conservation Society conducts marine mammal research in ecology, health, animal movement, and human impacts, advises on monitoring, and contributes to an interactive database for marine species that gathers data from around the globe. Ocean Conservation Society's scientific findings help inform decisions regarding protected areas, key corridors, and shape conservation and management policy. Ocean Conservation Society has written dozens of scientific papers on marine mammals in peer-reviewed journals.

Ocean Conservation Research (OCR) improves understanding of how the noises generated by underwater acoustical communication networks, military sonar, airgun surveys, seafloor oil and gas processing, and shipping vessels impact marine animals in order to inform the policies and practices of the public, industry, and lawmakers. OCR enables understanding of how animals use sound and acoustical perception to perceive and understand their surroundings. OCR enables the public and policymakers to appreciate that marine animal auditory and other perceptual systems can be different from our own modes of perception, exceed ours in breadth and complexity of information, and how essential such systems are for marine animals to be able to experience their surroundings, as well as how dependent marine animals are on them for interacting with their environment to carry out essential life functions.

Sea Life Conservation uses a multidisciplinary approach to identify disruptive forces that present challenges to coastal and marine life, in order to ensure the fulfillment of a legacy of ecosystem health and its benefit to humanity for all of the future. Sea Life Conservation monitors changes in U.S. laws for their potential to effect environmental harms, aids in understanding the true cost of loss of natural resources, including coastal, marine, and wetland habitat by promulgating their valuation when these are proposed to be appropriated for specific uses which impair them, and protects public access to nature.

American Cetacean Society (ACS) has been dedicated to bringing education, current research, and critical conservation issues to people who care about cetaceans and the habitats on which they depend. ACS has eight chapters and is headquartered in California. ACS has long been the go-to resource for reliable information on cetaceans, and protects cetaceans and their habitats through public education, research grants, and conservation actions. American Cetacean Society has a governing board of specialists from all over the United States and an independent Scientific Advisory Council comprised of internationally recognized researchers.

Save the Whales is an organization that has worked tirelessly for 40 years to protect whales and whale birthing places from perils occasioned by expansion of mining operations, military operations, entanglement, pollutants, and whaling. Save the Whales engages in both rescue operations and litigation to protect whales, and has a strong focus on education on marine mammals and the ways in which the ocean environment is sensitive to disturbance. It effects, through education, empowerment of youth to understand that their actions can effect change.

The Great Whale Conservancy focuses on protecting the world's great whales from ship strikes, plastic pollution, and lethal sound pollution that interferes with their capacity to communicate and navigate, and on protecting their habitat with the goal of restoring global populations to pre-whaling levels; assists in research evaluating the effects of plastics by providing feces samples to Ocean Alliance; participates in public and policy talks; directly aids entangled whales, often by reporting entanglements; and together with Ocean Defenders Alliance helps remove hazards from popular routes of transiting and feeding whales and develops strategy to do so.

Whales of Guerrero's mission is to study and protect whales, boost the environmentally-sustainable economy, and prevent environmental degradation, especially in important habitats. Whales of Guerrero conducts marine wildlife surveys and galvanizes an emerging group of Fishery and Conservation Leaders so they can lead the community toward long-term marine restoration and conservation.

Founded by marine mammal science, environmental science, education, and conservation experts, Coastal Research Education Society of Long Island

(CRESLI) fulfills its mission through research and education via cooperative alliances with researchers, educational institutions, and other organizations, undertakes wildlife-watching trips that serve as a dual platform for data collection and education, photo-identifies whales in the eastern NY Bight and Great South Channel and other marine mammals in an effort to understand their population dynamics and distribution, and is a member of the Citizen's and Technical Advisory Committees of the South Shore Estuary Reserve.

Gotham Whale studies marine mammals in the New York Bight, focusing on lunge feeding, proximity to urban environments, site fidelity, potential for encounters with vessels, as well as discerning population identity and range as well as the potential for overlap with human activities that present hazards. Gotham Whale engages citizens in whale sighting and facilitates reporting to aid conservation and research efforts.

FULL ENVIRONMENTAL IMPACT STATEMENT FOR LEASE SALES AND OCEAN-BOTTOM-CHARACTERIZATION ACTIVITIES OF OCS AREAS

BOEM, under Biden-Harris Administration, continues to decline to make an Environmental Impact Statement (EIS) prior to lease sale of ocean areas, even knowing that such lease sales, with 100% certainty, will result in sea floor exploration/SAP activities requiring ensonification, and knowing that based on the sound frequency at which NARW communicate, adverse effects on the remaining NARW population of such sound-producing site-characterization activities are highly likely. Likewise, BOEM, continues to issue determinations of "no significant impact" in Environmental Assessments of lease area exploratory activities ("site characterization") by the lessee-developers. There is reason to find that such determinations are inappropriate, and that a full review of such activity is warranted.

There is reason for grave concern. For example, endangered North Atlantic Right Whales (“NARW”) speak or vocalize (make tonal sounds) at less than or equal to 2.5 kHz at volumes less than 162 dB re 1 µPa m [See Table 1 page 155 of May 10, 2013 Section 7 Consultation for Lease Issuance and Site Assessment Activities NER-2012-9211; https://media.fisheries.noaa.gov/2021-03/BOEM_2020IHA_MarineSiteAssessment_BioP_OPR1.pdf?null=].

Site characterization studies include exploration of the ocean bottom by emitting sounds from the surface of the water from a boat and recording the bounceback of sound using microphones fixed to long lines which are towed behind the vessel.

The Draft EA for the Empire Wind, for example, shows the brand and model of Sparkers and Seismic Air guns (so-called "bubble"[3] guns) that are representative of those expected to be used. This equipment will emit sounds of the same sound frequencies as the calls of the NARW, which anthropogenic sounds are received by the NARW **louder** (188dB and 192 dB[4] respectively) than are the natural calls of the NARW, and thus are reasonably expected to "mask" them, or in common terms, drown them out. Right whales are highly dependent upon sound to maintain contact; They emit contact calls to communicate with conspecifics to keep aware of each other's locations. Additionally mothers and young calves must maintain close proximity in order for the calf to nurse and for the mother being able to protect her calf by placing herself between her calf and predators, and NARW use contact calls to do this[5].

There are only 340 North Atlantic Right Whales left at this time[6]. Although referencing an uneven sex ratio, the Strategy Document does not emphasize enough that in the world today there exist only about 79 females able to breed, and thus the document does not make clear how seriously imperiled the NARW are.

It is important to understand that the decibel scale is a logarithmic one. So, as is the case here (example above taken from actual developer's plans), sound-

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[3] A quaint term for Seismic Air Gun that causes a rapid release of compressed air which produces a loud sound that travels through the water to the ocean floor. Some of this sound energy is reflected off features of the seafloor and captured near the water's surface in another device called a "streamer".

[4] (re 1 µPa m). See e.g. Table 6 of Draft EA Empire Wind, Sparkers and Knudsen SPB, respectively. Bubble Guns are also a concern 1.1 kHz

[5] Christopher W. Clark of the Imogene Powers Johnson Senior Scientist at the Bioacoustics Research Program, Cornell Lab of Ornithology, testifying on March 7, 2019 Before the House Natural Resource Committee, Subcommittee on Water, Oceans, and Wildlife Hearing on "Examining the Threats to the North Atlantic Right Whale"...internet source: https://www.congress.gov/116/meeting/house/109022/witnesses/HHRG-116-II13-Wstate-ClarkC-20190307.pdf].

[6] (+/- 7 individuals)

emissions with a dB level that is 25 to 35 dB higher than the whale's call has a loudness level of about **six to ten times** the whale call's loudness.

Site characterization surveys for any given lease area do not involve a pulse sound being delivered once in a while, but rather continuously between 1 and 20 pulses per second as the vessel travels along transect, as its purpose is to gain a complete picture of the seafloor in the entire leased area. This takes place for very prolonged periods to cover the transect distances. Whereas Site characterization activities for the subject lease areas can be expected to take place in multiple areas contemporaneously, and whereas all these factors combined can reasonably expected to result in exposure to noise that is repeated over and over from dozens of different sources at the same time or quasi-coincidentally, this collectively affects wide areas.

Use of NARW seasonal route and overall distribution data to inform which ocean areas should be selected to become lease areas for sale was warranted but not considered, and would have reduced the expected negative impacts.

From BOEM's and NOAA's own published data (Draft Strategy at pgs. 46-52, and pg. 57 of the Strategy, internet source https://www.regulations.gov/document/BOEM-2022-0066-0003 last accessed 11/22/2022) shows that for continued existence of the NARW, there could hardly have been a worse choice of location of areas for lease sale for development than what was chosen first—the block comprised of the OCS-A-0520 (Beacon), OCS-A-0521 (Mayflower), OCS-A-0522 (Liberty), OCS-A-0487 (Sunrise), and OCS-A-0500 (Bay State) planned power plants. The choice of the areas that should be leased could hardly have been worse, as this block has the highest density of NARW presence and for longer than any other part of the Atlantic Outer Continental Shelf. NARW pass through this area when traversing between calving grounds in the South Atlantic and three main feeding areas[7] to the north. Looking at NARW distribution by scrolling through pages 46-57 of BOEM's draft NARW Strategy document, the seasonal time lapse, or looking at mean annual density at Figure 1a on page 8 of Strategy, makes clear that this key corridor required preservation and should have been off limits for leasing and development. The statement by BOEM "OSW must be developed responsibly in order to not exacerbate the [NARW] species dire status" rings hollow, as the agency BOEM itself, of all the areas in the outer continental shelf, chose to lease the specific location of ocean area

[7] (Cape Cod/Massachusetts Bay; Bay of Fundy; SW Scotian Shelf)

for development expected to produce some of the worst exacerbation the NARW's decline based on actual data of density of NARW occurrence.

(continued on next page)

Figure A Offshore Wind lease areas and Wind Energy Areas overlaid on a color-coded map of mean annual density of NARW in the northeast U.S. [Source: BOEM-NOAA Draft Strategy document at pg. 8, modified by marking with arrows]

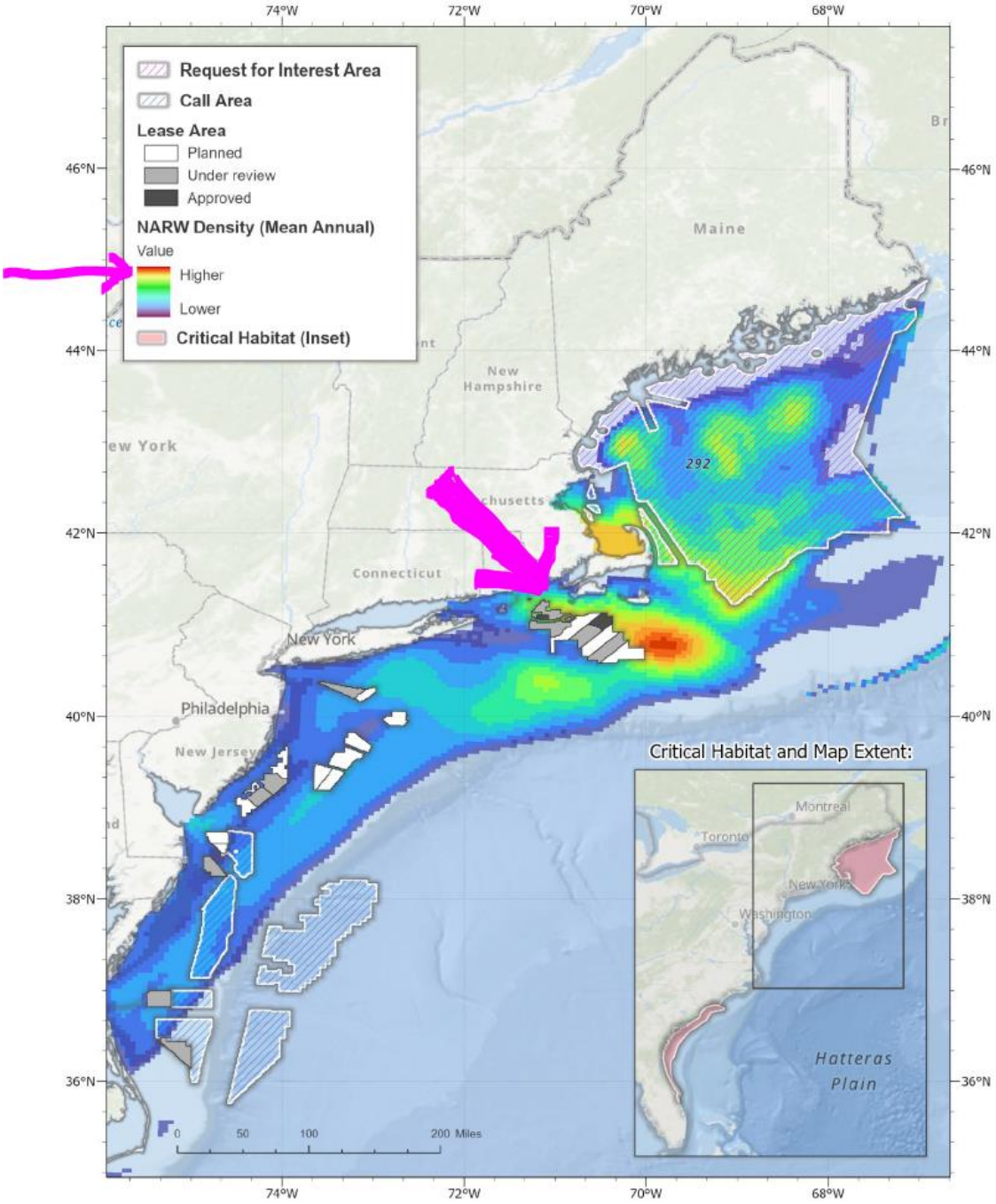
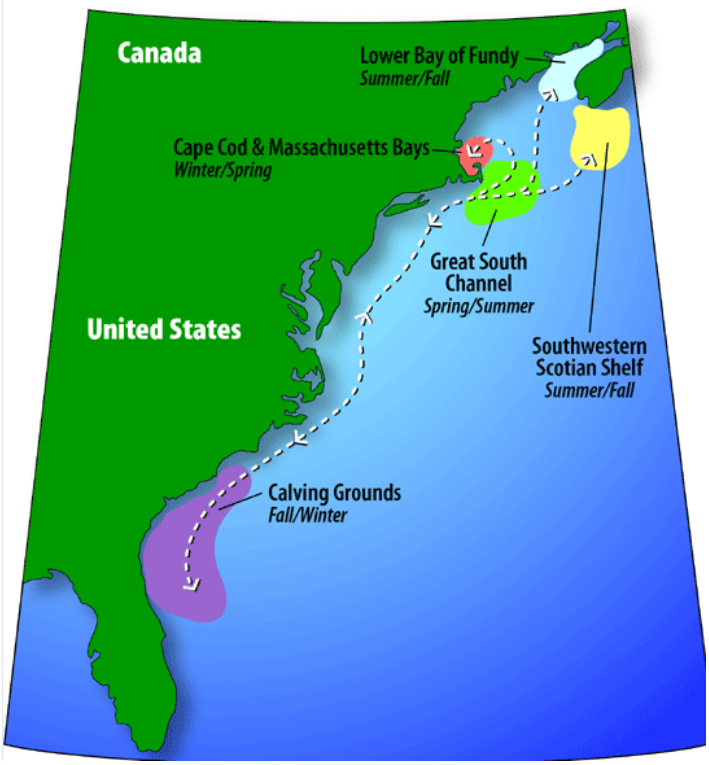


FIGURE B Annual Migration Pathway [Source: Woods Hole Oceanographic Institute https://www.whoi.edu/page.do?pid=126458&tid=3622&cid=2482]



BOEM's lease of this areas in this block without an Environmental Impact Statement is based on the false notion promulgated in case law [Fisheries Survival Fund v. Bernhardt, Case No. 16-cv-2409 (TSC), 5 (D.D.C. Feb. 14, 2020)] that the connection between the lease of such ocean areas and harm to marine life is too tenuous to require a full environmental review because BOEM still "retains authority to preclude construction". Effect of the location of the lease areas on the NARW population should have been assessed, to prioritize for conservation, and to help inform about how modifications in changes to location of areas proposed for lease sale might have mitigated the impacts to migrating whales and to avoid conflict with the harm that can reasonably be expected by exploration, development, and operations.

Page 9 of the Strategy document shows transparent outline of (but does not label) the Cape Romain and Grand Strand Wind Energy Areas directly within the Critical Habitat of the NARW that is their calving grounds. [See Figure C, below]. A Wind Energy Area is an area chosen by BOEM as most suitable for commercial wind energy activities. The large Cape Romain and Grand Strand Wind Energy Areas not only are directly in the migration route, but the location chosen—for them and other nearby other wind energy areas together

with already-leased area—are at the area key to passage of NARW to the only other portion of the calving/nursing grounds.

Figure C. Critical Habitat of NARW in the South Atlantic. Fuchsia arrows point out the north and south points along the coast delineating it. The Wind Energy Areas are outlined in white.

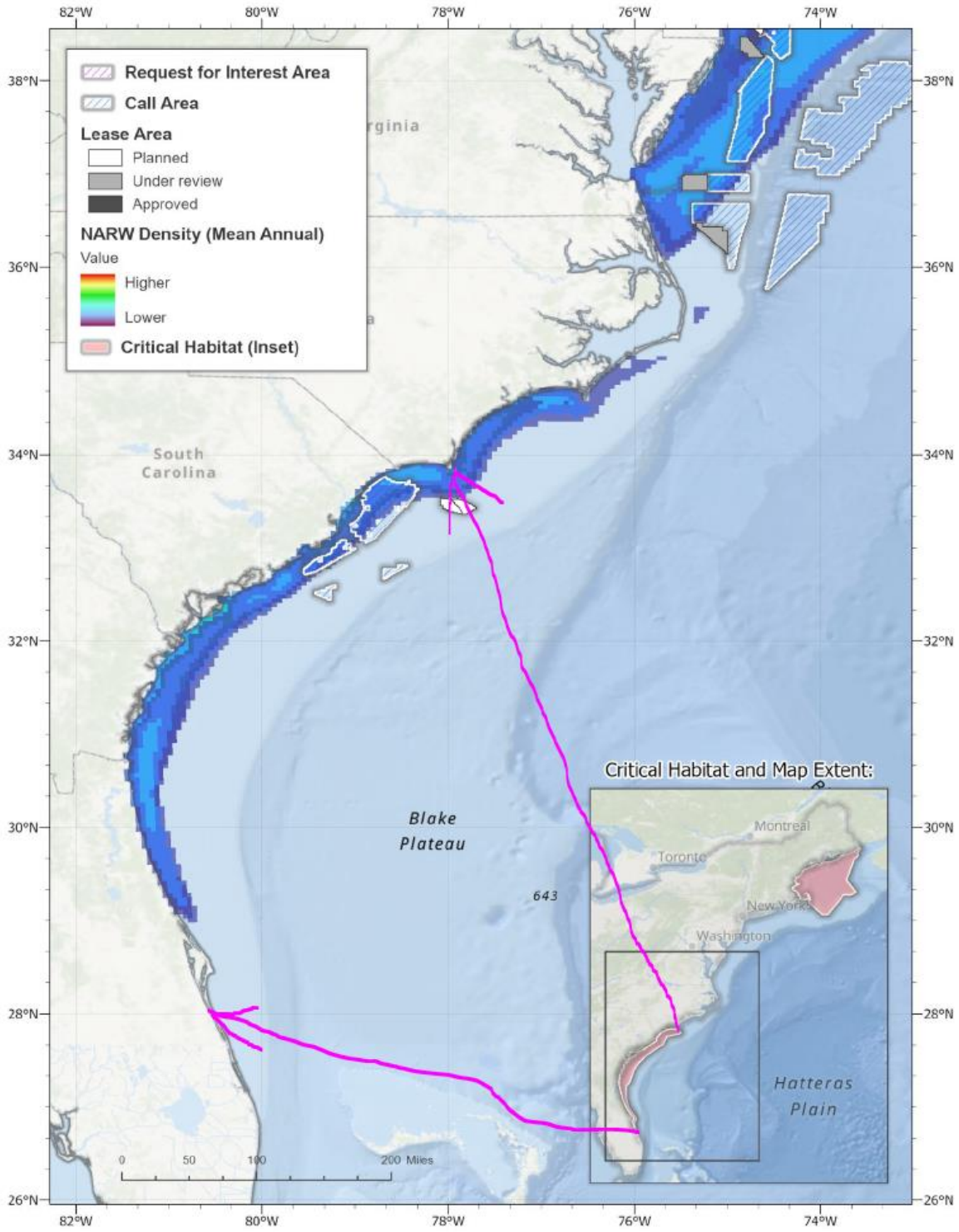


Figure D. Wind Energy Areas in Critical Habitat of NARW in the South Atlantic. [Source: https://www.boem.gov/sites/default/files/documents/renewable-energy/North-Carolina-South-Carolina-Stakeholder-Assessment.pdf]

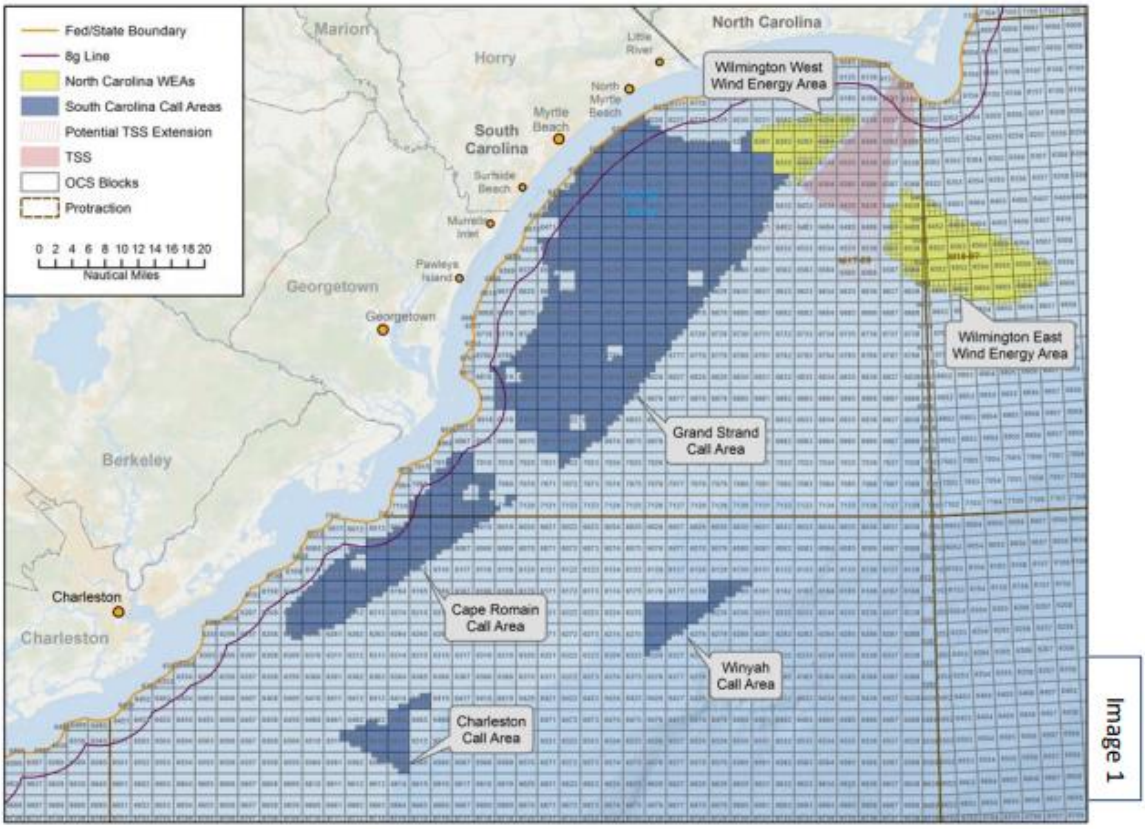


Image 1

Though the direct impact of the proposed action (the lease sales itself) would have negligible impact, the definition of lease areas for proposed sale and the selection of which of the areas will actually be leased will obviously causally effect which areas will foreseeably be developed and that can have serious impact.

Given these considerations, and the fact that the momentum from billions in development investment in the projects anticipated in these lease areas and need to fulfill government mandates, there is created a very strong impetus to build in a lease area once the lease is awarded. A finding of no significant impact for lease sales is unreasonable. Instead, the impacts of such a lease sale require further environmental inquiry (full EIS); Development in those areas is the reasonably foreseeable—indeed likely—consequence of the sale of the leases. Lease shapes, sizes, and locations are not easily, or legally, modifiable.

BOEM is requested to perform a full review (writing an EIS) for the sale of each lease area.

Even forgetting about the environmental impact of pile driving, and the effects of turbine operation (impacts from noise, sea strata mixing, weather changes), given the ample evidence that there are significant harmful effects[8] to marine life of sea-floor characterization activity (because this activity entails ensonification of vast areas of ocean floor. This is typical of SAP/lease area characterizations by developers of the lease site), and given that the sea floor of these lease areas *will* be characterized if a lease sale goes through, then—under most circumstances—a finding of no significant impact of such ensonification activities will not be a reasonable one and a full review should be performed (resulting in an Environmental Impact Statement (EIS)[9] of these lease site characterization activities.

An EA (Environmental Assessment) should yield a finding of "no significant impact" only when the proposed action cannot reasonably be expected to have direct or indirect significant environmental effects, 40 CFR §1501.5(c)(1), or if the effects are expected to be only insignificant. Otherwise a full EIS (Environmental Impact Statement) is required to be prepared.

Lease site characterization activities to explore the ocean bottom via equipment that repeatedly ensonifies the site over large areas is reasonably expected to adversely impact baleen whales and other cetaceans.

Sonar anthropogenic noise has been shown in Cetaceans to extend non-feeding periods[10], decrease feed-dives[11], induce a non-feeding state[12], abate

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8 https://www.regulations.gov/comment/BOEM-2021-0054-0053

9 Environmental Impact Statement

10 Ziphius cavirostris (Cuvier Beaked) whales responded strongly to playbacks of sonar at low received levels (RLs of 89–127 dB re 1 μPa); They ceased normal fluking and echolocation, swam rapidly and silently away, extended dive duration and subsequently fed less by extending the time between foraging forays.

11 Blue whales, Balaenoptera musculus, displayed behavioral responses to controlled exposure experiments for mid-frequency active sonar. The whales stopped feeding, increased swimming speed and travelled away from the sound source, with displacement occurring at a received level of 140 dB re 1 μPa, and cessation of feeding, occurring at even lower source levels [Goldbogen, J. A., Southall, B. L., DeRuiter, S. L., Calambokidis, J., Friedlaender, A. S., Hazen, E. L., et al. (2013). Blue whales respond to simulated mid-frequency military sonar. Proc. R. Soc. B 280:20130657. doi: 10.1098/rspb.2013.0657]. The researchers surmised that "frequent exposures to mid-frequency anthropogenic sounds may pose significant risks to the recovery rates of endangered blue whales" because they ceased feeding and were displaced [page 6, infra]. These baleen whales thus alter biologically important activities in the presence of sonar sounds.

12 Physeter macrocephalus (Sperm Whales) "switched to the active non-foraging state over received sound pressure levels of 131–165 dB re 1 μPa during LFAS exposure [(1kHz-2kHz frequency active sonar) Isojunno, S., Curé, C., Kvadsheim, P.H., Lam, F.-P.A., Tyack, P.L., Wensveen, P.J. and Miller,

communications[13] that may be relevant to foraging, mating, social cohesion, or parenting, and to increase whale call loudness at increased energetic cost presumably to increase signal-to-noise ratio in an attempt to maintain basic call function. In some studies, these effects are triggered by sound pressure level (loudness of sound) lower, and in some cases much lower, than standard established regulatory 'general' thresholds for that which constitutes harassment to marine mammals[14].

THE DRAFT STRATEGY DOCUMENT DOESN'T CONTAIN STRATEGY

A NARW Strategy Document should contain actual strategy. The purpose of actually stating strategy in a Draft Strategy document is so that BOEM and NOAA can get public feedback and improve on the strategy.

The Draft NARW Strategy Document is short on actual strategy, but long on statements that BOEM and NOAA will work together, on more highlights of the need to develop a strategy to address threats, plans for outreach to others, categorization of what of tools will be used in the future to develop a strategy, announcements that it will develop a strategy, announcements that it will develop decision-support tools, announcements that the agencies will be proactive in presenting the strategy once it is formed, announcements that it will assess our current understanding of threats, and declaration of intention

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P.J.O. (2016), Sperm whales reduce foraging effort during exposure to 1–2 kHz sonar and killer whale sounds. Ecol Appl, 26: 77-93.]

13 Blue Whales Respond to Anthropogenic Noise. PLOS ONE. February 29, 2012. M. Melcón, A. Cummins, S. Kerosky, L Roche, S. Wiggins, J. Hildebrand. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0032681]

14 E.g., rates of whale calling increased as soon as airgun noises were detectable, and rate increased with increase in loudness up to a received air-gun sound level of 94dB. To the extent that air gun loudness exceeded 127 dB, calling rates decreased sharply, and past 160 dB, the (Bowhead) whales stopped calling and were virtually silent. [Blackwell, Nations, McDonald, Thode, Mathias, Kim, et al. (2015) Effects of Airgun Sounds on Bowhead Whale Calling Rates: Evidence for Two Behavioral Thresholds. PLoS ONE 10(6): e0125720. doi:10.1371/journal.pone.01257]. Another study of the same species showed calling rates decreased when whales were near (median distance 41—45 km) an airgun. Median received sound levels from the airgun pulse at those sites were at least 116 dB

to develop a list of preliminary measures, and listing of preliminary measures that it will consider (read *could* require) for any individual project.

This is doublespeak and filler-talk.

We respectfully request BOEM reissue the Draft with an actual strategy.

There is mention that the agencies will support the development of studies with sufficient statistical power to detect change is fine, but what studies are proposed that will evaluate the effects of OSW activities on the NARW?

The scientific community, conservation groups, and other interested parties would like to know what studies are proposed, what mitigation strategies are proposed, so that the public can make suggestions and provide input on the suitability and adequacy of proposed studies and mitigation strategies and how they may be improved upon. The purpose of public review is so that a free exchange of ideas can help enlighten the best way forward and ways not to proceed.

The Draft "Strategy" document does say it will "implement monitoring efforts identified in the draft NOAA Fisheries and BOEM Northeast U.S. Federal Survey Mitigation Strategy"[15], but a look at this second document reveals that its topic is to mitigate the impact of OSW (Offshore Wind) on NOAA fishery *surveys*, not on the fisheries themselves (e.g. section 4, p.11). Again, this covers impact of Offshore Wind Energy Development on ongoing surveys and products, not on fisheries themselves, nor on Marine Mammal populations, let alone specific marine mammal species. It contains "to do" lists for evaluating impacts on the fisheries surveys; For instance, it states NOAA may be precluded from conducting surveys or performing sampling in the wind development area due to human safety reasons. The document does not at all cover how the NARW can be saved from the harm expected to occur as the result of OSW lease sales, exploration, development, or operations. It does not cover any strategies for this at all.

The only survey even mentioned[16] that NOAA is performing on NARW is an aerial survey. NOAA then states that it is averse to changing survey methods,

[15] media.fisheries.noaa.gov/2022-03/NOAA%20Fisheries-and-BOEM-Federal-Survey-Mitigation_Strategy_DRAFT_508.pdf

[16] In the NOAA Fisheries and BOEM Federal Survey Mitigation Implementation Strategy - Northeast U.S. Region that is incorporated in the Draft Strategy by reference

but is silent on evaluating or adding other methods that may help detect effects of OSW activities on the NARW.

Adding even further to the myriad of pro forma statements such as "As we support the realization of our nascent offshore wind energy potential we must do so responsibly and in a way that uses mitigation guidance, studies, and mapping tools" does not get us any closer to proving-out and committing to defined, actual strategies effective in reducing harm to endangered species that mandate protocol known to be protective.

For example, the Strategy, does not make Passive Acoustic Monitoring a required method for NARW detection to maintain exclusion/clearance zones around the conduct of OSW activities that can harm them when conducted in location and time of year at which they are known to appear.

Instead " the magnitude of work previously and currently being undertaken...." in the area of Passive Acoustic Monitoring and other areas is "acknowledge[d]", and Passive Acoustic Monitoring, is identified in "a general description of preliminary measures [that the agencies] consider [as] having potential ...that will [be] ...consider[ed] for individual projects".

We have the following question: Why has BOEM stated in the Strategy Document that it will only "consider" using, during the individual project environmental review processes, the conduct of continuous archival Passive Acoustic Monitoring in and around lease areas?

We feel that BOEM can and should employ stronger language and actually commit in the strategy document, such as: Given the seasonal distribution of NARW, if NARW density, based on past NOAA surveys, or current measures of copepod abundance, is expected to exceed a certain threshold within a lease area or not-too-granular subset thereof, then BOEM requires collection of archival passive acoustic monitoring of that area for a period of three years conducted by an independent party prior to the conduct in that area by the lessee or his assigns of activity suspected to cause harm to NARW (such as but not limited to the use of bubble guns, sparkers, pile driving, and turbine operation). The density threshold should be stated in the Strategy Document so that conservation groups can provide feedback on its propriety.

Likewise, for clearance and shutdown zones, state what BOEM requires, so that the public (including conservation groups, scientists, and interested parties) can provide helpful information to BOEM and NOAA as to whether the requirement is sufficient to protect the NARW.

BOEM, in the Draft Strategy, says it will "consider" suggestions from NOAA to avoid issuing new leases in high-risk areas that adversely impact high-value NARW critical habitat. BOEM then point blank states it may decide "issuing new leases in these [high-risk critical] areas is not avoidable"[17].

In what way is it "not avoidable"? It is very avoidable. Simply do not propose to sell or issue leases there. The Cape Romain and Grand Strand Wind Energy Areas must not be leased because not only are they critical NARW habitat for calving/nursing, passage through them is needed to access the rest of the calving/nursing grounds.

To expect developers will voluntarily "avoid proposing development in areas that may impact high-value habitat and/or high-density/use areas" on BOEM's unenforceable suggestion (p.39 Draft Strategy) is unrealistic.

The Strategy Document makes clear that it is BOEM's intention to never issue a final disapproval of construction in leased area, provided that at least *some* form of mitigation measures are able to be employed in the subject area; The Draft Strategy indicates (at bottom p.38 through first para. 39): *if a COP plan is disapproved, BOEM will inform the lessee of the reasons and of the conditions for approval*. BOEM has sold leases (Figure A) and designated Wind Energy Areas (Figure C) in what, by all indicators, are the worst possible locations for the continued existence of NARW. Now BOEM appears to announce that there does not even exist the possibility for unconditional disapproval of a COP in these areas even if upon environmental review the harms to NARW of development plans are reasonably expected to be too severe[18].

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[17] See pg.38 Draft Strategy; "If issuing new leases in these areas is not avoidable..."

[18] E.g. If adverse effects of power plant operation on migrating NARW is shown, development of the Wilmington West and Wilmington East Lease area is likely to impede access to calving grounds, or require exiting the OCS and entry into the Blake Plateau (an area Baleen whales currently avoid), and/or require additional energy expenditure by NARW for migration from careening around this plant or zig-zagging through it. Wilmington West and East should not be developed.

Appearing to a forehand relinquish its right or willingness, if warranted by the environmental review, to issue an unconditional disapproval (if the environmental consequences to NARW are found severe enough), the Bureau states it still retains "the authority to suspend operations." (pg. 39, Draft Strategy).

The Bureau must already be aware that shutting down operations on already built power plants for harm to NARW that was foreseeable aforehand would present nightmarish due process legal challenges by developers where BOEM has already, for such critical areas at high risk of adverse impact, abdicated its responsibility to not designate these high-risk NARW areas for "proposed lease areas", abdicated its responsibility to refrain from the offer and sale of leases of hi-risk NARW areas, and decided aforehand that conditional approval is always universally available to lessees even if the consequence to NARW is severe despite the mitigation.

To wait until resources are already committed to start protecting the NARW is not only legally infeasible, but entirely defeats the purpose of the National Environmental Policy Act, which is to weigh the effects on the environment prior to the irreversible and irretrievable commitment of resources.

THE STRATEGY DOCUMENT NEEDS TO BETTER EXPLORE THE CONNECTION BETWEEN HAZARDS CITED AND SPECIFIC HARMS TO NARW

The Draft Strategy does not discuss the connection between hazards cited and specific harms to NARW. It will not be possible for BOEM to develop effective measures to avoid, minimize, and monitor effects of exploration, construction, & operation if the nexus between the harm-causing events and the specific harms that befall the NARW are not laid out bare.

(1) noise, power plant operational noise
   a. psychological stress
   b. oxidative stress
   c. temporary hearing loss or impairment
   d. permanent hearing loss or impairment

e. masking, drowning out, or obfuscation by OSW activity of sounds from conspecifics or prey
    i. interference with mother-calf communication
    ii. interference with reproduction
    iii. interference with feeding
    iv. cost of behavioral responses
        1. energetically more costly change in annual migratory route
        2. energetically more costly change in sound frequency of vocalization produced[19]

Question for BOEM whose answers should be included in the strategy document: What methods of evaluating these has been proposed? Which method is the best? Which are achievable given practical considerations? What are the obstacles to measuring these that can be overcome and how can we overcome them?

(2) noise, lease area exploration, including site-characterization

a. thru e. (same considerations and questions as "a" thru "e" for operational noise)
f. effects on prey (kill zone of zooplankton) estimated effected area and consequence to NARW.

(3) vessels ship strikes ➡ traumatic injury and death, reduced condition during recovery causing reduced survival and lost reproductive opportunity, disability and concomitant reduced survival.

(4) rope/moorings/cables ➡ entanglement

a. restriction or limitation of movement

v. difficulty breathing / death by drowning

[19] right whales call at a higher sound frequency, and at a lower rate, in higher noise conditions.[Parks SE, Clark CW, Tyack PL (2007) Short- and long-term changes in right whale calling behavior: the potential effects of noise on acoustic communication. J Acoust Soc Am 122: 3725−3731]

vi. inability or difficulty feeding
    1. death by starvation, or reduced condition causing premature death from reduced survival

vii. increase in parasite load ➡ reduced condition

b. increased drag ➡ energetic costs ➡ reduced condition
    1. reduced survival ➡ premature death
    2. reproductive failure

c. wounds that do not heal (tissue infection, skin conditions, lice parasitism, impaired locomotion)

d. disfigurement

(5) Vibration and Long turbulent wakes "Von Karman Street" vortex shedding (caused by water current passing by cylindrical masts of the turbines), as well as changes to water turbidity and weather from operation of the plants.

f. ocean vertical strata mixing
g. changes to turbidity
h. changes to water current velocity, direction, and flow, and concomitant effects on geographic distribution of zooplankton
i. weather changes, including cloud cover that may impact zooplankton abundance and ecosystems (Figure E)

Figure E Example of weather changes likely to result from OSW operation

DISCONTINUE USE OF BAD PRACTICES IN ASSESSING EFFECTS OF OPERATIONAL NOISE

In the Underwater Acoustic Mitigation Assessments that are being used to review effects of turbine operation (For example, Equinor's Empire Wind COP, at Appendix M, on page M21), the information from Nedwel et al 2004[20], on which multiple COPs have relied, is completely outdated and inapplicable to the proposed power plant's expected operational noise. This reference in the COP assessment to the frequency and associated decibel levels of turbine-produced underwater sound is invalid. In the year 2004, a large commercial wind turbine had a rotor diameter of 114 m or so. The rotor sweep of each of the turbines proposed in Equinor's Empire has diameter 260 m. The much larger turbines planned for extant projects are expected to have a sound signature with a comparatively higher peak pressure in the lower frequencies, among other differences, than turbines installed circa 2004.

The underwater sound signature of the specific turbines planned to be installed should be directly and actually measured from existing GE Haliade X 18 MW or other turbines and other intended to be used. If this is not possible because the turbine has never before been used globally, then the underwater sound signature of turbines of like size located in the most comparable installation environment should be directly and actually empirically measured. That is, the underwater sound pressure levels at varying distances from the sound source should be measured at various frequencies.

There's appears no earnest effort in the COPs or the NEPA reviews to understand, study, or report on - nor even is there reasonable mention or examination - of the effects of operational noise on sea mammals. There is also lacking any review of the scientific literature on this. (See, for example, Empire Wind COP Section M.5.5 on page M.23 of Appendix M).

The notion expressed in the COPs and environmental reviews that operational noise can be expected to be significantly masked by background noise is

[20] Nedwell, Jeremy R., J. Langworthy, and D. Howell. 2004. Assessment of sub-sea acoustic noise and vibration from offshore wind turbines and its impact on marine wildlife; initial measurements of underwater noise during construction of offshore windfarms, and comparison with background noise. Subacoustech Report Reference: 544R0424, November 2004, to COWRIE.

unsubstantiated. Large Wind Turbine noise is characterized by sharp spectral peaks at the blade-passing frequency and its integer harmonics. Only after the recorded sound of a turbine is passed through a traditional smoothing (mathematical) algorithm can the output be deemed to be something that can be 'masked' by background noise. Though it has been argued that this transformation needs to be performed to be able to even compare the noise to background noise, it is a most reasonable position to say that it should not be, because this is not the sound that is actually experienced. Therefore, the conclusion that the sound can be "masked" by background sounds such as the sound of ocean itself –which sounds do not have such properties – should be doubtful.

The use of sound for communication and acquisition of information about the environment has evolved across the years and constitutes an important aspect of marine mammal behavior, including that of endangered baleen whales. Given the increasing level of anthropogenic noise in the ocean, it is of concern that high-intensity anthropogenic noise (both in Offshore Wind Turbine construction and operations, as well as during ensonification that is used to characterize and study the sea floor after a lease sale) may impact communication and foraging behaviors involving marine mammal sound production and ability to hear sounds coming from prey or conspecifics over the sounds produced by ocean-bottom site characterization, construction, and operation typical of Offshore Wind development. For example, Blue whales were less likely to produce calls in the presence of mid-frequency active sonar. Reduction was more pronounced when the sound source was closer to the animal, and when the anthropogenic sound level was higher. Anthropogenic noise, even at frequencies well above the whales' sound production range, has been demonstrated to have a strong probability of eliciting changes in vocal behavior [Melcón ML, Cummins AJ, Kerosky SM, Roche LK, Wiggins SM, Hildebrand JA (2012) Blue Whales Respond to Anthropogenic Noise. PLoS ONE 7(2): e32681. https://doi.org/10.1371/journal.pone.0032681; February 29, 2012]. This completely debunks the assumption promulgated in most assessments that anthropogenic noise is only reasonably likely to be considered harassment or affect fitness when the frequency matches those frequencies range to which the species communicates or is most attuned. The implications for marine mammals of anthropogenic noise likely to be emitted from wind-turbine power plants during operation have not been studied and

could result changes that result in a decrease in fitness of these and other marine mammals in areas within auditory reach of the project. Given the grand scale on which wind projects are expected to be built and that so much of the OCS is intended to be developed, and given that migration of NARW is long-range, it is unlikely that NARW will be able to migrate outside the auditory reach of operational noise from wind projects. Disruption of the making of calls for foraging or mating or to maintain group cohesion may reduce fitness and thus can be injurious to stock and a Level-A harm.

Habitat modification can constitute "harm" within the meaning of a take in the Endangered Species Act. Our U.S. Supreme Court has concluded habitat modification is a take if it actually injures wildlife, with injury including "perturbations that cause them not to use … otherwise suitable habitat,"

Assessments need to estimate reasonable effects on the NARW of how far a distance from the turbine the effects are expected to attenuate below harassment level, and must determine whether – within that distance – overlapping areas of harassment would result from adjacent turbine to create a larger enjoined harassment area.

Sound is a pressure wave which is created by a vibrating object, and moves through a medium such as water or air. When the pressure wave reaches the hearing apparatus, it is perceived as the experience of sound. We use the word sound or noise to include when it has an effect on other organ systems, we do not mean that the experience of sound or the experience of noise causes the effect, but that the pressure waves that cause the experience of noise also cause other effects in the body. Thus it is not required that the pressure waves be experienced as a type of noise which causes aversion (nor even that they be audible) in order for such pressure waves to cause actual physiological harm. However, aversion to audible noise is an adaptation present in many animals which serves to prevent physiological harm by the pressure waves themselves on organs and tissues, not only to hearing organs.

Noise causes destructive Reactive Oxygen Species in the mammalian vascular system and in organs (not limited to the organs of the hearing apparatus).

[E.g. Bayo Jimenez MT, Frenis K, Kröller-Schön S, Kuntic M, Stamm P, Kvandová M, Oelze M, Li H, Steven S, Münzel T, Daiber A. Noise-Induced Vascular Dysfunction, Oxidative Stress, and Inflammation Are Improved by Pharmacological Modulation of the NRF2/HO-1 Axis. Antioxidants (Basel). 2021 Apr 19;10(4):625. doi: 10.3390/antiox10040625. PMID: 33921821; PMCID: PMC8073373.]

A consequence to marine animals of various taxa of noise exposure is increased reactive oxygen species ("ROS"), such as hydrogen peroxide, superoxide, and hydroxyl radicals which are produced by normal bodily processes but cause oxidative damage to diverse cellular components, including membranes, proteins, and DNA, if they are not "neutralized" by antioxidant defenses. Two important enzymes of the cochlear antioxidant defense system[21] are metalloenzymes that work together to regulate ROS production in virtually every cell in the body [*Id.*]. These protective systems can become overworked and depleted from exposure to noise, and subject the organism to intense damage at the cellular level.

Thus behavioral aversion to noise should not necessarily be viewed as maladaptive, even if the avoidance behavior contributes to reduced feeding and reduced reproductive success (i.e. even if the behavioral response to noise has fitness consequences) because it may be protective of the integrity of tissues and of essential biochemical processes by preventing noise from eliciting oxidative stress and depleting antioxidant systems that offer such protection.

Because of this, noise shouldn't be viewed as a harmless stimulus of an annoyance or spooking response. Rather, pressure waves bearing certain properties not only produce the experience of noise but are also sources of physiological harm against which aversions, behavioral avoidance, and spooking serves to protect the individual by bringing the individual away from the source of harm. The fitness consequences (loss of effective habitat, immune compromise[22], energetic tradeoffs creating lowering of survival risk

[21] cytosolic copper/zinc superoxide dismutase, and selenium-dependent glutathione peroxidase

[22] Celi, M. et al. Shipping noise affecting immune responses of European spiny lobster (*Palinurus elephas*). Can. J. Zool. 93, 113–121 (2015).

or reproductive success, etc.) of the animal removing itself from physiological harm also constitutes harm.

Reactive oxygen species (molecules) can oxidize lipids and proteins - including membrane bound enzymes and receptors- , destroy or destabilize membranes, disrupt ionic balance, interfere with cellular signaling and calcium homeostasis, attack DNA and disrupt protein synthesis, alter cytoskeletal components, and damage DNA repair and transcription processes, and can also lead to nerve cell damage through excitatory amino acids.

Activity of these protective systems of antioxidant enzymes have been shown to be present throughout the body, in cochlea, brain, retina (eye), and lung tissues in mammals [Pierson, M. G. and Gray, B. H. 1982) Superoxide dismutase activity in the cochlea. *Hear. Res. 6:* 141-51].

While adverse effects of noise is widely known to occur through a psychological stress response from auditory perception, as well as (if intense enough) directly harm the auditory apparatus, adverse effects can also occur through other pathways, in other organ systems including mammalian vascular and nervous systems, and have been shown to occur as the result of noise. [See e.g., Cheng H, Wang B, Tang C, Feng G, Zhang C, Li L, Lin T, Du F, Duan H, Shi M, Zhao G. Infrasonic noise induces axonal degeneration of cultured neurons via a Ca^{2+} influx pathway. Toxicol Lett. 2012 Jul 20;212(2):190-7. (Nerve axon degeneration) doi: 10.1016/j.toxlet.2012.05.015. Epub 2012 May 22. PMID: 22626861]

Oftentimes, the effects of noise at the fringes of the hearing range of the animal are assumed to have little to no effect. The purpose of "M-weighting functions" is to be able to predict how loudly a sound of a certain frequency is perceived by the animal. Sounds at frequencies outside of those to which an animal is most sensitive must be actually louder to have the same level of perceived loudness as a sound at a frequency to which an animal is more attuned/sensitive. The assumption often made is that because hearing is less sensitive at the outer limits of the hearing range, the effects to the animal (potential for adverse impact) will be insignificant or non-existent unless inordinately loud. Specifically, what is assumed is that perceived loudness is a reliable measure of potential impact. [Southall, B. L., Bowles, A. E., Ellison, W. T., Finneran, J. J., Gentry, R. L., Greene, C. R., ... Tyack, P. L. (2007). Marine

mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals, 33(4), 411–414. https://doi.org/10.1578/AM.33.4.2007.411]. However, more recent studies show both that this assumption is not met [See Weichenberger M, Bauer M, Kühler R, Hensel J, Forlim CG, Ihlenfeld A, et al. (2017) Altered cortical and subcortical connectivity due to infrasound administered near the hearing threshold – Evidence from fMRI. PLoS ONE 12(4): e0174420. https://doi.org/10.1371/journal.pone.0174420] and that sound outside of the ordinary frequencies at which an animal hears can have adverse consequences on the nervous and cardiovascular systems [Du F, Yin L, Shi M, Cheng H, Xu X, Liu Z, Zhang G, Wu Z, Feng G, Zhao G. Involvement of microglial cells in infrasonic noise-induced stress via upregulated expression of corticotrophin releasing hormone type 1 receptor. Neuroscience. 2010 May 19;167(3):909-19. doi: 10.1016/j.neuroscience.2010.02.060. Epub 2010 Mar 4. PMID: 20206673.; Pei, ZH., Chen, BY., Tie, R. et al. Infrasound Exposure Induces Apoptosis of Rat Cardiac Myocytes by Regulating the Expression of Apoptosis-Related Proteins. Cardiovascular Toxicology 11, 341 (2011). https://doi.org/10.1007/s12012-011-9126-y ; Ana Lousinha, Maria João R. Oliveira, Gonçalo Borrecho, José Britoa, Pedro Oliveira, António Oliveira de Carvalho, Diamantino Freitas, Artur P. Águas, Eduardo Antunes. Infrasound induces coronary perivascular fibrosis in rats. Cardiovascular Pathology 37 (2018) 39–44. https://www.sciencedirect.com/science/article/abs/pii/S1054880718302862?via%3Dihub; Pei Z, Zhuang Z, Xiao P, Chen J, Sang H, Ren J, Wu Z, Yan G. Influence of infrasound exposure on the whole L-type calcium currents in rat ventricular myocytes. Cardiovasc Toxicol. 2009 Jun;9(2):70-7. doi: 10.1007/s12012-009-9037-3. Epub 2009 Apr 22. PMID: 19387569].

Large wind-turbine power plant operation generates noise that has pronounced infra and low-frequency sound signatures. Exposure to low-frequency noise is associated with chronic stress in The North Atlantic Right Whale as evidenced by empirical study [Rosalind M. Rolland, Susan E. Parks, Kathleen E. Hunt, Manuel Castellote, Peter J. Corkeron, Douglas P. Nowacek, Samuel K. Wasser and Scott D. Kraus. Evidence that ship noise increases stress in right whales. Proceedings Royal Society B: Biological Sciences Vol. 279, No. 1737 (22 June 2012), pp. 2363-2368]. Operation of large wind-turbine power plants produces low-frequency noise.

Chronic, too-frequently repeated, or unmodifiable stressors can precipitate cardiovascular dysregulation in mammals causing tachycardia, hypertension, and reduced heart rate variability. These and other reactions affect brain function and cause hormonal and immunologic changes that are self-perpetuating [Grippo AJ. The utility of animal models in understanding links between psychosocial processes and cardiovascular health. Soc Personal Psychol Compass 5: 164–179, 2011] and have health and survival consequences.

INJURY TO THE HEARING APPARATUS OCCURS BELOW THE "PTS" (SOUND PRESSURE LEVEL CAUSING FULL/PARTIAL PERMANENT DEAFNESS) AND CAN ALSO OCCUR BELOW THE "TTS" (SOUND PRESSURE LEVEL CAUSING TEMPORARY HEARING LOSS)

Noise previously thought to be "benign" in that it does not manifest in permanent threshold shift after an exposure event, can cause irreversible neural damage after repeated or cumulative exposure. [Wang Y, Ren C. Effects of repeated "benign" noise exposures in young CBA mice. J of the Association for Research in Otolaryngology. 2012 Aug;13(4):505-15. doi: 10.1007/s10162-012-0329-0. Epub 2012 Apr 25. PMID: 22532192; PMCID: PMC3387307.].

Post-exposure recovery of threshold sensitivity to sound, or in layman's terms regaining ordinary reaction to sound, after "TTS" has been assumed to indicate reversal of damage to delicate structures of the inner ear. However, following noise-induced damage to the ear, damage can be progressive. In a mammalian experiment, Rapid, extensive, and irreversible loss of synapses was found to have occurred within 24 h post exposure, and delayed and progressive loss of cochlear neurons over the course of months was found, even though the hair cells remained and regained normal function [Kujawa SG, Liberman MC. Adding insult to injury: cochlear nerve degeneration after "temporary" noise-induced hearing loss. J Neurosci. 2009 Nov 11;29(45):14077-85. doi: 10.1523/JNEUROSCI.2845-09.2009. PMID: 19906956; PMCID: PMC2812055.] .

Threshold for tissue injury has been found to occurs at lower threshold than the threshold for Temporary Threshold Shift (TTS) onset [Houser, D.S. When Is Temporary Threshold Shift Injurious to Marine Mammals?. J. Mar. Sci.

Eng. 2021, 9, 757. https://doi.org/10.3390/jmse9070757]. While the animals may regain an observable behavioral reaction to sound, as measured by gross reaction to sound, even though the injuries persist, a gross behavioral reaction to sound or an auditory evoked potential at a specified frequency is not necessarily an indication that the animal is able to hear normally. For example, an animal who is unable to hear complex auditory scenes, or integrate[23] sounds, or who suffers tinnitus or hyperacusis, each and all of which can have survival or other fitness consequences, may still have gross behavioral reactions in sound tests showing responsivity to frequency at specified sound levels.

BOEM's and NOAA's nearly singular focus[24,25] on PTS distance (distance from activity at which partial or full permanent deafness will be induced in the whale) as the only indicator of "take" (premature death or reproductive failure affecting the population) is not reasonable.

THERE IS LIKELY INCREASED PROBABILITY OF INJURY AND OTHER FITNESS COSTS TO NARW DURING FULL/PARTIAL DEAFNESS BOUTS

Even if one were to assume, for arguments' sake, that whales fully recover from TTS (hearing threshold shifts that are temporary), this does not mean there are no survival or reproductive consequences. Conspecific and mother-calf communication are important. In the time that a calf is experiencing such

[23] Temporal-spectral integration is a phenomenon where sound actually experienced is the result of neural processing to optimize hearing for detection of patterns from acoustic inputs likely to be relevant to the animal. [Räsänen O, Laine UK. Time-frequency integration characteristics of hearing are optimized for perception of speech-like acoustic patterns. J Acoust Soc Am. 2013 Jul;134(1):407-19. doi: 10.1121/1.4807499. PMID: 23862817. https://pubmed.ncbi.nlm.nih.gov/23862817/] This is akin to adjusting the equalizer on your car radio so that you can hear the signal as intended and to remove sharp peaks and dips that create harsh, unpleasant sounds, or that interfere with the sounds that are relevant to you.

[24] E.g. NOAA states: "Level A harassment is not expected …due to the small PTS zones associated with HRG equipment types planned for use." [https://www.federalregister.gov/documents/2022/10/12/2022-22150/takes-of-marine-mammals-incidental-to-specified-activities-taking-marine-mammals-incidental-to]. PTS zones are zones in which sounds are so loud that Permanent (hearing) Threshold Shifts (partial or full deafness) in the animal occur.

[25] BOEM is focused on mitigating only PTS (clearing NARW from those areas in which sound production is so loud that it will cause deafness): E.g. https://www.boem.gov/High-Resolution-Geophysical-Surveys/

effect, it can get separated from its mother and be subject to predation or other harms. Whales, while their hearing is impaired, may be slower to avoid dangers such as ships, which can increase the likelihood of death, may have greater difficulty assessing local variation in prey density, and may not be able to orient themselves, which can lead to danger, travelling longer distances and the associated energetic costs, encounters with fishing gear, and other real survival and reproductive costs. The agencies claim there are no effects because the probability of an individual event and the occurrence of a whale at that location are small. The agencies assume the time spent impaired has no fitness cost and that the likelihood of a given impairment from a specific activity at a point location happening when NARW is present is so small as to be negligible due to the NARW's low population numbers, and do not take into account that these events have the potential to occur across the vast areas in which OSW activity is planned to be conducted, or that activities are nearly continuous for months and several dozen vessels may move throughout a lease area conducting them. The cumulative time for recovery of temporary hearing impairment/deafness, and cumulative probability of encounters over the areas planned to be leased and developed, together with an estimate of the increase in mortality while hearing is impaired should be examined.

FALSE DICHOTOMY : LEVEL A HARM VERSUS DISTURBANCES THAT ARE MINOR AND HAVE NO POPULATION LEVEL CONSEQUENCES

Level A harassment is defined as an event that cause at least 50% mortality. Just because something does not cause 50% mortality in the short term does not mean that it does not have extremely serious impacts to the population.

It is utterly unreasonable to seek to mitigate harm only when the harm qualifies as Level A harm. Surely the Bureau should not ignore reductions in survival expected to result from the proposed activities just because the harm fails to exceed a short-term 50% death rate. What about a harm-causing stressor that causes a 25% mortality risk over three months to at least ten individuals? Or a 2% annual risk of mortality from that cause for twenty years to the whole population? Too myopic a focus on the MMPA definition and criteria for A-Level harm will surely cause the BOEM and NOAA to miss potential for significant adverse impacts to the NARW population that could cause or contribute to worldwide extinction.

For example, in another species of Baleen whale, the gray whale, the whales were observed to move around (avoid) a stationary source of active sonar emissions[26], with avoidance occurring at a received level of approximately 140 dB. Movement to avoid a loud sound source may not seem like a major impact, but it is estimated that just 10 days of lost foraging opportunities due to disturbance could lead to an unsuccessful pregnancy or loss of a calf[27].

For noise, it is incorrect to list behavioral disturbance as a type of minor harm rather than a harm-causing event. This has led to the adoption of the false premise that "harassment" is a temporary minor and recoverable harm. Behavioral disturbance, like entanglement, should be considered ***a harm-causing intermediary event*** the incidence of which is greatly increased by offshore wind exploration and development activity, and which event much like entanglement, has real potential to causes bodily harm, death, and population-impacting reduction in survival and reproduction.

UNDERSTANDING OF ENTANGLEMENT HARMS AND HOW THEY CAN BE MITIGATED

For hazard type (3) rope/moorings/cables, the presence of risk of a harm-causing event "entanglement" is mentioned, but the types of bodily harm that result from entanglement are not discussed anywhere, nor are the modes of death, or modes of affected fitness (survival and reproduction) reduction.

Materials may differ in the propensity to saw deeply through tissues, in drag properties, and entanglement propensity. Given that entanglements are only

[26] Buck, J. R., and Tyack, P. L. (2000). Responses of gray whales to low frequency sounds. *J. Acoust. Soc. Am.* 107, 2774. doi: 10.1121/1.428908 ; Croll, D. A., Clark, C. W., Calambokidis, J., Ellison, W. T., and Tershy, B. (2001). Effect of anthropogenic low-frequency noise on the foraging ecology of *Balaenoptera* whales. *Anim. Conserv.* 4, 13–27. doi: 10.1017/S1367943001001020 ; Tyack, P. (2009). Acoustic playback experiments to study behavioral responses of free-ranging marine animals to anthropogenic sound. *Mar. Ecol. Prog. Ser.* 395, 187–200. doi: 10.3354/meps08363

[27] Villegas-Amtmann, S., Schwartz, L. K., Sumich, J. L., and Costa, D. P. (2015). A bioenergetics model to evaluate demographic consequences of disturbance in marine mammals applied to gray whales. Ecosphere 6, 1–19. doi: 10.1890/ES15-00146.1

very rarely ameliorated quickly after occurring and that animals experience reduced condition from increased drag and difficulty breathing, moving, and feeding, it may be helpful to understand how choice of diameter, weave style, and material may influence the severity and type of harm to entangled whales, the probability of becoming entangled in the first place, and may lend suggestions for guidelines to mediate the harm.

VESSEL STRIKE AVOIDANCE

Strategy to avoid vessel strikes should include *collective* monitoring via reporting and real-time alerts received from other vessels.

Adapt or employ a system like Whale Safe https://whalesafe.com/[28] to monitor NARW in the mid-Atlantic, and require the OSW developers and their assigns subscribe, as a condition of lease sale or project development. Whale Safe (or similar systems) helps mariners avoid collisions with the marine mammals and helps score shipping companies on compliance and will help grade OSW developer exploration and construction fleets on their whale safety compliance. The system produces daily alerts informing subscribers how likely ships are to encounter as well as a web-based interactive map showing the locations of individual whale detections to mariners. Buoys each equipped with an underwater microphone listens for whale songs and uses an algorithm to automatically identify what species of whale is vocalizing before beaming the detection to a satellite. Second, trained marine mammal observers and citizen scientists use a smartphone app to report any and all whale sightings from boats. Third, mathematical modelling uses this information plus gleaned from years of recent historical data and the latest oceanographic data (such as sea surface temperature and ocean currents) to predict the probability of encountering a NARW in real time. Enforce compliance by suspending lease area exploration or construction activities for a temporary period if an OSW developer or their assigns should be found to be non-compliant.

Consult with Stellwagen Bank National Marine Sanctuary (SBNMS) and Jeffreys Ledge to learn about long term passive-acoustic NARW study [See

[28] Similarly, Friends of the Sea https://friendofthesea.org/ have an online platform for reporting sightings

Temporal patterns of North Atlantic right whale vocalizations during the winter and spring in the Northwest Atlantic, USA by Guerreiro da Silva, A, Vu, E, Risch, D & Van Parijs, S M (2012). Bioacoustics, Volume 21 (1): 70][29], and modify a system like 'Whale Safe' to detect NARW, deploy the buoys in the lease areas, require OSW lease exploration fleets and construction and maintenance ships to subscribe, monitor these companies' respective compliance, and suspend lease area exploration or construction activities by the OSW developer for a temporary period if an OSW developer or their assigns should be found to be non-compliant.

SCORING OF DEVELOPER COMPLIANCE WITH WHALE-SAFE PRACTICES SHOULD BE MANDATORY

BOEM should promulgate needed regulation that provides for assigning a score or index number to developers and their assigns to reflect whether they fully comply with each of a suite of practices proven to reduce vessel whale strikes, similar to the way the "Friends of the Sea" organization scores and certifies shipping companies for 100% compliance with whale-safe practices:

- Use full-time observations and technology such as thermal imaging cameras/binoculars to detect nearby whales, require documentation, and audit by an independent party.

- Require real-time sharing of whale-sighting data with nearby vessels via an online platform that can alert other vessels in real time. Require participation in receiving alerts.

[29] See e.g. https://portal.nrwbuoys.org/ab/dash/ buoy data. Also see, for comparison of systems, https://www.frontiersin.org/articles/10.3389/fmars.2022.873888/full

- Follow established procedures after sighting whales nearby, such as changing route or slowing ship speed or discontinuing OSW activity known to be harmful.

- Comply with voluntary and regulatory speed reductions and collision-mitigation guidelines.

- Provide lookouts with proper whale-sighting equipment and training, assign adequate lookouts (2 per vessel facing in opposite directions to cover 360 degrees) sufficient for shift coverage in short shifts because vigilance causes fatigue and higher error rate beyond 4 hours.

- **Use ducted or hidden propellers** to avoid possible whale injuries.

Audits for compliance should be conducted and non-compliance enforced by temporary suspensions.

NARW CONDITION PRIMARILY DEPENDENT UPON ITS FOOD SUPPLY

NARW filter-feed on Calanus finmarchicus, a species of copepod, and other zooplankton. Seismic Air Guns[30] which are used in Offshore Wind lease area exploration activities) creates a zone of death for zooplankton of radius (at least) three quarters of a mile from its firing. Air gun signal exposure decreased zooplankton abundance when compared with controls, and caused a two- to threefold increase in dead adult and larval zooplankton. Impacts were observed out to the maximum (three quarter mile) range sampled, which was more than two orders of magnitude, or 100 times greater than the previously assumed impact range of 10 m. [*See* McCauley, Day, Swadling, Fitzgibbon,Watson & Semmens, 2017. Widely used marine seismic survey air gun operations negatively impact zooplankton. Nature Ecology & Evolution volume 1, Article number: 0195 (2017)]. BOEM has repeatedly

[30] A.k.a "bubble" gun, See Table 6 EA, for example, of Equinor Draft EA.

underestimated the effect of exploratory activities on zooplankton. For example, the Empire Wind Draft EA (Environmental Assessment) states that "other organisms inhabiting the water column … are unlikely to be affected by noise unless they are within a few meters [the impact range] of the activities. Therefore, only a small percentage of the…overall plankton…would be affected." [page 39, Draft EA, internal reference citations omitted]. This is a severe underestimation and is difficult to reconcile with the three-quarter mile zone of impact from the source demonstrated[31] by sampling surveys and the fact that when used for ocean bottom exploration of lease areas, the guns are fired "over long durations and over large areas"[32] from arrays towed by vessels for many months, moving slowly throughout the lease area until the entirety of the lease area is characterized. This will happen multiple lease areas simultaneously, potentially. Because the array is towed at a slow 3-4 knots, and firing occurs at least several times a minute, killzones from each firing are centered only tens of meters apart, so the zooplankton killzone from one Seismic air gun discharge overlaps that of the next, creating a continuous zooplankton kill zone swath *a mile and a half wide* with the vessel trajectory centered over it. This is an astronomical loss of zooplankton[33].

It should be examined whether the power of Underwater USBL Positioning systems might be high enough to affect NARW prey. Underwater USBL Positioning Systems emit Ultrasound (in the 18 kHz – 30 kHz frequency range) and are intended to be used for the proposed activities according to EAFs of several of the proposed projects underway. E.g. Empire Wind EAF Table 6. Several of the other types of site characterizing equipment stated to be used produce high powered sounds in the range (20 kHz – 100 kHz), though it may not be the dominant frequency. High-powered Ultra Sound (frequency 20 kHz, 60 Hz, 80 Hz) applied to sea water[34] causes extremely high mortality rates of zooplankton; Mortality of 94-99% for copepods, 86-99% for copepod nauplii was measured[35]. The rapid formation and implosion

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[31] Id.

[32] Atlantic G&G PEIS, page viii, incorporated by reference into the Draft EA

[33] Particularly considering that the seismic activities are conducted over track lines until the entire lease area is covered, and that lease areas totaling a million or so acres will be characterized in the near future.

[34] being investigated as a method to sterilize ship ballast water by killing the animals in the water

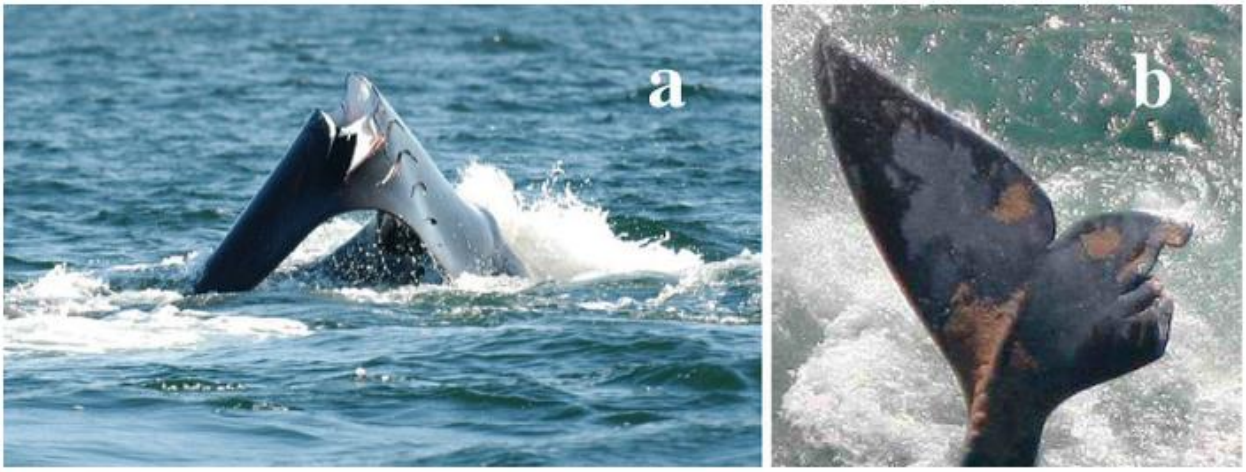
[35] Sassi, Viitasalo, Rytkönen, and Erkki Leppäkoski, 2005 Experiments with ultraviolet light, ultrasound and ozone technologies for onboard ballast water treatment. VTT Industrial Systems, 2005. Ed.

of microscopic gas bubbles is a shear force that can rupture cell membranes, and is so powerful that it can literally lyse water molecules forming highly active hydroxyl free radicals, with a high oxidation potential.

INCENTIVIZE USE OF VESSELS WITH DUCTED OR HIDDEN PROPELLERS

We recommend BOEM incentivize the use of vessels with ducted or hidden propellers because they can sharply reduce propeller injury. BOEM should require a phase-in where initial 1-3 years only a small proportion of fleet should be required, with increasing proportion in years 4-5. It would be helpful also to provide grants and incentives to accomplish this.

Figure F. Propeller Injuries cause disability, premature death, and increased parasite load in NARW. [36]



Flukes of a North Atlantic right whale incised by a propeller: (a) March 10, 2005, (b) September 3, 2005. Note the substantial cyamid spread and tissue failure. The animal has not been sighted since. Catalog: NEAq Eg #2425; photos: (a) NEAq, (b) Tim Voorheis

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Kariainen. https://www.vttresearch.com/sites/default/files/pdf/tiedotteet/2005/T2313.pdf]

[36] Source: Case definition: Chronic entanglement trauma of Pinnipeds and Cetaceans April 2013 In book: Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma Chapter: Case definition: Chronic entanglement trauma of Pinnipeds and *Cetaceans* Publisher: Diseases of Aquatic Organisms 103: 229-264Editors: M. J. Moore, J. V. D. Hoop, S. G. Barco, A. M. Costidis, F. M. Gulland, P. D. Jepson, K. T. Moore, S. Raverty and W. A. McLellan

THE EFFECT OF TURBINE OPERATIONAL NOISE ON THE ABUNDANCE OF COPEPOD AND OTHER ZOOPLANKTON PREY OF NARW

The effect of operational noise of wind-turbine power plants on oxidative stress of the copepod prey of NARW requires study. Noise induces oxidative stress in copepods, as inferred by oxidative stress indicators under noise conditions as compared to controls. [e.g. Tremblay, Nelly & Leiva, Laura & Beermann, Jan & Meunier, Cédric & Boersma, Maarten. (2020). Effects of low-frequency noise and temperature on copepod and amphipod performance. Proceedings of Meetings on Acoustics. 37. 10.1121/2.0001275. internet source: https://asa.scitation.org/doi/pdf/10.1121/2.0001275] .

The chronic effect of noise created during offshore wind turbine operations, which can have duration of operation of twenty five to thirty five years, must be understood. Since sensitive receptors cover the whole body of crustaceans to detect their surroundings, those low frequency noises may disrupt basic ecological and physiological functions. Researchers designed an experiment to understand the joint effect of noise and temperature on copepod. The copepod Acartia tonsa is commonly used as a proxy for a range of fundamental processes that relate to marine planktonic crustaceans. Noise from operational wind turbines may alter the capacity of Copepod (an Arthropod Crustacean), and challenge gathering the energy required to fulfil all their biological functions (e.g. development, growth, reproduction, and survival by mean of escape behavior), concluded the researchers, who discovered that low-frequency noise spurs antioxidant activities which is a signal of oxidative stress, and concluded that chronic exposure is likely to deplete antioxidant enzymes important for detoxifying ordinary products of metabolism. [See Tremblay, Leiva, Beermann, Meunier, Boersma, 2019. Effects of low-frequency noise and temperature on copepod and amphipod performance. Proc. Mtgs. Acoust. 37, 040005 (2019). https://doi.org/10.1121/2.0001275] Depleted antioxidant activities has observed across almost every taxonomic group exposed to noise that has been studied, including mammals[37] and even plants[38].

[37] E.g. Koc, Ersoy, Ilhan, Erken, Sahın, 2015. Is rosuvastatin protective against on noise-induced oxidative stress in rat serum?. Noise Health, 17, 11–16. ; Also See McFadden, Ohlemiller, Ding, Shero, Salvi (2001). The influence of superoxide dismutase and glutathione peroxidase deficiencies on noise-induced hearing loss in mice. Noise Health, 3, 49–64

[38] Zohreh Haghighi Kafash, Z. Haghighi Kafash, Shahrzad Khoramnejadian, S. Khoramnejadian, Ali Akbar Ghotbi-Ravandi, A. Akbar Ghotbi-Ravandi, & Somayeh Farhang Dehghan, S. Farhang Dehghan. (0000). Traffic noise induces oxidative stress and phytohormone imbalance in two urban plant species. Basic and applied ecology, Vol 60, pp.1-12. doi: 10.1016/j.baae.2022.01.010

REQUIRE MULTIPLE DETECTION METHODS TO MAKE UP FOR SINGLE METHOD SHORTCOMINGS

Detection methods by Marine Mammal Observers (MMO) including Protected Species Observers (PSO) are traditionally recommended and are all that is currently planned to be relied on for detecting presence of NARW during site characterization (lease area exploration after lease sale), and construction activities, for mitigation. However, there are logistical difficulties in determining the presence of animals that may spend significant amounts of time underwater [https://www.sciencedirect.com/science/article/pii/S0025326X17308809]. This is especially so for whales, where the likelihood of detecting a whale at the surface in normal conditions has been estimated for some species to be only one in a hundred. [Barlow, J., and Gisiner, R. (2006). Mitigating, monitoring and assessing the effects of anthropogenic sound on beaked whales. J. Cetacean Res. Manag. 7, 239–249]. Passive Acoustic Monitoring (PAM), Vessel-mounted or aircraft-mounted thermal Infrared (IR) systems, and high performance RADAR offer monitoring tools for the detection of marine mammals at sea can supplement visual observer effort to produce much better detection of when whales are actually present. [Ursula K. Verfuss, Douglas Gillespie, Jonathan Gordon, Tiago A. Marques, Brianne Miller, Rachael Plunkett, James A. Theriault, Dominic J. Tollit, Daniel P. Zitterbart, Philippe Hubert, Len Thomas. Comparing methods suitable for monitoring marine mammals in low visibility conditions during seismic surveys, Marine Pollution Bulletin, Volume 126, 2018, Pages 1-18; internet source: https://www.sciencedirect.com/science/article/pii/S0025326X17308809]. RADAR works to supplement MMO/PSO in low sea state (untumultous, unchoppy water) conditions. IR systems work in low light, fog, or dark conditions. Observer fatigue is a well-known source of perception bias. Maintaining visual vigilance is mentally and physically taxing and observer performance diminishes if observers are not sufficiently rested. In addition, weather and other environmental conditions affect detection probability; for example, visual detection becomes increasingly difficult as sea state

increases[39]. No approval should issue for a wind project that proposes to use Marine Mammal Observers (MMO) as the only method of detection when other technologies are available which, when combined with MMO/PSO, more accurately detect NARW. Only conditional approval should be given for site characterization (exploration of sea bottom /SAP) activities with the condition that all of MMO/PSO PAR and IR combined be used. IR can help ameliorate MMO shortcomings in fog or other conditions that impair visual contact with NARW or its blow spray. PAR can improve greatly upon the false negatives caused by submerged animals that plague the MMO detection method when it is used alone.

NARW avoid migration routes outside the outer continental cliff because of dangers, lack of food there, and/or additional energetic expenditures involved. The NARW may not be able to avoid the mentioned cluster of lease areas south of Martha's Vineyard and Nantucket because once these areas are developed, there will only be a limited swath between these lease areas and the cliff ; Operational noise from the turbines is reasonably expected, based on the 952 foot size and large rotor size to extend beyond the lease areas to the cliff edge and beyond. If operational noise adversely effects NARW feeding, communication, or reproduction, aircraft-mounted IR monitoring scouts should be employed and those turbines which are producing operational noise that have area of effect reaching the NARW location should be shut down temporarily upon NARW detection until they are out of the area effected.

DEVELOP AND UTILIZE METHODS OF REMOTELY ASSESSING NARW HEALTH

Because there are only 79 breeding females left, waiting for the collection of direct evidence of reduction in survival or reproduction from OSW activity to change OSW planning, approvals, and operation may be too late to avoid the harm that causes an extinction event to become inevitable, ways to remotely

[39] [H. Marsh, D.F. Sinclair. Correcting for visibility bias in strip transect aerial surveys of aquatic fauna J. Wildl. Manag. (1989), pp. 1017-1024; Also see D. Palka. Effects of Beaufort sea state on the sightability of harbour porpoises in the Gulf of Maine Report of the International Whaling Commission, 46 (1996), pg. 575-582].

assess NARW health need to be utilized and included in the repertoire of tools that are used to determine the impact of OSW activity on them.

[Investigating the thermal physiology of Critically Endangered North Atlantic right whales Eubalaena glacialis via aerial infrared thermography. Lonati, Zitterbart, Miller, Corkeron, Murphy, Moore. July 2022 Endangered Species Research 48:139-154. https://www.int-res.com/articles/esr2022/48/n048p139.pdf; *Also see* Hunt, K. E., Moore, M. J., Rolland, R. M., Kellar, N. M., Hall, A. J., Kershaw, J., et al. (2013). Overcoming the challenges of studying conservation physiology in large whales: a review of available methods. Conserv. Physiol. 1, cot006. doi: 10.1093/conphys/cot006]

LIMIT VESSEL SPEED TO TEN NAUTICAL MILES PER HOUR AS CONDITION OF ANY OCS LEASE

As condition of lease, BOEM should limit speed of vessels during site surveys/characterization, during construction, and during operation to 10 Nautical Miles per hour to mitigate deaths and serious injury caused by ship strike. The severity of injuries from ship collisions with large marine animals often depends on the size and speed of the vessel, with the probability of death or serious injury increasing as vessel speed increases. Impact forces increase with speed, as does the probability of a strike at a given distance. The probability of death or serious injury increases rapidly with increasing vessel speed. Specifically, the probability of serious injury or death increased from 45 to 75 percent as vessel speed increased from 10 to 14 nautical mile per hour (kts), and exceeded ninety percent at 17 kts. [See e.g., Conn, P. B., and G. K. Silber. 2013. Vessel speed restrictions reduce risk of collision-related mortality for North Atlantic right whales. Ecosphere 4(4):43. http://dx.doi.org/10.1890/ES13-00004.1]. Though NOAA-imposed speed limits are in effect seasonally in prescribed "seasonal management areas", or "SMAs" designed to correspond with the timing and locations of right whale migration, feeding, and nursery activities where they co-occur with high vessel traffic densities, the above research by Conn et al. shows that a speed limit of 10 knots has demonstrated benefit *outside the November through April window during which the NOAA regulation is in effect*. BOEM has the

regulatory authority and responsibility to protect ocean resources while and may impose a speed limit as condition of lease. Development of even one OCS lease area into an operational wind turbine power plant will represent a marked increase in vessel traffic. The North Atlantic right whale (*Eubalaena glacialis*) is particularly vulnerable to vessel strikes. To mitigate the probability of serious injury or death by ship strike, a 10 nautical mile per hour speed limitation should be placed on vessels conducting surveying activities in the bight, as well as on any vessels engaged in construction or operation of a wind-energy power plant on the lease site. Limiting, as condition of lease, vessel speed to 10 kts for vessels engaged in surveying activities or research for ocean energy development, and construction and operations of the plants, would reduce ship strikes deaths of large marine mammals by as much as thirty percent.

BOEM SHOULD PUBLISH DRAFT ENVIRONMENTAL REVIEWS THAT MAKE TRANSPARENT HOW MANY WHALES AND OTHER MARINE MAMMALS ARE EXPECTED TO DIE AND BE HARMED AS A RESULT OF THE PROPOSED ACTIVITIES

Many of the Draft EAs (Environmental Assessments) for specific OCS activity in specific lease areas do not actually state how many whales are expected to be harmed by the proposed activities, and instead refer to the Atlantic PEIS G&G which is for wind area characterization for areas from Florida to Delaware, and indicate effects are “similar”. That report, for example, indicated B-Level harm is expected to come to 4.17 million Bottlenose Dolphins, or roughly 600,000 Bottlenose per year on average, as a result of the proposed activities. But there is no ready way for the reader to translate that into how many Dolphins of this species will be harmed in the specific activity proposed for review whose draft they are reading.

Except for endangered species, this does not have to be detailed by species, but the Draft EAs and EISs should not leave it to the reader to sift through scores of tables and sum up numbers. Rather, it is incumbent on the Bureau to

at least provide a “thumbnail sketch” of the impact of the proposed action, not just qualitative descriptions of effects. E.g. the Equinor request to harm mammals in the G&G included the request for authorization to harm 181 whales (request to incidentally harm 165 whales during lease site exploration and another 16 whales in cable studies). Assuming equal density per square area, multiplying this by 8 to represent an area equivalent to the larger area of the exploration of the NY Bight lease sales proposed in 2021, yields that 1,448 whales are expected to be harmed as the result of the proposed action in the NY-NJ Bight alone.

For transparency to the public, mention of the estimated expected quantity of marine mammals harmed and the estimated expected quantity of marine mammals killed must be included in the Environmental Assessment or Environmental Impact Statement for: each new ocean area lease sale, each SAP, and each construction project. Such mention should be in easy-to-understand language that is plainly understandable to the public.

For example, "46,352 seals are expected to be harmed and 26,000 dolphins are expected to be harmed by the proposed site and cable route exploration activities. 1,448 whales are expected to be harmed by the proposed activities, which is expected to include 9 endangered individual whales."

CHANGES TO CRITICAL HABITAT AREAS

Designation of critical habitat areas, and concomitant vessel routing modifications, and other modifications to ocean resource management in response to such designation—are built upon the notion that whales will visit the same foraging grounds at the same times each year [Vanderlaan, A.S.M., R.K. Smedbol, and C.T. Taggart. 2011. Fishing-gear threat to right whales (Eubalaena glacalis) in Canadian waters and the risk of lethal entanglement. Canadian J. Fisheries and Aquatic Sci. 68(12):2,174-2,193 https://doi.org/10.1139/f2011-124]. A disruption to this regularity, as a consequence of rapid oceanographic changes, has exposed whales to increased risks as they have ranged beyond their regulation-protected areas, prompting new survey effort and risk-reduction measures. [e.g., Davies, K.T., and S.W. Brillant. 2019. Mass human caused mortality spurs federal action to protect endangered North Atlantic right whales in Canada. Marine Policy 104:157–162, https://doi.org/10.1016/ j.marpol.2019.02.019.]. One approach to

making management more dynamic is forecasting at subannual using dynamic species distribution models informed by distributions of their prey. *For example,* Pendleton et al. [40] predicted, based on distribution of *C. finmarchicus,* highly favorable *E. glacialis* foraging habitat south of Nantucket, which was at that time outside of the known foraging areas. This region was subsequently found to be a foraging hotspot [Leiter, S.M., K.M. Stone, J.L. Thompson, C.M. Accardo, B.C. Wikgren, M.A. Zani, T.V.N. Cole, R.D. Kenney, C.A. Mayo, and S.D. Kraus. 2017. North Atlantic right whale Eubalaena glacialis occurrence in offshore wind energy areas near Massachusetts and Rhode Island, USA. Endangered Species Research 34:45–59, https://doi.org/10.3354/ esr00827.]. This demonstrates the potential value of oceanographic forecasts as early warning systems and as adaptation tools in a more rapidly changing environment.

PACE OF U.S. OFFSHORE WIND DEVELOPMENT

BOEM and NOAA have indicated that the Draft Strategy provides ways of implementing the goal of "protecting biodiversity and promoting ocean co-use" and that the vision is to "promote the recovery of North Atlantic right whales while responsibly developing offshore wind energy."

The big question is what will happen when there are a lot of turbines installed on the outer continental shelf and will it affect the migratory behavior of these animals in a way that adversely impacts them? Given the precarious situation of NARW's remaining population, if this question cannot be answered aforehand, the planned rapid rate of Offshore development is not designed to facilitate ocean shelf "co-use" by OSW and NARW.

BOEM and NOAA opted not to publish a draft of a proposed policy for protection of the NARW to avoid and minimize harmful effects of Offshore Wind construction and operation, which, after public comment and feedback and revision, could have been binding in that the responsibilities outlined within would be required to be undertaken. Instead BOEM and NOAA opted

[40] Pendleton, D.E., P.J. Sullivan, M.W. Brown, T.V. Cole, C.P. Good, C.A. Mayo, B.C. Monger, S. Phillips, N.R. Record, and A.J. Pershing. 2012. Weekly predictions of North Atlantic right whale Eubalaena glacialis habitat reveal influence of prey abundance and seasonality of habitat preferences. Endangered Species Research 18(2):147–161, https://doi.org/10.3354/esr00433.

to publish a document which does not make its policy clear, but "rather, ... recognizes efforts to date and identifies areas where [the agencies] will work together alongside our industry partners in an effort to focus on the information...needed..." et cetera. That BOEM and NOAA included a disclaimer that the strategy document is not a policy document (p.2 Draft Strategy) also means that the execution of the strategy, even once finalized, is not binding or required to be executed.

The progress in development of Offshore Wind is underway. There are only approximately 79 NARW females left that have the potential to bear calves. This species' survival on this planet depends on the certain and resolute implementation of effective strategies. The undersigned greatly appreciate all the work that has been done to date. We hope BOEM and NOAA, given our input and the input of others, and with the knowledge gained from all the research completed to date, will promptly create and effect policy that requires the lessons learned to actually be implemented to prevent Offshore Wind Development from causing or contributing to an extinction event of this magnificent animal.

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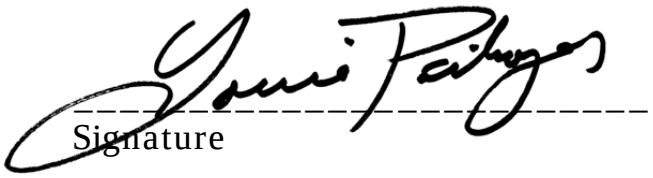

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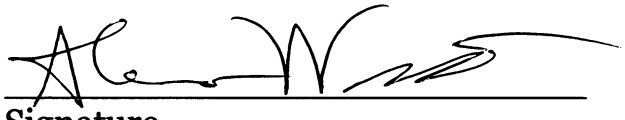

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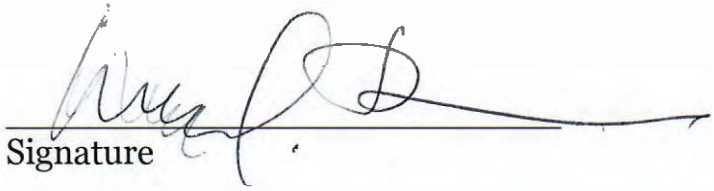

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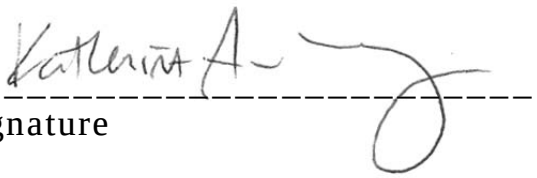

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