Center for Biological Diversity – Coastal Conservation League – Earthjustice – Environment North Carolina – Natural Resources Defense Council – North Carolina League of Conservation Voters – North Carolina Coastal Federation – North Carolina Conservation Network – Ocean Conservation Research – Oceana – One Hundred Miles – South Carolina Wildlife Federation – Southern Environmental Law Center

August 28, 2015

Jolie Harrison
Chief, Permits and Conservation Division
Office of Protected Resources
National Marine Fisheries Service
1315 East-West Highway
Silver Spring, MD 20910
ITP.Laws@noaa.gov

RE: *Notice of Receipt of Applications for Incidental Harassment Authorization ("IHA") for Geophysical Surveys in the Atlantic Ocean, 80 Fed. Reg. 45,195 (July 29, 2015)*

Dear Ms. Harrison:

On behalf of the Center for Biological Diversity, Earthjustice, Natural Resources Defense Council, Oceana, Ocean Conservation Research, Southern Environmental Law Center, and our Coalition partners, we welcome the opportunity to comment on the Notice of Receipt of Applications for Incidental Harassment Authorizations ("IHA") for geophysical surveys in the Atlantic Ocean, specifically on the "[b]est available scientific information and appropriate use of such information in assessing potential effects of the specified activities on marine mammals and their habitat; [a]pplication approaches to estimating acoustic exposure and take of marine mammals; [and] [a]ppropriate mitigation measures and monitoring requirements for these activities."[1]

As you are aware, our organizations are profoundly concerned about the harm to marine mammals, including critically endangered North Atlantic right whales (*Eubalaena glacialis*) ("right whales"), from these proposed high-energy seismic surveys in the Atlantic Ocean. These extensive activities will have serious impacts including from ship strikes and sound. The best available science demonstrates that airgun blasts disrupt baleen whale behavior and impair their communication on a vast scale; affect vital behavior in a wide range of other marine mammal species, also at great distances; and can undermine fundamental behaviors in fish and other marine mammal prey species. Given the scales involved, surveys taking place off the coast of Virginia could well affect endangered species off southern New England down through the Carolinas, impacting the entire migratory range of the endangered right whale. And the degree of activity proposed by the pending applications is enormous. Collectively, three of the applicants (Spectrum Geo ("Spectrum"), TGS-NOPEC ("TGS"), and ION GeoVentures ("ION")) have proposed to run very high-powered seismic airgun arrays over more than 93,000 miles of trackline over the next year alone, with as many as five seismic vessels operating at any one

[1] 80 Fed. Reg. at 45,195.

time. The Bureau of Ocean Energy Management ("the Bureau") anticipates that hundreds of thousands of miles of survey lines will be run over the next several years. It is no exaggeration to say that the proposed activity, beginning with the four applications pending here, will significantly degrade the acoustic environment of the Atlantic region.

For these and other reasons, seventy-five leading marine scientists, including leading biologists and bioacousticians from Duke University, Cornell University, the New England Aquarium, and other respected institutions, submitted a letter to President Obama, in March, expressing concern that Atlantic seismic surveys could compromise the health and habitat of marine mammals and other species.[2] The scientists rejected the premise that the proposed surveys would have only a "negligible impact" on marine species and populations. On the contrary, they concluded that the activity is likely to have "significant, long-lasting and widespread impacts on the reproduction and survival of fish and marine mammal populations in the region."[3] "Opening the U.S. east coast to seismic airgun exploration," they wrote, "poses an unacceptable risk of serious harm to marine life at the species and population levels, the full extent of which will not be understood until long after the harm occurs."[4]

And yet, remarkably, none of the applications that the Fisheries Service has received addresses the large-scale biological impacts that the scientific community has identified. Among other faults, they fail to base their take estimates on best available science, ignoring the behavioral disruptions that have been documented at vastly greater distances than they analyze; they fail to adequately describe the cumulative impacts of their activities on marine mammal species and stock and their habitat; and they fail to adequately describe the availability of equipment, methods, and other means of effecting the least practicable adverse impact on marine mammals, as the agency's regulations require. Furthermore, they are inconsistent in their use of impact assessment models and methodologies, even while they propose using similar equipment in the same regions, affecting the same populations of animals. Surely these applications cannot be deemed adequate and complete, as the agency's regulations demand.

As an initial matter, we therefore urge the Fisheries Service to clarify that the applications are not adequate or complete for purposes of issuance of a proposed rule. To proceed otherwise would violate the agency's regulations; would effectively shift the burden of quantitative modeling and analysis to the agency, as it supplements what is missing from the applications; and would leave the Fisheries Service with insufficient time to consider these and other comments submitted by the public, including the interested scientific community, at the agency's request.[5] Indeed, the Fisheries Services aims to issue proposed IHAs in September 2015—

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[2] Letter from Christopher Clark et al. to President Barack Obama (Mar. 15, 2015), *available at* http://docs.nrdc.org/wildlife/files/wil_15030401a.pdf (emphasis added) (attached as Exhibit 1) [hereinafter Scientists' Letter].
[3] *Id.*
[4] *Id.*
[5] *See, e.g., Western Coal Traffic League v. United States*, 677 F.2d 915, 927 (D.C. Cir. 1982) ("An agency decision may not be reasoned if the agency ignores vital comments regarding relevant factors, rather than providing an adequate rebuttal."), *cert. denied* 459 U.S. 1086 (1982); *Home Box Office v. FCC*, 567 F.2d 9, 35 (D.C. Cir. 1977) ("The opportunity to comment is

[6]allowing at most a couple of weeks to read, incorporate, and modify its analyses on the basis of public comment. The agency should simply, and correctly, deem the applications inadequate and incomplete.

Where an activity could harass or injure marine mammals, the actor—here, the seismic surveying companies—must obtain an IHA from the Fisheries Service under Section 101 of the Marine Mammal Protection Act ("MMPA").[7] However, if the activity could seriously injure or kill a marine mammal, then the seismic surveying companies must obtain a Letter of Authorization ("LOA") and an IHA is not appropriate.[8] The information before the agency is already sufficient for the agency to determine that increased risk of ship strike and predation, and other direct and indirect effects resulting from these activities, have the potential to seriously injure or kill marine mammals. Accordingly, the applications must also be rejected because the regulations do not allow the agency to issue an IHA for such activities.

Even if the Fisheries Service were to consider these IHA applications, the Fisheries Service may issue an IHA only if the activity takes a "small number" of marine mammals and will have only a "negligible impact on the species or stock."[9] When issuing an IHA, the agency must use "the best scientific evidence available."[10] When authorizing take under the MMPA, the Fisheries Service must prescribe "methods" and "means of effecting the least practicable impact" on protected species and their habitat, as well as "requirements pertaining to the monitoring and reporting of such taking."[11] Complying with these requirements requires the agency to substantially revise the impact analysis presented in the pending applications, and to consider mitigation that matches the true scale of impact of the activities under review.

BACKGROUND

The Atlantic Ocean is a rich and important coastal environment that supports threatened and endangered species, marine mammals, commercial and recreational fisheries, and other recreational activities. The applicants' plans put this coastal environment at risk. This section briefly provides information about the MMPA and the potential harms of seismic airgun testing, from both acoustic and non-acoustic sources.

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meaningless unless the agency responds to significant points raised by the public."), *cert. denied*, 434 U.S. 829 (1977).

[6] Email from Craig Woolcott, Congressional Affairs Specialist, NOAA, to Congressional Offices, July 25, 2015 (attached as Exhibit 2).

[7] 16 U.S.C. § 1371.

[8] 50 C.F.R. § 216.106.

[9] 16 U.S.C. § 1371(a)(5).

[10] *Id.* § 1371(a)(3)(A).

[11] *Id.* § 1371(a)(5)(A)(ii), (D)(iv).

I. THE MARINE MAMMAL PROTECTION ACT.

The MMPA was adopted more than thirty years ago to ameliorate the consequences of human impacts on marine mammals. Its goal is to protect and promote the growth of marine mammal populations "to the greatest extent feasible commensurate with sound policies of resource management" and to "maintain the health and stability of the marine ecosystem."[12] A careful approach to management was necessary given the vulnerable status of many of these populations as well as the difficulty of measuring the impacts of human activities on marine mammals in the wild.[13] "[I]t seems elementary common sense," the House Committee on Merchant Marine and Fisheries observed in sending the bill to the floor, "that legislation should be adopted to require that we act conservatively—that no steps should be taken regarding these animals that might prove to be adverse or even irreversible in their effects until more is known. As far as could be done, we have endeavored to build such a conservative bias into the [MMPA]."[14]

The heart of the MMPA is its so-called "take" provision, a moratorium on the harassing, hunting, or killing of marine mammals.[15] Under the law, the Fisheries Service may grant exceptions to the take prohibition, provided it determines, among other things that such take would (a) take only small numbers of marine mammals and (b) have only a negligible impact on marine mammal species and stocks.[16] The "small numbers" and "negligible impact" determinations are legally separate and distinct requirements of the MMPA and may not be conflated.[17] Finally, in authorizing take under the MMPA, the Fisheries Service must prescribe "methods" and "means of effecting the least practicable impact" on protected species as well as "requirements pertaining to the monitoring and reporting of such taking."[18]

II. POTENTIAL HARMS FROM SEISMIC AIRGUN TESTING.

Sound is a fundamental element of the marine environment. Whales, fish, and other wildlife depend on it as a component of essential behaviors, such as breeding, feeding, navigating, and avoiding predators—in short, for their survival and reproduction. It is no exaggeration to say that the IHA applicants' proposed surveys would significantly degrade the acoustic environment of the Atlantic region. Additionally, the proposed surveys would increase the risk of serious injury or mortality from ship strikes and other direct and indirect effects resulting from the activity.

To survey for oil and gas, industry tows arrays of high-powered airguns behind ships, firing intense pulses of compressed air roughly every ten to twelve seconds, twenty-four hours per day, for days, weeks, or months on end. A large seismic airgun array can produce effective peak

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[12] *Id.* § 1361(6).
[13] *Id.* § 1361(l), (3).
[14] Report of the House Committee on Merchant Marines and Fisheries, *reprinted in* 1972 U.S. Code Cong. & Admin. News 4148.
[15] 16 U.S.C. § 1362(13).
[16] *Id.* § 1371(a)(5).
[17] *NRDC v. Evans*, 279 F.Supp.2d 1129, 1150–53 (N.D. Cal. 2003).
[18] 16 U.S.C. § 1371(a)(5)(A)(ii), (D)(vi).

sound pressures higher than those of virtually any other man-made source save explosives;[19] and although airguns sit vertically in the water column, their noise can propagate horizontally thousands of miles from any given survey,[20] making them significant contributors to low-frequency ambient noise in the ocean.

It is well established that the high-intensity pulses produced by airguns can cause a range of impacts on marine mammals, including broad habitat displacement, disruption of vital behaviors essential to foraging and breeding, loss of biological diversity, and, in some circumstances, injuries and mortalities. For example, scientists have shown that a single seismic survey can cause endangered fin and humpback whales to stop vocalizing—an essential behavior for breeding and foraging—and can cause baleen whales to abandon their habitat.[21] Sperm whale foraging success can decline significantly after exposure to airguns, with potentially serious long-term consequences.[22] Harbor porpoises are acutely sensitive to human sound sources and have been observed engaging in avoidance responses fifty miles from a seismic airgun array; harbor porpoises that remain closer to seismic arrays have been shown to suffer decrements in foraging success, even at relatively moderate levels of exposure.[23] Bowhead whales migrating through the Beaufort Sea have almost completely avoided areas where airguns were used and

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[19] Nat'l Research Council, *Ocean Noise and Marine Mammals* (2003). For a sample of some man-made noises in the ocean, see Emily Anthes, *When Fish Shout*, New Yorker, Nov. 10, 2014, http://www.newyorker.com/tech/elements/when-fish-shout.

[20] *See, e.g.*, S.L. Nieukirk et. al., *Low-Frequency Whale and Seismic Airgun Sounds Recorded in the Mid-Atlantic Ocean*, 115 J. Acoustical Soc'y *A.* 1832–43 (2004).

[21] *See*, e.g., Manuel Castellote et al., *Acoustic and Behavioral Changes by Fin Whales (*Balaenoptera physalus*) in Response to Shipping and Airgun Noise*, 147 Biological Conservation 115 (2012); S. Cerchio et al., *Seismic Surveys Negatively Affect Humpback Whale Singing Activity off Northern Angola*, 9 PLoS ONE e86464 (2014).C.W. Clark & G.C. Gagnon, *Considering the Temporal and Spatial Scales of Noise Exposures from Seismic Surveys on Baleen Whales* (IWC Sci. Comm. Doc. IWC/SC/58/E9) (2006); Correspondence from C.W. Clark to Michael Jasny, NRDC, (Apr. 2010); *see also* K. MacLeod. et al., *Abundance of Fin (Balaenoptera physalus) and Sei Whales (B. Borealis) Amid Oil Exploration and Development off Northwest Scotland*, 8 J. Cetacean Research & Mgmt. 247–54 (2006).

[22] P.J.O. Miller et al., *Using At-Sea Experiments to Study the Effects of Airguns on the Foraging Behavior of Sperm Whales in the Gulf of Mexico*, 56 Deep-Sea Research I 1168–81 (2009).

[23] *E.g.*, D.E. Bain & R. Williams, *Long-Range Effects of Airgun Noise on Marine Mammals: Responses as a Function of Received Sound Level and Distance* (IWC Sci. Comm. Doc. IWC/SC/58/E35) (2006); R.A. Kastelein et al., *Behavioral Avoidance Threshold Level of a Harbor Porpoise (Phocoena Phocoena) for a Continuous 50 kHz Pure Tone*, 123 J. Acoustical Soc'y Am. 1858–61 (2008); R.A. Kastelein, *The Influence of Acoustic Emissions for Underwater Data Transmission on the Behavior of Harbour Porpoises (Phocoena Phocoena) in a Floating Pen*, 59 Mar. Enviro. Res. 287–307 (2005); P.F. Olesiuk et al., *Effect of the Sound Generated by an Acoustic Harassment Device on the Relative Abundance and Distribution of Harbor Porpoises (Phocoena Phocoena) in Retreat Passage, British Columbia*, 18 Mar. Mamm. Sci. 843–62 (2002).

have had their vocalizations disrupted.[24] As discussed further below, the exposure levels implicated in all of these studies are lower—indeed orders of magnitude lower on a decibel scale—than the threshold used to evaluate airgun behavioral impacts in the IHA applications that are now before you for review.

Similarly, airgun noise can also mask the calls of vocalizing whales over vast distances, substantially compromising their ability to communicate, feed, find mates, and engage in other vital behavior.[25] The intermittency of airgun pulses hardly mitigates this effect since their acoustic energy spreads over time and can sound virtually continuous at distances from the array.[26] Indeed, the enormous scale of this acoustic footprint has been confirmed by studies in many regions of the globe, including the Arctic, the northeast Atlantic, Greenland, and Australia.[27] According to modeling from Cornell and NOAA, the highly endangered right whale is particularly vulnerable to masking effects from low-frequency sources given the acoustic and behavioral characteristics of its calls.[28] Repeated insult from airgun surveys, over months and seasons, would come on top of already urbanized levels of background noise and pose a threat to marine mammals at the population scale.

As discussed below, noise from the acoustic sources proposed by applicants can also injure and kill marine mammals, by causing injury close to the array or by inducing adverse secondary effects, such as increasing the risk of ship strike, stranding, or predation. Moreover, the Bureau and the Fisheries Service have recognized in each of their independent programmatic analyses,

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[24] G.W. Miller et al., *Whales*, *in Marine Mammal and Acoustical Monitoring of Western Geophysical's Open-Water Seismic Program in the Alaskan Beaufort Sea, 1998* (W.J. Richardson, ed.) (1999); W.J. Richardson et al., *Displacement of Migrating Bowhead Whales by Sounds from Seismic Surveys in Shallow Waters of the Beaufort Sea*, 106 *J. Acoustical Soc'y Am.* 2281 (1999).

[25] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10).

[26] *Id.*; Weilgart, L. (ed.), Report of the workshop on alternative technologies to seismic airgun surveys for oil and gas exploration and their potential for reducing impacts on marine mammals, 31 Aug. – 1 Sept., 2009, Monterey, Calif. (2010) (available at www.okeanos-stiftung.org/okeanos/download.php?id=19).

[27] S.L. Nieukirk et al., *Sounds from Airguns and Fin Whales Recorded in the Mid-Atlantic Ocean, 1999–2009*, 131 J. Acoustical Soc'y of America 1102 (2012); S.L. Nieukirk et al., *Low-frequency Whale and Seismic Airgun Sounds Recorded in the Mid-Atlantic Ocean*, 115 J. Acoustical Soc'y of America 1832 (2004); E.H. Roth et al., *Underwater Ambient Noise on the Chukchi Sea Continental Slope*, 131 J. Acoustical Soc'y of America 104 (2012); J. Gedamke, Ocean Basin Scale Loss of Whale Communication Space: Potential Impacts of a Distant Seismic Survey, Biennial Conference on the Biology of Marine Mammals, November–December 2011, Tampa, FL (abstract).

[28] Clark et al., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources; Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009).

the "potential risk that survey vessels could strike and injure or kill marine mammals."[29] For example, the Programmatic Biological Opinion recognizes that Atlantic seismic surveying activities could cause injuries and mortalities to marine mammals, including critically endangered right whales, through non-acoustic sources, such as ship strikes.[30] And right whales are particularly prone to ship strikes.[31] Even one right whale death caused by humans would have adverse population-level effects, jeopardizing the survival of the species. Current anthropogenic activities already cause more than one right whale death per year: From 2008 through 2012, a minimum of 4.75 right whales were killed each year, including 3.85 deaths from fishery entanglement and 0.9 deaths from ship strikes.[32]

The same high-intensity pulses can also adversely affect marine mammal prey species. For example, airguns can dramatically decrease fisheries catch rates of various commercial and recreational fish species (by 40–80%) over thousands of square kilometers around a single array, indicative of substantial horizontal or vertical displacement.[33] One study found higher fish populations outside a seismic shooting area, indicating a long-term effect of seismic activity displacing fish away from these sound sources.[34] Decreased catch rates have led fishers in British Columbia, Norway, Namibia, and other jurisdictions to seek compensation for their losses from the industry.[35] Other effects on fish, derived largely from tests on other low-

[29] BOEM, Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement, Vol. I, at 2-40 ("There is a potential risk that survey vessels could strike and injure or kill marine mammals."); *see also* Fisheries Service, Programmatic Geological and Geophysical Activities in the Mid- and South Atlantic Planning Areas from 2013 to 2020 at 158, 188 (2013), available at http://www.boem.gov/Final-Biological-Opinion-19-July-2013. ("When the vulnerability of right whales to ship strikes is combined with the density of ship traffic within the distribution of right whales, ship strikes seem almost inevitable."); *id.* at 272 ("We did not estimate the number of blue whales that might be exposed to vessel traffic independent of the number of individuals that might be exposed to seismic and HRG surveys because the data we would have needed to support those analyses were not available."); *id.* at 275 (same for fin whales); *id.* at 277 (same for humpback whales); *id.* at 280 (same for North Atlantic right whales); *id.* at 283 (same for sei whales).
[30] Fisheries Service, *supra* note 28 at 158, 188 (2013), available at http://www.boem.gov/Final-Biological-Opinion-19-July-2013.
[31] Fisheries Service, *Recovery Plan for the North Atlantic Right Whale* IG-1 (August 2004).
[32] Waring et al., 2014 Draft Marine Mammal Stock Assessment Reports (2014), available at http://www.nmfs.noaa.gov/pr/sars/pdf/atl2014_draft.pdf.
[33] A. Engås et al., *Effects of Seismic Shooting on Local Abundance and Catch Rates of Cod (Gadus Morhua) and Haddock (Melanogrammus Aeglefinus)*, 53 Canadian J. Fisheries &Aquatic Sciences 2238–49 (1996); *see also* J.R. Skalski et al., *Effects of Sounds from a Geophysical Survey Device on Catch-per-Unit-Effort in a Hook-and-Line Fishery for Rockfish (Sebastes Ssp.)*, 49 Canadian J. Fisheries & Aquatic Sciences 1357–65 (1992).
[34] A. Slotte et al., *Acoustic Mapping of Pelagic Fish Distribution and Abundance in Relation to a Seismic Shooting Area off the Norwegian West Coast*.67 Fisheries Research 143–50 (2004).
[35] *See, e.g.,* British Columbia Seafood Alliance, *Fisheries and Offshore Seismic Operations: Interaction, Laison, and Mitigation: The East Coast Experience* (2004), *available at*

frequency noise sources, include habitat abandonment, chronic stress, reduced reproductive performance, and hearing loss.[36]

DISCUSSION AND RECOMMENDATIONS

I. AS A THRESHOLD MATTER, THESE IHA APPLICATIONS SHOULD BE REJECTED BECAUSE THEY ARE INSUFFICIENT, AND IF THE FISHERIES SERVICE CONSIDERS THESE APPLICATIONS MORE TIME IS NEEDED FOR REVIEW.

A. The IHA Applications Should Be Rejected Because They Do Not Contain Sufficient Information For Evaluation.

For the many reasons described in these comments, the applications now under review are inadequate and incomplete. They fail, for example, to base their take estimate on best available science; fail to adequately describe the impact of the activity on marine mammal species and stock and their habitat; and fail to adequately describe the availability of equipment, methods, and other means of effecting the least practicable adverse impact on marine mammals, as the agency's regulations require. What is more, they are inconsistent in their use of models and methodologies, even while they propose using similar equipment in the same regions, affecting the same populations of animals. Proceeding would violate the agency's regulations; would effectively shift the burden of quantitative modeling and analysis to the agency, as it supplements what is missing from the applications; and would leave the Fisheries Service with plainly insufficient time to consider these and other comments submitted by the public, including the interested scientific community, at the agency's request.[37] Until the applicants have corrected these deficiencies, the Fisheries Service should deem the four pending applications inadequate and incomplete for purposes of further review.

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http://www.bcseafoodalliance.com/documents/Canpitt.pdf; Anonymous, Key issues and possible impacts of seismic activities on tunas, for the Large Pelagic and Hake Longlining Association in Namibia, presentation given at the Benguela Current Commission 5th Annual Science Forum, Sept. 24, 2013 (2013) (provided to NRDC by the Namibian Ministry of Fisheries and Marine Resources)

[36] R.D. McCauley et al., *Marine Seismic Surveys: Analysis and Propagation of Air-Gun Signals, and Effects of Air-Gun Exposure on Humpback Whales, Sea Turtles, Fishes, and Squid* (2000); R. McCauley et al., *High Intensity Anthropogenic Sound Damages Fish Ears*, 113 J. Acoustical Soc'y America 638–42 (2003); A.R. Scholik et al., *Effects of Boat Engine Noise on the Auditory Sensitivity of the Fathead Minnow, Pimephales promelas*, 63 Envt. Biology Fishes 203–09 (2002).

[37] *See, e.g.*, *Western Coal Traffic League v. United States*, 677 F.2d 915, 927 (D.C. Cir. 1982) ("An agency decision may not be reasoned if the agency ignores vital comments regarding relevant factors, rather than providing an adequate rebuttal."), *cert. denied* 459 U.S. 1086 (1982); *Home Box Office v. FCC*, 567 F.2d 9, 35 (D.C. Cir. 1977) ("The opportunity to comment is meaningless unless the agency responds to significant points raised by the public."), *cert. denied*, 434 U.S. 829 (1977).

B. The IHA Applications Should Be Rejected And LOA Applications Should Be Required.

Under the MMPA, the Fisheries Service may issue an IHA only if a proposed activity takes a "small number" of marine mammals and will have only a "negligible impact on the species or stock."[38] However, if a proposed activity could cause serious injuries or deaths to marine mammals, then the Fisheries Service must require a letter of authorization ("LOA") based on rule-making.[39] Given the risks of serious injury or mortality from direct and indirect effects of the proposed activities, including by the TDI-Brooks high-resolution survey, as described below, the Fisheries Service should carefully consider whether the proposed activities could cause marine mammal serious injuries or deaths. If an activity has the potential to seriously injure or kill marine mammals, then the seismic surveying companies must obtain a LOA.[40]

Seismic survey vessels moving to and from their surveying areas, and potentially during surveying, may strike, injure, and/or kill marine mammals. The agency's Programmatic Biological Opinion recognizes the potential for survey boats to strike whales, including critically endangered right whales: "When the vulnerability of right whales to ship strikes is combined with the density of ship traffic within the distribution of right whales, ship strikes seem almost inevitable."[41] Additionally, airguns have the potential to displace marine mammals into areas where they stand a higher risk of ship-strike or predation; or to cause stranding (as the echosounder system proposed by TDI-Brooks is likely to have done off Madagascar, *see infra* under "Mitigation"); or to induce other behavioral effects that compromise an animal's survival. For example, airgun noise could disrupt or mask the low-amplitude contact calls that right whale mother-calf pairs use during the mother's foraging dives, leading potentially to separation. Accordingly, the applications must also be rejected because the MMPA does not allow the agency to issue an IHA for such activities.

C. More Time Should Be Granted For Review

The Fisheries Service's aims to review the and publish proposed IHAs in September 2015,[42] allowing at most a couple of weeks to read, incorporate, and modify its analyses on the basis of public comment. The agency must ensure sufficient time to incorporate these comments into its analyses for the draft IHAs for these activities. The Administrative Procedure Act ("APA") requires an agency to "give interested persons an opportunity to participate in [a] rule making through submission of written data, views, or arguments with or without opportunity for oral

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[38] 16 U.S.C. § 1371(a)(5).
[39] 50 C.F.R. § 216.106.
[40] 50 C.F.R. § 216.106. Because the activity could seriously harm or kill marine mammals, through ship strikes or entanglement, the Fisheries Service should consider requiring the companies to obtain LOAs instead of IHAs.
[41] Fisheries Service, *supra* note 41, at 158.
[42] Email from Craig Woolcott, Congressional Affairs Specialist, NOAA, to Congressional Offices, July 25, 2015 (attached as Exhibit 2).

presentation."[43] "After *consideration* of the relevant matter presented, the agency shall incorporate in the rules adopted a concise general statement of their basis and purpose."[44] Thus, the Fisheries Service must give the public the opportunity to comment, and the agency must consider the public's comments.[45] We urge the agency to take the time it needs to consider fully these comments and its analyses before issuing draft IHAs for these applications.

II. BEST AVAILABLE SCIENTIFIC INFORMATION AND APPROPRIATE USE OF SUCH INFORMATION.

Under separate cover, we have submitted documents that we believe represent best available scientific information on the impacts of seismic airguns, and other relevant acoustic sources, on marine mammals and marine mammal prey species, including those cited in this letter.[46] These documents are not intended to be comprehensive. Nonetheless, they represent a considerable body of evidence establishing the nature and magnitude of harms that can be caused by seismic airguns. We request that the Fisheries Service carefully consider these documents and take all of this evidence into account when reviewing the pending IHA applications. Any failure to do so would be arbitrary and capricious.

III. MODELING AND ANALYZING TAKES OF MARINE MAMMALS.

To ensure compliance with the MMPA, the Fisheries Service must carefully consider the potential takes of marine mammals before issuing a draft IHA. The issues listed here are essential to an accurate assessment of impacts from the proposed activities:

- Propagation Modeling
- Density Modeling

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[43] 5 U.S.C. § 553(c).
[44] *Id.*
[45] *See, e.g., Western Coal Traffic League v. United States*, 677 F.2d 915, 927 (D.C. Cir. 1982) ("An agency decision may not be reasoned if the agency ignores vital comments regarding relevant factors, rather than providing an adequate rebuttal."), *cert. denied* 459 U.S. 1086 (1982); *Home Box Office v. FCC*, 567 F.2d 9, 35 (D.C. Cir. 1977) ("The opportunity to comment is meaningless unless the agency responds to significant points raised by the public."), *cert. denied,* 434 U.S. 829 (1977); *Lloyd Noland Hospital & Clinic v. Heckler*, 619 F. Supp. 1, 7 (N.D. Ala. 1984) ("This statute requires the agency to consider relevant comments and then incorporate a 'concise general statement' of the rule's 'basis and purpose.' The courts have interpreted this 'basis and purpose' requirement to mean that the agency must address, and if necessary rebut, significant comments made regarding a proposed rule.").
[46] The documents cited in Exhibit 3, except for (*Nowacek et al.*, 2015), which is was then not yet published, were compiled on a thumb drive and were delivered by mail to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. (*Nowacek et al.,* 2015) was submitted separately.

- Behavioral Take Thresholds
- Auditory Thresholds
- Take Analysis for Other Acoustic Sources
- Masking Effects
- Impact Analysis for Right Whales
- Cumulative Impacts
- Serious Injuries and Mortalities, and
- Use of the Same Models for All Four IHA Applications.

A. Propagation Modeling

Sound propagation and noise attenuation in the ocean is a complex topic. In lieu of comprehensive regional and temporal sound propagation models, the Fisheries Service is likely to rely on some simple assumptions. Unfortunately, the assumptions made in the PEIS and applications fail to capture the spatial and temporal extent of airgun noise propagation and do not represent best available science.

First, the Fisheries Service, in modeling propagation loss, cannot assume that sound from the applicants' acoustic sources will spread spherically across the entire sound field. The PEIS and applicants assume that sound will indeed propagate spherically, i.e., in a hemispherical pattern away from the source as it would in an unbounded medium. Accordingly, they determine propagation loss by using the simple formula of $20\log_{10}(r1/r2)$, where $r1$ is the reference distance (usually 1 meter) and $r2$ is the subject distance for evaluation. But this simplistic model falls far short of capturing even the basic propagation characteristics found in the sea, which presents at least five distinct propagation characteristics: Sagittal relative to the first incident wave, surface ducting, variable propagation in the mixed layer, cylindrical propagation in the SOFAR (Sound Fixing and Ranging) channel, and planar propagation along the seafloor.

For example, once the acoustical energy hits a boundary such as a thermocline or the seafloor, acoustic energy tends to spread in a cylindrical pattern wherein the attenuation formula is a more gradual $10\log_{10}(r1/r2)$. In fact, there is some continuum between these attenuation conditions, so depending on the distance between the receiver and the source the attenuation formula may be closer to 17 dB to 13 dB as the sound spreads outwards. Additionally, noise may be concentrated within the water column through surface ducting, a secondary transmission path in the top boundary of the ―mixed layer above the marine thermocline. Although the propagation in this transmission path is dependent on the wavelength of the source, the angle of incidence, the depth of the mixed layer, and the surface conditions, the attenuation characteristics within a surface duct are more consistent with the cylindrical model of $10\log_{10}r$.[47]

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[47] Urick, R. J. 1983. *Principles of Underwater Sound*. (3rd Edition). McGraw-Hill Book Company, New York, NY. Chapter 6, https://www.dropbox.com/sh/62mv7w7w2m0xch8/AABNP5EHtvLTcZNX7XbmSlwIa/Urick%20-%20Sound%20Propagation%20in%20the%20Sea.pdf?dl=0.

Additionally low-frequency propagation along the seabed can spread in a planar manner where attenuation over distance is even less than the cylindrical propagation model and, depending on benthic profile and composition, can propagate with significantly greater efficiently than cylindrical propagation would indicate.[48]

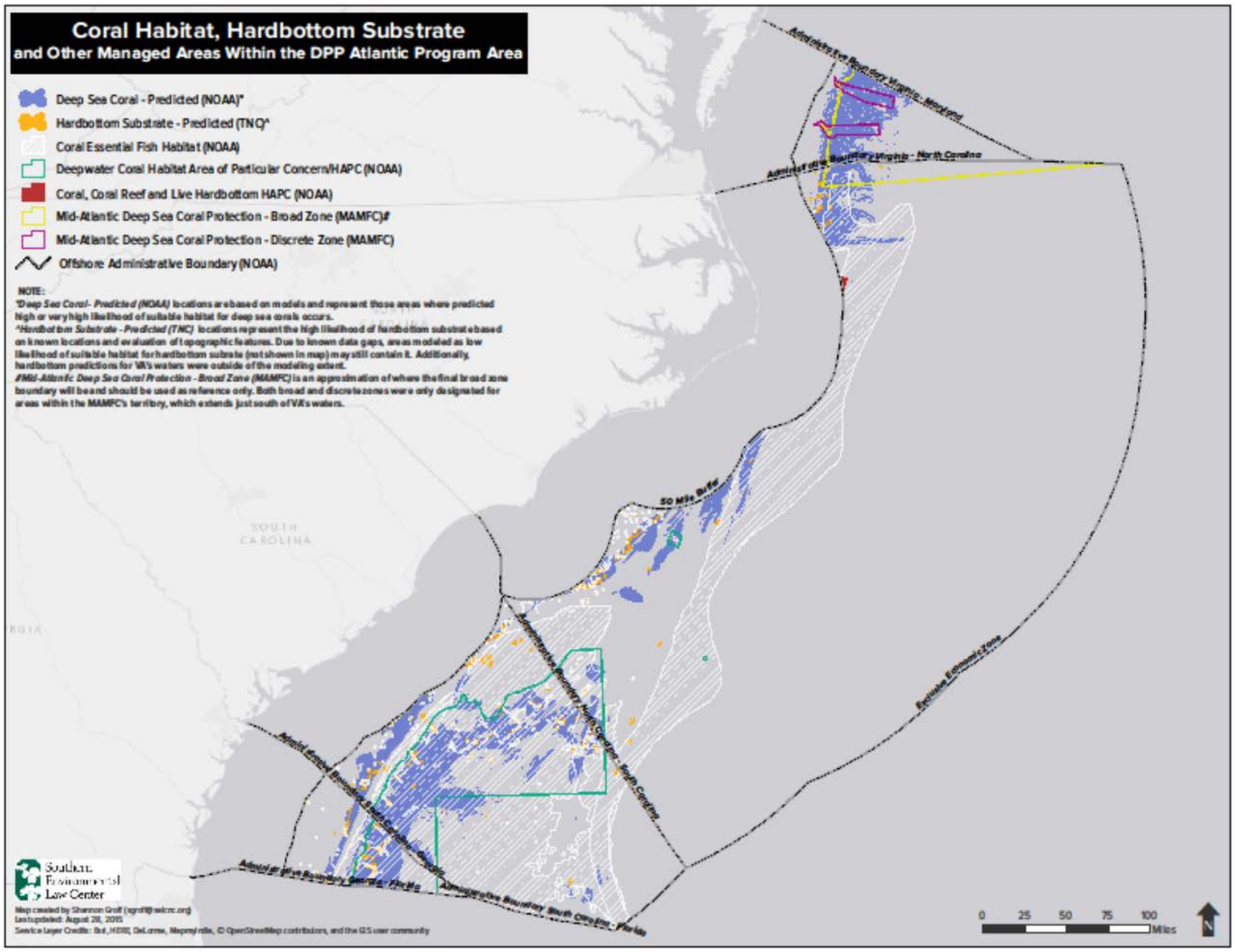
The choice of spreading formula can have significant consequences for the Fisheries Service's take estimation, as can be seen from a simple propagation analysis. Transmission in the surface duct, along with the far-field cylindrical propagation highlights concerns in the far field pertaining to both required "exclusion zones" and the efficacy of marine mammal observers (MMO). In these conditions a large airgun array with a source level of 229 dB re:1µPa @ 1m[49] would require 13km to attenuate to 180dB re:1µPa exposure level.

$$229\text{dB} - 180\text{dB} = 41\text{dB} \rightarrow 10\log_{10}(1/13000) = -41\text{dB}$$

Or 1425 meters would be required given spherical to cylindrical spreading in the near-field mixed layer:

$$229\text{dB} - 180\text{dB} = 41\text{dB} \rightarrow 13\log10\ (1/1425) = -41\text{dB}$$

[48] Ralph A. Stephen, et.al. *Deep seafloor arrivals in long range ocean acoustic propagation* (2013) J. Acoust. Soc. Am. 134, 3307; http://dx.doi.org/10.1121/1.4818845
[49] 229 dB was derived from a typical Seismic Array source level of 235 dB –6dB to accommodate for directionality of the array. All of the source levels cited in the IHAs are higher than 235db so this model is very conservative.


Coral Habitat, Hardbottom Substrate
and Other Managed Areas Within the DPP Atlantic Program Area
Deep Sea Coral - Predicted (NOAA)*
Hardbottom Substrate - Predicted (TNC)^
Coral Essential Fish Habitat (NOAA)
Deepwater Coral Habitat Area of Particular Concern/HAPC (NOAA)
Coral, Coral Reef and Live Hardbottom HAPC (NOAA)
Mid-Atlantic Deep Sea Coral Protection - Broad Zone (MAMFC)#
Mid-Atlantic Deep Sea Coral Protection - Discrete Zone (MAMFC)
Offshore Administrative Boundary (NOAA)
NOTE:
*Deep Sea Coral - Predicted (NOAA) locations are based on models and represent those areas where predicted high or very high likelihood of suitable habitat for deep sea corals occurs.
^Hardbottom Substrate - Predicted (TNC) locations represent the high likelihood of hardbottom substrate based on known locations and evaluation of topographic features. Due to known data gaps, areas modeled as low likelihood of suitable habitat for hardbottom subrate (not shown in map) may still contain it. Additionally, hardbottom predictions for VA's waters were outside of the modeling extent.
#Mid-Atlantic Deep Sea Coral Protection - Broad Zone (MAMFC) is an approximation of where the final broad zone boundary will be and should be used as reference only. Both broad and discrete zones were only designated for areas within the MAMFC's territory, which extends just south of VA's waters.
50 Mile Buffer
SOUTH CAROLINA
Southern Environmental Law Center
0 25 50 75 100 Miles

Observer effectiveness over these ranges is not just impractical, it is improbable, especially in the low-visibility conditions in which the seismic vessels would often operate. It is clear that, in most situations, a large capacity survey cannot avoid subjecting marine mammals to Level A harassment exposures from either the surface ducting or the cylindrical propagation of acoustical energy, or from spherical to cylindrical spreading in the mixed layer.

Second, the Fisheries Service must not assume, as do at least some of the present applications (see TGS application at 7), that the proposed surveys will take place entirely in areas with soft or sandy bottoms. On the contrary, recent modeling of offshore areas by NOAA indicates a high likelihood of coral bottom habitat through a substantial portion of the proposed survey area, particularly along the shelf break and upper continental slope—areas that would be subject, in two of the proposed surveys, to higher densities of track-lines. (See Fig. 1, which shows NOAA-modeled coral bottom habitat within the Bureau's Draft Proposed Program, beginning 50 miles from shore.) As you know, hard bottom compositions, including coral bottoms, can significantly increase propagation of airgun noise, as a recent comparison between modeled sound exposure levels in soft- and hard-bottom areas off Central California illustrates.[50] The Fisheries Service, in preparing its take analysis, cannot assume that the proposed surveys will take place entirely in soft-bottom habitat, but conservatively must take the likely occurrence of coral bottom into account.

Third, the Fisheries Service must not assume that the noise received from each firing of a high-energy seismic array is a single pulse. Considering only reflected sound off the sea bottom and the direct noise from the hemispherical propagation, the receiver is hit with at least three distinct wave fronts: sagittal, surface-reflected, and bottom-reflected. All three transmission paths having different geometrical lengths as well as different transmission speeds due to temperature, pressure, and salinity factors. These three paths must be integrated into the Sound Exposure Level ("SEL") metric in the near-to-intermediate field.

Additionally, it is well established that, due to multipath transmission and reverberation effects, airgun pulses tend to elevate ambient noise in the far field across much or the entire inter-pulse interval.[51] Because the noise would effectively be continuous over most of the sound field, take

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[50] J. Wood et al., PG&E Offshore 3-D Seismic Survey Project EIR: Marine Mammal Technical Report, Appendix H, Central Coastal California Seismic Imaging Project Final Environmental Report (2012) (CSLC EIR No. 758).

[51] Guerra, M., Thode, A.M., Blackwell, S.B., Macrander, A.M. (2011) *Quantifying seismic survey reverberation off the Alaskan North Slope.*, J. Acoustical Society of America 130:5 3046-3058. Nieukirk, S.L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P., Goslin, J. (2012) *Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean*, 1999-2009, J. Acoustical Society of America 131:1102- 1112. Nieukirk, S.L., Stafford, K.M., Mellinger, D.K., Dziak, R.P., and Fox, C.G.(2004) *Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean* J. Acoustical Society of America 115: 1832-1843. Roth, E.H., Hildebrand, J.A., Wiggins, S.M., and Ross, D. (2012). *Underwater ambient noise on the Chukchi Sea continental slope* J. Acoustical Society of America 131:104-110

estimates (and mitigation) should be based on NMFS' Level B threshold of 120 dB (SPL) for "continuous noise" rather than its 160 dB (SPL) threshold for impulsive noise, assuming (against our recommendation) that the agency continues to rely on these outdated metrics to estimate take. Use of the 120 dB threshold is particularly appropriate, as opposed to the 160 dB threshold, since the surveys will likely be occurring around the clock.

The Fisheries Service should take all of these factors into account when modeling sound propagation for any draft IHAs.

B. Density Modeling

The use of reliable density estimates of marine mammals is essential to the Fisheries Service's impact analysis. To comply with the MMPA's mandate to use the "best scientific evidence available," the Fisheries Service should use the model produced by the Cetacean Density and Distribution Mapping program for the Atlantic ("CetMap"), since it contains the most comprehensive and up-to-date information.

At the direction of NOAA, Duke University scientists earlier this winter produced density maps for cetaceans off the east coast of the United States and in the Gulf of Mexico, which, in fulfillment of CetMap's objectives, are "time- and species-specific, using survey data and models that estimate density using predictive environmental factors."[52] These maps are intended to replace earlier models, including the Navy Operating Area Density Estimates ("NODE") database and a habitat preference model produced previously by Duke. Indeed, the Bureau stated in Volume III of the PEIS that it "expects that the CetMap density data will be superior to the NODE database used for the calculations in the Programmatic EIS" and that it intended to use CetMap when available.[53]

Of the four IHA applicants, however, only TGS uses the CetMap model to estimate exposures of marine mammals to the noise produced by its proposed activities. Both the Spectrum and the ION applications incorporate marine mammal densities from the Navy's NODE estimates. This older model bases its density estimates on "the NMFS-Southeast Fisheries Science Center (SEFSC) shipboard surveys conducted between 1994 and 2006."[54] The density outputs from this database are four surface density plots for each season and each marine mammal species in the Western Atlantic Ocean.

But CetMap provides a more comprehensive and thorough estimate of marine mammal densities and distribution in the Atlantic than its predecessor models. First, the CetMap model incorporates nearly twice as many years of vessel survey data as NODE, covering the period 1992 to 2014, including, crucially, the last eight years that are considered by NOAA to be of greatest reliability.[55] Second, unlike NODE, CetMap supplements vessel survey data with aerial

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[52] BOEM, *supra* note 41, at 1-28.
[53] BOEM, *supra* note 45, at E-71.
[54] BOEM, *supra* note 45, at E-26.
[55] J. Moore & R. Merrick, eds., *Guidelines for Assessing Marine Mammal Stocks: Report of the GAMMS III Workshop, February 15-18, 2011, La Jolla, California* (2011) (NOAA Tech. Memo. NMFS-OPR-47).

survey data over the same time periods. Given that some species exhibit vessel avoidance, aerial surveys can be an essential means of detecting and estimating marine mammal densities.[56] Aerial surveys are also an important component of marine mammal surveying because they allow for coverage of greater areas then ship-based surveys. One applicant proposing to conduct seismic surveys in the Atlantic Ocean has already used CetMap in its take estimates, meaning the remaining companies have the ability to conduct updated take estimates using the best models available.

Therefore, the Fisheries Service should use CetMap to calculate marine mammal density and distribution.

C. Behavioral Take Thresholds

The Fisheries Service must use the "best scientific evidence available" and consider behavioral disturbances of marine mammals from sound sources below the existing thresholds.[57]

With the development of compact "Data Tags"[58] and the continued refinement of locational "passive acoustic monitoring," research scientists can now track animals over greater periods of time and across longer distances, allowing them to retrieve a continuous account of the tracked animal's response to a disruptive stimulus or document changes in the vocalizations of multiple animals over, in some cases, very large scales. With this expanded access to data, scientists are finding that behavioral disruptions are occurring at much lower noise exposure levels than what the Fisheries Service currently accepts as the threshold for Level B disturbances,[59] and at much larger distances than what on-board Marine Mammal Observers are capable of observing. These lower exposure levels and wider disturbance areas are particularly pertinent to the Atlantic Outer Continental Shelf plans because of the likelihood that multiple and concurrent seismic airgun surveys will disrupt larger proportions of marine mammal populations, and disrupt individual marine mammals more frequently, than what is assumed in the models presented in any of the IHA applications.[60]

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[56] Laird A. Henkel et al., *Comparison of Aerial and At-Sea Survey Methods for Estimating Abundance and Distribution Of Marbled Murrelets and Other Marine Birds and Mammals* (2006), *available at* http://www.car-spaw-rac.org/IMG/pdf/Comparison_of_aerial_and_at-sea_survey_methods_for_estimating_abundance_and_distribution_of_marbled_murrelets_and_other_marine_birds_and_mammals_Final_Report.pdf.
[57] *Id.* § 1371(a)(3)(A).
[58] Data tags or "DTAGS" are data logging devices that are attached to animals to record conditions such as depth, acoustical exposure, vector, temperature, and chemical conditions. Once fixed to a subject animal, DTAGS can intimately record the animal responses to environmental conditions such as noise exposure.
[59] $160dB_{RMS}$ re: 1µPa for behavioral disruption for impulsive noise (e.g., impact pile driving), $120dB_{RMS}$ re: 1µPa for behavioral disruption for non-pulse noise (e.g., vibratory pile driving, drilling).
[60] None of the IHA's under review includes the likelihood that surveys will be occurring simultaneously with other surveys. This perspective is solely under the purview of the Fisheries Service, which the agency must incorporate into the permit approval process. For inadequacy of

Recent research on disruption thresholds has demonstrated, for example, that:

- Bowhead whales (*Balaena mysticetus)* increase call rates at initial detection of airguns at 94 dB re: 1µPa,[61] then decrease after 127 dB, and stop calling above 160 dB.[62]
- Harbor porpoise buzz rates, a proxy for foraging success,[63] decrease 15% with exposure to seismic airguns at 130–165 dB.[64]
- Sperm whale buzz rates decrease by an average of 19% on exposure to airgun received levels above 130 dB.[65]
- Blue whale call rates increase with exposure to seismic "sparkers"[66] at 140 dB.[67]
- Fin whale call rates decrease and migratory disruption occurs when exposed to seismic airgun surveys at 175 to 285 km and noise levels below shipping noise.[68]
- Seismic survey activity disrupts the breeding display, or singing, of humpback whales across large areas of ocean.[69]
- Blue whales ceased calling on 143 dB exposure to airguns.[70]
- Fin whale and humpback whales stop vocalizing, and at least some are displaced, over an area of at least 100,000 square nautical miles near a seismic airgun source.[71]

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the propagation models, including more accurate models for concurrent surveys, and continuous "reverberant" noise in the far field, see Comment of Michael Stocker, OCS, to Gary D. Goeke, BOEM (April 30, 2014) (attached as Exhibit 4).

[61] All decibels (dB) herein are referenced to 1 µPa.

[62] S.B. Blackwell SB et al., *Effects of Airgun Sounds on Bowhead Whale Calling Rates: Evidence for Two Behavioral Thresholds*, 10 PLoS ONE e0125720 (2015).

[63] Odontocete biosonar is characterized by siting clicks. Once the prey is sited the predator hones in on the prey in what sounds like a "buzz"—indicating a capture, and thus sustenance.

[64] E. Pirotta et al., *Variation in Harbour Porpoise Activity in Response to Seismic Survey Noise*, 10 Biol. Lett. 20131090 (2014), *available at* http://dx.doi.org/10.1098/rsbl.2013.1090.

[65] P.J.O. Miller et al., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I* 56: 1168-1181 (2009).

[66] A "sparker" is an electro-dynamic seismic impulse source that generates a loud electrical spark across a gap producing a plasma or vapor bubble that collapses and generates a low-frequency impulse.

[67] Lucia Di Iorio & Christopher W. Clark, *Exposure to seismic survey alters blue whale acoustic communication*, Biol. Lett. 6, 51–54 (2010).

[68] Manuel Castellote et al., *Acoustic and Behavioral Changes by Fin Whales (*Balaenoptera physalus*) in Response to Shipping and Airgun Noise*, 147 Biological Conservation 115 (2012).

[69] S. Cerchio et al., *Seismic Surveys Negatively Affect Humpback Whale Singing Activity off Northern Angola*, 9 PLoS ONE e86464 (2014).

[70] Mark A. McDonald et al., *Blue and Fin Whales Observed on a Seafloor Array in the Northeast Pacific*, 98 J. Acoustical Soc'y of America, 1 (1995).

[71] C.W. Clark & G.C. Gagnon, *Considering the Temporal and Spatial Scales of Noise Exposures from Seismic Surveys on Baleen Whales* (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E9); C.W.

In short, the best available evidence shows that seismic airguns behaviorally affect baleen whales across a range of behavioral states; namely foraging, breeding, and migrating at received levels and distances that vastly exceed what the Fisheries Service's regulatory thresholds account for. But airguns have also been shown to affect foraging behavior in odontocetes, including in sperm whales and harbor porpoises, two very disparate odontocete species, at relatively low levels of exposure (above 130 dB).[72] Beaked whales, though never tested experimentally for their response to airgun noise, are known for their sensitivity to various types of anthropogenic sound, including to predominantly low-frequency sources such as vessels, and they alter or abandon their foraging and avoid sounds at levels of 140 dB and below.[73]

All of these disruptions indicate responses that would elevate metabolic stress,[74] cause displacement from areas of biological importance,[75] compromise interspecific communication, and interfere with foraging and other behaviors vital to overall health.

Currently, the lower threshold for Level B takes is 120 dB for continuous noises. However, in Blackwell et al. (2015),[76] calling rates of bowhead whales increased as soon as airgun pulses were detectable (with a cumulative sound exposure level, or $CSEL_{10min}$, of 94 dB re $1\mu Pa^2$-s),

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Clark, pers. comm. with M. Jasny, NRDC (Apr. 2010); *see also* K. MacLeod et al., *Abundance of Fin (*Balaenoptera physalus*) and Sei Whales (*B. Borealis*) Amid Oil Exploration and Development off Northwest Scotland*, 8 J. Cetacean Research & Mgmt. 247 (2006). Similarly, one study found that a low-frequency, high-amplitude fish mapping sonar silenced humpback whales at distance of 200 km, where received levels ranged from 88 to 110 dB. D. Risch et al., *Changes in Humpback Whale Song Occurrence in Response to an Acoustic Source 200 km Away*, 7 PLoS ONE e29741 doi:10.1371/journal.pone.0029741 (2012).

[72] Researchers have also observed harbor porpoises to engage, in some circumstances, in avoidance responses fifty miles from a seismic airgun array, a result that is consistent with both captive and wild animal studies showing harbor porpoises abandoning habitat in response to pulsed sounds at low received levels. D.E. Bain & R. Williams, *Long-range Effects of Airgun Noise on Marine Mammals: Responses as a Function of Received Sound Level and Distance* (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E35).

[73] N.A. Soto et al., *Does Intense Ship Noise Disrupt Foraging in Deep-diving Cuvier's Beaked Whales (*Ziphius cavirostris*)?*, 22 Mar. Mamm. Sci. 690 (2006); Pirotta, E., Milor, R., Quick, N., Moretti, D., Di Marzio, N., Tyack, P., Boyd, I., and Hastie, G., Vessel noise affects beaked whale behavior: Results of a dedicated acoustic response study, PLoS ONE 7(8): e42535. doi:10.1371/journal.pone.0042535 (2012). *See also* P.L. Tyack et al., *Beaked Whales Respond to Simulated and Actual Navy Sonar,* 6 PLoS ONE e17009 (2011), *available at* doi:10.13371/journal.pone.0017009; Cal. State Lands Comm., Draft Environmental Impact Report (EIR) for the Central Coastal California Seismic Imaging Project H-47 (2012) (CSLC EIR No. 758).

[74] Rosalind M. Rolland et al., *Evidence that Ship Noise Increases Stress in Right Whales*, Proc. R. Soc. B (2012), *available at* doi:10.1098/rspb.2011.2429.

[75] Manuel Castellote et al., *Acoustic and Behavioral Changes by Fin Whales (*Balaenoptera physalus*) in Response to Shipping and Airgun Noise*, 147 Biological Conservation 115 (2012).

[76] *Id.*

well below the Fisheries Service's current *continuous* exposure level threshold, let alone its 160 dB threshold for impulsive noise. That latter threshold, which is employed by all of the pending applications, is simply not supportable under any understanding of "best available science." Little if any of the above data describing behavioral disturbances below the 160 dB threshold were available in 1999, when the High Energy Seismic Survey panel issued the report on which the Fisheries Service purportedly based its threshold.[77] Since that time, the literature on ocean noise has expanded enormously due to appreciable increases in research funding from the U.S. Navy, the oil and gas industry, and other government and commercial funding sources. The evidentiary record for a lower threshold in this situation substantially exceeds the one for mid-frequency sonar in *Ocean Mammal Institute v. Gates*,[78] in which a U.S. District Court judge invalidated a Fisheries Service threshold that ignored documented impacts at lower received levels as arbitrary and capricious.

The Fisheries Service must revise the thresholds and methodology used to estimate behavioral takes from airgun use. Specifically, we urge the following:

(1) Optimally, the Fisheries Service should employ a combination of specific thresholds for which sufficient species-specific data are available and generalized thresholds for all other species.[79] These thresholds should be expressed as linear risk functions, where appropriate, to account for intraspecific and contextual variability, just as the agency has done for years (using different risk functions, of course) in Navy authorizations.[80] Data from all species should be used to produce generalized thresholds for species lacking sufficient data.

(2) The Fisheries Service must revise its general, multi-species behavioral take threshold to reflect the best available science. An imminently forthcoming paper, whose authors include leading biologists and bioacousticians, concludes that, as a single threshold for cetaceans, a behavioral risk function centered at 140 dB (SPL) comes far closer to reflecting the extant literature on seismic airgun exploration than does the agency's ancient 160 dB threshold.[81] (The paper is to be released on Sept. 1, 2015.) For a general behavioral threshold, the Fisheries Service should adopt a risk function with a mid-point no higher than the 140 dB cited there.

(3) Should the Fisheries Service decline to revise its existing behavioral thresholds, it should appropriately use its threshold for continuous noise, rather than its threshold for impulsive noise, in estimating take. Fundamentally, the use of a multi-pulse standard for behavior harassment does not take into account the spreading of seismic pulses over the interpulse interval due to reverberation and multipath propagation.

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[77] High Energy Seismic Survey Team, High Energy Seismic Survey Review Process and Interim Operational Guidelines for Marine Surveys offshore Southern California (1999).
[78] 546 F. Supp. 2d 960, 973–75 (D.Hawaii 2008).
[79] By "thresholds," we mean either bright-line thresholds or linear risk functions.
[80] *See, e.g.*, 74 Fed. Reg. 4,844, 4,844–85 (Jan. 27, 2009).
[81] D.P. Nowacek et al., Marine Seismic Surveys and Ocean Noise: Time for Coordinated and Prudent Planning, *Frontiers in Ecology and the Environment* (in press).

The continuous, or virtually continuous, nature of the airgun sound has been indicated by myriad sources: for example, in published and unpublished analyses of airgun noise propagation across the interpulse interval;[82] in several papers showing that seismic exploration in the Arctic, the east Atlantic, off Greenland, and off Australia produces virtually continuous ambient noise at vast distances from the array;[83] and by the Fisheries Service's former Open Water Panels for the Arctic, which twice characterized the seismic airgun array as a mixed impulsive/continuous noise source and stated that the Fisheries Service should evaluate its impacts on that basis.[84] Because airgun survey noise would be continuous over most of the sound field, the 120 dB "continuous noise" exposure threshold is far more appropriate than the 160 dB threshold for take estimation should the agency choose not to revise its existing standards.

(4) Finally, the Fisheries Service must consider that even behavioral disturbance can amount to Level A take, or to serious injury or mortality, if it interferes with essential life functions through secondary effects. For example, displacement from migration paths can result in heightened risk of ship strike or predation. This displacement should present a significant concern for right whales because their migratory path lies in the middle of the proposed seismic airgun survey area, and right whales are particularly susceptible to ship strike.[85]

D. Auditory Thresholds.

The Fisheries Service must set proper thresholds for Level A takes, particularly marine mammal hearing loss. Revised and updated noise exposure guidelines are currently under review by the Fisheries Service. The agency is currently revising its criteria for temporary and permanent auditory impacts[86] because the agency itself recognizes that the old acoustic thresholds are outdated. The Fisheries Service must also recognize that the old acoustic

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[82] M. Guerra et al., *Quantifying Seismic Survey Reverberation off the Alaskan North Slope*., 130 J. Acoustical Soc'y of America 3046; pers. comm. with C. Clark (June 2015) (analysis of noise propagation in review).

[83] S.L. Nieukirk et al., *Sounds from Airguns and Fin Whales Recorded in the Mid-Atlantic Ocean, 1999–2009*, 131 J. Acoustical Soc'y of America 1102 (2012); S.L. Nieukirk et al., *Low-frequency Whale and Seismic Airgun Sounds Recorded in the Mid-Atlantic Ocean*, 115 J. Acoustical Soc'y of America 1832 (2004); E.H. Roth et al., *Underwater Ambient Noise on the Chukchi Sea Continental Slope*, 131 J. Acoustical Soc'y of America 104 (2012); J. Gedamke, Ocean Basin Scale Loss of Whale Communication Space: Potential Impacts of a Distant Seismic Survey, Biennial Conference on the Biology of Marine Mammals, November–December 2011, Tampa, FL (abstract)..

[84] *Id.*; *see also* Expert Panel Review 2010.

[85] 59 Fed. Reg. 28,793; 80 Fed. Reg. 9,313; Fisheries Service, *Recovery Plan for the North Atlantic Right Whale IG-1* (August 2004).

[86] NOAA, Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals: Acoustic Threshold Levels for Onset of Permanent and Temporary Threshold Shifts (Dec. 23, 2013).

guidelines do not represent the "the best scientific evidence available."[87] Several of the signers to this letter, based on consultation and review by three bioacousticians, submitted extensive comments on the first draft criteria, which address, among other issues, new data that have appeared since the Southall et al. study was published in 2007. These include data indicating that harbor porpoises experience threshold shift on exposure to airgun signals at substantially lower levels than the two mid-frequency cetaceans (bottlenose dolphins and beluga whales) previously tested.[88]

The Fisheries Service established the upper limit of Level B Takes under the rubric of an exposure that is likely to cause Temporary Threshold Shift (TTS). But here the threshold only refers to a compromise in the animal's sensitivity to signal amplitude without consideration for compromise in hearing acuity, which is an equally important component of healthy hearing. Research has revealed that while outer hair cells in the cochlea (which sense signal amplitude) do not seem to be damaged permanently by over-excitation, a TTS exposure can cause a loss of afferent nerve terminals and a delayed degeneration of the cochlear nerve, permanently compromising hearing acuity in terrestrial mammals.[89] Given that auditory structure and function is highly conserved across mammalian species, there is no reason to think that a comparable degeneration would not also occur in marine mammals. At least some auditory impacts that have previously been categorized as "Level B," because presumed recoverable, should be re-categorized as "Level A."

Hearing loss remains a significant risk where the agency does not require aerial monitoring as standard mitigation, fails to restrict operations in low-visibility conditions, sets safety zone boundaries that may be inadequate to protect high-frequency cetaceans, and does not firmly establish seasonal exclusion areas for biologically important habitat.

The Fisheries Service should take a conservative approach and apply the best available scientific evidence represented in a more precautionary standard for marine mammal hearing loss than is currently proposed.

E. Take Analysis for Other Acoustic Sources.

The Fisheries Service should consider the two following points in assessing impacts from non-airgun acoustic sources.

First, recent investigation into a mass stranding of melon-headed whales raises strong concerns about the impacts of some high-frequency acoustic systems proposed in the present applications. On May 30, 2008, a pod of some 100 to 200 whales stranded in Loza Lagoon, a large mangrove

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[87] 16 U.S.C. § 1371(a)(3)(A).

[88] K. Lucke et al., *Temporary Shift in Masked Hearing Thresholds in a Harbor Porpoise (*Phocoena phocoena*) after Exposure to Seismic Airgun Stimuli*, 125 J. Acoustical Soc'y of America 4060 (2009).

[89] H.W Lin et al., *Primary Neural Degeneration in the Guinea Pig Cochlea after Reversible Noise-induced Threshold Shift*, 12 J. Ass'n. Research Otolaryngology 605 (2011); S.G. Kujawa & M.C. Liberman, Adding Insult to Injury: Cochlear Nerve Degeneration after "Temporary" Noise-induced Hearing Loss, 29 J. Neuroscience 14077-2 (2009).

estuary on the northwest end of Madagascar; despite rescue efforts, at least half are believed to have died, with unknown consequences for the larger population. The report of an Independent Scientific Review Panel ruled out nearly all potential causes of this pelagic species entering the lagoon, and found that the "most plausible and likely behavioral trigger" was an industrial multibeam echosounder ("MBES") employed by Exxon, in close spatial and temporal association with the stranding event.[90]

The multibeam echosounder associated with that event, the Kongsberg Simrad EM120, has an output carrier frequency of 12 kHz, with 191 directional but overlapping sound beams, an across-track beam fan width of 150°, and an output source level of 236-242 dB (RMS). One of the present applicants, TDI-Brooks, has proposed to deploy a highly similar system, the Kongsberg Simrad EM122, which uses the same peak frequency at an even higher source level (245 dB (RMS))—and, indeed, deploying it from the very same vessel that operated the MBES system off Madagascar. As the Madagascar report found, such equipment could still easily propagate noise at levels above 120 decibels over a greater than 30 km radius even though MBES pulses are directed downwards towards the seafloor. Given the system's frequent noise output and the findings of the Madagascar report, the Fisheries Service should more appropriately apply its take threshold for continuous noise sources (120 dB) rather than its threshold for impulsive noise sources (160 dB) to this MBES system, assuming, again, that it persists in utilizing these old metrics for take estimation. Additionally, as noted below in the "Mitigation" section of these comments, the Fisheries Service must consider the potential for marine mammal stranding if this system is employed.

Second, two recent papers document the significant frequency "leakage" that can occur in some geophysical sound sources, particularly sources used in high-resolution surveys, such as echosounders, that combine high source levels with rapid rise times. The leakage is so significant that tested sources with peak frequencies at and above 200 kHz, well beyond the range of marine mammal hearing, produced substantial noise within marine mammal hearing ranges in much lower bands.[91] For example, a BioSonics sonar system produces 165 dB (SPL) in the 1/3-octave band centered at 20 kHz, and at comparable levels of sound across much of the frequency spectrum below 100 kHz. While these source levels are appreciably lower, at relevant frequencies, than those generated by sub-bottom profilers and other lower-frequency systems, their amplitude is sufficient to induce behavioral effects and contradicts the assumptions made in BOEM's PEIS, in its modeling of representative low-energy sources.[92]

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[90] Southall, B.L., Rowles, T., Gulland, F., Baird, R. W., and Jepson, P.D. 2013. Final report of the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (*Peponocephala electra*) in Antsohihy, Madagascar.

[91] Deng, Z.D., Southall, B.L., Carlson, T.J., Xu, J., Martinez, J.J., Weiland, M.A., and Ingraham, J.M., 200 kHz commercial sonar systems generate lower frequency side lobes audible to some marine mammals, *PLoS ONE* 9(4): e95315.doi:10.1371/journal.pone.0095315 (2014); Hastie, G.D., Donovan, C., Götz, T., and Janik, V.M, Behavioral responses by grey seals (*Halichoerus grypus*) to high frequency sonar, *Marine Pollution Bulletin* 79: 205-210 (2014)..

[92] *See* PEIS at App. D-21 to D-33.

Furthermore, the short rise times that these sources exhibit are correlated across mammalian species with startle response, raising concerns about sensitization. In a 2011 study, researchers demonstrated that sounds eliciting an acoustic startle response in captive grey seals were associated with "rapid and pronounced" sensitization, taking hold after only about three playbacks, whereas sounds that failed to induce a startle response did not sensitize the animals.[93] The startled seals then displayed sustained spatial avoidance, rapid flight responses, and "clear signs of fear conditioning," and, once sensitized, even avoided food that was proximate to the sound source. According to the authors, sounds with short rise times thus have "the potential to cause severe effects on long-term behavior, individual fitness and longevity of individuals in wild animal populations." In one of the more recent studies, the BioSonics sonar system discussed above produced a strong behavioral response in the same species, leading the researchers to conclude that it could produce startle responses, and therefore potentially sensitization, as well.[94] The Fisheries Service should consider the effects of short rise time from these (and other) sources.

F. Masking Effects.

The Fisheries Service should consider masking effects from the mixed impulsive/continuous noise source airguns because the best scientific evidence available demands this consideration. Masking of natural sounds begins when received levels rise above ambient noise levels at relevant frequencies, i.e., where one sound affects the perception of another sound.[95] As noted above, studies of airgun propagation in several regions around the world, and under varied propagation conditions, demonstrates that airguns raise ambient noise levels across the interpulse interval and can do so over enormous distances. The applications' failure to account in any way for masking effects renders them, as in so many other ways, inadequate and incomplete. Such consideration is essential to the agency's take, small numbers, and negligible impact findings, especially for species such as right whales, which are particularly vulnerable.

To assess masking effects, the Fisheries Service should implement the model developed by researchers at NOAA and Cornell that quantifies impacts on the communication space of marine mammals.[96] Researchers have already applied that published model to shipping noise

[93] Götz, T., and Janik, V.M, Repeated elicitation of the acoustic startle reflex leads to sensitisation in subsequent avoidance behaviour and induces fear conditioning, *BMC Neurosci* 12:30. doi:10.1186/1471-2202-12-30 (2011).

[94] Hastie et al., Behavioral responses by grey seals.

[95] C.W. Clark et al., *Acoustic Masking in Marine Ecosystems as a Function of Anthropogenic Sound Sources* (2009) (IWC Sci. Comm. Doc. SC/61/E10); C.W. Clark et al., *Acoustic Masking in Marine Ecosystems: Intuitions, Analysis, and Implication*, 395 Marine Ecology Progress Series 201 (2009); *see also* M. Castellote et al., *Potential Negative Effects in the Reproduction and Survival on Fin Whales (*Balaenoptera physalus*) by Shipping and Airgun Noise* (2010) (IWC Scientific Committee Doc. No. SC/62/E3).

[96] L.T. Hatch et al., *Quantifying Loss of Acoustic Communication Space for Right Whales in and around a U.S. National Marine Sanctuary*, 26 Conservation Bio. 983 (2012).

off Massachusetts and off British Columbia.[97] And the same researchers involved in the Massachusetts study applied it to airgun surveys, finding, as in the case of shipping noise, that right whales were particularly vulnerable.[98] Additionally, researchers sponsored by British Petroleum, working with colleagues at the University of California and the North Slope Borough, have applied the model to an analysis of masking effects from seismic operations in the Beaufort Sea.[99] The best available science requires the Fisheries Service to incorporate the Cornell/NOAA model into its analysis.

G. Impact Analysis for Right Whales.

The North Atlantic right whale is considered one of the most endangered species of large whales in the world. Indeed, as the Fisheries Service has repeatedly stated, "the loss of even a single individual [right whale] may contribute to the extinction of the species" and "preventing the mortality of one adult female a year" may alter this outcome.[100] The Fisheries Service must make conservative assumptions in assessing the impacts of the proposed surveys on this species.

First, the Fisheries Service must consider the potential for serious injury and mortality in right whales, either from ship-strike by a seismic vessel or from the indirect effects of noise. Right whales are extremely vulnerable to ship-strike given their slow speeds, their occupation of waters near shipping lanes, and the extended time they spend at or near the water surface. More than half (10 out of 14) of the post-mortem findings for right whales that died from significant trauma in the northwest Atlantic between 1970 and 2002 indicated that vessel collisions were a contributing cause of death (in the cases where presumed cause of death could be determined);[101] and these data are likely to grossly underestimate the actual number of animals struck, as animals

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[97] Ibid.; R. Williams et al., Acoustic quality of critical habitats for three threatened whale populations, 17 *Animal Conservation* 174-85 (2014).

[98] C.W. Clark et al., *Acoustic Masking in Marine Ecosystems as a Function of Anthropogenic Sound Sources* (2009) (IWC Sci. Comm. Doc. SC/61/E10); C.W. Clark et al., *Acoustic Masking in Marine Ecosystems: Intuitions, Analysis, and Implication*, 395 Marine Ecology Progress Series 201 (2009).

[99] E. Fleishman & B. Streever, *Assessment of Cumulative Effects of Anthropogenic Underwater Sound: Project Summary and Status* 2 (2012).

[100] Endangered Fish and Wildlife; Advance Notice of Proposed Rulemaking (ANPR) for Right Whale Ship Strike Reduction, 69 Fed. Reg. 30,857, 30,858 (June 1, 2004); *see also* Endangered Fish and Wildlife; Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales, 73 Fed. Reg. 60,173, 60,173 (Oct. 10, 2008); Taking of Marine Mammals Incidental to Commercial Fishing Operations; Atlantic Large Whale Take Reduction Plan, 72 Fed. Reg. 34,632, 34,632 (June 25, 2007); Marine Mammals; Atlantic Large Whale Take Reduction Plan (ALWTRP) Regulations; Seasonal Area Management (SAM) Program, 66 Fed. Reg. 50,390, 50,392 (Oct. 3, 2001).

[101] M.J. Moore et al., Morphometry, *Gross Morphology and Available Histopathology in North Atlantic Right Whale (*Eubalena glacialis*) Mortalities (1970-2002*), 6 Journal of Cetacean Research and Management 199-214 (2004).

struck but not recovered, or not thoroughly examined, cannot be accounted for.[102] Further, some types of anthropogenic noise have been shown to induce near-surfacing behavior in right whales, increasing the risk of ship-strike at relatively moderate levels of exposure.[103] It is possible that mid-frequency sub-bottom profilers and broadband airguns could produce the same effects, and both should be treated conservatively. Additionally, studies of other baleen whale species, including migratory bowhead whales, indicate that airgun noise can induce substantial displacement, by tens of kilometers (see above). In 2008, the Fisheries Service issued a rule to protect right whales from ship strikes by limiting vessel speed to less than ten knots in certain areas, known as Seasonal Management Areas or Dynamic Management Areas. If airgun surveys push a right whale out of a Seasonal Management Area or Dynamic Management Area, that whale may enter an area where vessels are traveling at a greater speed, presenting a greater danger of ship strikes.[104]

Second, the agency must account for the importance of right whale habitat in the region. The U.S. mid- and southeast Atlantic regions contain both the majority of the right whale's migratory corridor and the species' only known calving grounds. The Fisheries Service has characterized the latter as "a location vital to the population" and "a very high-risk area for pregnant females, new mothers, and calves."[105] Waters from the Altamaha River in Georgia (north of Brunswick) to San Sebastian Inlet in Florida (south of Melbourne) are federally designated as critical habitat, specifically to protect it.[106] In addition, these and other waters in the southeast have been designated as special management areas to protect right whales from significant threats, such as ship-strikes and gillnet fishing.[107] Earlier this year, the agency proposed expanding this critical habitat designation to include areas within approximately forty miles of the coastline running from Cape Fear, North Carolina to forty-three miles north of Cape Canaveral, Florida.[108] In doing so, the agency explained that the calving, nursing, and rearing areas off the coasts of Florida, Georgia, South Carolina, and North Carolina are part of "the *only* known calving ground

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[102] R.R. Reeves et al., *Report of the North Atlantic Right Whale Program Review, 13–17 March 2006, Woods Hole, Massachusetts* (2007) (prepared for the Marine Mammal Commission).
[103] D.P. Nowacek et al., *North Atlantic Right Whales (*Eubalaena glacialis*) Ignore Ships but Respond to Alerting Stimuli*, 271 Proceedings of the Royal Society of London, Part B: Biological Sciences 227-231 (2004).
[104] See elsewhere in these comments for discussion of other potential indirect effects on right whales.
[105] Fisheries Service, Final Environmental Impact Statement to Implement Vessel Operational Measures to Reduce Ship Strikes to North Atlantic Right Whales at 4-4 (Aug. 2008).
[106] *See* 59 Fed. Reg. 28,793, 28,803 (June 3, 1994).
[107] *See, e.g.*, Endangered Fish and Wildlife; Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions With North Atlantic Right Whales 73 Fed. Reg. 60,173; Taking of Marine Mammals Incidental to Commercial Fishing Operations; Atlantic Large Whale Take Reduction Plan, 72 Fed. Reg. 34,632 (June 25, 2007).
[108] Fisheries Service, Endangered and Threatened Species; Critical Habitat for Endangered North Atlantic Right Whale, 80 Fed. Reg. 9,313, 9,319 (proposed Feb. 20, 2015). A map of the proposed area is included as Exhibit 5. *See also* Comment from Margaret Cooney, IFAW, to Mary Colligan, Assistant Regional Administrator of NMFS Protected Resources Division, Apr. 21, 2015 (attached as Exhibit 6).

for right whales, and that the most biologically valuable portion of the species' population is utilizing this habitat."[109]

Right whales occupy waters well beyond the areas current designated or proposed as critical habitat. A recent passive acoustic study from Cornell University's Bioacoustics Research Program indicates a year-round presence of critically endangered right whales off the coasts of Virginia and Georgia. The study found that, between sixteen and *at least* sixty-three nautical miles off Virginia's coast, right whales are present throughout the year with peak concentrations occurring from mid-January through late March and with some of the most frequent occurrence found further offshore.[110] The study made similar findings for right whales off the Georgia coast. Given this, it is reasonable and conservative to expect similar right whale occurrence throughout the region. The new evidence of offshore presence is consistent with the findings of the CetMap working group established by NOAA, which recently identified a "biologically important" migratory corridor and calving area that is substantially broader than the critical habitat designated by NOAA.[111]

Third, the Fisheries Service must account for long-range behavioral disruption in modeling take and assessing impacts on right whales. The seasonal closures proposed by the Bureau in the PEIS are insufficient to protect the species. These closure areas do not include the new areas proposed by the Fisheries Service as right whale critical habitat, let alone the migratory corridor and calving grounds designated as biologically important by the CetMap working group and identified as having virtually year-round right whale presence by the recent Cornell study. Although the Bureau commits itself, in the PEIS, to seasonally avoid all right whale critical habitat, there is no indication that the Fisheries Service, which has been sued for unlawful delay in the matter, will have revised its critical habitat designation before the proposed seismic surveys would begin. Regardless, as discussed elsewhere in these comments, a single seismic source can significantly disrupt right whale behavior and reduce right whale communication on a population scale. Multiple studies demonstrate large-scale impacts across a range of baleen whale species and a variety of behavioral contexts; and modeling from Cornell and NOAA shows the right whale is particularly vulnerable to masking effects from low-frequency ambient noise given the acoustic and behavioral characteristics of its calls.[112]

Fourth, the Fisheries Service must consider impacts from all reasonably foreseeable activities—including but not limited to other activities for which MMPA authorizations have been issued—

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[109] *Id.*

[110] Aaron Rice et. al., *Acoustic Ecology of North Atlantic Right Whales off of the Virginia Coast: Data Quality and Initial Right Whale Presence Results* (Oct. 2013) (attached as Exhibit 7). This study was partially funded by and prepared for Oceana and the International Fund for Animal Welfare. Dr. Rice presented the results to Brian Hooker and other staff in the Bureau's Office of Renewable Energy Programs in Herndon, VA on Thursday, November 14, 2013.

[111] E. LaBrecque et al., Biologically Important Areas for Cetaceans within U.S. Waters—East Coast Region, 41(1) *Aquatic Mammals* 17-29 (2015).

[112] Clark et al., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources; Clark et al., Acoustic masking in marine ecosystems: intuitions, analysis, and implication.

in making its determinations. For example, the Fisheries Service estimated that current Navy sonar activity in the Atlantic Ocean could cause sixty instances of temporary hearing loss and fifty-one takes by behavioral harassment per year.[113] Beyond the four applications at issue, the Bureau estimates hundreds of thousands of additional line kilometers of surveys over the next six years. And seismic surveys in the Mid-Atlantic and South Atlantic planning areas would add cumulatively to the high levels of noise that right whales already experience from commercial shipping in their foraging grounds and along their migratory route—and that already reduces their communication space and increases their metabolic stress levels.[114] The aggregate of these effects, along with the effects of seismic surveying in the U.S. East Coast, could cause significant long-term cumulative effects on right whales.

Given the vulnerability of the species, the Fisheries Service must conservatively apply the best available science in determining the impacts of the proposed activities.

H. Cumulative Impacts.

The Fisheries Service must properly analyze the cumulative impacts of the proposed surveys on marine populations and species. As 75 ocean scientists recently stated with respect to the Atlantic Coast, seismic activity will have "significant, long-lasting and widespread impacts on the reproduction and survival" of threatened whales and commercial fish populations.[115] Many of the signatories are prominent experts in marine bioacoustics and in the biology of marine mammals, fish, and other species. Yet the PEIS that BOEM prepared, despite estimating that geophysical surveys will disrupt vital marine mammal behavior more than 13 million times over the initial six-to-seven years, makes no serious effort to analyze the cumulative population-level effects of these impacts.

In other regions, managers and researchers have begun producing quantitative assessments of the population consequences of human disturbance on marine mammals. For example, researchers at the University of St. Andrews have analyzed the impacts of North Sea wind farm construction on the area's harbor porpoise population, and have determined, based on studies of pile-driving impacts on harbor porpoise foraging, that predicted levels of construction would cause a 12-13 percent population decline over 12 years. Notably, the researchers observed that such a decline was likely to go undetected through current monitoring efforts, and also that the noise-quieting mitigation required by the German government would very significantly curb the decline to under 1 percent.[116] We already have the tools to model the aggregate effects of human noise on

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[113] Fisheries Service, Takes of Marine Mammals Incidental to Specified Activities; U.S. Navy Training and Testing Activities in the Atlantic Fleet Training and Testing Study Area, 78 Fed. Reg. 73,009, 73,055 (Dec. 4, 2013).
[114] Rosalind M. Rolland et al., *Evidence that Ship Noise Increases Stress in Right Whales,* Proc. R. Soc. B doi:10.1098/rspb.2011.2429 (2012).
[115]Letter from Scientists to Obama re Atlantic Seismic (March 5, 2015), *available at* http://docs.nrdc.org/wildlife/files/wil_15030401a.pdf.
[116] U.K. Verfuss et al., *Does Noise Mitigation Matter? Population Consequences of Piling Noise on Marine Mammals* (2014) (presentation given at IMCC Noise Workshop, Glasgow, Aug. 13, 2014).

marine mammal populations and, where uncertainties exists, alternatives such as expert solicitation are available.[117] The impact assessment provided thus far, in the Bureau's PEIS, is conclusory, and, as the scientists' letter indicates, completely out of line with the determination of some of the leading experts in the field.

The four proposed surveys would take place over the same time period in the same region, and adversely affect the same populations with similar technologies. Furthermore, they would be occurring within a broader context of increased seismic surveys, with applications from other seismic companies already pending before BOEM and possibly before the Fisheries Service itself, and of offshore Navy activity, which take the Fisheries Service has already authorized in high numbers through 2018. The Fisheries Service's past practice of avoiding consideration of cumulative impacts and population-level analysis is not acceptable here. The agency must analyze cumulative impacts on each affected marine mammal population in the region, both in making its "negligible impact" determinations and in satisfying its independent NEPA responsibilities.

I. Serious Injuries and Mortalities.

Because of the risks of serious injury or mortality from near-shore operations, including by the TDI-Brooks high-resolution survey, and from indirect effects, the Fisheries Service should carefully consider whether the proposed activities could cause marine mammal serious injuries or deaths. If an activity could seriously harm or kill marine mammals, then the seismic surveying companies must obtain a LOA.[118]

Seismic survey vessels moving to and from their surveying areas, and potentially during surveying, may strike, injure, and/or kill marine mammals. The agency's Programmatic Biological Opinion recognizes the potential for survey boats to strike whales, including critically endangered right whales: "When the vulnerability of right whales to ship strikes is combined with the density of ship traffic within the distribution of right whales, ship strikes seem almost inevitable."[119] Additionally, airguns have the potential to displace marine mammals into areas where they stand a higher risk of ship-strike or predation; or to cause stranding (as the echosounder system proposed by TDI-Brooks is likely to have done off Madagascar, *see infra* under "Mitigation"); or to induce other behavioral effects that compromise an animal's survival. For example, airgun noise could disrupt or mask the low-amplitude contact calls that right whale mother-calf pairs use during the mother's foraging dives, leading potentially to separation. As discussed above, the loss of even one right whale would have adverse population-level effects. The Fisheries Service must consider the risk of serious injury or mortality posed by the proposed activities.

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[117] See, e.g., S.L. King et al., *An Interim Framework for Assessing the Population Consequences of Disturbance*, Methods in Ecology and Evolution doi: 10.1111/2041-210X.12411 (2015).

[118] 50 C.F.R. § 216.106. Because the activity could seriously harm or kill marine mammals, through ship strikes or entanglement, the Fisheries Service should consider requiring the companies to obtain LOAs instead of IHAs.

[119] Fisheries Service, *supra* note 41, at 158.

J. Use the Same Models for All Four IHA Applications.

Finally, for each category of models required for the IHAs, including marine mammal density, sound propagation, and take models, the Fisheries Service should ensure consistency in the models used so that the impacts can be evaluated in a uniform manner. The reason behind the request for model consistency is three-fold: (1) managers can analyze the impacts to marine mammals more thoroughly and completely if all companies use one set of models; (2) the public can compare the subsequent draft IHAs to look at cumulative impacts more easily; and (3) application of the same models for similar activities affecting the same populations is essential to ensure use of the best available science.

IV. MITIGATION REQUIREMENTS.

It is not sufficient for the Fisheries Service, in fulfilling its mitigation requirements under the MMPA, to simply prescribe safety zones and ramp-up procedures. Such measures, while helpful in reducing risk of near-source injury, are incommensurate to the scale of impact of the acoustic sources here under review. Compliance with the MMPA's "small numbers" and "negligible impact" standards and "least practicable adverse impact" requirement requires the agency to effectively mitigate the long-range, cumulative effects of this profoundly controversial activity. The Fisheries Service should (1) reduce the environmental footprint of acoustic sources; (2) minimize the amount of seismic airgun activity; and (3) use area closures to protect important species and habitat. In addition, it should use best practices in defining operational mitigation.

A. Reduce the Environmental Footprint of Acoustic Sources.

Given the distances over which airgun noise, and the sound from certain other acoustic sources, are known to affect marine mammals, it should be a primary aim of the Fisheries Service's mitigation to minimize the acoustic footprint of the proposed surveys. To this end, the agency should, for example, (1) require use of commercially available quieting technologies for airguns; (2) require attainment of lowest practicable source levels; and (3) carefully select the multibeam echosounders that the companies may use.

1. Quieting Technologies for Airguns.

Quieting technologies are among the most promising means of mitigating ocean noise, with potentially significant long-term reductions in cumulative exposures and impacts on marine species. Industry experts and biologists participating in a September 2009 workshop reached the following conclusions: that airguns produce a great deal of "waste" sound and generate peak levels substantially higher than needed for offshore exploration; that a number of quieting technologies were technically feasible and could be made available for commercial use within a few years; and that governments should accelerate development and use of these technologies through both research and development funding and regulatory engagement.[120] A 2007 report by

[120] Report of the Workshop on Alternative Technologies to Seismic Airgun Surveys for Oil and Gas Exploration and Their Potential for Reducing Impacts on Marine Mammals, 31 Aug.–1 Sept., 2009, Monterey, Calif. (Weilgart, L. ed. 2010), *available at* www.okeanos-stiftung.org/okeanos/download.php?id=19.

Noise Control Engineering reached similar conclusions,[121] and, in 2013, the Bureau hosted an international workshop focused in substantial part on seismic as a target for mitigation.

A number of new technologies are now on the horizon of commercial availability. Perhaps the best known is marine vibroseis, a vibratory source that could, by spreading the acoustic energy embedded in a short airgun pulse over several seconds, significantly reduce effective source levels and all but eliminate acoustic output above 100 Hz, which is waste energy for geophysical exploration. A Geo-Kinetics system was field-tested in the Gulf of Mexico last January for shallow-water application, and may be available for commercial deployment at the end of the calendar year.[122] Three other vibroseis systems are in Joint Industry Program development under the terms of the *NRDC v. Jewell* settlement agreement.[123] The environmental superiority of such systems is indicated in a forthcoming technical paper from Curtin University modelers, funded by the International Fund for Animal Welfare: it reports general reductions in both SPL and SEL exposures from an experimental vibroseis system, as compared with a similarly sized airgun array, across several operational scenarios.

Other quieting technologies include modified airguns, including Bolt's new "e-source" airguns, which promise reductions in noise output of 15 dB or more in frequencies above 80–120 Hz, and which will be available for delivery by the end of the calendar year;[124] and BP's "staggered-fire" (or "popcorn") method of seismic acquisition, which could reduce amplitudes by as much as 20 dB.[125] Nor is this list comprehensive.[126] The MMPA requires consideration of equipment and equipment modifications that would reduce impacts on marine mammals.[127] *At minimum*, the Fisheries Service must consider requiring applicants to use the new Bolt airguns, which have been publicly advertised since late 2014 and will be commercially available during the proposed survey periods. It should also investigate the availability of the Geo-Kinetics system for part or all of the proposed surveys.

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[121] J, Spence et al., *Review of Existing and Future Potential Treatments for Reducing Underwater Sound from Oil and Gas Industry Activities* (2007) (NCE Report 07-001) (prepared by Noise Control Engineering for Joint Industry Programme on E&P Sound and Marine Life).
[122] Pers. comm. from M. Jasny, NRDC, with B. Pramik, Geo-Kinetics (Apr. 2015).
[123] Settlement Agreement, *NRDC v. Jewell*, Case. No. 2:10-cv-01882 (E.D. La.) (settlement entered June 24, 2013).
[124] Bolt Technology Corporation, Engineered for the Marine Environment: The World's Ffirst Bandwidth-controlled airgun, *available at* www.bolt-technology.com/pages/product_esource.htm (last visited Aug. 28, 2015); Teledyne Bolt, eSource Introduction (undated PowerPoint presentation).
[125] A. Ross & R.L. Abma, Offshore Prospecting Signal Processing Controlled Source Signaling, US Patent 20,120,147,701, June 14, 2012, *available at*: http://www.faqs.org/patents/app/20120147701 (accessed June 2014).
[126] *See, e.g.*, J.Y. Guigné et al., *Acoustic Zoom High-resolution Seismic Beamforming for Imaging Specular and Non-specular Energy of Deep Oil and Gas Bearing Geological Formations*, 21 J. Natural Gas Science & Engineering 568 (2014).
[127] *See, e.g.*, 16 U.S.C. § 1371(a)(5)(A)(ii)(I); 50 C.F.R. § 216.104(a)(11).

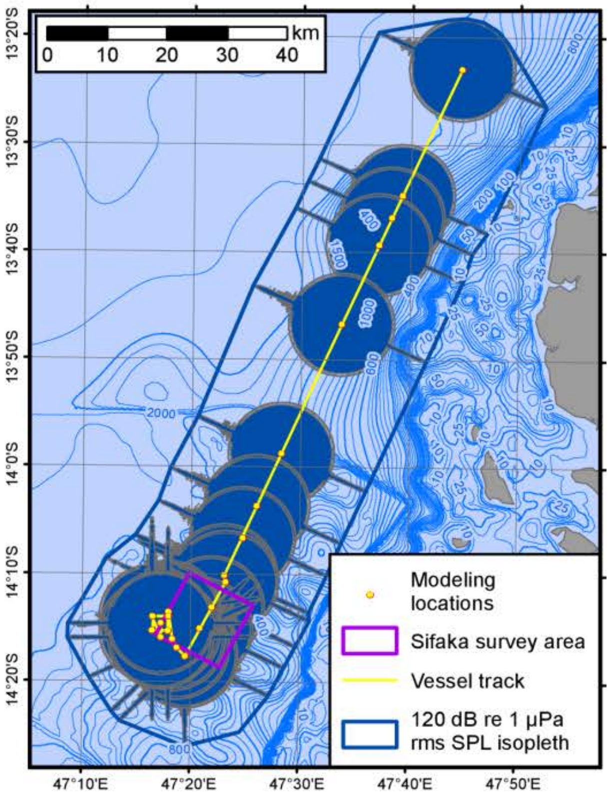

Fig. 2. Modeling of the EM 120 system off the Madagascar coast (Southall et al. 2013).

2. Lowest Practicable Source Levels.

The Fisheries Service should (a) require operators to reduce the effective source levels of their surveys to the lowest practicable level, and provide a transparent standard and oversight mechanism to ensure compliance; and (b) require operators to calibrate their airgun arrays before beginning a survey in order to minimize horizontal propagation of the noise signal, and report field-checked source levels to the agency for purposes of transparency and compliance. Pursuant to the settlement agreement in *NRDC v. Jewell*, the Bureau is presently developing a standard for determining lowest practicable source levels, which is likely to be included in the Programmatic Environmental Impact Statement that the agency develops for Gulf of Mexico geophysical surveys; but the Fisheries Service has an independent obligation under the MMPA to minimize impacts of Atlantic seismic surveys on marine mammals, and it legally cannot and must not wait for the Bureau to finalize its own standards. Additionally, as with the Arctic, the Fisheries Service should prescribe a protocol for in-field sound source validation, both for minimizing horizontal propagation and for verifying source level estimates.

3. Selection of Multibeam Echosounders.

Similarly, the Fisheries Service must prescribe available quieting technology for other acoustic sources that are likely to cause impacts to marine mammals. TDI-Brooks proposes using a multibeam echosounder, the Kongsberg EM 122, whose peak frequency of 12 kHz is far below that of virtually all MBES systems on the market,[128] and well within the range of best hearing for many cetaceans. Indeed, the relevant characteristics of the Kongsberg system, with a nominal source level of 245 dB (SPL), are comparable with some hull-mounted naval sonar systems, e.g., the AN/SQS-25. Even though echosounders, as opposed to military sonar systems, are directed towards the seafloor, such equipment could still easily propagate noise at levels above 120 dBs over a 30–35 km diameter, as a report on an associated mass stranding involving a nearly identical system, with a smaller nominal source level, found (see Fig. 2). As TDI-Brooks notes in its application, a less powerful Kongsberg system, the EM 302, whose peak frequency of 30 kHz

[128] *See, e.g.*, Kongsberg Maritime, *Multibeam echosounders*, *available at* http://www.km.kongsberg.com/ks/web/nokbg0240.nsf/AllWeb/620F423FA7B503A7C1256BCD0023C0E5?OpenDocument (last visited Aug. 28, 2015).

would attenuate far more rapidly than that of the proposed system, would cover most of the area the applicant wishes to survey; indeed, that system, according to Kongsberg, is capable of operating to water depths of 7000m. Better still, the EM 710 MKII, which can survey water depths to 2000m, would still cover the majority of the proposed study area, including waters on the shelf break and upper slope that are likely to have higher densities of multiple cetacean species.[129]

Moreover, the Fisheries Service may not be able to authorize use of the Kongsberg system under an IHA. On May 30, 2008, a pod of some 100 to 200 whales stranded in Loza Lagoon, a large mangrove estuary on the northwest end of Madagascar; despite rescue efforts, at least half are believed to have died, with unknown consequences for the larger population. The report of an Independent Scientific Review Panel ruled out nearly all potential causes of this pelagic species entering the lagoon, and found that the “most plausible and likely behavioral trigger” was the similar Kongsberg EM 120 system employed by Exxon, in close spatial and temporal association with the stranding event.[130] (TDI-Brooks proposes using the very same vessel that was used in that event.) Lamont-Doherty Earth Observatory employed a comparable multibeam sonar system—with a center frequency of 15.5 kHz and associated source levels of 237 dB—in a research survey prior to the Gulf of California beaked whale stranding in September 2002, which the survey closely correlated with and may have played a role in that event as well.[131] TDI-Brooks proposes using the system close to the Florida coastline, not substantially further than the roughly 25km distance at the Madagascar system’s closest approach to land, with the potential of driving pelagic species, with high acoustic sensitivity at 12 kHz, close to shore, where they would experience heightened stranding risk.

Given the evident potential for stranding and mortality, we do not believe that the Fisheries Service can legally use an IHA to cover deployment of the EM 120 system for the entire proposed study area. In any case, the Fisheries Service should require use of a less powerful system pursuant to the mitigation provision of the MMPA

B. Minimize the Amount of Seismic Airgun Activity.

Given the extraordinarily large spatial scales over which airgun noise propagates, the most effective available mitigation measures involve reducing the acoustic footprint of the activity (previous section) or reducing the amount of the activity (this section).[132] The Fisheries Service’s continued reliance on an outdated, irrational, and non-conservative threshold, the

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[129] *Id.*

[130] B.L. Southall et al., Final Report of the Independent Scientific Review Panel Investigating Potential Contributing Factors to a 2008 Mass Stranding of Melon-headed Whales (*Peponocephala electra*) in Antsohihy, Madagascar (2013).

[131] T.M. Cox et al., *Understanding the Impacts of Anthropogenic Sound on Beaked Whales*, 7 *J. Cetacean Res. Manage.* 177 (2006); J. Hildebrand, *Impacts of Anthropogenic Sound*, *in* T.J. *Marine Mammal Research: Conservation beyond Crisis* 101 (Ragen et al., eds. 2006).

[132] Time-area closures also have significant value, but are likely to be less effective at mitigating loss of communication space and reducing the long-distance behavioral responses, such as changes in vocalization, documented especially in baleen whales.

160 dB step-function for behavioral harassment, impedes proper application of the MMPA's "small numbers" provision in determining how much seismic activity is allowable under law. As noted above, a series of recent papers demonstrates impacts at far lower received levels, in a range of species and across a variety of behavioral contexts, than the Fisheries Service presently assumes; and a forthcoming paper whose authors include some of the world's leading biologists and bioacousticians concludes that, as a single threshold for cetaceans, a behavioral risk function centered at 140 dB (SPL) comes far closer to reflecting the extant literature on seismic airgun exploration than does the agency's ancient 160 dB threshold.[133] Should the Fisheries Service adopt that behavioral risk function, in line with the best available science, the scale of the proposed geophysical surveys—two of which separately propose more than 60,000 line-kilometers of high-energy seismic in a single year—would almost certainly, and rightly, decrease.

Other means to reduce the amount of seismic activity in a given year include, but are not limited to, setting a limit on the amount of total annual activity allowable from all proposed seismic survey activity in the Atlantic; or requiring applicants to share data.

C. Use Area Closures to Protect Important Species and Habitat.

To satisfy the MMPA's "small numbers," "negligible impact," and "least practicable adverse impact" standards, the Fisheries Service should also use area closures in sensitive areas to protect marine mammals and their habitats.

1. Right Whale Seasonal Closure.

As noted above, a number of studies produced over the last three years demonstrate that industrial airguns impact important behaviors of baleen whales over extraordinarily large spatial scales. These studies include Blackwell et al.'s 2013 and 2015 papers on seismic impacts on migrating bowhead whales;[134] Castellote et al.'s 2012 study on the impacts of seismic airguns on (presumably) foraging fin whales;[135] and Cerchio et al.'s 2014 paper on seismic impacts on breeding humpback whales;[136] and these papers are consistent with several others showing impacts over large areas (e.g., Clark and Gagnon 2008 and Di Iorio and Clark 2010).[137] In short,

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[133] D.P. Nowacek et al., *Marine Seismic Surveys and Ocean Noise: Time for Coordinated and Prudent Planning*, Frontiers in Ecology and the Environment (in press).
[134] S.B. Blackwell et al., *Effects of Airgun Sounds on Bowhead Whale Calling Rates in the Alaskan Beaufort Sea*, 29 Marine Mammal Science E342 (2013); S.B. Blackwell et al., *Effects of Airgun Sounds on Bowhead Whale Calling Rates: Evidence for Two Behavioral Thresholds*, 10 PLoS ONE e0125720 (2015), *available at* doi:10.1371/journal.pone.0125720.
[135] M. Castellote et al., *Acoustic and Behavioural Changes by Fin Whales (*Balaenoptera physalus*) in Response to Shipping and Airgun Noise*, 147 Biological Conservation 115 (2012).
[136] Cerchio, S., Strindberg, S., Collins, T., Bennett, C., and Rosenbaum, H., Seismic surveys negatively affect humpback whale singing activity off Northern Angola, *PLoS ONE* 9(3): e86464. doi:10.1371/journal.pone.0086464 (2014).
[137] *E.g.*, C.W. Clark & G.C. Gagnon, *Considering the Temporal and Spatial Scales of Noise Exposures from Seismic Surveys on Baleen Whales* (2006) (IWC Sci. Comm. Doc.

whether measured by distance (e.g., greater than 100 km, as in the case of Castellote et al. (2012)) or exposure levels (e.g., below 120 dB, as in the case of the Blackwell papers), the nominal impact area from any single survey encompasses a substantial part of the right whale's migratory corridor and/or calving grounds. Right whales are also particularly vulnerable to masking effects, which are occasioned by reverberation and the spreading of the airgun pulse through multi-path propagation, and which can, likewise, occur over vast distances.[138] The seasonal closure that the Bureau proposed in its PEIS is predicated on a smaller impact area and does not sufficiently protect right whales from behavioral impacts, including changes in vocalizations and displacement; significant indirect impacts, including a potentially increased risk of ship strike and predation; and loss of communication space. The Fisheries Service should therefore prohibit high-energy seismic surveys within the mid-Atlantic and southeast Atlantic regions from November 1 through April 30, the right whale's migration and calving period.

2. Area Closures for Other Important Marine Mammal Habitat.

Time and place restrictions designed to protect high-value habitat are one of the most effective means to reduce the potential impacts of noise and disturbance, including noise from oil and gas exploration.[139] It was for this express reason that NOAA, in 2011, established a working group on Cetacean Density and Distribution Mapping, to define marine mammal hotspots for management purposes.[140] The Fisheries Service must consider restricting seismic surveys, on either a seasonal or year-round basis, from important marine mammal habitat, whether to ensure satisfaction with the MMPA's negligible impact and small numbers standards, or to meet the "least practicable adverse impact" requirement.

Of clear importance is the area off "the Point" of Cape Hatteras. This area lies at the confluence of the Gulf Stream and the Labrador Current, creating a dynamic ocean front that supports an abundance of marine life, from plankton and invertebrates, to forage fish, to large marine predators such as tuna, swordfish, sharks, seabirds, and marine mammals. Marine mammals occur at exceptionally high densities off Cape Hatteras compared to other areas along the

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IWC/SC/58/E9); L. Di Iorio & C.W. Clark, *Exposure to Seismic Survey Alters Blue Whale Acoustic Communication*, 6 Biology Letters 51 (2010).

[138] L.T. Hatch et al., *Quantifying Loss of Acoustic Communication Space for Right Whales in and around a U.S. National Marine Sanctuary*, 26 Conservation Bio. 983 (2012); *see also* C.W. Clark et al., *Acoustic Masking in Marine Ecosystems as a Function of Anthropogenic Sound Sources* (2009) (IWC Sci. Comm. Doc. SC/61/E10).

[139] *See, e.g.*, T. Agardy et al., A Global Scientific Workshop on Spatio-temporal Management of Noise, Report of Workshop held in Puerto Calero, Lanzarote, June 4–6, 2007; S. Dolman et al., Technical Report on Effective Mitigation for Active Sonar and Beaked Whales (2009) (working group convened by European Cetacean Society); OSPAR Commission, *Assessment of the Environmental Impact of Underwater Noise* (2009) (report issued as part of OSPAR Biodiversity Series, London, UK); Convention on Biological Diversity, *Scientific Synthesis on the Impacts of Underwater Noise on Marine and Coastal Biodiversity and Habitats* (2012) (UNEP/CBD/SBSTTA/16/INF/12).

[140] Memorandum from Dr. Jane Lubchenco, Undersecretary of Commerce for Oceans and Atmosphere, to Nancy Sutley, Chair, Council on Environmental Quality at 2 (Jan. 19, 2010).

Atlantic Coast.[141] The Cape's occurrence between the temperate ecosystem to the north and the subtropical ecosystem to the south also means that many species ranges have either a southern or northern terminus at the Cape.[142] Indeed, according to the new model produced by Duke University for CetMap, Cape Hatteras has the highest marine mammal biodiversity of any area along the Atlantic, and rivals locations internationally renowned for their diversity of species, including northwest Spain, Hawaii, San Diego, and Cape Cod.[143] Yet this same habitat falls within the study area of all four of the applications now before the agency, and within the study area of all the applications the Bureau has received; in two of the three surveys now before the Fisheries Service, it would be subjected to tracklines of relatively high-density. The Fisheries Service should exclude seismic exploration from the Cape Hatteras area, and should consider closures in other areas (e.g., the mid-Atlantic canyons and the Charleston Bump) that may represent significant offshore marine mammal habitat.

D. Use Best Practices in Defining Operational Mitigation.

As discussed above, the most effective available method of mitigating impacts from seismic surveys on marine mammals is reducing the activity as well as the environmental footprint of the activity; and time-area closures may also be effective, as NOAA has recognized. We therefore urge the Fisheries Service to develop and prescribe these other methods and not merely spend its time fine-tuning operational mitigation meant to reduce injury risk close to the source array. That said, the Fisheries Service should consider the following measures to improve the effectiveness of operational mitigation:

(a) Ensure that its safety zone requirement applies to all cetacean species, including delphinids, which are not presently included in the Bureau's Notice to Lessees (NTL 2012-G02) in the Gulf of Mexico.

(b) Require the use of multiple platforms for marine mammal detection, for purposes of maintaining safety zones. This includes use of sufficient numbers of marine mammal observers (i.e., two on/ two off, on two-hour monitoring shifts) with substantial prior experience; real-time passive acoustic monitoring; and use of thermal imaging for plume detection.[144]

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[141] P.N. Halpin et al., *OBIS-SEAMAP: The World Data Center for Marine Mammal, Sea Bird, and Sea Turtle Distributions*, 22 Oceanography 104–115 (2009).
[142] B.D. Best et al.,*Online Cetacean Habitat Modeling System for the U.S. East Coast and Gulf of Mexico*, 18 Endangered Species Research 1-15 (2012); R.S. Schick et al., *Community Structure in Pelagic Marine Mammals at Large Spatial Scales*, 434 Marine Ecology Progress Series 165-181 (2011).
[143] B.L. Byrd et al., *Strandings as Indicators of Marine Mammal Biodiversity and Human Interactions off the Coast of North Carolina*, 112 Fishery Bulletin 1-23 (2014).
[144] D.P. Zitterbart et al., *Automatic Round-the-clock Detection of Whales for Mitigation from Underwater Noise Impacts*, 8 PLoS ONE e71217 (2013), *available at* doi:10.1371/ journal.pone.0071217. It is my understanding that thermal detection technology has significantly improved since this paper was published. The Fisheries Service should contact the authors.

(c) Ensure, as it has in Cook Inlet, that any so-called "mitigation airguns" employed by operators have interpulse intervals (~60 seconds) designed to reduce ensonification while providing a warning signal.

(d) Consider additional "best practices" for safety zone maintenance and monitoring, as set forth in Weir and Dolman (2007) and Parsons et al. (2009).[145]

(e) Incorporate the latest data on ramp-up design, which indicates the need to carefully stagger airgun addition in ways that are potentially perceived by marine mammals as increased noise,[146] into any ramp-up requirement it prescribes here.

(f) Impose a minimum separation distance on seismic vessels beyond the 40 km proposed by the Bureau in its PEIS. As noted above, the literature indicates that baleen whale species may experience displacement around seismic arrays well beyond the 160 dB isopleth; the proposed 40 km separation would do little to mitigate the displacement and allow transit of the whale.[147] Moreover, in settling upon 40 km as its separation distance, BOEM appears to have assumed spherical spreading throughout the sound field, when, again, as discussed above, a more conservative propagation loss formula should be used to account for cylindrical spreading.[148] For these and other reasons, the Fisheries Service should consider larger, more conservative separation distances including, but not limited to, 90 km, which is the distance considered in the Arctic DPEIS.

(g) Require trackline design that minimizes the potential for stranding where surveys are operating closer to shore. Biologists have expressed concern—based on correlations of airgun surveys with some marine mammal stranding events as well as the traditional use of sound in cetacean drive fisheries—that seismic operations (and other intense noise

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[145] C.R. Weir & S.J. Dolman, *Comparative Review of the Regional Marine Mammal Mitigation Guidelines Implemented During Industrial Seismic Surveys, and Guidance Towards a Worldwide Standard*, 10 J. Int'l Wildlife L. & Policy 1 (2007); E.C.M. Parsons et al., *A Critique of the UK's JNCC Seismic Survey Guidelines for Minimising Acoustic Disturbance to Marine Mammals: Best Practice?*, 58 Marine Pollution Bulletin 643 (2009).
[146] D. Cato, Analysis of the Effectiveness of Ramp-up Design in Mitigation Measure, presentation given at Ocean Noise 2015, Vilanova i la Geltrú, Barcelona, May 15, 2015.
[147] *See, e.g.*, Blackwell et al., *Effects of Airgun Sounds on Bowhead Whale Calling Rates* (2013), *supra* note 135; Clark & Gagnon, *Considering the Temporal and Spatial Scales of Noise Exposures*, *supra* note 20; W.J. Richardson et al., *Displacement of Migrating Bowhead Whales by Sounds from Seismic Surveys in Shallow Waters of the Beaufort Sea*, 106 J. Acoustical Soc'y of America 2281 (1999).
[148] Applying a spherical spreading formula of 20log(r), broadband sound pressure levels at the mid-point between the two arrays would be 152 dB if the sound from the two surveys are in phase, or 149 dB if they are not. By contrast, a cylindrical spreading formula of 10log(r) would yield a received level at the mid-point of 195 dB if the sound from the two surveys are in phase, or 192 dB if they are not. Of course, the actual received level is likely to be somewhere between these two unrealistic models, but Fisheries Service, unlike BOEM in its PEIS, should not assume spherical spreading throughout the sound field.

sources) could cause marine mammals to strand, particularly if used near shore.[149] To reduce analogous risk in other contexts, Australia and the North Atlantic Treaty Organization Undersea Research Program have required planners of mid-frequency sonar exercises to design their tracklines to minimize the potential for embayment and stranding.[150]

(h) Require operators to validate the assumptions about propagation distances used to establish safety zones, calculate take, and make negligible impact determinations. Such analysis should assess received levels beyond the 160 dB, 180 dB, and 190 dB isopleths, to include the 120 dB and 140 dB isopleths as well.

(i) Require that all vessels associated with geological and geophysical activities, including support vessels, adhere to a ten knot speed limit when operating or transiting, to reduce ship-strike risk on right whales and other baleen whales. Specific language on this point is needed, as in the case of the Neptune LNG facility, to ensure that all vessels (and not just those vessels over sixty-five feet in length) and all affected waters (beyond the areas immediately surrounding the major Mid-Atlantic ports) are covered by the speed limit. Should the Fisheries Service wish to focus this provision on right whale conservation, it should use the Cornell (Rice et al.) passive acoustics data to set temporal and spatial parameters around the requirement.

CONCLUSION

The four applications pending before the agency are deficient in their impact and mitigation analysis and do not afford the Fisheries Service a means of fulfilling its responsibilities under the MMPA. We therefore urge the Fisheries Service to find the four pending applications inadequate and incomplete for purposes of further processing beyond this initial stage of review. If the agency moves ahead regardless, we urge it to leave sufficient time for proper consideration of the recommendations made herein, and in other public comments, before publishing proposed IHAs.

Thank you for considering these comments. We welcome the opportunity to meet with you and your staff at any time, and we will continue to engage in this process moving forward.

Very truly yours,

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[149] R.L. Brownell et al., *Hunting Cetaceans with Sound: A Worldwide Review*, 10 J. Cetacean Res. Mgmt. 81 (2008); J. Hildebrand, *Impacts of Anthropogenic Sound, in Marine Mammal Research: Conservation beyond Crisis* 101 (T.J. Ragen et al., eds. 2006); IWC Scientific Committee, *Report of the Scientific Committee of the International Whaling Commission: Annex K: Report of the Standing Working Group on Environmental Concerns* (2009).

[150] Royal Australian Navy, Maritime Activities Environmental Management Plan: Procedure S1 (2006); NATO Undersea Research Centre, NATO Undersea Research Centre Human Diver and Marine Mammal Risk Mitigation Rules and Procedures, at 10 (2006) (NURC Special Pub. NURC-SP-2006-008).

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EXHIBIT 1

Civil Penalties Program

The goal of the BSEE OCS Civil Penalties Program is to ensure safe and environmentally sound operations on the Outer Continental Shelf. Through the pursuit, assessment, and collection of civil penalties the program is designed to encourage compliance with the Outer Continental Shelf Lands Act (OCSLA) and BSEE's implementing regulations.

2014 Civil Penalties Summary
Penalties Paid through the Calendar Year of 2014

(1/1/2014 - 12/31/2014)

Name of Violator and Case No.	Violation and Date(s)	Penalty Paid and Date Paid	Regulation(s) Violated 30 CFR)
Linder Oil Company (Production Services Network) G-2009-001	During the course of a BSEE inspection the shutdown valve (SDV), for the fuel gas to the main generator, was bypassed. It was also discovered that Linder was discharging produced water from the production separator into the containment skid. Oct. 25- Oct. 28, 2008 Oct. 2 – Oct. 28, 2008	$150,000* 6/20/14 12/24/14 ***Note: Represents partial payments pursuant to a Settlement Agreement that also addressed Linder's decommissioning obligations. Linder owed a total penalty of $500,000. Linder has now paid a total of $500,000.**	250.803 250.803(a)
McMoran Oil & Gas LLC G-2011-007	During a BSEE incident investigation, it was discovered that McMoran failed to move equipment containing hydrocarbons at least 35 feet from welding area. Another violation was the explosion and rupture of two oil tanks which resulted in spilled oil into the Gulf of Mexico.	$60,000 11/25/14	250.300(a) 250.113

	May 21, 2010 (2 violations)		
McMoran Oil & Gas LLC G-2012-007	During a BSEE incident investigation, it was discovered that a tubing hanger pin ejected while attempting to separate well head from well bore causing an injury. Oct. 27, 2011	$35,000 12/5/14	250.107(a)
Anadarko Petroleum Corporation (Ensco Offshore Co.) G-2012-030	During a BSEE incident investigation, it was discovered that Anardarko failed to develop and use a management system for operation of the subsea BOP system, which includes procedures for prevention of accidental or unplanned disconnects of the system. It was also found that the driller's energized BOP panel was accessed with ongoing wireline operations in the well bore. No JSA had been developed and no Permit to Work had been issued because appropriate personnel were not aware of the action. Dec. 8, 2011 - Feb.19, 2012 Feb. 19, 2012	$70,000 10/10/14	250.401 250.442
Apache Corporation G-2012-038	During the course of a BSEE investigation, it was discovered that the swing brake on the crane was inoperative at the time of the incident. None of the individuals involved in the operation, with the exception of the crane operator, had knowledge of this deficiency. This deficiency was not covered in the JSA. Furthermore, the individuals interviewed	$40,000 9/26/14	250.107

	admitted to not wearing gloves during the operation, despite the wearing of gloves being cited in the JSA. August 12, 2012		
Fairways Offshore Exploration, Inc. (DeLeon & Associates, LLC) G-2013-010	During the course of a BSEE inspection, the SCSSV for Well A-2 and A-2D was being utilized as a tubing plug. The tubing plug had not been tested for leakage at the required 6 month interval. Feb 1 – Oct 24, 2012	$40,000 5/6/2014	250.804(a)(1)
Energy Resource Technology GOM, Inc. G-2013-017	During the course of an unannounced BSEE inspection, it was discovered that the operator failed to shut-in all wells while performing Hot-work cutting operations within the Well-Bay. ERT failed to perform operations in a safe and workmanlike manner. November 26, 2012	$30,000 8/25/14	250.107
Mariner Energy Resources, Inc. G-2013-021	During a BSEE incident investigation, multiple violations were discovered that led to an overpressure event in production vessels that caused a fire. Sept. 2, 2010 (8 violations)	$295,000 11/12/14	250.107 250.107(a) 250.803(c) 250.803(b)(8) 250.300(a)
Energy Resource Technology GOM, Inc. (Wood Group Production Services) G-2013-022	During the course of a BSEE investigation, it was determined that a crane lifting operation led to the collapse of the crane boom, causing a fatality. August 16, 2011 (2 violations)	$80,000 3/12/14	250.401(e)
Ensco Offshore Co.	During a BSEE incident investigation, it was discovered that Ensco	$70,000 12/2/14	250.442 250.401(e)

G-2013-025	failed to develop and use a management system for operation of the subsea BOP system, which includes procedures for prevention of accidental or unplanned disconnects of the system. It was also found that the driller's energized BOP panel was accessed with ongoing wireline operations in the well bore. No JSA had been developed and no Permit to Work had been issued because appropriate personnel were not aware of the action. Feb. 19, 2012 Dec. 9, 2011 – Feb. 19, 2012		
McMoRan Oil & Gas LLC (Danos & Curole Marine Contractors, Inc.) G-2013-028	During the course of a BSEE Investigation into an incident with injury, it was discovered that McMoRan failed to adhere to safety policies and perform all operations in a safe and workmanlike manner during riser pipe decommissioning operations. They did not having proper management and onsite supervision to address safety hazards and deficiencies that contributed to the cause of the incident. March 30, 2013	$35,000 9/28/14	250.107(a)(1)
Stone Energy Corporation G-2013-029	During an inspection, it was discovered that Stone Energy did not comply with blowout prevention equipment requirements during the well abandonment operation. The well was not in a Temporarily	$50,000 8/6/14	250.170(c)(1) 250.1706(c)(5)

	Abandoned (T&A'd) status at the time of the inspection. This means that communication still existed between the hydrocarbon bearing zone and the wellbore. The kill line not being connected as required posed a threat to personnel and the facility in the event of a well control situation. March 26, 2013 (2 violations)		
Black Elk Energy Offshore Operations, LLC 2013-030	During the course of a BSEE inspection, it was discovered that the Sump Tank LSH selector valve was in the bypass position, it was not flagged, nor was it being monitored. The Sump Tank is the containment system for deck drainage from all production vessel skids. Due to the safety device being in the bypass mode, the LSH would not have been able to perform its design function and shut in the facility in the event of a high level in the Sump Tank. March 11, 2013	$30,000 4/9/14	250.803(c)
GOM Shelf LLC G-2013-032	During an inspection, several violations were discovered. Inspectors found that a test separator had been placed out of service on the instrument panel. When inspectors questioned why the vessel was out of service, they found that it had been placed out of service because it was full of sand. Inspectors returned to the structure a day later, performed a re-test and audited the	$1,230,000 11/12/14	250.802(b) 250.107(a)(1)

	records. Records showed that GOM Shelf was aware of sand entering the production system for a prolonged period of time. Despite this awareness, GOM Shelf failed to take steps to sufficiently address the sand hazards. This failure placed the safety of people on the facility, as well as the environment, at risk. March 12, 2013 Feb. 1 – March 12, 2013		
Arena Offshore, LP (Danos & Curole Marine Contractors, Inc.) G-2013-033	During the course of a BSEE investigation, it was determined Arena failed to adhere to safety policies and perform all operations in a safe and workmanlike manner during riser pipe decommissioning operations. They did not having proper management and supervision to address safety hazards and deficiencies that contributed to the cause of the incident. March 30, 2013	$35,000 8/6/14	250.107(a)
Danos and Curole Marine Contractors, Inc. G-2013-034	During the course of a BSEE investigation, it was determined D&C failed to operate in a safe and workmanlike manner for not following their Safe Work Practice Procedures and policies, including failure to utilize Stop Work Authority, Hazard Recognition & Control, and Open Hole Safety. These failures to adhere to proper management and onsite supervision to address safety hazards and equipment deficiencies in	$30,000 7/30/14	250.107(a)(1)

	planning, and make operational errors contributed to the cause of the injury. March 30, 2013		
Chevron U.S.A. Inc. G-2013-035	During the course of a BSEE investigation, it was discovered that the operator failed to operate in a safe and workmanlike manner by failure to utilize proper personal protective equipment per the "Corrosive Chemical Procedure" while dismantling the pump assembly. In addition, there was not a Material Safety Data Sheet for the chemical located on the facility nor was there a Job Safety Analysis or permit to work prepared with this job task. Finally, there was no eye wash station(s) located near the temporary chemical pumping area. May 21, 2013	$35,000 9/23/14	250.107(a)(1)
Black Elk Energy Offshore Operations, LLC G-2013-036	During an onsite BSEE investigation, there was a pollution incident that involved a gasket failure on the departing pipeline riser resulting in the release of liquid hydrocarbons into Gulf of Mexico waters. Also, the facility had been shut-in prior to Black Elk receiving a Performance Improvement Plan (PIP) notification letter from the BSEE Regional Director which states in part: 1) Keep all facilities that currently are in a shut-in status in such status until it provides BSEE with documentation of the corrective actions taken to safely return each	$70,000 4/9/2014	250.101 250.107(a)

	facility into operational status to BSEE's satisfaction. 2) Notify the appropriate District Office at least 48 hours prior to returning these facilities to production to allow for the proper BSEE inspection. Black Elk failed to conduct operations in accordance with lease stipulations as noted in excerpts number 1&2 above from the November 21, 2012 PIP notification letter. February 1, 2013 (2 violations)		
Mariner Energy, Inc. G-2013-037	During the course of a BSEE inspection, 3 violations were discovered where operations were not being conducted in a safe and workmanlike manner. Violation 1 involved unsecured and improperly assembled scaffolding/ fabricated platform utilized for the decommissioning operations. BSEE inspectors observed that the scaffolding/fabricated platform was not secured to the platform and was missing some of the bracings and pins. This could have allowed the scaffolding to shift while personnel were working from the scaffolding deck. Violation No. 2 involved an open-hole/fall hazard located on the deck scaffolding. This hazard posed a potential threat of personnel falling onto the lower platform deck or into the Gulf of Mexico waters from the decking of the scaffolding. Violation No. 3) also involved an Open-	$280,000 4/4/2014	250.107(a)

	hole/fall hazard located on the platform lower deck. BSEE inspectors observed personnel working on a section of the platform deck that had no hand rails presenting a threat of personnel falling into the Gulf of Mexico Waters. May 22-28, 2013		
Apache Corporation G-2013-038	During a BSEE incident investigation, it was discovered that the rigger on top of Marine Portable Transfer tank unhooked the D-ring and then dropped it over the side of tank. The D-ring caught the right index finger of the employee between the side of the tank and the D-ring. It was initially stated that the rigger was wearing the company required high-visibility, impact resistant gloves, but later into the investigation changed his testimony to say he was not wearing any gloves at the time of the incident. April 11, 2013	$75,000 11/12/14	250.107(a)(1)
Linder Oil Company G-2013-039	During a BSEE inspection of the facility's plug and abandonment operations, the inspector found an open hole that was un-barricaded on one side and accessible to personnel working on the well deck creating a fall hazard. After further review of documents, it was found that after pulling the drive pipe from the well B1, an approximately 34" diameter hole was created in the grating in the well deck area.	$25,000 6/20/14	250.107(a)(1)

	May 16, 2013		
Black Elk Energy Offshore Operations, LLC 2013-040	During the course of a BSEE investigation into an incident with injury, the investigators discovered 2 violations of failing to conduct operations in a safe and workmanlike manner. May 4, 2013	$75,000 4/28/14	250.107(a)(1)
BP Exploration & Production Inc. G-2013-041	During the incident investigation, two violations were found. One was for discharging pollutants into Gulf waters and the other was for failure to maintain equipment in a safe manner which led to the discharge. April 19, 2013 (2 violations)	$65,000 11/14/14	250.107 250.300(a)
W&T Offshore, Inc. G-2013-043	During the course of a BSEE inspection, it was discovered that the LSL for the Oil Treater was operating in the by-pass position, and was not flagged or monitored by personnel. June 7, 2013	$30,000 4/24/14	250.803(c)
Hercules Offshore G-2013-045	During the course of a BSEE investigation on a drilling rig, it was determined that the air hoist cable had become entangled with the hose safety clamp during the replacement of inner bushings. The bushing puller tool and air hoist hook were secured to an anchor post after the bushings were replaced. It was also observed that the driller's view of the entangled air hoist cable was obstructed by the traveling block and top drive. The downward	$25,000 3/25/14	250.107(a)

	force of the traveling block and top drive put an undetermined amount of force on the cable and anchor post, breaking the post from the rig floor allowing either the anchor post or the bushing puller tool to strike the injured party. July 8, 2013		
Dynamic Offshore Resources, LLC (Fieldwood Energy, LLC) G-2013-046	During the course of a BSEE investigation into pollution incident, it was discovered that LSH for the Flash Tank (MBB-150) was in bypass and not flagged and monitored resulting in the operator's failure to prevent unauthorized discharge of pollutants into offshore waters. February 27, 2013 March 2, 2013	$45,000 8/4/14	250.803 250.107(a)
Arena Offshore, LP (Wood Group Production Services) G-2013-047	During the incident investigation, it was found that a person was injured when a flash fire occurred while employees were conducting an acidizing operation on the float cell. The flash fire resulted in a contract employee suffering first and second degree burns on his right arm and torso. July 20, 2013	$40,000 8/25/14	250.107(a)
Express P&A G-2013-048	During a BSEE on-site inspection, multiple violations were found. Personnel were working in unsafe areas of the platform; there was unsecured and improperly assembled scaffolding; missing handrails on the platform deck as well as gaps in	$84,000 10/3/14	250.107(a)

	existing handrails. May 24-28, 2013		
Apache Corporation G-2013-049	During the course of a BSEE onsite inspection, it was discovered that the fire and gas detection system for several portable buildings were found with the power switch in the off position rendering the system inoperable and disabling the backup battery system, leaving the building without adequate fire detection. June 24-27, 2013 (4 violations)	$360,000 9/4/14	250.803(b)(9)(v)
Nexen Petroleum U.S.A. Inc. G-2013-051	During the course of an inspection, BSEE Inspectors discovered the SCSSV for wells I-1 and I-2 operating in the by-pass position. Also, they were not flagged or monitored by personnel. September 13, 2013 (2 violations)	$40,000 8/30/14	250.107(a)
Energy XXI GOM, LLC G-2013-052	During a BSEE onsite inspection, inspectors observed multiple oil-leaks on the gas compressor. During a follow up inspection, the operator failed to correct multiple oil leaks on the gas compressor. July 30-September 17, 2013	$7,248 3/5/14	250.107
Dynamic Offshore Resources, LLC G-2013-053	During the incident investigation, it was found that on several occasions the rig crew made the decision to continue to pull drill pipe out of the wellbore even while they were taking gains through the trip tank.	$125,000 10/7/14	250.456(a)

	May 6 – June 6, 2013		
Nexen Petroleum U.S.A. Inc. G-2013-055	During the course of a BSEE inspection, inspectors discovered that the helicoptor landing deck was being utilized as an extension of the platform to conduct abandonment operations without the addition of hand rails. September 24, 2013	$20,000 9/26/14	250.107(a)
SandRidge Energy G-2013-056	During an inspection, gas was observed escaping from a vent cover of a wet oil tank, into the atmosphere, without flame arrestor protection. Sept. 30 - Oct. 9, 2013	$250,000 11/14/14	250.107
Fairways Offshore Exploration G-2014-002	BSEE inspector discovered a violation in which the operator was unable to provide testing records for the Well JA-2D SCSSV, being utilized as a tubing plug. In addition, the operator failed to correct a previous violation for failure to conduct required daily pollution inspections. Sept. 30, 2011 – Aug. 29, 2013 Dec. 7, 2012 – Aug.29, 2013	$32,250 10/3/14	259.301 250.804(a)(1)(i)
McMoran Oil and Gas LLC G-2014-004	An inspection was conducted because an oil sheen was spotted during flight. Violations connected to the spill were due to the sump pile not operating automatically; the LSH and sum pile pneumatic pump failed, and then the sump pile was used as a processing device. October 24, 2013 (3 violations)	$85,000 11/13/14	250.300(b)(4) 250.802(b) 250.300(a)

Century Exploration New Orleans, LLC G-2014-005	During the course of a BSEE onsite inspection, it was discovered that the Coiled Tubing Unit reel gear and chain guards/covers were not installed to protect personnel from the moving components. October 29, 2013	$20,000 10/20/14	250.107
W&T Offshore, Inc. G-2014-006	During an inspection, it was discovered that a fusible cap had been placed on the SSV (of Well G-9) during testing the previous day. The fusible cap had been left in place rendering the SSV inoperable and locking the valve in the open position. The SSV was not flagged, nor was it being monitored by personnel Aug. 7 – 8, 2014	$60,000 11/10/14	250.803(c)
Black Elk Energy Offshore Operations, LLC 2014-007	During an onsite inspection BSEE issued three INCs (one for each well that was flowing at the time the bypassed relay was found.) BSEE Inspectors performed a function test of the emergency ESD system while the relay was in bypass, to see if the SCSSV's pressure would bleed off. During this function test, the SCSSV's control pressure did not bleed off. April 29, 2013 (3 violations)	$180,000 4/28/14	250.803(c) 250.803
Chevron U.S.A. Inc. G-2014-010	During the course of a BSEE investigation into an incident with injury, Chevron failed to properly supervise construction operations after a	$25,000 7/6/14	250.107(a)

	construction worker was injured while stepping on grating that was secured with plastic zip ties. December 9, 2013		
Hilcorp Energy GOM, LLC G-2014-013	During a BSEE onsite inspection, three INCs were issued and forwarded for civil penalty review. An inspector discovered a LSL on the L.P. Separator was in bypass mode, and the separator win in operation and not being tested or maintained. Another violation discovered was that the bottom isolation valve for the LSH on the sump was in the closed position. The sump was not being tested or maintained. The third violation discovered was a valve on the air supply for the sump pump was in the closed position preventing its ability to automatically operate. May 24, 2012 (3 violations)	$75,000 8/14/14	250.803(c) 250.300(b)
Chevron U.S.A. Inc. G-2014-015	During the course of an inspection, BSEE Inspectors discovered an open hole next to the Lease Automatic Custody Transfer skid. The hole was not properly barricaded to prevent personnel from entering the hazardous area. September 1-9, 2013	$160,000 7/30/2014	250.107
Anadarko Petroleum Corporation G-2014-017	During the course of a BSEE investigation involving injuries, it was discovered that a composite air pressure vessel exploded causing a large fireball and flying shrapnel, followed by a venting sound. The	$37,000 9/23/14	250.107(a)

	Subsea personnel were injured, receiving second and third degree burns from the flash fire. November 2, 2013		
SandRidge Offshore, LLC (Wood Group Production Services) G-2014-019	During the course of a BSEE investigation involving injuries, it was discovered that an employee was attempting to clear a line that was being used to transfer coolant (antifreeze) from a 500 gallon poly tank to a compressor. The poly tank exploded and severely injured employee's hand.	$35,000 9/8/14	250.107(a)
Fairfield Nodal G-2014-023	During the course of a BSEE field investigation, Fairfield failed to follow an approved plan that led to the fatality of Spotted Dolphin by entanglement of the tethered line on the Dolphin. November 7, 2013 – January 24, 2014 (2 violations)	$430,000 12/17/14	250.551.3 250.551.6(a)(2)
Tana Exploration Company, LLC G-2014-025	During the time of the inspection, BSEE Inspectors discovered that the well abandonment operations with the tree removed did not contain a secondary power source, independent from the primary source, with sufficient capacity to close all BOP stack components and hold them closed. BSEE Inspectors discovered the pneumatic supply line connected to the pneumatic driven secondary pump on the Hydraulic Power Unit having its "Air Pump Shut-off Valve" in the closed or blocked	$25,000 12/24/14	250.1706

	position. April 18, 2014		
EPL Oil and Gas, Inc. (Spartan Offshore Drilling, LLC) G-2014-029	During the course of a BSEE investigation into an incident with injury, the investigators discovered that an employee was injured while preparing the Texas Deck to install the pollution pan around the BOP on the drilling rig. The section of grating was not secured at the time of the incident. December 17, 2013	$37,000 11/13/14	250.107(a)
Cochon Properties, LLC G-2014-030	During an inspection, it was discovered that the gas detection system in the temporary living quarters was inoperable. The power switch to the gas detection-monitoring unit was in the off position. May 27, 2014	$20,000 11/19/14	250.107(a)
EnVen Energy Ventures, LLC G-2014-031	During a BSEE inspection, upon review of the SCSSV inspection records, the inspectors discovered that the leakage rate for the SCSSVs used in lieu of a tubing plug, in two wells, was above the maximum allowable set forth in the regulations. Nov. 10, 2013 – Feb. 12, 2014 Nov. 10, 2013 – Mar. 15, 2014	$438,000 11/21/14	250.804(a)(1)(i) 250.804(a)(1)(i)
Beta Operating Company, LLC P-2013-002	During the course of a BSEE investigation into an incident with injury, the investigators discovered that an injured party received an electric shock of an estimated 98,000 volts at very low amperage. The person was not wearing proper	$25,000 4/7/14	250.107

	personal protective equipment as required by the JSA at the time of the incident.		
Exxon Mobil Corporation P-2013-003	During the course of a BSEE investigation into an incident with injury, the investigators discovered that an employee fell off the dragway onto the drill deck. September 18, 2012	$30,000 4/30/14	250.107(a)
Exxon Mobil Corporation P-2014-001	During the course of a BSEE investigation, it was discovered that a release of H_2S gas under high pressure occurred due to maintenance of an incorrect injection gas compressor fitting. A maintenance team commenced work on the wrong fitting which led to a blowout. January 19, 2013	$20,000 9/12/14	250.107
Beta Operating Company, LLC P-2014-005	During the course of a BSEE investigation, it was discovered that crude oil was released through the flare boom. A safety device was bypassed for reasons other than startup, maintenance or testing and was not properly flagged or monitored. May 23, 2014	$30,000 12/15/14	250.803(c)
Total Penalties Paid: 1/1/2014 - 12/31/2014 **53 Cases:** $5,695,498			

The purpose of publishing this civil penalties summary is to provide information to the public regarding OCSLA and regulatory violations of special concern in OCS operations and to provide an additional incentive for safe and environmentally sound operations.

ESD	Emergency Shut Down
INC	Incident of Non Compliance
JSA	Job Safety Analysis

LSH	Level Safety High
LSL	Level Safety Low
SCSSV	Surface Controlled Subsurface Safety Valve
SDV	Shut Down Valve
SSV	Subsurface Safety Valve

EXHIBIT 2

By Regular and Electronic Mail

July 2, 2012

Mr. Gary D. Goeke
Chief, Regional Assessment Section
Office of Environment (MS 5410)
Bureau of Ocean Energy Management
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394
GGEIS@boem.gov

Re: **Comments on the Draft PEIS for Atlantic G&G Activities**

Dear Mr. Goeke:

On behalf of our organizations and our millions of members, we write to submit comments on the Draft Programmatic Environmental Impact Statement ("DPEIS") for geological and geophysical ("G&G") activities off the mid-Atlantic and southeast coasts. 77 Fed. Reg. 19321 (Mar. 30, 2012). For the reasons discussed in detail below, we believe that the DPEIS not only fails to meet the environmental review standards prescribed by the National Environmental Policy Act ("NEPA"), but fails to an extent that cannot be remedied through the issuance of a final EIS. Accordingly, if BOEM intends to allow oil and gas exploration in the Atlantic, we believe that the document must be thoroughly revised and reissued as a draft for further public review and comment.

We are profoundly concerned about BOEM's intention to permit high-intensity seismic surveys in the Atlantic region, not only because of the potentially catastrophic impacts of OCS drilling, but because of the significant environmental harm represented by airgun exploration itself.

It is undisputed that sound is a fundamental element of the marine environment. Whales, fish, and other wildlife depend on it for breeding, feeding, navigating, and avoiding predators – in short, for their survival and reproduction – and it is no exaggeration to say that BOEM's proposed action would dramatically degrade the acoustic environment along most of the east coast. To prospect for oil and gas, the industry typically tows arrays of high-volume airguns behind ships, firing intense impulses of compressed air – often as loud as explosives – about every 12 seconds, 24 hours per day, for days, weeks, or months on end. Increasingly, the available science demonstrates that these blasts disrupt baleen whale behavior and impair their communication on a vast scale; that they harm a diverse range of other marine mammals; and that they can significantly impact fish and fisheries, with unknown but potentially substantial effects on coastal communities. Given the scales involved, surveys taking place off the coast of Virginia could well affect endangered species off southern New England down through the Carolinas, impacting the endangered right whale's entire migratory range. And the degree of activity contemplated under this EIS is enormous, with BOEM having already received permit applications to run hundreds of thousands of miles of survey lines during the pre-leasing phase alone.

Even according to BOEM's estimates – which significantly understate the harm – oil and gas activity would injure up to 138,500 marine mammals and disrupt marine mammal feeding, calving, breeding, and other vital activities more than 13.5 million times over the next eight years alone.

NEPA dictates that, before opening the floodgates to this action, BOEM must employ rigorous standards of environmental review, including a fair and objective description of potential impacts, a comprehensive analysis of all reasonable alternatives, and a thorough delineation of measures to mitigate harm. Unfortunately, the DPEIS falls far short of these standards. Instead, it provides an analysis that on almost every crucial point is disconnected from the relevant science, in a way that consistently tends to understate impacts and, consequently, to rationalize BOEM's proposed action. To cite just a few examples:

- BOEM relies on a 13-year-old, cookie-cutter threshold for harm that was recently castigated by some of the world's leading experts in this field as "overly simplified, scientifically outdated, and artificially rigid" – leading to a serious misconception of the scale of the impact area and a massive underestimate of marine mammal take.

- It fails to assess the far-reaching cumulative impacts of airgun blasting on marine mammal communication, despite the availability of Cornell and NOAA models, simply stating without any discernible support (and contrary to the literature) that masking effects on marine mammals would be "minor."

- It fails to incorporate new studies, accepted by the Navy and other state and federal agencies and incorporated into their recent impact statements, demonstrating that marine mammals are more susceptible to hearing loss than previously believed.

- In lieu of a serious analysis of cumulative impacts, it strings together a few unsupported and indeed baseless statements, ignoring not only its own marine mammal take numbers but also failing to consider such patently foreseeable impacts as the Navy's substantial takes of the same populations over the same period (just analyzed in the Navy's Draft EIS for the Atlantic Fleet).

- Despite acknowledging that airguns can cause wide-scale displacement of fish species – disrupting spawning and reproduction, altering migration routes, and impairing feeding, and dramatically reducing catch rates – it assumes without support that effects on both fish and fisheries would be localized and "minor."

Nor is BOEM's analysis of alternatives any more credible. **The fundamental problem is that the agency simply does not take the problem of cumulative, sublethal impacts seriously; and misprising the scale and potential significance of the impacts, it fails to consider alternatives and mitigation adequate to address it.** It does not even attempt to identify biologically important areas within the enormous activity area, aside from critical habitat for the right whale and loggerhead sea turtles. It does not attempt to reduce the extraordinary amount of activity by restricting exploration from areas that are unlikely to be leased, beginning with important Navy training areas, or to reduce the environmental footprint of the activity that does occur. It fails even to devise a long-term monitoring plan, which is a staple of Navy mitigation and essential to any meaningful adaptive management program. Instead, other than an insufficiently small time-area closure for the critically endangered right whale, BOEM's preferred alternative relies on mitigation that the Courts have rightly described in other contexts as "woefully inadequate and ineffectual." These faults are all the more serious given BOEM's decision to avoid programmatic review under the Marine Mammal Protection Act.

Our organizations strongly support Alternative C, which would bar oil and gas exploration activity from the region, but allow G&G activity for renewable energy development and minerals exploration on a case-by-case basis, preserving the status quo. It makes no sense on either economic or ecological grounds to open the greater portion of the east coast to oil and gas development. If, however, BOEM proceeds with this poorly conceived policy, it must correct the fundamental errors in the present DPEIS. Merely revising the draft into a final EIS is not sufficient, because its pervasive flaws and omissions have effectively deprived federal and state agencies, the scientific community, and the general public of their statutory right to an objective description of the activity and a meaningful opportunity to comment.

These comments (1) provide background on NEPA and the science of ocean noise; (2) assess BOEM's scant alternatives analysis and recommend additional alternatives and mitigation measures for consideration; (3) critique the document's analysis of impacts on marine species; and (4) discuss what BOEM must do to satisfy its obligations under other statutes. Our recommendations for BOEM's alternatives analysis, mitigation, and monitoring are summarized as follows.[1]

(1) BOEM should assess alternatives that place meaningful caps or limits on offshore activities, to reduce disruptions of marine mammal behavior.

(2) BOEM should eliminate duplication of survey effort by prescribing or incentivizing the use of common surveyors, particularly for the extensive 2-D surveys expected within the first five years of activity.

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[1] Except as indicated, these recommendations are intended to apply to seismic airgun activities, rather than to G&G activities more generally.

(3) BOEM should develop alternatives for the development and implementation of "greener" exploration technology, of which several possibilities are described below.

(4) BOEM should exclude from G&G exploration areas that are unlikely to be leased in the near future, whether for biological, political, or economic reasons, such as waters within 50 miles of the Virginia shore or waters important to the Navy's national security mission.

(5) BOEM should consider establishing buffer zones around all of its time-area closures, to prevent ensonification of important habitat at disruptive levels.

(6) BOEM should develop time-area closures for marine mammals based on a systematic analysis of their density, distribution, and habitat use within the area of interest. To begin with, it should expand the time-area closure for North Atlantic right whales to fully capture the calving grounds and migration corridor, and put the Cape Hatteras Special Research Area off limits on a year-round basis.

(7) BOEM should extend the seasonal Brevard County time-area closure for sea turtles to near-coastal areas through North Carolina, and should consult with NMFS to ensure inclusion of all loggerhead critical habitat in any closure provision.

(8) BOEM should consider alternatives that exclude key fish habitat and fisheries, including submarine canyons in the mid-Atlantic, and Habitat Areas of Particular Concern designated by the Mid-Atlantic and South Atlantic Fishery Management Councils.

(9) BOEM should exclude airgun surveys within a 145 dB isopleth around established dive sites.

(10) BOEM should require that airgun survey vessels use the lowest practicable source levels, minimize horizontal propagation of the sound signal, and minimize the density of track lines consistent with the purposes of the survey, and, to this end, should consider establishing an expert panel within the agency to review survey designs with the aim of reducing their wildlife impacts.

(11) BOEM should require operators to validate *in situ* the assumptions about propagation distances used to establish safety zones and calculate take, as is required in the Arctic.

(12) BOEM should therefore require that all vessels associated with G&G activities, including support vessels and vessels used in HRG surveys, adhere to a 10 knot speed limit when operating or transiting at all times.

(13) BOEM should require that vessels avoid important habitat, such as right whale calving grounds, when transiting to G&G activities.

(14) BOEM should require that all vessels used in oil and gas G&G activities undergo measurement for their underwater noise output per American National Standards Institute/ Acoustical Society of America standards (S12.64); that all such vessels undergo regular maintenance to minimize propeller cavitation; and that all new industry vessels be required to employ the best ship-quieting designs and technologies available for their class of ship.

(15) BOEM should consider prescribing larger, more conservative separation distances, since marine mammals can experience displacement and other impacts well beyond the 160 dB isopleth, on which the current proposed separation distance is based.

(16) BOEM should require that operators working close to shore design their tracklines to minimize the potential for embayments and strandings.

(17) BOEM should reconsider the size of the safety zones it would prescribe as part of its nominal protocol for seismic airgun surveys, taking into account new data on the threshold shift in marine mammals; and should consider establishing larger shutdown zones for certain target species, such as right whales.

(18) BOEM should improve its real-time monitoring requirements, by reducing the length of time a marine mammal observer can continuously work; requiring that observers used on airgun surveys have meaningful field experience; mandating, or at least presumptively requiring, the use of passive acoustic monitoring; prescribing aerial surveillance on a case-by-case basis; and, for HRG surveys, requiring two trained observers in order to maintain coverage on both sides of the survey vessel.

(19) BOEM should commit to consider limiting activities in low-visibility conditions on a case-by-case basis, and describe the conditions under which it might be required.

(20) BOEM should immediately develop a long-term monitoring program, to establish environmental baselines, to determine long-term impacts on populations of target species, and to test whether the biological assumptions underlying the DPEIS are correct.

(21) BOEM should incorporate an adaptive management plan into its alternatives, and should also set forth a protocol for emergency review or suspension of activities, if serious unanticipated impacts are found to occur.

I. BACKGROUND: ENVIRONMENTAL IMPACTS AND NEPA COMPLIANCE

A. Impacts of Airgun Surveys and Other G&G Activities

For offshore exploration, the oil and gas industry typically relies on arrays of airguns, which are towed behind ships and release intense impulses of compressed air into the water about once every 10-12 seconds.[2] A large seismic airgun array can produce effective peak pressures of sound higher than those of virtually any other man-made source save explosives;[3] and although airguns are vertically oriented within the water column, horizontal propagation is so significant as to make them, even under present use, one of the leading contributors to low-frequency ambient noise thousands of miles from any given survey.[4] Indeed, the enormous scale of this acoustic footprint has now been confirmed by studies of seismic in numerous regions around the

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[2] Airguns are not used in surveys for renewable energy projects.

[3] National Research Council, *Ocean Noise and Marine Mammals* (2003).

[4] Nieukirk, S.L., Stafford, K.M., Mellinger, D.K., Dziak, R.P., and Fox, C.G., Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean, *Journal of the Acoustical Society of America* 115: 1832-1843 (2004).

globe, including the Arctic, the northeast Atlantic, Greenland, and Australia (see *infra* at § IV.B.1).

It is well established that the high-intensity pulses produced by airguns can cause a range of impacts on marine mammals, fish, and other marine life, including broad habitat displacement, disruption of vital behaviors essential to foraging and breeding, loss of biological diversity, and, in some circumstances, injuries and mortalities.[5] Consistent with their acoustic footprint, most of these impacts are felt on an extraordinarily wide geographic scale – especially on endangered baleen whales, whose vocalizations and acoustic sensitivities overlap with the enormous low-frequency energy that airguns put in the water. For example, a single seismic survey has been shown to cause endangered fin and humpback whales to stop vocalizing – a behavior essential to breeding and foraging – over an area at least 100,000 square nautical miles in size, and can cause baleen whales to abandon habitat over the same scale.[6]

Similarly, airgun noise can also mask the calls of vocalizing baleen whales over vast distances, substantially compromising their ability to communicate, feed, find mates, and engage in other vital behavior.[7] The intermittency of airgun pulses hardly mitigates this effect since their acoustic energy spreads over time and can sound virtually continuous at distances from the array.[8] According to recent modeling from Cornell and NOAA, the highly endangered North Atlantic right whale is particularly vulnerable to masking effects from airguns and other sources given the acoustic and behavioral characteristics of its calls.[9] As discussed further below, the exposure levels implicated in all of these studies are lower – indeed orders of magnitude lower on a decibel scale – than the threshold used to evaluate airgun behavioral impacts in the DPEIS. Repeated insult from airgun surveys, over months and seasons, would come on top of already urbanized levels of background noise and, cumulatively and individually, would pose a significant threat to populations of marine mammals.

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[5] *See, e.g.*, Hildebrand, J.A., Impacts of anthropogenic sound, *in* Reynolds, J.E. III, Perrin, W.F., Reeves, R.R., Montgomery, S., and Ragen, T.J. (eds), *Marine Mammal Research: Conservation beyond Crisis* (2006); Weilgart, L., The impacts of anthropogenic ocean noise on cetaceans and implications for management. *Canadian Journal of Zoology* 85: 1091-1116 (2007).

[6] Clark, C.W., and Gagnon, G.C., Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E9); Clark, C.W., pers. comm. with M. Jasny, NRDC (Apr. 2010); *see also* MacLeod, K., Simmonds, M.P., and Murray, E., Abundance of fin (*Balaenoptera physalus*) and sei whales (*B. Borealis*) amid oil exploration and development off northwest Scotland, *Journal of Cetacean Research and Management* 8: 247-254 (2006).

[7] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10).

[8] *Id.*; Weilgart, L. (ed.), Report of the workshop on alternative technologies to seismic airgun surveys for oil and gas exploration and their potential for reducing impacts on marine mammals, 31 Aug. – 1 Sept., 2009, Monterey, Calif. (2010) (available at www.okeanos-stiftung.org/okeanos/download.php?id=19).

[9] Clark et al., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources; Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009).

Airguns are known to affect a broad range of other marine mammal species beyond the endangered great whales. For example, sperm whale foraging appears to decline significantly on exposure to even moderate levels of airgun noise, with potentially serious long-term consequences;[10] and harbor porpoises have been seen to engage in strong avoidance responses fifty miles from an array.[11] Seismic surveys have been implicated in the long-term loss of marine mammal biodiversity off the coast of Brazil.[12] Broader work on other sources of undersea noise, including noise with predominantly low-frequency components, indicates that beaked whale species would be highly sensitive to seismic noise as well.[13]

Airgun surveys also have important consequences for the health of fisheries. For example, airguns have been shown to dramatically depress catch rates of various commercial species (by 40-80%) over thousands of square kilometers around a single array,[14] leading fishermen in some parts of the world to seek industry compensation for their losses. Other impacts on commercially harvested fish include habitat abandonment – one hypothesized explanation for the fallen catch rates – reduced reproductive performance, and hearing loss.[15] Even brief playbacks of predominantly low-frequency noise from speedboats have been shown to significantly impair the ability of some fish species to forage.[16] Recent data suggest that loud, low-frequency sound also disrupts chorusing in black drum fish, a behavior essential to breeding in this commercial

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[10] Miller, P.J.O., Johnson, M.P., Madsen, P.T., Biassoni, N., Quero, M., and Tyack, P.L., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I* 56: 1168-1181 (2009).

[11] Bain, D.E., and Williams, R., Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E35).

[12] Parente, C.L., Pauline de Araújo, J., and Elisabeth de Araújo, M., Diversity of cetaceans as tool in monitoring environmental impacts of seismic surveys, *Biota Neotropica* 7(1) (2007).

[13] Tyack, P.L., Zimmer, W.M.X., Moretti, D., Southall, B.L., Claridge, D.E., Durban, J.W., Clark, C.W., D'Amico, A., DiMarzio, N., Jarvis, S., McCarthy, E., Morrissey, R., Ward, J., and Boyd, I.L. (2011), Beaked whales respond to simulated and actual Navy sonar, PLoS ONE 6(3): e17009. Doi:10.1371/journal.pone.0017009; Soto, N.A., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A., and Borsani, J.F. (2006), Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (Ziphius cavirostris)? Mar. Mamm. Sci. 22: 690-699.

[14] Engås, A., Løkkeborg, S., Ona, E., and Soldal, A.V., Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), *Canadian Journal of Fisheries and Aquatic Sciences* 53: 2238-2249 (1996); *see also* Skalski, J.R., Pearson, W.H., and Malme, C.I., Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes ssp.*), *Canadian Journal of Fisheries and Aquatic Sciences* 49: 1357-1365 (1992).

[15] McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, K., Marine seismic surveys: analysis and propagation of air-gun signals, and effects of air-gun exposure on humpback whales, sea turtles, fishes, and squid (2000) (report by Curtin U. of Technology); McCauley, R., Fewtrell, J., and Popper, A.N., High intensity anthropogenic sound damages fish ears, *Journal of the Acoustical Society of America* 113: 638-642 (2003); Scholik, A.R., and Yan, H.Y., Effects of boat engine noise on the auditory sensitivity of the fathead minnow, *Pimephales promelas*, *Environmental Biology of Fishes* 63: 203-209 (2002).

[16] Purser, J., and Radford, A.N., Acoustic noise induces attention shifts and reduces foraging performance in three-spined sticklebacks (Gasterosteus aculeatus), PLoS One, 28 Feb. 2011, DOI: 10.1371/journal.pone.0017478 (2011).

species.[17] Several studies indicate that airgun noise can kill or decrease the viability of fish eggs and larvae.[18]

The amount of disruptive activity under consideration in this PEIS is enormous. Since MMS issued its Notice of Intent in 2010, it has received roughly 10 applications for G&G activity in the Atlantic region. 75 Fed. Reg. 16830, 16832. Most of these applications involve extensive airgun surveys in the Mid-Atlantic and South Atlantic planning regions: for example, Spectrum Geo has proposed shooting 112,500 line miles of surveys from Massachusetts down to Florida, Western Geco another 54,900 miles between New Jersey and Georgia, and CGG Veritas more than 42,000 miles running northwards from Florida.[19] As you know, industry will conduct more surveys as areas are opened for leasing, and will send ships back again and again to certain areas of interest to see how geologic features there change over time.

In all, the PEIS estimates more than 617,000 kilometers of 2D surveys, 2500 blocks of 3D/ 4D surveys (each block being about 9 square miles), and 900 blocks of wide-azimuth surveys in the Mid-Atlantic and South Atlantic Planning Areas through 2020, plus hundreds of thousands of additional kilometers of high-resolution surveys, vertical seismic profiling, and electromagnetic exploration, plus disturbance from vessel noise, node and cable installation, and other activities. PEIS at Table 3-3. The 2D surveys alone equate to about 8.8 years of continuous airgun activity, running 24 hours per day, 365 days per year, assuming vessel speeds of 4.5 knots. The 3D surveys, which according to BOEM's assumptions would not even begin until 2016, amount to 4 to 10.8 years of continuous activity assuming (per recent 3D surveys in the Arctic) 7 to 19 miles of trackline for every square mile of lease block. There is no indication that these estimates represent a worst-case scenario for G&G activity in the region, nor does the PEIS provide any projections for G&G activity beyond the 2013-2020 study period. In any case, BOEM is contemplating an enormous amount of activity with a vast environmental footprint.

B. Compliance with NEPA

Enacted by Congress in 1969, NEPA establishes a national policy to "encourage productive and enjoyable harmony between man and his environment" and "promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man." 42 U.S.C. § 4321. In order to achieve its broad goals, NEPA mandates that "to the fullest extent possible" the "policies, regulations, and public laws of the United States shall be

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[17] Clark, C.W., pers. comm. with M. Jasny, NRDC (Apr. 2010).

[18] Booman, C., Dalen, J., Leivestad, H., Levsen, A., van der Meeren, T., and Toklum, K., Effecter av luftkanonskyting på egg, larver og yngel (Effects from airgun shooting on eggs, larvae, and fry), *Fisken og Havet* 3:1-83 (1996) (Norwegian with English summary); Dalen, J., and Knutsen, G.M., Scaring effects on fish and harmful effects on eggs, larvae and fry by offshore seismic explorations, *in* Merklinger, H.M., *Progress in Underwater Acoustics* 93-102 (1987); Banner, A., and Hyatt, M., Effects of noise on eggs and larvae of two estuarine fishes, *Transactions of the American Fisheries Society* 1:134-36 (1973); L.P. Kostyuchenko, Effect of elastic waves generated in marine seismic prospecting on fish eggs on the Black Sea, *Hydrobiology Journal* 9:45-48 (1973).

[19] MMS, Atlantic Geological and Geophysical (G&G) Activities Programmatic Environmental Impact Statement (PEIS), *available at* www.gomr.mms.gov/hompg/offshore/atlocs/gandg.html (accessed May 12, 2010).

interpreted and administered in accordance with [NEPA]." 42 U.S.C. § 4332. As the Supreme Court explained,

> NEPA's instruction that all federal agencies comply with the impact statement requirement – and with all the requirements of § 102 – "to the fullest extent possible" [cit. omit.] is neither accidental nor hyperbolic. Rather the phrase is a deliberate command that the duty NEPA imposes upon the agencies to consider environmental factors not be shunted aside in the bureaucratic shuffle.

Flint Ridge Development Co. v. Scenic Rivers Ass'n, 426 U.S. 776, 787 (1976). Central to NEPA is its requirement that, before any federal action that "may significantly degrade some human environmental factor" can be undertaken, agencies must prepare an environmental impact statement. *Steamboaters v. F.E.R.C.*, 759 F.2d 1382, 1392 (9th Cir. 1985) (emphasis in original).

The fundamental purpose of an EIS is to force the decision-maker to take a "hard look" at a particular action – at the agency's need for it, at the environmental consequences it will have, and at more environmentally benign alternatives that may substitute for it – before the decision to proceed is made. 40 C.F.R. §§ 1500.1(b), 1502.1; *Baltimore Gas & Electric v. NRDC*, 462 U.S. 87, 97 (1983). This "hard look" requires agencies to obtain high quality information and accurate scientific analysis. 40 C.F.R. § 1500.1(b). "General statements about possible effects and some risk do not constitute a hard look absent a justification regarding why more definitive information could not be provided." *Klamath-Siskiyou Wilderness Center v. Bureau of Land Management*, 387 F.3d 989, 994 (9th Cir. 2004) (*quoting Neighbors of Cuddy Mountain v. United States Forest Service*, 137 F.3d 1372, 1380 (9th Cir. 1998)). The law is clear that the EIS must be a pre-decisional, objective, rigorous, and neutral document, not a work of advocacy to justify an outcome that has been foreordained.

To comply with NEPA, an EIS must *inter alia* include a "full and fair discussion" of direct and indirect environmental impacts (40 C.F.R. § 1502.1), consider the cumulative effects of reasonably foreseeable activities in combination with the proposed action (*id.* § 1508.7), analyze all reasonable alternatives that would avoid or minimize the action's adverse impacts (*id.* § 1502.1), address measures to mitigate those adverse effects (*id.* § 1502.14(f)), and assess possible conflicts with other federal, regional, state, and local authorities (*id.* § 1502.16(c)). We offer the following comments to ensure MMS' compliance with these important mandates.

III. ALTERNATIVES AND MITIGATION

According to NEPA's implementing regulations, the alternatives analysis is "the heart of the environmental impact statement" and is intended to "provid[e] a clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. § 1502.14. The alternatives analysis should "serve as the means of assessing the environmental impact of proposed agency actions, rather than justifying decisions already made." *Id.* § 1502.2(g). Additionally, agencies are required to disclose and analyze measures to mitigate the impacts of proposed actions. *Id.* §§ 1502.14(f), 1502.16(h). This analysis must be "reasonably complete" in order to properly evaluate the severity of the adverse effects of an agency's proposed action prior to the agency making a final decision. *Robertson v. Methow Valley Citizens Council*, 490 U.S. 332, 352 (1989). Unfortunately, the PDEIS' alternatives and mitigation analyses are incomplete and do not satisfy the regulatory standards.

A. Failure to Develop Reasonable Alternatives

The purpose of an EIS is to "rigorously explore and objectively evaluate all reasonable alternatives" to the proposed action. 40 C.F.R. § 1502.14(a). That discussion of alternatives "is the heart of the [EIS]" (*id.* at § 1502.14), and it "guarantee[s] that agency decision-makers have before them and take into proper account all possible approaches to a particular project (including total abandonment of the project) which would alter the environmental impact and the cost-benefit balance." *Alaska Wilderness Recreation & Tourism Ass'n v. Morrison*, 67 F.3d 723, 729 (9th Cir. 1995) (quoting *Bob Marshall Alliance v. Hodel*, 852 F.2d 1223, 1228 (9th Cir. 1988)); *see also Angoon v. Hodel*, 803 F.2d 1016, 1020 (9th Cir. 1986) ("[T]he touchstone for our inquiry is whether an EIS's selection and discussion of alternatives fosters informed decision-making and informed public participation.") (quoting *California v. Block*, 690 F.2d 753, 767 (9th Cir. 1982)). These standards have not been met.

1. Failure to develop alternatives based on different permissible levels of activity

BOEM should place meaningful caps or limits on offshore activities that disrupt marine mammal behavior. As NOAA has found, "[t]here is currently a great deal of concern that a variety of human sources of marine sound (e.g., vessel traffic, seismic activity, sonar, and construction activities) are acting in a cumulative way to degrade the environment in which sound-sensitive animals communicate."[20] Airguns in particular can cause low-frequency background noise to rise significantly over very large areas of ocean (see *infra* at § IV.B.1), and the best available evidence indicates that such noise can interfere with foraging in some species at moderate levels of exposure,[21] and substantially interfere with the communication abilities of marine mammals, particularly baleen whales, at very considerable distances.[22] These effects cannot be eliminated through the use of area closures alone, especially given the long distances at which masking can occur. Yet the DPEIS declines even to consider an alternative limiting the amount of activity that can be conducted in the Atlantic, or part of the Atlantic, over a given period.

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[20] Memorandum from Dr. Jane Lubchenco, Undersecretary of Commerce for Oceans and Atmosphere, to Nancy Sutley, Chair, Council on Environmental Quality at 2 (Jan. 19, 2010).

[21] *E.g.*, Miller, P.J.O., Johnson, M.P., Madsen, P.T., Biassoni, N., Quero, M., and Tyack, P.L., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I* 56: 1168-1181 (2009).

[22] *E.g.*, Clark, C.W., and Gagnon, G.C., Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E9); Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10).

The DPEIS does not provide any reason for BOEM's lack of consideration of activity limits. In their recent DPEIS for Arctic geophysical exploration, however, the agencies based their tentative rejection of this alternative not on the grounds that it exceeded their legal authority, but that it did not meet the purpose and need of the proposed action.[23]

In fact, determining the legally acceptable limits of activity is essential to NMFS' issuance of take authorizations in the Atlantic – which, presumably, would be that agency's purpose and need.[24] Pursuant to NMFS' own general regulations, an incidental harassment authorization must be revoked if the authorized takings "individually or in combination with other authorizations" are having more than a negligible impact on the population or an unmitigable adverse impact on subsistence.[25] Unfortunately, the DPEIS makes no attempt to assess whether the scope of activities it contemplates satisfies the negligible impact standard. Similarly, considering limits on activities is essential to BOEM's permitting and other requirements under OCSLA.

In the Arctic, instead of developing a suitable alternative for the EIS, the agencies proposed, in effect, to consider overall limits on activities when evaluating individual applications under OCSLA and the MMPA.[26] It would, however, be much more difficult for NMFS or BOEM to undertake that kind of analysis in an individual IHA application or OCSLA exploration plan because the agencies often lack sufficient information to take an overarching view of the activities occurring that year. Determining limits at the outset would also presumably reduce uncertainty for industry. In short, excluding any consideration of activity limits from the alternatives analysis in this EIS frustrates the purpose of programmatic review, contrary to NEPA.[27]

2. Failure to develop alternative based on eliminating duplicative survey effort

It seems obvious that BOEM should eliminate duplication of survey effort and should not permit multiple surveys, or parts of surveys, in the same locations for the same or similar purposes. NMFS' expert Open Water Panel has twice called for the elimination of unnecessary, duplicative surveys, whether through required data sharing or some other means.[28] In the Atlantic, data

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[23] National Marine Fisheries Service, Effects of Oil and Gas Activities in the Arctic Ocean, Draft Environmental Impact Statement at 2-45 (Dec. 2011).

[24] *Id*. at 1-3 to 1-4.

[25] 50 C.F.R. § 216.107(f)(2). Additionally, NMFS must ensure that the activity does not take more than "small numbers" of marine mammal species and stocks – another standard that the agency improperly fails to evaluate in the DPEIS.

[26] National Marine Fisheries Service, Effects of Oil and Gas Activities in the Arctic Ocean, Draft Environmental Impact Statement at 2-45 (Dec. 2011).

[27] *See also* 40 C.F.R. § 1500.2(e) (stating that agencies should identify and assess alternatives that would "avoid or minimize adverse effects of [proposed] actions upon the quality of the human environment").

[28] Burns, J., Clark, C., Ferguson, M., Moore, S., Ragen, T., Southall, B., and Suydam, R., Expert panel review of monitoring and mitigation protocols in applications for incidental harassment authorizations related to oil and gas exploration, including seismic surveys, in the Chukchi and Beaufort Seas at 10 (2010) (Expert Panel Review 2010); Brower, H., Clark, C.W., Ferguson, M., Gedamke, J., Southall, B., and Suydam, R., Expert panel review of

sharing through the use of common surveyors seems particularly appropriate given the large number of wide-ranging 2-D surveys for which applications have already been received.

The DPEIS does not analyze this alternative "because its main benefit (a limit on concurrent surveys) is already addressed by Alternative B." DPEIS at 2-49. Putting aside the fact that Alternative B may not be adopted, BOEM has obviously mischaracterized the effects and benefits of a consolidation measure. Consolidating surveys would reduce concurrence by the standards of BOEM's Alternative B only if the surveys in question happened to come within 40 km of one another *while operating* – a scenario that seems likely to represent a relatively small number of instances. On the contrary, the plain benefit of consolidation is to reduce the cumulative, not necessarily simultaneous, impacts of seismic activity on marine species. As NMFS' expert Open Water Panel observed: "Although the risks to marine mammals and marine ecosystems are still somewhat poorly described, unnecessarily duplicative surveys must increase those risks."[29] BOEM's stated rationale for not considering this alternative does not make sense.

Additionally, BOEM avers that consolidating and coordinating surveys "does not clearly fall under the mandates of this Agency," or its sister agencies the Department of Energy and U.S. Geological Survey. DPEIS at 2-49. This argument seems similar to one advanced in the Arctic DPEIS, wherein the agencies suggested that BOEM could not adopt a data sharing measure, on the grounds that it cannot "require companies to share proprietary data, combine seismic programs, change lease terms, or prevent companies from acquiring data in the same geographic area."[30] Yet this analysis overlooks BOEM's statutory duty under OCSLA to approve only those permits whose exploration activities are not "unduly harmful" to marine life. 43 U.S.C. § 1340(a); *see also* 30 C.F.R. § 550.202. While OCSLA does not define the standard, it is difficult to imagine an activity more expressive of "undue harm" than a duplicative survey, which obtains data that the government and industry already possess and therefore is not necessary to the "expeditious and orderly development, subject to environmental safeguards" of the outer continental shelf. 30 U.S.C. § 1332(3). It is thus within BOEM's authority to decline individual permit applications that it finds are unnecessarily duplicative, in whole or part, of existing or proposed surveys or data.

Additionally, nothing in OCSLA bars BOEM from incentivizing the use of common surveyors or data sharing, as already occurs in the Gulf of Mexico, to reduce the total survey effort. Certainly the Gulf of Mexico business model has led to the "expeditious and orderly development" of that region. 30 U.S.C. § 1332(3). The DPEIS fails to consider this latter alternative, even though it could substantially reduce the quantity of 2-D survey effort expected in the region over the next several years. BOEM must consider an alternative that eliminates duplicative effort.

3. Failure to develop a viable technology-based alternative

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monitoring protocols in applications for incidental harassment authorizations related to oil and gas exploration in the Chukchi and Beaufort Seas, 2011: Statoil and ION Geophysical at 9 (2011) (Expert Panel Review 2011).

[29] Burns et al., Expert panel review at 10 (2010).

[30] National Marine Fisheries Service, Effects of Oil and Gas Activities in the Arctic Ocean, Draft Environmental Impact Statement at 2-46 (Dec. 2011).

The DPEIS, despite acknowledging the potential for alternative technology to reduce potential impacts on marine wildlife, has failed to develop and consider any alternatives for the development and implementation of that technology. DPEIS at 2-54.

New technology represents a promising means of reducing the environmental footprint of seismic exploration. Industry experts and biologists participating in a September 2009 workshop on airgun alternatives reached the following conclusions: that airguns produce a great deal of "waste" sound and generate peak levels substantially higher than needed for offshore exploration; that a number of quieter technologies are either available now for commercial use or can be made available within the next five years; and that, given the natural resistance of industry, governments should accelerate development and use of these technologies through both research and development funding and regulatory engagement.[31] Among the technologies discussed in the 2009 workshop report are engineering modifications to airguns, which can cut emissions at frequencies not needed for exploration; controlled sources, such as marine vibroseis, which can dramatically lower the peak sound currently generated by airguns by spreading it over time; various non-acoustic sources, such as electromagnetic and passive seismic devices, which in certain contexts can eliminate the need for sound entirely; and fiber-optic receivers, which can reduce the need for intense sound at the source by improving acquisition at the receiver.[32] An industry-sponsored report by Noise Control Engineering made similar findings about the availability of greener alternatives to seismic airguns, as well as alternatives to a variety of other noise sources used in oil and gas exploration.[33]

The draft EIS instead relies on out-of-date information in characterizing the availability of certain technologies. For example, marine vibroseis – which has the potential to reduce peak sound levels by 30 decibels or more and virtually eliminate output above 100 Hz – is on the verge of commercial availability, with useable arrays produced by Geo-Kinetics and PGS now being tested for their environmental impacts on fish, and other models in development through the Canadian government and a Joint Industry Program.[34] Yet the DPEIS uses a 2010 personal communication with PGS for the proposition that a commercial electric vibroseis array is not "available for data collection at this time" (DPEIS at 2-50) – an outdated observation that does

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[31] Weilgart, L. ed., Report of the workshop on alternative technologies to seismic airgun surveys for oil and gas exploration and their potential for reducing impacts on marine mammals, 31 Aug. – 1 Sept., 2009, Monterey, Calif. (2010), *available at* www.okeanos-stiftung.org/okeanos/download.php?id=19.

[32] *Id*.

[33] Spence, J., Fischer, R., Bahtiarian, M., Boroditsky, L., Jones, N., and Dempsey, R., Review of existing and future potential treatments for reducing underwater sound from oil and gas industry activities (2007) (NCE Report 07-001) (prepared by Noise Control Engineering for Joint Industry Programme on E&P Sound and Marine Life). Despite the promise indicated in the 2007 and 2010 reports, neither NMFS nor BOEM has attempted to develop noise-reduction technology for seismic or any other noise source, aside from BOEM's failed investigation of mobile bubble curtains.

[34] Tenghamn, R., An electrical marine vibrator with a flextensional shell, *Exploration Geophysics* 37:286-291 (2006); LGL and Marine Acoustics, Environmental assessment of marine vibroseis (2011) (Joint Industry Programme contract 22 07-12).

not reflect current fact. Nor does the DPEIS consider the specific airgun modifications discussed in Weilgart (2010). *See* DPEIS at 2-53.

Critically, the DPEIS fails to include any actionable alternatives to require, incentivize, or test the use of new technologies in the Atlantic, or indeed in any other region. Such alternatives include: (1) mandating the use of marine vibroseis or other technologies in pilot areas, with an obligation to accrue data on environmental impacts; (2) creating an adaptive process by which marine vibroseis or other technologies can be required as they become available; (3) deferring the permitting of surveys in particular areas or for particular applications where effective mitigative technologies, such as marine vibroseis, could reasonably be expected to become available within the life of the EIS; (4) providing incentives for use of these technologies as was done for passive acoustic monitoring systems in NTL 2007-G02; and (5) exacting funds from applicants to support accelerated mitigation research in this area. The final EIS must consider these alternatives.

B. Failure to Consider Additional Time-Place Restrictions

Time and place restrictions designed to protect high-value habitat are one of the most effective means to reduce the potential impacts of noise and disturbance, including noise from oil and gas exploration.[35] It was for this express reason that NOAA, in 2011, established a working group on Cetacean Density and Distribution Mapping, to define marine mammal hotspots for management purposes.[36] Unfortunately, the PDEIS, while identifying two possible time-area closures for North Atlantic right whales and one possible closure for sea turtles, does not consider any other areas for any other species. Nor, as discussed below, are its proposed right whale closures adequate to protect right whales.

As a general matter, the PDEIS does not give any consideration to year-round area closures, for reasons that are unclear. It makes no sense to open up areas for geophysical exploration – adding to the cumulative noise burden, impairing the communication space of the right whale and other species – that are unlikely to be leased, whether for biological, political, or economic reasons. For example, the lease sale area off Virginia that Interior included in its 2012-2017 leasing program (but aborted after the BP spill) stood more than 50 miles offshore, in order to reduce

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[35] *See, e.g.*, Agardy, T., Aguilar Soto, N., Cañadas, A., Engel, M., Frantzis, A., Hatch, L., Hoyt, E., Kaschner, K., LaBrecque, E., Martin, V., Notarbartolo di Sciara, G., Pavan, G., Servidio, A., Smith, B., Wang, J., Weilgart, L., Wintle, B., and Wright, A, A global scientific workshop on spatio-temporal management of noise, Report of workshop held in Puerto Calero, Lanzarote, June 4-6, 2007 (2007); Dolman, S., Aguilar Soto, N., Notabartolo di Sciara, G., Andre, M., Evans, P., Frisch, H., Gannier, A., Gordon, J., Jasny, M., Johnson, M., Papanicolopulu, I., Panigada, S., Tyack, P., and Wright, A., Technical report on effective mitigation for active sonar and beaked whales (2009) (working group convened by European Cetacean Society); OSPAR Commission, Assessment of the environmental impact of underwater noise (2009) (report issued as part of OSPAR Biodiversity Series, London, UK); Convention on Biological Diversity, Scientific synthesis on the impacts of underwater noise on marine and coastal biodiversity and habitats (2012) (UNEP/CBD/SBSTTA/16/INF/12).

[36] Memorandum from Dr. Jane Lubchenco, Undersecretary of Commerce for Oceans and Atmosphere, to Nancy Sutley, Chair, Council on Environmental Quality at 2 (Jan. 19, 2010).

conflict with military, fishing, and other uses. 73 Fed. Reg. 67201, 67205 (Nov. 13, 2008).[37] If lease sales are unlikely within 50 miles of the Virginia shore, seismic exploration can be excluded from these areas while meeting the stated purpose and need. BOEM should identify areas within the mid- and southeast Atlantic that are unlikely to be opened to lease sales within the 2017-2022 period due to conflict of use, political opposition, and other factors, and consider an alternative (or alternatives) that restricts oil and gas exploration in these areas.

Recently, in their DEIS for oil and gas exploration in the Arctic, BOEM and NMFS argued that they lack authority under the MMPA and OCSLA to prescribe year-round closures.[38] Instead, they suggest that the proper time for consideration of permanent closures is during the offshore leasing program and lease sale processes.[39] Yet BOEM's relegation of this alternative to the leasing process is not consistent with its obligation, at the exploration and permit approval stage, to reject applications that would cause "serious harm" or "undue harm." *E.g.*, 43 U.S.C. § 1340(a); 30 C.F.R. § 550.202. It is reasonable for BOEM to define areas where exploration activities would exceed these legal thresholds regardless of time of year, just as it defines areas for seasonal avoidance pursuant to other OCSLA and MMPA standards. Moreover, the lease sale stage is not a proper vehicle for considering permanent exclusions for strictly off-lease activities, such as the off-lease seismic surveys that would account for all of the oil and gas exploration activity during the first five years of the study period. The DPEIS must consider establishing year-round exclusion areas as well as seasonally-based closures.

Finally, as a general matter, the PDEIS does not consider establishing buffer zones around areas of biological importance, aside from a "setback distance" to prevent seafloor disturbance within the Monitor and Gray's Reef National Marine Sanctuaries and such other buffer zones as may be warranted to protect benthic communities. DPEIS at C-18.[40] Buffer zones are a standard feature of biosphere reserves; have been recommended by numerous experts for use in mitigation of undersea noise around reserves, exclusion areas, and National Marine Sanctuaries; and are regularly prescribed by NMFS around exclusion areas for Navy sonar training.[41] NMFS has established a list of objectives for habitat avoidance and other mitigation measures, including reduction in the total number of marine mammal takes and the reduction in the severity, intensity, or number of exposures, particularly (but not exclusively) for vulnerable species. *See*,

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[37] BOEMRE, Virginia Lease Sale 220 Information (2010), *available at* www.gomr.boemre.gov/homepg/lsesale/220/matl220.html (accessed June 2012) (confirming lease sale area is at least 50 miles offshore).

[38] National Marine Fisheries Service, Effects of Oil and Gas Activities in the Arctic Ocean, Draft Environmental Impact Statement at 2-44 (Dec. 2011).

[39] *Id*.

[40] The DPEIS does incorrectly mischaracterize its proposed seasonal exclusion for right whales, as set forth in Alternative B, as a "continuous buffer… from active acoustic sources" (DPEIS at 4-213) but this exclusion area represents part of the right whale's migratory corridor and calving grounds, not a buffer zone.

[41] *E.g.*, Agardy et al., A global scientific workshop on spatio-temporal management of noise; Hatch, L.T., and Fristup, K.M., No barrier at the boundaries: Implementing regional frameworks for noise management in protected natural areas, *Marine Ecology Progress Series* 395: 223-244 (2009); Hoyt, E., Marine Protected Areas for Whales, Dolphins, and Porpoises: A World Handbook for Cetacean Habitat Conservation and Planning, 2nd Edition (2011); 72 Fed. Reg. 46846, 46846-46893 (Apr. 21, 2007).

e.g., 74 Fed. Reg. 3886 (Jan. 21, 2009). On this basis, BOEM should consider and adopt meaningful buffer zones around its exclusion areas.

More specifically:

1. Time-place restrictions for marine mammals

The DPEIS study area includes important marine mammal habitat that was not considered for time-place restrictions. For example:

(a) North Atlantic right whale habitat

The cetacean species of greatest concern in the region is the North Atlantic right whale, a species that has a minimum population of only about 361 whales and is considered the most imperiled large whale on the planet. In order to protect this species and comply with its obligations under the Endangered Species Act, BOEM must seasonally exclude all North Atlantic right whale habitat areas from seismic and other proposed activities. These areas include both the designated critical habitat identified in the PDEIS' Alternative A as well as areas that have not yet been designated as critical habitat but are known to be important migratory habitat.

Notably, NMFS is considering whether to expand right whale critical habitat in response to a Sept. 16, 2009 petition filed by the Center for Biological Diversity, Humane Society of the United States, Whale and Dolphin Conservation Society, Defenders of Wildlife, and Ocean Conservancy. That petition identified additional areas that are critical for breeding, raising calves, migrating, and feeding, and which should be included as designated critical habitat for the species. In relevant part, the petitioners requested that NMFS:

> …
>
> (2) expand right whale critical habitat in the waters off the Southeast United States to include coastal waters from the shore out to 35 nautical miles off the coast of South Carolina, and waters off the coast of Georgia and Florida from approximately 32.0° N latitude, 80.35° W southward to approximately 28° N latitude, 80.35° W longitude…; and
>
> (3) designate as right whale critical habitat coastal waters all waters along the migratory corridor of the mid-Atlantic from the shore out to 30 nautical miles, between the northern border of South Carolina (approximately 33.85° N latitude and 78.53° W longitude) northward to the southeastern corner of Cape Cod, Massachusetts (approximately 41.55° N latitude, 70.0° W longitude), southeastward to the southern

corner of the current Great South Channel Critical Habitat (41.0° N latitude and 69.1° W longitude).[42]

It is worth noting that a 30 nm coastal exclusion (along the lines defined above) does not include a buffer zone as the DPEIS suggests (DPEIS at 4-213), but reflects the extent of the right whale migratory corridor itself.[43] Regardless of their status as critical habitat, these areas should be avoided, and added to the DPEIS' alternatives analysis as an extension to the 20 nm coastal time-area closure of Alternative B.

Additionally, contrary to the present Alternatives A and B (*see* DPEIS at 2-4), a seasonal exclusion for right whales should also apply to HRG surveys, including for renewables. During the migration, any substantial deflection of mothers and calves around a low- to mid-frequency sound source such a sub-bottom profiler – a result that is particularly likely for activities occurring landward of the animals –[44] could put the animals at greater risk of killer whale predation or exposure to rougher seas. In the calving grounds as well as the migration corridor, any behavioral response similar to that observed in Nowacek et al. (2004) – in which right whales, responding to an acoustic alarm, positioned themselves directly below the water surface – would put them at substantially greater risk of vessel collision. Right whales were demonstrated to respond significantly to alarm signals, which occupied the same frequencies as the sub-bottom profilers intended for HRG surveys, at received levels of 133-148 dB re 1 µPa (RMS).[45] If anything, these levels could underestimate the response threshold for many of the whales, given the heightened reactions to other sound sources that have been observed in baleen whale mothers and calves.[46]

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[42] Center for Biological Diversity, The Humane Society of the United States, Whale and Dolphin Conservation Society, Defenders of Wildlife, and Ocean Conservancy, Petition to Revise Critical Habitat Designation for the North Atlantic Right Whale at 1-2 (2009).

[43] Knowlton, A.R., Ring, J.B., and Russell, B., Right whale sightings and survey effort in the mid-Atlantic region: Migratory corridor, time frame, and proximity to port entrances (2002) (report submitted to NMFS ship-strike working group); Kraus, S., New England Aquarium, pers. comm. with Michael Jasny, NRDC (Apr. 2012). *See also* Fujiwara, M., and Caswell, H., Demography of the endangered North Atlantic right whale, *Nature* 414: 537-541 (2001); Kraus, S.D., Prescott, J.H, Knowlton, A.R., and Stone, G.S., Migration and calving of right whales (*Eubalaena glacialis*) in the western North Atlantic, *Reports of the International Whaling Commission* 10: 139-144 (1986); Ward-Geiger, L.I., Silber, G.K., Baumstark, R.D., and Pulfer, T.L., Characterization of ship traffic in right whale critical habitat, *Coastal Management* 33: 263-278 (2005).

[44] Buck, J.R., and Tyack, P.L., Reponses of gray whales to low frequency sounds, *Journal of the Acoustical Society of America* 107: 2774 (2000).

[45] Nowacek, D.P., Johnson, M.P., and Tyack, P.L., Right whales ignore ships but respond to alarm stimuli, *Proc. Royal Soc. London, Pt. B: Biol. Sci.* 271: 227-231 (2004).

[46] *E.g.*, McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J., and McCabe, K., Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid (2000) (report from Curtin University of Technology). It is also worth noting that, under some conditions, migrating bowheads avoid airgun pulses out to the 120 dB isopleths and gray whales avoid industrial noise and low-frequency sounds out to 120 dB or 140 dB. Buck and Tyack, Responses of gray whales, *supra*; Malme, C.I., Miles, P.R., Clark, C.W., Tyack, P., and Bird, J.E., Investigations of the potential effects of underwater noise from petroleum industry activities on migrating gray whale behavior: Phase II: January 1984 migration (1984) (NTIS PB86-218377); Richardson, W.J., Miller, G.W.,

Received levels of 130 dB and above could easily occur more than 10 kilometers from the chirpers, boomers, and pile drivers at issue here. Real-time visual monitoring is very difficult for right whales, especially during high sea states, nighttime operations, and other low-visibility conditions, and is further complicated by the size of the impact zone that the monitoring effort would have to cover.[47]

As NRDC observed in our comments on BOEM's recent EA on mid-Atlantic Wind Energy Areas, we would support allowing some small amount of sub-bottom profiling activity to occur during the winter exclusion period provided (1) that the operators have conscientiously planned to complete their HRG surveys outside the seasonal exclusion months, (2) that their inability to complete the surveys is due to unforeseen circumstances, and (3) that permitting some small amount of HRG activity to occur during the winter months would allow them to avoid extending their survey effort into the following calendar year. That said, given the conservation status of this species, we recommend extension of the right whale time-area closure to HRG activity.

(b) Cape Hatteras Special Research Area

The area of interest also includes habitat known to be important for multiple cetacean species. For example, the continental shelf break off Cape Hatteras features a major oceanic front created by the Gulf Stream, which veers off into the Atlantic and merges with Labrador Current, creating conditions for warm-core rings and high abundance of marine mammals and fish.[48] Among the many species that are drawn to this area in high abundance are long- and short-finned pilot whales and Risso's dolphin, whose interactions with the pelagic longline fishery have exceeded the insignificance threshold for potential biological removal and triggered the formation

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and Greene, C.R., Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea, *Journal of the Acoustical Society of America* 106: 2281 (1999).

[47] *E.g.*, Barlow, J., and Gisiner, R., Mitigation and monitoring of beaked whales during acoustic events, *Journal of Cetacean Research and Management* 7: 239-249 (2006); 72 Fed. Reg. 46846, 46875 (Aug. 21, 2007) (SURTASS LFA rulemaking); Dolman, S., Aguilar de Soto, N., Notabartolo di Sciara, G., Andre, M., Evans, P., Frisch, H., Gannier, A., Gordon, J., Jasny, M., Johnson, M., Papanicolopulu, I., Panigada, S., Tyack, P., and Wright, A., Technical report on effective mitigation for active sonar and beaked whales (2009) (report from European Cetacean Society); Parsons, E.C.M., Dolman, S.J., Jasny, M., Rose, N.A., Simmonds, M.P., and Wright, A.J., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practice? *Marine Pollution Bulletin* 58: 643-651 (2009).

[48] Churchill, J., Levine, E., Connors, D., and Cornillon, P., Mixing of shelf, slope and Gulf Stream water over the continental slope of the Middle Atlantic Bight, *Deep Sea Research Part I: Oceanographic Research Papers*, 40: 1063-1085 (1993); Hare, J., Churchill, J., Cowen, R., Berger, T., Cornillon, P., Dragos, P., Glenn, S.M., Govoni, J.J., and Lee, T.N., Routes and rates of larval fish transport from the southeast to the northeast United States continental shelf, *Limnology and Oceanography* 47: 1774-1789 (2002); Garrison, L., Swartz, S., Martinez, A., Burks, C., and Stamates, J., A marine mammal assessment survey of the southeast US continental shelf: February-April 2002 (2003) (NOAA Technical Memorandum NMFS-SEFSC-492); Waring, G., Josephson, E., Fairfield-Walsh, C., and Maze-Foley, K., U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments—2008 (2009) (NOAA Tech Memo NMFS NE 210); 74 Fed. Reg. 23349, 23349-23358 (May 19, 2009).

of a take reduction team under the MMPA.[49] The Cape Hatteras Special Research Area, designated by NMFS as a tool to manage the marine mammal-fishery interactions, captures most of the crucial habitat, having some of the highest densities of cetaceans in the entire region and being one of the most important sites for charter, commercial, and recreational pelagic fisheries.[50] BOEM must consider excluding – and, indeed, under any meaningful management plan, must exclude – this area.

(c) Other areas identifiable through habitat mapping

Remarkably, BOEM has not attempted any systematic analysis of marine mammal habitat for purposes of establishing time-area closures within the area of interest. This stands in obvious counter-distinction to the Navy's 2008 programmatic EIS for sonar activities in the region, which formulated several alternatives based on predictive modeling of marine mammal habitat. There is no reason why a similar analysis should not be done here. Indeed, given the importance of time-area closures in mitigating acoustic impacts, such an analysis (and the gathering of any needed data in support of that analysis) is essential to a reasoned choice among alternatives. 40 C.F.R. § 1502.22.

(1) Predictive mapping.— Over the past few years, researchers have developed at least two predictive models to characterize densities of marine mammals in the area of interest: the NODE model produced by the Naval Facilities Engineering Command Atlantic, and the Duke Marine Lab model produced under contract with the Strategic Environmental Research and Development Program, both to fulfill the Navy's responsibilities for offshore activities under NEPA and other statutes.[51] Indeed, the Navy employed the NODE model in developing three habitat-based alternatives, in its own programmatic EIS, for sonar training off the U.S. east coast from 2009 to 2014.[52] Further, NOAA has convened a Cetacean Density and Distribution Mapping Group with the purpose of evaluating, compiling, supplementing, and enhancing available density information for marine mammals within the U.S. EEZ.[53] Its product, which includes habitat-based density maps and other data for nearly all of BOEM's area of interest, broken down by species and month, was

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[49] 74 Fed. Reg. 23349, 23350.

[50] 74 Fed. Reg. 23349; NMFS, Environmental Assessment, Regulatory Impact Review, and Final Regulatory Flexibility Analysis for the Final Pelagic Longline Take Reduction Plan (Jan. 2009) (produced by NMFS Southeast Regional Office).

[51] U.S. Navy, Final Atlantic Fleet Active Sonar Training Environmental Impact Statement/ Overseas Environmental Impact Statement (2008); Read, A., and Halpin, P., Final report: Predictive spatial analysis of marine mammal habitats (2010) (SI-1390, report prepared for SERDP); Duke Marine Lab, Marine Animal Model Mapper, *available at* http://seamap.env.duke.edu/serdp/serdp_map.php (accessed June 2012).

[52] Navy, Final Atlantic Fleet Active Sonar Training EIS.

[53] Memorandum from Dr. Jane Lubchenco, Undersecretary of Commerce for Oceans and Atmosphere, to Nancy Sutley, Chair, Council on Environmental Quality (Jan. 19, 2010).

shared in late May at an expert workshop that was partly funded by BOEM, and is slated for public release in early July.[54]

BOEM must use these sources, which represent best available science and, indeed, have partly been used in prior Navy NEPA analyses and rulemakings, to identify important marine mammal habitat and develop reasonable alternatives to the proposed action. *See* 40 C.F.R. § 1502.22. Species of particular importance, aside from the North Atlantic right whale, include the five other large whale species listed under the Endangered Species Act, *i.e.*, blue, fin, sei, humpback, and sperm whales; and beaked whales and harbor porpoises, whose vulnerability to anthropogenic noise is well recognized.

(2) Persistent oceanographic features.— Marine mammal densities are correlated over medium to large scales with persistent ocean features, such as ocean currents, productivity, and surface temperature, as well as with concentrations in other marine species, such as other apex predators and fish.[55] The occurrence of these features is often predictable enough to define core areas of biological importance on a year-round or seasonal basis.[56] In the area of interest, the most important of these features is the Gulf Stream; warm-core rings that develop off the Gulf Stream are likely to provide particularly important habitat for beaked whales, which are considered especially sensitive and vulnerable to anthropogenic sound. Analysis of these features should figure in predictive mapping, but can be used to supplement maps that do not take dynamic features into account.

2. Time-place restrictions for sea turtles

The single time-area closure included in Alternative B, a seasonal avoidance of coastal waters off Brevard County, Florida, is not sufficient to protect endangered and threatened species of sea turtles from harm due to proposed G&G activities off the mid- and south Atlantic.

BOEM's area of interest overlaps with populations of sea turtles, including green, leatherback, loggerhead, hawksbill, and Kemp's Ridley, and contains thousands of nesting locations of particular importance to loggerhead sea turtles. Indeed, the U.S. and Oman represent the majority of nesting sites for loggerhead sea turtles worldwide;[57] limiting anthropogenic disturbances to these nesting locations is paramount for the global conservation of this species. The DPEIS observes that "…breeding adults, nesting adult females, and hatchlings could be

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[54] NOAA, Cetecean and Sound Mapping, *available at* www.st.nmfs.noaa.gov/cetsound (accessed June 2012).

[55] Hyrenbach, K.D., Forney, K.A., and Dayton, P.K. (2000), Marine protected areas and ocean basin management, *Aquatic Conservation: Marine and Freshwater Ecosystems* 10:437-458.

[56] *Id.* ("Design Recommendations for Pelagic MPAs" include the use of persistent oceanographic features like sea temperature to define core areas for protection).

[57] FWS and NMFS, Recovery Plan for the Northwest Atlantic Population of the Loggerhead Sea Turtle (*Caretta caretta*) Second Revision (2008) (*available at* www.nmfs.noaa.gov/pr/pdfs/recovery/turtle_loggerhead_atlantic.pdf).

exposed to airgun seismic survey-related sound exposures at levels of 180 dB re 1 μPa or greater. Potential impacts could include auditory injuries or behavioral avoidance that interferes with nesting activities." DPEIS at 2-17. The recovery plan for the Northwest Atlantic population of loggerhead sea turtles also notes that several aspects of oil and gas activities, including seismic surveying, threaten these populations.[58] And recent analysis of sea turtle hearing confirms that loggerheads and other sea turtles have their greatest acoustic sensitivity below 400 Hz, which much of the energy produced by airguns is concentrated.[59] Given these findings, as well as the global significance of the region for loggerheads, all important habitats for endangered and threatened sea turtles in the area of interest should be avoided.

Although Brevard County, Florida represents vital loggerhead nesting habitat and must be protected, many additional sea turtle nesting sites are found each year within the mid- and south Atlantic planning areas, in Georgia, South Carolina, North Carolina, and other parts of Florida, as displayed in Figures 4-14 and 4-16 of the DPEIS. Volusia County, Florida, for instance, has had an average of 1,865 loggerhead sea turtles nests reported between 2007-2011.[60] In 2010 on Georgia beaches 1,761 loggerhead nests were found.[61] South Carolina sea turtle nests in 2011 included 4,018 loggerheads, 3 greens and 4 leatherbacks.[62] North Carolina sea turtle nests in 2011 included 948 loggerheads, 16 greens and 1 Kemp's Ridley.[63] Long-term datasets show nesting declines for loggerheads in North Carolina, South Carolina, Georgia, and southeast Florida, [64] and it is critical to their recovery to protect females heading to and from their nesting beaches as well as hatchlings that enter the neritic zone. Nesting females and hatchlings could be disturbed or injured by the proposed G&G activities in any of these locations through an increase in vessel traffic, accidental oil discharges, and noise propagation from the use of airguns. For these reasons, BOEM should exclude from seismic airgun activity all near-coastal waters from Florida through North Carolina, from May 1 through October 31, to protect both nesting females and hatchlings.

Important foraging and migrating habitat should also receive consideration for time-area closure. Loggerheads that were tracked after nesting at Archie Carr National Wildlife Refuge, in Brevard County, headed north and followed three main foraging and migratory patterns between Virginia

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[58] *Id*.

[59] Piniak, W.E.D., Mann, D.A., Eckert, S.A., and Harms, C.A., Amphibious hearing in sea turtles, *in* Popper, A.N., and Hawkins, A., eds., *The Effects of Noise on Aquatic Life* at 83-88 (2012).

[60] FWC/FWRI Statewide Nesting Beach Survey Program Database as of 8 Feb. 2012, Loggerhead Nesting Data 2007-2011, *available at* http://myfwc.com/media/2078432/LoggerheadNestingData.pdf.

[61] Georgia Department of Natural Resources. Sea Turtle Conservation and Research, *available at* http://www.georgiawildlife.com/node/1804 (accessed May 2012).

[62] South Carolina Department of Natural Resources, SC Marine Turtle Conservation Program, *available at* http://www.dnr.sc.gov/seaturtle/ (accessed May 2012).

[63] North Carolina Wildlife Commission, Sea Turtle Nest Monitoring System: North Carolina loggerhead, *available at* http://www.seaturtle.org/nestdb/index.shtml?view=1&year=2011.

[64] NMFS, Loggerhead Sea Turtle (*Caretta caretta*), *available at* http://www.nmfs.noaa.gov/pr/species/turtles/loggerhead.htm (accessed May 2012).

and North Carolina.[65] These foraging and migratory areas for loggerheads conflict with the mid- and south Atlantic planning areas, and the impacts to loggerheads could occur outside of nesting beaches.

Finally, BOEM must create time-area closures to avoid future conflicts with loggerhead critical habitat. NOAA has established Distinct Population Segments ("DPSs") for loggerheads, including in the Northwest Atlantic, and has until September 2012 to designate critical habitat for them. 76 Fed. Reg. 58868 (Sept. 22, 2011). The Final PEIS should reflect the current development of this rulemaking. BOEM should consult with NOAA on the designation and incorporate time-area closures within the Final PEIS to avoid conflicts with these areas.

In sum, BOEM should extend its proposed Brevard County exclusion to coastal areas from Florida up through North Carolina during the sea turtle nesting season, from May 1 through October 31; should identify and exclude important foraging and migrating habitat outside the nesting areas; and should establish time-area closures for all loggerhead critical habitat, which NMFS is required to designate, under the Endangered Species Act, by September 2012.

3. Time-place restrictions for fish and fisheries

The DPEIS does not consider any alternative that would exclude important fish habitat areas from G&G and other detrimental activities. While the document describes a number of areas in the mid-Atlantic and southeast Atlantic that provide especially important fish habitat and fishery resources, it simply dismisses effects on these areas.

Similarly, the Draft PEIS does not give serious consideration to space and use conflicts with commercial and recreational fisheries. The document considers such conflicts only in the context of permanent structures that physically block access to fishing sites, which it asserts will be rare. However, lethal and sublethal impacts to targeted fish species, including changes in their behavior or movements, as well as habitat degradation stemming from the proposed action would also adversely impact – and therefore conflicts with – commercial and recreational fishing uses.

The Final PEIS must consider alternatives that exclude key fish habitat and fisheries from the proposed action. These areas include:

(a) Charleston Bump and gyre complex.— Charleston Bump and the gyre surrounding it as a result of rapidly moving Gulf Stream waters provide a highly productive, nutrient-rich area that contributes significantly to primary and secondary production in the region. In addition, this area provides essential nursery habitat for numerous offshore fish species. The importance and sensitive nature of this seafloor and gyre habitat make it incompatible with the proposed seismic activities.

[65] Evans, D., Cariani, S., Ehrhart, L.M., Identifying migratory pathways and foraging habitat use by loggerhead turtles (*Caretta caretta*) nesting on Florida's east coast, *Sea Turtle Conservancy and UCF* (2011).

(b) The Point (also known as Hatteras Corner).— This area is formed at the confluence of the Gulf of Mexico with other water bodies, creating a highly productive open-water habitat. Adults of many highly migratory species such as tuna and swordfish congregate in this area. In addition, a wide diversity of larval fishes is found here.

(c) Ten Fathom Ledge and Big Rock.— These areas feature complex and valuable bottom habitat that is known to be used by some 150 reef-associated species. Ten Fathom Ledge encompasses numerous patch reefs consisting of coral, algae, and sponges on rock outcroppings covering 352 km^2 of ocean floor. Big Rock encompasses 93 km^2 of deep reef. Both areas are highly vulnerable to damage from bottom disturbances, sedimentation, and contamination associated with the proposed activities.

(d) Submarine canyons and canyon heads.— These structurally complex ecosystems provide critically important benthic and pelagic habitats for numerous fish species, sharks, sea birds, and marine mammals. The canyons plummet down several miles and their solid undersea walls provide a hard substrate foundation for bottom-dwelling species.[66] Among these is the golden tilefish, which create unique habitat for co-evolved species by burrowing extensively into the canyon walls, giving them the appearance of miniature, underwater versions of the pueblo villages of the American Southwest.[67] And the canyons represent high-value habitat for many other species, include monkfish, hakes, skates, American lobster, and red crab, as well as such lesser-known species as cod-like grenadiers and bioluminescent lanternfish.[68] Endangered sperm whales, beaked whales, dolphins, and other marine mammals come to the canyons and seamounts to feed on the schools of squid and fish that congregate there.[69] More than 200 species of invertebrates have been identified in the

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[66] Natural Resources Defense Council. Priority Ocean Areas for Protection in the Mid-Atlantic: Findings of NRDC's Marine Habitat Workshop at 25, 27 (Jan. 2001).

[67] *Id*.; Lumsden, S.E., T.F. Hourigan, A.W. Bruckner, & G. Dorr, eds., The state of deep coral ecosystems of the United States at 211 (2007) (NOAA Technical Memorandum CRCP-3, *available at* http://coris.noaa.gov/activities/deepcoral_rpt/pdfs/DeepCoralRpt2007.pdf).

[68] NRDC, Priority Ocean Areas; NMFS, Resource Survey Report: Bottom Trawl Survey. March 7 – April 28, 2007 (2009) (available at http://www.nefsc.noaa.gov/esb/rsr/sbts/sbts_2007/large_file.pdf); NMFS & NEFMC. Protecting Sensitive Deep-Sea Canyon Habitats through Fisheries Management: A Case Study in the Northeastern United States (2009) (available at http://www.nefmc.org/habitat/managing_fisheries_poster.pdf); Marine Conservation Biology Institute, Places in the Sea: Hudson Canyon (2009) (available at http://www.mcbi.org/shining_sea/place_atlantic_hudson.htm); NOAA Ocean Explorer. Mission Plan: Mountains in the Sea" (2009) (available at http://oceanexplorer.noaa.gov/explorations/03mountains/background/plan/plan.html); Lumsden et al., The state of deep coral ecosystems at 211; NOAA, Explorations: Deep East: Logs: Summary of the Expedition (2009) (*available at*, http://oceanexplorer.noaa.gov/explorations/deepeast01/logs/oct1/oct1.html).

[69] Waring, G.T., Hamazaki, T., Sheehan, D., Wood, G., and Baker, S., Characterization of beaked whale (*Ziphiidae*) and sperm whale (*Physeter macrocephalus*) summer habitat in shelf-edge and deeper waters off the northeast U.S." *Marine Mammal Science* 17: 703-717 (2001); Waring, G.T., Josephson, E., Maze-Foley, K., and Rosel, P.E., eds., U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments – 2011 (2011).

Atlantic submarine canyons and seamounts, including species of black corals, boreal red corals, sponges, and feather-like sea pens.[70]

Submarine canyon and canyon head habitats are highly vulnerable to damage associated with bottom disturbances, sedimentation, and contamination from the proposed activities; and fish and other canyon species are particularly vulnerable to acoustic impacts from seismic surveys, which may be exacerbated by reverberation from the canyon walls. For these reasons, the Atlantic canyons, including such highly productive areas such as Norfolk Canyon and Georgetown Hole, should be excluded from all such activities, as should all Gear Restricted Areas for golden tilefish.

(e) Areas designated as Habitat Areas of Particular Concern ("HAPCs") by the Mid-Atlantic or South Atlantic Fishery Management Councils.— BOEM should consider excluding the following designated areas:

- HAPCs for coral, coral reefs, and live/hard bottom habitats
  - North Carolina: 10-Fathom Ledge, Big Rock, The Point
  - South Carolina: Charleston Bump, Hurl Rock
  - Georgia: Gray's Reef National Marine Sanctuary
  - Florida: Tube worm (*Lophelia*) reefs off FL's central east coast, *Oculina* Bank off coast from Fort Pierce to Cape Canaveral, nearshore (0-12 ft.) hard bottom off coast from Cape Canaveral to Broward County
- HAPCs for penaeid, rock, and royal red shrimps
- HAPCs for reef fish/snapper-grouper management unit, and areas that meet the criteria for Essential Fish Habitat-HAPCs for these species
  - medium- to high-profile offshore hard bottoms where spawning normally occurs
  - localities of known or likely periodic spawning aggregations
  - nearshore hard bottom areas
  - The Point, Ten Fathom Ledge, and Big Rock
  - Charleston Bump
  - mangrove habitat
  - seagrass habitat
  - oyster/shell habitat
  - all coastal inlets
  - all State-designated nursery habitats of particular importance to snappers-groupers (e.g., primary and secondary nursery areas designated in North Carolina)
  - pelagic and benthic *Sargassum*
  - Hoyt Hills for wreckfish
  - the *Oculina* Bank HAPC
  - all hermatypic coral habitats and reefs

[70] Oceana. There's No Place Like Home at 9; Lumsden et al., The state of deep-coral ecosystems, at 200, 203; NRDC, Priority Ocean Areas.

  - manganese outcroppings on the Blake Plateau
  - Council-designated Artificial Reef Special Management Zones
- HAPCs for coastal pelagic species
  - Sandy shoals of Cape Lookout, Cape Fear, and mid-Cape Hatteras; The Point, Ten-Fathom Ledge, Big Rock (North Carolina)
  - Charleston Bump, Hurl Rocks (South Carolina)
  - Nearshore hardbottom (Florida)

(f) South Atlantic Deepwater MPAs.— These areas, established in 2009 by the South Atlantic Fishery Management Council, support various snapper and grouper species, including snowy grouper, speckled hind, and blue tilefish. Many of the deep-dwelling species the area supports are slow-growing and already struggling to recover from overfishing and habitat damage.

(g) Gray's Reef National Marine Sanctuary.

(h) Areas known to be inhabited by and/or proposed as critical habitat for Atlantic sturgeon.

In addition, BOEM must analyze an alternative that would require any entity carrying out the proposed activities to identify aggregations of forage species and prohibit operations within the vicinity of such aggregations that might disturb them. Similarly, BOEM must analyze an alternative that would prohibit the proposed activities from being carried out in the vicinity of spawning aggregations of grouper and snapper species, as well as concentrations of *Sargassum*, which provides vital nursery habitat to numerous species in Atlantic shelf waters and the Gulf Stream.

C. Failure to Adequately Consider Reasonable Mitigation and Monitoring Measures

The DPEIS does not adequately consider, or fails to consider at all, a number of other reasonable measures that would reduce environmental risk from the proposed activities. These measures include:

(1) Exclusion of airgun surveys around established dive sites.— It is well established that intense undersea noise can jeopardize the health and safety of human divers. For this reason, the Navy has established a significant acoustic stand-off zone around established dive sites, for training and operations of its SURTASS LFA system as well as for other acoustic sources.[71] The Navy's 145 dB stand-off for SURTASS

[71] Navy, Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar (2001) (notes that standard was endorsed by Navy's Bureau of Medicine and Surgery and the Naval Sea Systems Command); Navy, Final Supplemental Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar (2007).

LFA is based on research showing severe discomfort in a portion of experienced civilian divers, on exposure to low-frequency noise at that level.[72] Given the lack of any analogous studies on airgun noise, BOEM should adopt the Navy's 145 dB threshold as the best available standard for high-intensity, low-frequency airguns. The stand-off zone should apply to Monitor and Gray's Reef National Marine Sanctuaries as well as to other established dive sites.

(2) Survey design standards and review.— BOEM should require that airgun survey vessels use the lowest practicable source levels, minimize horizontal propagation of the sound signal, and minimize the density of track lines consistent with the purposes of the survey.[73] None of these measures is considered in the DPEIS. We would note that, in the past, the California Coastal Commission has required the U.S. Geological Survey to reduce the size of its array for seismic hazards work, and to use alternative seismic technologies (such as a minisparker), to reduce acoustic intensities during earthquake hazard surveys to their lowest practicable level.[74] Additionally, BOEM should consider establishing an expert panel, within the agency, to review survey designs with the aim of reducing their wildlife impacts. These requirements are consistent with both the MMPA's "least practicable impact" requirement for authorizing marine mammal take and OCSLA's "undue harm" requirement for permitting of offshore exploration.

(3) Sound source validation.— Relatedly, BOEM should require operators to validate the assumptions about propagation distances used to establish safety zones and calculate take (*i.e.*, at minimum, the 160 dB and 180 dB isopleths). Sound source validation has been required of Arctic operators for several years, as part of their IHA compliance requirements, and has proven useful for establishing more accurate, *in situ* measurements of safety zones and for acquiring information on noise propagation.[75] It should be clarified that safety zone distances would initially be established in site-specific EAs and applications for MMPA authorization, to ensure opportunity for agency review and analysis.

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[72] Navy, Final Overseas Environmental Impact Statement and Environmental Impact Statement for Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) Sonar: Technical Report 3 (1999).

[73] Parsons, E.C.M., Dolman, S.J., Jasny, M., Rose, N.A., Simmonds, M.P., and Wright, A.J., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practice? *Marine Pollution Bulletin* 58: 643-651 (2009); Burns, J., Clark, C., Ferguson, M., Moore, S., Ragen, T., Southall, B., and Suydam, R., Expert panel review of monitoring and mitigation protocols in applications for incidental harassment authorizations related to oil and gas exploration, including seismic surveys, in the Chukchi and Beaufort Seas (2010) (NMFS Expert Panel Review 2010); Brower, H., Clark, C.W., Ferguson, M., Gedamke, J., Southall, B., and Suydam, R., Expert panel review of monitoring protocols in applications for incidental harassment authorizations related to oil and gas exploration in the Chukchi and Beaufort Seas, 2011: Statoil and ION Geophysical (2011) (NMFS Expert Panel Review 2011).

[74] *See*, *e.g.*, California Coastal Commission, Staff Recommendation on Consistency Determination No. CD-16-00 (2000) (review of USGS survey off southern California).

[75] *See*, *e.g.*, Burns et al., Expert Panel Review (2010), *supra*; Brower et al., Expert Panel Review (2011), *supra*.

(4) Expansion of the speed-reduction requirement for vessels engaged in G&G activities.— As it stands, BOEM would require G&G ships to maintain a 10 knot speed restriction only when "mother/calf pairs, pods, or large assemblages of cetaceans are observed near an underway vessel," or where the conditions specified in the existing right whale ship-strike rule (50 C.F.R. § 224.105) apply. DPEIS at 2-7. This requirement should be expanded.

Ship strikes represent one of the leading threats to the critically endangered North Atlantic right whale. More than half (n=10 of 14) of all North Atlantic right whales that died from significant trauma between 1970 and 2002, and were recovered for pathological examination, had vessel collision as a contributing cause of death (in cases where presumed cause of death could be determined);[76] and these data are likely to grossly underestimate the actual number of animals struck, as animals struck but not recovered, or not thoroughly examined, cannot be accounted for.[77] Each fatal strike could constitute jeopardy under the Endangered Species Act. As NMFS has repeatedly stated, "the loss of even a single individual [North Atlantic right whale] may contribute to the extinction of the species" and "preventing the mortality of one adult female a year" may alter this outcome.[78]

For these reasons, significant steps have been taken over the last several years to reduce the threat of right whale collisions by (1) shifting and narrowing Traffic Separation Schemes ("TSS"), (2) designating "areas to be avoided" ("ATBA"), and (3) establishing seasonal speed reductions for vessels in known right whale habitat. With respect to speed reductions, the best available science indicates that limiting ship speed to 10 knots reduces both the collision risk for right whales and the risk of mortality should a collision occur.[79] NMFS has therefore set a 10 knot limit on ships greater than 65 feet in length transiting certain waters along the eastern seaboard, including areas off the Mid-Atlantic.[80] The agencies have separately extended this requirement to all construction vessels associated with the Cape Wind project, as well as to both construction *and* support ships associated with the Neptune liquid natural

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[76] Moore, M. J., Knowlton, A.R., Kraus, S.D., McLellan, W.A., and Bonde, R.K., Morphometry, gross morphology and available histopathology in North Atlantic right whale (*Eubalena glacialis*) mortalities (1970-2002), *Journal of Cetacean Research and Management* 6:199-214 (2004).

[77] Reeves, R.R., Read, A., Lowry, L., Katona, S.K., and Boness, D.J., *Report of the North Atlantic right whale program review*, 13–17 March 2006, Woods Hole, Massachusetts (2007) (prepared for the Marine Mammal Commission).

[78] *See* 69 Fed. Reg. 30,857, 30,858 (June 1, 2004); *see also* 73 Fed. Reg. 60,173, 60,173 (Oct. 10, 2008); 72 Fed. Reg. 34,632, 34,632 (June 25, 2007); 66 Fed. Reg. 50,390, 50,392 (Oct. 3, 2001).

[79] Laist, D.W., Knowlton, A.R., Mead, J.G., Collet, A.S., and Podesta, M., Collisions between ships and whales, *Marine Mammal Science* 17: 35-75 (2001); Pace, R.M., and Silber, G.K., Simple analyses of ship and large whale collisions: Does speed kill? Biennial Conference on the Biology of Marine Mammals, December 2005, San Diego, CA. (2005) (abstract); Vanderlaan, A.S.M., and Taggart, C.T., Vessel collisions with whales: The probability of lethal injury based on vessel speed, Marine Mammal Science 23: 144-156 (2007); NMFS, 2010 Large Whale Ship Strikes Relative to Vessel Speed (2010) (*available at* http://www.nmfs.noaa.gov/pr/pdfs/shipstrike/ss_speed.pdf).

[80] 73 Fed. Reg. 60173, 60173-60191 (Oct. 10, 2008).

gas ("LNG") facility regardless of vessel length. Notably, both the Cape Wind and Neptune LNG speed limits apply to waters beyond those covered by NMFS' ship-strike rule.[81] A speed reduction measure in this case would, of course, also reduce the risk of fatal ship strikes on other endangered baleen whales, such as fin and humpback whales, which also occur within the WEAs and shoreward.

BOEM should therefore require that all vessels associated with G&G activities, including support vessels, adhere to a 10 knot speed limit when operating or transiting: i.e., at all times. This measure is easily practicable for most vessels involved in G&G activities: seismic boats proceed at a nominal 4.5 knots when operating and at generally slow speeds (below 13-14 knots) when transiting. But specific language on this point is needed, as in the case of the Neptune LNG facility, to ensure that all vessels (and not just those vessels over 65 feet in length) and all affected waters (beyond the areas immediately surrounding the major Mid-Atlantic ports) are covered by the speed limit, and that the requirement persists beyond the original 5-year term of the existing right whale ship-strike rule. Because this measure would likewise reduce the risk of vessel collisions with other species, including other endangered baleen whales, and because it would significantly reduce cavitation noise,[82] it should apply throughout the year and not only during periods of right whale occurrence.

Finally, as per requirements for the Neptune LNG facility,[83] the EA should specify that designated crew members must receive National Oceanic and Atmospheric Administration ("NOAA") certified training regarding marine mammal and sea turtle presence and collision avoidance procedures, prior to the commencement of construction and support activities.

(5) Vessel avoidance of important habitat.— It is well established that vessel routing can significantly reduce both cumulative noise exposure and the risk of ship-strikes.[84] Indeed, the agencies admit in their DPEIS for Arctic exploration that routing ships around important habitat would benefit species in that region, including bowheads,

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[81] Cape Wind Associates, Construction and Operations Plan: Cape Wind Energy Project, Nantucket Sound, Massachusetts (Feb. 2011); NMFS, Biological Opinion: Issuance of license to Neptune LNG to MARAD to construct, own, and operate an LNG deepwater port, at 15-16 (2007) (license number F/NEr/2006/04000).

[82] Renilson, M., Reducing underwater noise pollution from large commercial vessels (2009) *available at* www.ifaw.org/oceannoise/reports; Southall, B.L., and Scholik-Schlomer, A. eds. Final Report of the National Oceanic and Atmospheric Administration (NOAA) International Symposium: Potential Application of Vessel-Quieting Technology on Large Commercial Vessels, 1-2 May 2007, at Silver Springs, Maryland (2008) (*available at* http://www.nmfs.noaa.gov/pr/pdfs/acoustics/vessel_symposium_report.pdf).

[83] NMFS, Biological Opinion at 15. By contrast, the mitigation set forth in Appendix C of the Draft EA merely requires that vessel and aircraft operators receive a "briefing." *See* Draft EA at 226.

[84] *E.g.*, Hatch, L., Clark, C., Merrick, R., Van Parijs, S., Ponirakis, D., Schwehr, K., Thompson, M., and Wiley, D., Characterizing the relative contributions of large vessels to total ocean noise fields: a case study using the Gerry E. Studds Stellwagen Bank National Marine Sanctuary, *Environmental Management* 42:735-752 (2008).

belugas, gray whales, and walruses.[85] Accordingly, the draft EIS should require avoidance of such areas, including right whale calving grounds, as a standard mitigation measure.

(6) Reduction of noise from vessels used in oil and gas G&G activities.— To further reduce undersea noise, BOEM should require that all vessels used in oil and gas G&G activities undergo measurement for their underwater noise output per American National Standards Institute/ Acoustical Society of America standards (S12.64); that all such vessels undergo regular maintenance to minimize propeller cavitation, which is the primary contributor to underwater ship noise; and that all new industry vessels be required to employ the best ship-quieting designs and technologies available for their class of ship.[86]

(7) Separation distances— As part of Alternative B, BOEM would require operators to maintain a 40 km separation distance between concurrent airgun surveys. DPEIS at C-21. While we agree with BOEM about the benefits of reducing simultaneous exposure of the same area, we believe the proposed separation distance is too small to accomplish the objective. Forty kilometers represents a doubling of the 160 dB isopleth around a large array, plus an additional 10 km buffer needed for marine species to freely transit through the area or otherwise escape disruptive levels of exposure. But marine mammals experience take at much lower levels of exposure, as discussed below at § IV.B. To take just one example, migrating bowhead whales experience displacement well beyond the 160 dB isopleths, out to 25-30 km; the proposed 40 km separation would do little to mitigate the displacement and allow transit of the animal.[87] BOEM should consider larger, more conservative separation distances including, but not limited to, 90 km, which is the distance considered in the Arctic DPEIS.

(8) Designing tracklines to minimize the potential for strandings.— Biologists have expressed concern, based on correlations of airgun surveys with some marine mammal stranding events as well as the traditional use of sound in cetacean drive fisheries, that seismic operations (and other intense noise sources) could cause marine mammals to strand, particularly if used near shore.[88] To reduce analogous risk in

[85] NMFS, Effects of Oil and Gas Activities in the Arctic Ocean, Draft Environmental Impact Statement at 4-160 to 4-161 (Dec. 2011).

[86] Renilson, Reducing underwater noise pollution from large commercial vessels; Southall and Scholik-Schlomer, eds., Final Report of the National Oceanic and Atmospheric Administration (NOAA) International Symposium: Potential Application of Vessel-Quieting Technology on Large Commercial Vessels.

[87] Richardson, W.J., Miller, G.W., and Greene Jr., C.R., Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea, *Journal of the Acoustical Society of America* 106: 2281 (1999).

[88] Brownell, R.L., Jr., Nowacek, D.P., and Ralls, K., Hunting cetaceans with sound: a worldwide review, *J. Cetacean Res. Manage.* 10: 81-88 (2008); Hildebrand, J., Impacts of anthropogenic sound, *in* Ragen, T.J., Reynolds III, J.E., Perrin, W.F., Reeves, R.R., and Montgomery, S. (eds.), *Marine Mammal Research: Conservation beyond*

other contexts, Australia and the NATO Undersea Research Program have required planners of mid-frequency sonar exercises to design their tracklines to minimize the potential for embayments and strandings, such as by avoiding tracks that could herd animals into bays and estuaries or keeping transmissions in bays to a minimum.[89] The potential location of deep-penetration airgun surveys close to shore recommend the use of the same measure in this case.

(9) Adequate safety zone distances.— BOEM should reconsider the size of the safety zones it would prescribe as part of its nominal protocol for seismic airgun surveys.

The DPEIS proposes establishing a safety zone of 180 dB re 1 µPa (with a 500 m minimum) around individual seismic arrays, correctly observing that this standard is generally consistent with NMFS' requirements for other acoustic sources. DPEIS at 2-5. It is not clear, however, whether BOEM took recent research into account when calculating nominal safety zone distances in the document. For example, Gedamke et al. (2011), whose lead author is the present director of NMFS' Bioacoustics Program, has put traditional means of estimating safety zones into doubt. That paper demonstrates through modeling that, when uncertainties about impact thresholds and intraspecific variation are accounted for, a significant number of whales could suffer temporary threshold shift (*i.e.*, hearing loss) beyond 1 km from a relatively small seismic array (source energy level of 220 dB re 1 µPa^2(s)) – a distance that seems likely to exceed BOEM's estimates (PDEIS at C-10).[90] Moreover, a recent dose-response experiment indicates that harbor porpoises are substantially more susceptible to temporary threshold shift than the two species, bottlenose dolphins and belugas, that had previously been tested.[91] And a number of recent studies suggest that the relationship between temporary and permanent threshold shift may not be as predictable as previously believed.[92] Further discussion appears at section IV.B.3 below ("Failure to set proper thresholds for hearing loss"). BOEM must take account of these studies, as, for example, by extending the safety zone by a precautionary distance, as the Navy and NMFS have done to compensate for uncertainties in the

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Crisis 101-123 (2006); IWC Scientific Committee, Report of the Scientific Committee of the International Whaling Commission: Annex K: Report of the Standing Working Group on Environmental Concerns (2009).

[89] Royal Australian Navy, Maritime Activities Environmental Management Plan: Procedure S1 (2006); NATO Undersea Research Centre, NATO Undersea Research Centre Human Diver and Marine Mammal Risk Mitigation Rules and Procedures, at 10 (2006) (NURC Special Pub. NURC-SP-2006-008).

[90] Gedamke, J., Gales, N., and Frydman, S., Assessing risk of baleen whale hearing loss from seismic surveys: The effect of uncertainty and individual variation, *Journal of the Acoustical Society of America* 129: 496-506 (2011).

[91] Lucke, K., Siebert, U., Lepper, P.A., and Blanchet, M.-A., Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli, *Journal of the Acoustical Society of America* 125: 4060-4070 (2009).

[92] Kastak, D., Mulsow, J., Ghoul, A., Reichmuth, C., Noise-induced permanent threshold shift in a harbor seal [abstract], *Journal of the Acoustical Society of America* 123: 2986 (2008) (sudden, non-linear induction of permanent threshold shift in harbor seal during TTS experiment); Kujawa, S.G., and Liberman, M.C., Adding insult to injury: Cochlear nerve degeneration after "temporary" noise-induced hearing loss, *Journal of Neuroscience* 29: 14077-14085 (2009) (mechanism linking temporary to permanent threshold shift).

case of SURTASS LFA. 67 Fed. Reg. 46712 (July 16, 2002); 72 Fed. Reg. 46846 (Aug. 21, 2007).

Additionally, BOEM should consider establishing a cumulative exposure metric for temporary threshold shift in addition to the present RMS metric, as suggested by Southall et al. (2007).[93]

Finally, BOEM should consider establishing larger shutdown zones for certain target species. Although time/area closures are a more effective means of reducing cumulative exposures of wildlife to disruptive and harmful sound, these expanded safety zones have value in minimizing disruptions, and potentially in reducing the risk of hearing loss and injury, outside the seasonal closure areas.[94] Visual sighting of any individual right whale should trigger shut-down; for other species, shut-down should occur if aggregations are observed within the 160 dB isopleth around the sound source.

(10) Adequate real-time monitoring.— It is well established that real-time visual shipboard monitoring is difficult for all marine mammal and sea turtle species, especially at night and during high sea states and fog.[95] Supplemental methods that have been used on certain other projects include ship-based passive acoustic monitors, hydrophone buoys and other platforms for acoustic monitoring, aerial surveys, shore-based monitoring, and the use of additional small vessels. Unfortunately, the real-time monitoring effort proposed in the DPEIS is inadequate.

While BOEM seems to require two observers for airgun surveys – the minimum number necessary to maintain 360 degree coverage around the seismic vessel – it otherwise sets forth requirements that are inconsistent with survey conventions and with prior studies of observer effectiveness. *First*, BOEM's "draft protocol" would allow visual observers to work at four-hour stretches, with two-hour breaks in between, and for a maximum of 12 hours per day. DPEIS at C-41. That four-hour work cycle doubles the amount of time conventionally allowed for marine mammal observation aboard NMFS survey vessels, and is even less appropriate for conditions where, as here, an animal's health is at stake. *Second*, BOEM's training requirements for marine mammal observers amount to little more than a desktop course – basically the "poor example" of a 45-minute "DVD" lesson criticized by Parsons et al. (2009) – and do not mandate any prior field experience. DPEIS at C-41 to C-42. Yet, as UK

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[93] Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran. J.J., Gentry, R.L., Greene, C.R., Jr., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L., Marine mammal noise exposure criteria: Initial scientific recommendations, *Aquatic Mammals* 33:411-521 (2007).

[94] *See* MMS, Final Programmatic Environmental Assessment, Arctic Outer Continental Shelf Seismic Surveys – 2006, OCS EIS/EA MMS 2006-038 at 110-111 (June 2006) (noting sensitivity of baleen whale cow-calf pairs).

[95] *See, e.g.*, Barlow, J., and Gisiner, R., Mitigation and monitoring of beaked whales during acoustic events, *J. Cetacean Res. Manage.* 7: 239-249 (2006); Parsons, E.C.M., Dolman, S.J., Jasny, M., Rose, N.A., Simmonds, M.P., and Wright, A.J., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practice? *Marine Pollution Bulletin* 58: 643-651 (2009).

data have demonstrated, use of observers with no meaningful experience in marine mammal observation, such as ships' crew, results in extremely low levels (approaching zero percent) of detection and compliance.[96] BOEM should require field experience in marine mammal observation of any

Furthermore, while it includes mandatory passive acoustic monitoring ("PAM") under Alternative B (DPEIS at C-21), the DPEIS discusses the measure in a later section as though it has already been "considered but not selected" (DPEIS at C-25 to C-26). The rationale for this seeming rejection is that the method is limited – but then, as the PDEIS acknowledges, visual observation is limited as well, "and most likely an integrated approach is necessary" (DPEIS at C-25). Real-time PAM has had some success in detecting toothed whale calls in the Arctic and elsewhere, as NMFS and its expert Open Water Panel have recognized; and towed arrays in the Gulf of Mexico have successfully detected sperm whales and implemented shut-down procedures.[97] Indeed, PAM systems appear to be widely used in the Gulf, in waters deeper than 200 meters; many of the same survey vessels are likely to be employed in east-coast exploration. There is no reason, especially given BOEM's high estimates of hearing loss, why PAM should not be mandated, or at least presumptively required.

Finally, BOEM improperly rules out aerial surveillance as a monitoring measure, apparently due to its limited application and to safety concerns that arise under some conditions. DPEIS at C-27. This, however, is hardly a reason to categorically reject the measure. The offshore industry routinely uses aircraft to carry out its own exploration and production activities; requiring flights to also reduce the environmental impacts of those activities should be viewed in the same light. Furthermore, the industry has run aerial monitoring around surveys in the Arctic since at least the 1980s. For its upcoming Arctic work, Shell is committed to implement an aerial program extending 37 kilometers from shore. 76 Fed. Reg. 69,958, 69,987 (Nov. 9, 2011). We agree that aerial monitoring should not be required of every airgun survey in every location within the two planning areas, but BOEM should consider prescribing it on a case-by-case basis, and should indicate in the Final EIS when they might be required.[98]

For HRG surveys, BOEM must require a sufficient number of competent, trained visual observers. Requiring only one trained observer, as proposed in Appendix C

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[96] Stone, C.J., The effects of seismic surveys on marine mammals in UK waters: 1998-2000 (2003) (Joint Nature Conservation Committee Report 323); *see also* Parsons et al., A critique of the UK's JNCC seismic survey guidelines, *supra*. It is worth noting that the "inexperienced" marine mammal observers involved in the UK study usually still received some basic training. Stone, The effects of seismic surveys, *supra*.

[97] *Id*.; Gillespie,D., Gordon, J., Mchugh, R., Mclaren, D., Mellinger, D.K., Redmond, P., Thode, A., Trinder, P., and Deng, X.Y., PAMGUARD: semiautomated, open source software for real-time acoustic detection and localization of ceteaceans, *Proceedings of the Institute of Acoustics* 30(5) (2008).

[98] We fully support efforts by NMFS, BOEM, the Office of Naval Research and others to develop unmanned planes for offshore aerial monitoring (*see* PDEIS at C-27), but unfortunately that is no substitute at the present time for manned aircraft.

(DPEIS at C-16), is simply not adequate to maintain a steady visual watch for more than two hours or to effectively monitor in all directions around the sound source.[99] At least two observers should be required to have any chance of effectively spotting marine mammals on both sides of the survey vessel.

(11) Limiting activities in low-visibility conditions.— The DPEIS does not consider limiting activities in low-visibility conditions, which, as the agencies acknowledged in their Arctic DPEIS for exploration activities, can reduce the risk of ship-strikes and near-field noise exposures.[100] Anticipating BOEM's objection, however, it may be said that the agencies' categorical rejection of this measure in the Arctic context is flawed. *First*, they suggest (correctly) that the restriction could extend the duration of a survey and thus the potential for cumulative disturbance of wildlife; but this concern would not apply in circumstances, such as in the right whale migratory corridor, where the prime mitigation concern is migratory species. *Second*, while they suggest that the requirement would be expensive to implement, they do not consider the need to reduce ship-strike risk in heavily-used migratory corridors in order to justify authorization of an activity under the IHA process.[101] At the very least, BOEM should commit to consider this measure on a case-by-case basis and to describe the conditions under which it might be required.

(12) Adequate long-term monitoring.— Numerous sources have called for thorough biological surveying before, during, and after seismic surveys in biologically important areas.[102] And yet – remarkably for an activity that even BOEM estimates would take millions of marine mammals each year – the DPEIS does not set forth a long-term monitoring plan nor give any indication that one will be developed. By comparison, the U.S. Navy, when it embarked on regulatory compliance for Atlantic Fleet sonar training, began devising a long-term plan and entered into partnerships with Duke Marine Lab and others to begin vessel surveys, habitat modeling, and

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[99] *See* Weir, C.R., and Dolman, S.J., Comparative review of the regional marine mammal mitigation guidelines implemented during industrial seismic surveys, and guidance towards a worldwide standard, *Journal of International Wildlife Law and Policy* 10: 1-27 (2007); Parsons, E.C.M., Dolman, S.J., Jasny, M., Rose, N.A., Simmonds, M.P., and Wright, A.J., A critique of the UK's JNCC seismic survey guidelines for minimising acoustic disturbance to marine mammals: Best practice? *Marine Pollution Bulletin* 58: 643-651 (2009).

[100] NMFS, Effects of Oil and Gas Activities in the Arctic Ocean, Draft Environmental Impact Statement at 4-160 to 4-153 (Dec. 2011).

[101] IHAs cannot issue to activities with the potential to cause serious injury or mortality. 16 U.S.C. § 1371(a)(5)(D).

[102] *E.g.*, IWC Scientific Committee, Report of the Scientific Committee of the International Whaling Commission: Annex K: Report of the Standing Working Group on Environmental Concerns (2004); IWC Scientific Committee, Report of the Scientific Committee of the International Whaling Commission: Annex K: Report of the Standing Working Group on Environmental Concerns (2006); Parsons et al., A critique of the UK's JNCC seismic survey guidelines, *supra*; Weilgart, L. (ed.), Report of the workshop on alternative technologies to seismic airgun surveys for oil and gas exploration and their potential for reducing impacts on marine mammals, 31 Aug. – 1 Sept., 2009, Monterey, Calif. (2010) (available at www.okeanos-stiftung.org/okeanos/download.php?id=19); Weir and Dolman, Weir, C.R., and Dolman, S.J., Comparative review of the regional marine mammal mitigation guidelines implemented during industrial seismic surveys, and guidance towards a worldwide standard, *Journal of International Wildlife Law and Policy* 10: 1-27 (2007).

research in support of that effort.[103] Incredibly, the sum total of relevant BOEM research in the Atlantic since 2006 – other than for offshore alternative energy – consists of (1) a study of marine productivity across BOEM's oil and gas planning areas – a national study in which the Atlantic was included, and (2) a study of sperm whale dive patterns. DPEIS at G-3.

The purpose of any monitoring program is to establish biological baselines, to determine long-term impacts on populations of target species, and to test whether the biological assumptions underlying the DPEIS are correct. There is no sign that BOEM has even begun to think about such a thing. Yet it is imperative that the agencies elaborate a monitoring plan now, during the NEPA process, since BOEM apparently refuses to apply to NMFS for a programmatic, 5-year rulemaking. We urge BOEM to begin consulting *immediately* with NMFS regional fisheries science centers as well as with non-government experts on the components of an effective plan.

We note that any meaningful long-term monitoring program should include passive acoustics. As has been the case in other regions, acoustic data can have enormous value in helping to define marine mammal distribution and abundance, detect impacts from noise-generating activities, and assess cumulative levels of noise exposure for purposes of adaptive management.[104] For example, PAM has served as a critical means of impact assessment for wind farm construction in Europe.[105] It provides an important supplemental source of information for some species, such as researchers have seen in Southern California, where passive acoustics have altered conclusions about baleen whale seasonality that were established on the basis of visual surveys alone. Real-time acoustic monitoring can also improve safety zone monitoring, particularly for cryptic, vocalizing species and for nighttime operations. Finally, PAM is also cost-effective, typically costing far less than visual surveys.[106]

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[103] U.S. Navy, Final Atlantic Fleet Active Sonar Training Environmental Impact Statement/ Overseas Environmental Impact Statement (2008).

[104] Hatch, L., Clark, C., Merrick, R., Van Parijs, S., Ponirakis, D., Schwehr, K., Thompson, M., and Wiley, D., Characterizing the relative contributions of large vessels to total ocean noise fields: A case study using the Garry E. Studds Stellwagen Bank National Marine Sanctuary, *Environmental Management* 42:735-752 (2008).; Clark et al., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources; Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: Intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009). (e.g., Hatch et al. 2008; Clark et al. 2009)

[105] Evans, P.G.H. (Ed.), Proceedings of the ECS/ASCOBANS Workshop: Offshore wind farms and marine mammals: impacts and methodologies for assessing impacts, at 50-59, 64-65 (2007) (ECS Special Publication Series No. 49, available at www.wdcs.org/submissions_bin/wind_farm_workshop.pdf); *see also* Carstensen, J., Henriksen, O. D., and Teilmann, J., Impacts of offshore wind farm construction on harbour porpoises: acoustic monitoring of echolocation activity using porpoise detectors (T-PODs), *Mar. Ecol. Prog. Ser.* 321: 295-308 (2006).

[106] *See* Scientific Advisory Group for Navy Marine Species Monitoring, Workshop report and recommendations (2011) (available at www.cascadiaresearch.org/Navy_MMM_Scientific_Advisory_group_report_May_2011.pdf) (report by experts convened by U.S. Navy, per NMFS regulation, to evaluate Navy's range monitoring program for marine mammals).

(13) Adaptive management.— In justifying its decision not to delay seismic exploration, BOEM claims to have taken an "adaptive management approach that would incorporate new technology and improved mitigation measures as they are developed and proven efficacious." DPEIS at 2-48. Yet nowhere in the DPEIS does the agency set forth the terms of an adaptive management program. Such a program, if it is not mere window-dressing, must include (1) a means of monitoring impacts on target species (see "Adequate long-term monitoring," above), (2) a means of encouraging and developing mitigation measures (see, e.g., "Failure to develop a viable technology-based alternative," above), and (3) a means of modifying the proposed action as new information and mitigation measures emerge. The DPEIS provides none of these elements. One can only draw, again, an invidious comparison with the Navy, whose activities throughout the U.S. EEZ include a long-term monitoring program and are subject to annual adaptive management review, on consultation with NMFS. *See*, *e.g.*, 74 Fed. Reg. 4844, 4854-4858, 4884-4885 (Jan. 27, 2009).[107] Nor does BOEM set forth a protocol for emergency review or suspension of activities, if serious unanticipated impacts, such as a mass stranding or a vessel collision with a right whale, are found to occur – a standard element of Navy sonar mitigation. *See*, *e.g.*, 50 C.F.R. 216.244(xxx).[108] Here as elsewhere, the agency must expand its analysis of alternatives and mitigation measures.

IV. IMPACTS ANALYSIS

A. Failure to Obtain Essential Information

It is undisputed that there are significant gaps in basic information about the mid- and south Atlantic regions, their wildlife, and the potential effects of noise and disturbance from oil and gas exploration.

NEPA regulations set out an "ordered process" for an agency preparing an EIS in the face of missing information. *Save Our Ecosystems v. Clark*, 747 F.2d 1240, 1244 (9th Cir. 1984). When there is incomplete information relevant to reasonably foreseeable significant adverse impacts that is essential to a reasoned choice among alternatives, an agency must obtain and include the missing information in the EIS if the overall costs of obtaining it are not exorbitant. 40 C.F.R. § 1502.22. If the costs are exorbitant or the means to obtain the information are unknown, agencies must provide in the EIS a number of responses including, a "summary of existing credible scientific evidence" and an evaluation of impacts "based upon theoretical approaches or research methods generally accepted in the scientific community." *Id*. at § 1502.22(b).

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[107] The agencies use MMPA as their vehicle in the Navy context, but of course a different adaptive management scheme could be established through the NEPA process.

[108] *See also*, *e.g*., NMFS, Stranding response plan for major Navy training exercises in the AFAST Study Area (2009) (available at www.nmfs.noaa.gov/pr/permits/afast_stranding_protocol_final.pdf).

The regulation furthers NEPA's purpose of ensuring that agencies make "fully informed and well-considered decision[s]," its mandate of "widespread discussion and consideration of the environmental risks and remedies associated with [a] pending project", and its "require[ment] that this evaluation take place *before* a project is approved." *Vt. Yankee Nuclear Power Corp. v. Natural Resources Def. Council,* 435 U.S. 519, 558 (1978) ("fully informed and well-considered decision[s]"; *LaFlamme v. FERC*, 852 F.2d 389, 398 (9th Cir. 1988) (internal quotation marks omitted).

The DPEIS cites to the applicable Council of Environmental Quality ("CEQ") regulation and maintains that it identifies those areas where information is unavailable to support a thorough evaluation of the environmental consequences of the alternatives. *See* DPEIS at 4-6. In fact, however, the document evades the analysis that § 1502.22 requires. In the first place, it fails to identify certain obvious gaps in information – such as important habitat areas for marine mammals – essential to a reasoned choice among alternatives. Beyond this, its modus operandi is to acknowledge major information gaps on virtually every topic under analysis, then insist – without any specific findings about their significance for the agencies' decisionmaking – that BOEM agency has an adequate basis for proceeding. *See, e.g.,* PDEIS at 4-46 (masking in marine mammals), 4-47 to 4-49 (stress and behavioral impacts in marine mammals), 4-79 (behavioral impacts on sea turtles). This approach simply does not satisfy NEPA.

The DPEIS, and the DPEIS that NMFS and BOEM recently prepared for the Arctic, reveal in many instances that relevant studies are already underway, indicating that obtaining essential information is not cost prohibitive. For example, a study undertaken by BP, the North Slope Borough, and the University of California "will help better understand masking and the effects of masking on marine mammals[.]"[109] NOAA has convened working groups on Underwater Sound Field Mapping and Cetacean Density and Distribution Mapping throughout the U.S. territorial sea and exclusive economic zone, including virtually the entirety of the present study area, for purposes of improving cumulative impact analysis and mitigation measures.[110] BOEM has an Environmental Studies Program that includes several relevant studies (though few specific to the Atlantic) and, more importantly, should serve as a vehicle for targeted research. *See* DPEIS at Appendix G. As the Ninth Circuit recently found, agencies have an obligation pursuant to NEPA "to ensure that data exists *before approval*" so that decisionmakers can "understand the adverse environmental effect *ab initio*." *Northern Plains Resource Council v. Surface Transport. Bd,* --- F.3d ----, 2011 WL 6826409, *14 (9th Cir. Dec. 29, 2011) (emphasis in original). BOEM has not done so here.

B. Failure to Set Proper Thresholds for Marine Mammal Take

As a comment letter from Duke Marine Lab has noted, the DPEIS has vastly underestimated marine mammal take from the proposed activity. The reasons for this are manifold, but lie principally in the agency's mistaken adoption of a 160 dB threshold for Level B take and its

[109] NMFS, Effects of Oil and Gas Activities in the Arctic Ocean: Draft Environmental Impact Statement at 4-88 (Dec. 2011).

[110] *Id*. at ES-34.

failure to calculate impacts from masking. Nor has BOEM performed a sensitivity analysis to determine how significantly its take and impact estimates would differ if some of its core assumptions – such as its 160 dB threshold – are wrong.

1. Illegal threshold for behavioral take

The DPEIS uses a single sound pressure level (160 dB re 1 µPa (RMS)) as a threshold for behavioral, sublethal take in all marine mammal species from seismic airguns. This approach simply does not reflect the best available science, and the choice of threshold is not sufficiently conservative in several important respects. Indeed, five of the world's leading biologists and bioacousticians working in this field recently characterized the present threshold, in a comment letter to BOEM and NMFS, as "overly simplified, scientifically outdated, and artificially rigid."[111] *See* 40 C.F.R. § 1502.22. BOEM must use a more conservative threshold for the following reasons:

(a) The method represents a major step backward from recent programmatic authorizations. For Navy sonar activity, NMFS has used a combination of specific bright-line thresholds (for harbor porpoises) and linear risk functions that endeavor to take account of risk and individual variability and to reflect the potential for take at relatively low levels.[112] In the wake of these past authorizations for acoustic impacts on marine mammals, the agencies' reversion to a single, non-conservative, bright-line threshold for all species is simply not tenable.

(b) The 160 dB threshold is non-conservative, since the scientific literature establishes that behavioral disruption can occur at substantially lower received levels for some species.

For example, a single seismic survey has been shown to cause endangered fin and humpback whales to stop vocalizing – a behavior essential to breeding and foraging – over an area at least 100,000 square nautical miles in size, and can cause baleen whales to abandon habitat over the same scale.[113] (Similarly, a low-frequency, high-amplitude fish mapping device was recently found to silence humpback whales at distance of 200 km, where received levels ranged from 88 to 110 dB.)[114] Sperm whale foraging success, as measured by buzz rate, appears to decline significantly on exposure to airgun received levels above 130 dB (RMS), with potentially serious

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[111] Clark, C., Mann, D., Miller, P., Nowacek, D., and Southall, B., Comments on Arctic Ocean Draft Environmental Impact Statement at 2 (Feb. 28, 2012).

[112] *E.g.*, 74 Fed. Reg. 4844, 4844-4885 (Jan. 27, 2009).

[113] Clark, C.W., and Gagnon, G.C., Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E9); Clark, C.W., pers. comm. with M. Jasny, NRDC (Apr. 2010); *see also* MacLeod, K., Simmonds, M.P., and Murray, E., Abundance of fin (*Balaenoptera physalus*) and sei whales (*B. Borealis*) amid oil exploration and development off northwest Scotland, *Journal of Cetacean Research and Management* 8: 247-254 (2006).

[114] Risch, D., Corkeron, P.J., Ellison, W.T., and van Parijs, S.M., Changes in humpback whale song occurrence in response to an acoustic source 200 km away, PLoS ONE 7(1): e29741. doi:10.1371/journal.pone.0029741 (2012).

long-term consequences.[115] Harbor porpoises are known to be acutely sensitive to a range of anthropogenic sources, including airguns. They have been observed to engage in avoidance responses fifty miles from a seismic airgun array – a result that is consistent with both captive and wild animal studies showing them abandoning habitat in response to pulsed sounds at very low received levels, well below 120 decibels (re 1 µPa (RMS)).[116] Bowhead whales migrating through the Beaufort Sea have shown almost complete avoidance at airgun received levels at 120-130 dB (RMS) and below;[117] for this reason BOEM has stated in past Arctic lease sale EISs that most bowheads "would be expected to avoid an active source vessel at received levels as low as 116 to 135 dB re 1 µPa when migrating.[118]. Beluga whales are highly sensitive to a range of low-frequency and low-frequency dominant anthropogenic sounds, including seismic airgun noise, which has been shown to displace belugas from near-coastal foraging areas out beyond the 130 dB (RMS) isopleth.[119]

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[115] Miller, P.J.O., Johnson, M.P., Madsen, P.T., Biassoni, N., Quero, M., and Tyack, P.L., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I* 56: 1168-1181 (2009).

[116] *E.g.*, Bain, D.E., and Williams, R., Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance (2006) (IWC Sci. Comm. Doc. IWC/SC/58/E35); Kastelein, R.A., Verboom, W.C., Jennings, N., and de Haan, D., Behavioral avoidance threshold level of a harbor porpoise (Phocoena phocoena) for a continuous 50 kHz pure tone, *Journal of the Acoustical Society of America* 123: 1858-1861 (2008); Kastelein, R.A., Verboom, W.C., Muijsers, M., Jennings, N.V., and van der Heul, S., The influence of acoustic emissions for underwater data transmission on the behavior of harbour porpoises (Phocoena phocoena) in a floating pen, *Mar. Enviro. Res.* 59: 287-307 (2005); Olesiuk, P.F., Nichol, L.M., Sowden, M.J., and Ford, J.K.B., Effect of the sound generated by an acoustic harassment device on the relative abundance and distribution of harbor porpoises (Phocoena phocoena) in Retreat Passage, British Columbia, *Mar. Mamm. Sci.* 18: 843-862 (2002).

[117] Miller, G.W., Elliot, R.E., Koski, W.R., Moulton, V.D., and Richardson W.J., Whales, *in* Richardson, W.J. (ed.), Marine Mammal and Acoustical Monitoring of Western Geophysical's Open-Water Seismic Program in the Alaskan Beaufort Sea, 1998 (1999); Richardson, W.J., Miller, G.W., and Greene Jr., C.R., Displacement of migrating bowhead whales by sounds from seismic surveys in shallow waters of the Beaufort Sea, *Journal of the Acoustical Society of America* 106:2281 (1999).

[118] *See, e.g.*, Beaufort Sea and Chukchi Sea Planning Areas Oil and Gas Lease Sales 209, 212, 217, and 221: Draft Environmental Impact Statement (2008) (OCS EIS/EA MMS 2008-0055); 71 Fed. Reg. 66,912, 66,913 (2006). although bowheads appear less aversive while feeding, the Arctic EIS rightly acknowledges that they may be "so highly motivated to remain in a productive feeding area" that they experience adverse effects and increased chronic stress. NMFS, Effects of Oil and Gas Activities in the Arctic Ocean, Draft Environmental Impact Statement at 4-99 (Dec. 2011).

[119] Miller, G.W., Moulton, V.D., Davis, R.A., Holst, M., Millman, P., MacGillivray, A., and Hannay. D., Monitoring seismic effects on marine mammals—southeastern Beaufort Sea, 2001-2002, *in* Armsworthy, S.L., et al. (eds.), Offshore oil and gas environmental effects monitoring/Approaches and technologies, at 511-542 (2005). *See also* Findley, K.J., Miller, G.W., Davis, R.A., and Greene, C.R., Jr., Reactions of belugas, Delphinapterus leucas, and narwhals, Monodon monoceros, to ice-breaking ships in the Canadian high Arctic, *Can. J. Fish. Aquat. Sci.* 224: 97-117 (1990); Cosens, S.E., and Dueck, L.P., Ice breaker noise in Lancaster Sound, NWT, Canada: implications for marine mammal behavior, *Mar. Mamm. Sci.* 9: 285-300 (1993); Fraker, M.A., The 1976 white whale monitoring program, MacKenzie estuary, report for Imperial Oil, Ltd., Calgary (1977); Fraker, M.A., The 1977 white whale monitoring program, MacKenzie estuary, report for Imperial Oil, Ltd., Calgary (1977); Fraker, M.A., The 1978 white whale monitoring program, MacKenzie estuary, report for Imperial Oil, Ltd., Calgary (1978); Stewart, B.S., Evans, W.E., and Awbrey, F.T., Effects of man-made water-borne noise on the behaviour of beluga whales, *Delphinapterus leucas*, in Bristol Bay, Alaska, Hubbs Sea World (1982) (report 82-145 to NOAA); Stewart, B.S., Awbrey, F.T., and Evans, W.E., Belukha whale (*Delphinapterus leucas*) responses to industrial noise in Nushagak

Beaked whales, though never tested experimentally for their response to airgun noise, have shown themselves to be sensitive to various types of anthropogenic sound, going silent, abandoning their foraging, and avoiding sounds at levels of 140 dB and potentially well below.[120] And these are merely examples, consistent with the broader literature. *See*, *e.g.*, DPEIS at 4-49.

Little if any of these data were available in 1999, when the High Energy Seismic Survey panel issued the report on which the 160 dB threshold is purportedly based;[121] since that time, the literature on ocean noise has expanded enormously due to massive increases in research funding from the U.S. Navy, the oil and gas industry, and other sources. The evidentiary record for a lower threshold in this case substantially exceeds the one for mid-frequency sonar in *Ocean Mammal Institute v. Gates*, 546 F. Supp.2d 960, 973-75 (D.Hawaii 2008), in which a Hawaiian District Court judge invalidated a NMFS threshold that ignored documented impacts at lower received levels as arbitrary and capricious.

(c) The use of a multi-pulse standard for behavior harassment is non-conservative, since it does not take into account the spreading of seismic pulses over time beyond a certain distance from the array.[122] NMFS' own Open Water Panel for the Arctic – which has included some of the country's leading marine bioacousticians – has twice characterized the seismic airgun array as a mixed impulsive/continuous noise source and has stated that NMFS should evaluate its impacts on that basis.[123] That analysis is supported by the masking effects model referenced above, in which several NMFS scientists have participated; by a number of papers showing that seismic exploration in the Arctic, the east Atlantic, off Greenland, and off Australia has raised ambient noise levels at significant distances from the array;[124] and, we expect, by the

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Bay, Alaska: 1983 (1983); Edds, P.L., and MacFarlane, J.A.F., Occurrence and general behavior of balaenopterid cetaceans summering in the St. Lawrence estuary, *Canada, Can. J. Zoo*. 65: 1363-1376 (1987).

[120] Soto, N.A., Johnson, M., Madsen, P.T., Tyack, P.L., Bocconcelli, A., and Borsani, J.F., Does intense ship noise disrupt foraging in deep-diving Cuvier's beaked whales (*Ziphius cavirostris*)? *Mar. Mamm. Sci*. 22: 690-699 (2006); Tyack, P.L., Zimmer, W.M.X., Moretti, D., Southall, B.L., Claridge, D.E., Durban, J.W., Clark, C.W., D'Amico, A., DiMarzio, N., Jarvis, S., McCarthy, E., Morrissey, R., Ward, J., and Boyd, I.L., Beaked whales respond to simulated and actual Navy sonar, *PLoS ONE* 6(3):e17009.doi:10.13371/journal.pone.0017009 (2011) (beaked whales); California State Lands Commission, Draft Environmental Impact Report (EIR) for the Central Coastal California Seismic Imaging Project at H-47 (2012) (CSLC EIR No. 758).

[121] High Energy Seismic Survey Team, High energy seismic survey review process and interim operational guidelines for marine surveys offshore Southern California (1999).

[122] *See* Expert Panel Review 2011.

[123] *Id*.; *see also* Expert Panel Review 2010.

[124] Gedamke, J., Ocean basin scale loss of whale communication space: potential impacts of a distant seismic survey, Biennial Conference on the Biology of Marine Mammals, November-December 2011, Tampa, FL (2011) (abstract); Nieukirk, S.L., Klinck, H., Klinck, K., Mellinger, D.K., and Dziak, R.P., Seismic airgun sounds and whale vocalization recorded in the Fram Strait and Greenland Sea, Biennial Conference on the Biology of Marine Mammals, November-December 2011, Tampa, FL (2011) (abstract); Nieukirk, S.L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P., Goslin, J., Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999-2009, *Journal of the Acoustical Society of America* 131:1102- 1112 (2012); Nieukirk, S.L., Stafford, K.M.,

modeling efforts of NOAA's Sound Mapping working group, whose public release is supposed to occur in early July. BOEM cannot ignore this science.

(d) The threshold's basis in the root mean square ("RMS") of sound pressure, rather than in peak pressure, is non-conservative. Studies have criticized the use of RMS for seismic because of the degree to which pulsed sounds must be "stretched," resulting in significant potential underestimates of marine mammal take (see below).[125]

NMFS must revise the thresholds and methodology used to estimate take from airgun use. Specifically, we urge the following:

(a) NMFS should employ a combination of specific thresholds for which sufficient species-specific data are available and generalized thresholds for all other species.[126] These thresholds should be expressed as linear risk functions where appropriate. If a single risk function is used for most species, the 50% take parameter for all the baleen whales and odontocetes occurring in the area should not exceed 140 dB (RMS), per the February 2012 recommendation from Dr. Clark and his colleagues. At least for sensitive species such as harbor porpoises and beaked whales, BOEM should use a threshold well below that number, reflecting the high levels of disturbance seen in these species at 120 dB (RMS) and below. Recent analysis by the California State Lands Commission provides another alternative, differentiating among low-frequency, mid-frequency, and high-frequency cetaceans in a manner that is generally consistent with Southall et al (2007).[127]

(b) Data on species for which specific thresholds are developed should be included in deriving generalized thresholds for species for which less data are available.

(c) In deriving its take thresholds, NMFS should treat airgun arrays as a mixed acoustic type, behaving as a multi-pulse source closer to the array and, in effect, as a continuous noise source further from the array, per the findings of the 2011 Open Water Panel cited above.

(d) Behavioral take thresholds for the impulsive component of airgun noise should be based on peak pressure rather than on RMS, or dual criteria based on both peak

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Mellinger, D.K., Dziak, R.P., and Fox, C.G., Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean, *Journal of the Acoustical Society of America* 115: 1832-1843 (2004); Roth, E.H., Hildebrand, J.A., Wiggins, S.M., and Ross, D., Underwater ambient noise on the Chukchi Sea continental slope, *Journal of the Acoustical Society of America* 131:104-110 (2012).

[125] Madsen, P.T., Marine mammals and noise: Problems with root-mean-squared sound pressure level for transients, *Journal of the Acoustical Society of America* 117:3952-57 (2005).

[126] By "thresholds," we mean either bright-line thresholds or linear risk functions.

[127] California State Lands Commission, Draft Environmental Impact Report at Chap. 4.4 and App. H, *supra*; *see also* Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran. J.J., Gentry, R.L., Greene, C.R., Jr., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L., Marine mammal noise exposure criteria: Initial scientific recommendations, *Aquatic Mammals* 33:411-521 (2007).

> pressure and RMS should be used. Alternatively, BOEM should use the most biologically conservative method of calculating RMS, following Madsen (2005). (See section IV.C. below for additional detail.)

2. Failure to analyze masking effects or set thresholds for masking

The DPEIS fails to consider masking effects, either from continuous noise sources such as ships or from mixed impulsive/continuous noise sources such as airguns. Some biologists have analogized the increasing levels of noise from human activities to a rising tide of "smog" that is already shrinking the sensory range of marine animals by orders of magnitude from pre-industrial levels. DPEIS at 3-43 (citing Clark et al. 2007).[128] Masking of natural sounds begins when received levels rise above ambient noise at relevant frequencies.[129] Accordingly, BOEM must evaluate the loss of communication space – and consider the extent of acoustic propagation – at far lower received levels than the DPEIS currently employs.

Researchers at NOAA and Cornell have created a model that quantifies impacts on the communication space of marine mammals. That published model has already been applied to shipping noise off Massachusetts and off British Columbia, and the same researchers involved in the Massachusetts study have applied it to airgun surveys as well.[130] Additionally, researchers at BP, working with colleagues at the University of California and the North Slope Borough, are applying the model to an analysis of masking effects from seismic operations in the Beaufort Sea.[131] Remarkably, the DPEIS – instead of applying the Cornell/NOAA model – simply states without any discernible support that masking effects on marine mammals would be "minor,"

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[128] *See also* Bode, M., Clark, C.W., Cooke, J., Crowder, L.B., Deak, T., Green, J.E., Greig, L., Hildebrand, J., Kappel, C., Kroeker, K.J., Loseto, L.L., Mangel, M., Ramasco, J.J., Reeves, R.R., Suydam, R., Weilgart, L., Statement to President Barack Obama of Participants of the Workshop on Assessing the Cumulative Impacts of Underwater Noise with Other Anthropogenic Stressors on Marine Mammals (2009); Clark, C., and Southall, B., Turn down the volume in the ocean, *CNN.com*, Jan. 20, 2012, *available at* www.cnn.com/2012/01/19/opinion/clark-southall-marine/index.html; McDonald, M.A., Hildebrand, J.A., and Wiggins, S.M., Increases in deep ocean ambient noise in the Northeast Pacific west of San Nicolas Island, California, *Journal of the Acoustical Society of America* 120: 711-718 (2006).

[129] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10); Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009). *See also* Castellote, M., Clark, C.W., and Lammers, M.O., Potential negative effects in the reproduction and survival on fin whales (*Balaenoptera physalus*) by shipping and airgun noise (2010) (IWC Scientific Committee Doc. No. SC/62/E3).

[130] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10); Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009); Williams, R., Ashe, E., Clark, C.W., Hammond, P.S., Lusseau, D., and Ponirakis, D., Inextricably linked: boats, noise, Chinook salmon and killer whale recovery in the northeast Pacific, presentation given at the Society for Marine Mammalogy Biennial Conference, Tampa, Florida, Nov. 29, 2011 (2011).

[131] Fleishman, E., and Streever, B., Assessment of cumulative effects of anthropogenic underwater sound: project summary and status, at 2 (2012).

meaning neither extensive nor severe. DPEIS at 4-44. Furthermore, it asserts that its mitigation protocol would "reduce the potential for masking" by excluding some marine mammals from the narrow safety zone that BOEM would establish around the seismic array (DPEIS at 4-47) – a statement that evinces a fundamental misunderstanding of how airgun noise propagates.

Assessing masking effects is essential to a reasoned consideration of impacts and alternatives, and BOEM's failure even to apply a relevant, published model that NOAA's scientists helped develop and that is being used by NOAA, Cornell, BP, the North Slope Borough, the University of California, and St. Andrews University in other regions plainly violates NEPA.

3. Failure to set proper thresholds for hearing loss

The DPEIS appears to estimate cases of temporary threshold shift, or hearing loss, in two ways: by using the original NMFS threshold of 180 dB (SPL), and by applying the hybridized standards set forth in Southall et al. (2007) for different marine mammal functional hearing groups.[132] Unfortunately, BOEM's particular use of Southall et al. (2007) neglects the modifications that have since been made to these standards, by Dr. Southall and the U.S. Navy, in light of new scientific information.

First, BOEM must modify its standard for high-frequency cetaceans to account for new threshold shift data on harbor porpoises. The new data show that harbor porpoises experience threshold shift on exposure to airgun signals at substantially lower levels than the two mid-frequency cetaceans (bottlenose dolphins and beluga whales) on which the Southall et al. acoustic criteria were based.[133] Given similarities between the harbor porpoise ear and that of other high-frequency cetaceans, both the U.S. Navy – in its recent DEISs for the Atlantic Fleet and the Southern California and Hawaii Range Complexes, and in a related technical report prepared by SPAWAR – and Dr. Southall and colleagues from St. Andrew's University, in their Environmental Impact Report for a seismic survey off the central California coast, have significantly reduced the temporary and permanent threshold shift criteria for all high-frequency cetaceans.[134] BOEM must do the same.

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[132] Southall, B.L., Bowles, A.E., Ellison, W.T., Finneran. J.J., Gentry, R.L., Greene, C.R., Jr., Kastak, D., Ketten, D.R., Miller, J.H., Nachtigall, P.E., Richardson, W.J., Thomas, J.A., and Tyack, P.L., Marine mammal noise exposure criteria: Initial scientific recommendations, *Aquatic Mammals* 33:411-521 (2007).

[133] Lucke, K., Siebert, U., Lepper, P.A., and Blanchet, M.-A., Temporary shift in masked hearing thresholds in a harbor porpoise (*Phocoena phocoena*) after exposure to seismic airgun stimuli, *Journal of the Acoustical Society of America* 125: 4060-4070 (2009).

[134] Finneran, J.J., and Jenkins, A.K., Criteria and thresholds for U.S. Navy acoustic and explosive effects analysis (Apr. 2012) (available at the aftteis.com website); Navy, Draft Environmental Impact Statement/ Overseas Environmental Impact Statement for Atlantic Fleet Training and Testing (2012); Navy, Hawaii-Southern California Training and Testing Activities Draft Environmental Impact Statement/ Overseas Environmental Impact Statement (2012); California State Lands Commission, Draft Environmental Impact Report (EIR) for the Central Coastal California Seismic Imaging Project at Chap. 4.4 and App. H (2012) (CSLC EIR No. 758) (includes report from Dr. Southall and colleagues at St. Andrews University).

Second, and similarly, BOEM must modify its Southall et al. standard for low-frequency cetaceans: the baleen whales. New data from SPAWAR indicates that mid-frequency cetaceans have greater sensitivity to sounds within their best hearing range than was supposed at the time Southall et al. was published.[135] It is both conservative and consistent with the methodology of that earlier paper to assume that low-frequency cetaceans, which have never been studied for threshold shift, also have greater sensitivity to sounds within their own best hearing range.[136] For this reason and others, Dr. Southall and his St. Andrew's colleagues reduced the threshold shift criteria for baleen whales exposed to airgun noise, in the report they recently produced for the California State Lands Commission.[137] Again, BOEM should do the same.

Hearing loss remains a very significant risk where, as here, the agency has not required aerial or passive acoustic monitoring as standard mitigation, appears unwilling to restrict operations in low-visibility conditions, has set safety zone bounds that are inadequate to protect high-frequency cetaceans, and has not firmly established seasonal exclusion areas for biologically important habitat. BOEM should take a conservative approach and apply the more precautionary standard, once the necessary modifications to Southall et al. (2007) have been made.

4. Failure to set proper thresholds for mid-frequency sources

BOEM has also failed to set appropriate take thresholds for sub-bottom profilers and other active acoustic sources.

As NMFS's Open Water Panel has indicated, some sub-bottom profilers used in Arctic oil and gas surveys have source levels and frequency ranges approaching that of certain active military sonar systems, with shorter intervals between pings.[138] Indeed, the chirp systems analyzed in the DPEIS (DPEIS at D-28) have threshold source levels close to that of the Navy's SQS-56 mid-frequency, hull-mounted sonar.[139] Additionally, these levels vastly exceed those analyzed for similar chirp systems used in HRG surveys for renewables, according to BOEM's recent programmatic EA for mid-Atlantic offshore wind.[140] BOEM's use of a 160 dB threshold under these circumstances is inappropriate. While we do not recommend the application of the Navy's generalized risk functions for mid-frequency sonar, enough data are available for some taxa to indicate species-specific thresholds. For purposes of authorizing mid-frequency sonar training, NMFS assumes that harbor porpoises are taken at received levels above 120 dB (RMS); and the Navy has adopted a 140 dB (RMS) threshold for beaked whales based on the findings of Tyack

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[135] Finneran and Jenkins, Criteria and thresholds, *supra*.

[136] *See* discussion in California State Lands Commission, Draft Environmental Impact Report at H-46, *supra*.

[137] *Id*. at 4.4-49 to 4-50 and H-46; *see also* PDEIS at 4-51 (noting need to reassess TTS in light of SPAWAR data).

[138] *See* Expert Panel Review 2011.

[139] *See, e.g.*, 74 Fed. Reg. 4,844 (Jan. 27, 2009); U.S. Navy, Final Atlantic Fleet Active Sonar Training Environmental Impact Statement/ Overseas Environmental Impact Statement (2008).

[140] *Cf.* BOEM, Commercial Wind Lease Issuance and Site Assessment Activities on the Atlantic Outer Continental Shelf Offshore New Jersey, Delaware, Maryland, and Virginia: Final Environmental Assessment at 28 (2012) (OCS EIS/EA BOEM 2012-003). The chirpers analyzed for wind farm HRG surveys have a source level of 201 dB.

et al. (2011).[141] At minimum, BOEM should adopt these specific thresholds for the mid-frequency acoustic sources considered in the DPEIS.

Furthermore, while the DPEIS does not provide ping intervals for sub-bottom profilers, the EA suggests that these sources may sound several times each second. It would be absurd to treat them as non-continuous sources.

C. Failure to Set Adequate Source Levels for Propagation Analysis

The DPEIS posits 230 dB (RMS) as a representative source level for purposes of modeling takes from large airgun arrays and 210 dB (RMS) for modeling takes from small arrays. DPEIS at 3-26. We see two significant issues with these assumptions.

First, as with behavioral risk thresholds, using the root mean square ("RMS") rather than peak pressure to estimate source levels for airguns is non-conservative and may not be biologically appropriate. The issue is not trivial: as Madsen 2005 observes, the RMS approach can result in underestimates of take of intense, impulsive sounds, depending on which method is used to calculate RMS and whether propagation takes place in a highly reverberant environment.[142] We recommend that BOEM use peak-pressure, or dual criteria of peak-pressure and RMS, to determine behavioral take for the impulsive component of the airgun source. Alternatively – and at the very least – BOEM should use the most biologically conservative method of determining RMS. According to Madsen's analysis, that method is likely to be the one followed by Madsen

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[141] *Id.*; Tyack, P.L., Zimmer, W.M.X., Moretti, D., Southall, B.L., Claridge, D.E., Durban, J.W., Clark, C.W., D'Amico, A., DiMarzio, N., Jarvis, S., McCarthy, E., Morrissey, R., Ward, J., and Boyd, I.L., Beaked whales respond to simulated and actual Navy sonar, *PLoS ONE* 6(3):e17009.doi:10.13371/journal.pone.0017009 (2011) (beaked whales). *See also* Miller, P.J., Kvadsheim, P., Lam., F.-P.A., Tyack, P.L., Kuningas, S., Wensveen, P.J., Antunes, R.N., Alves, A.C., Kleivane, L., Ainslie, M.A., and Thomas, L., Developing dose-response relationships for the onset of avoidance of sonar by free-ranging killer whales (*Orcinus orca*), presentation given at the Society for Marine Mammalogy Biennial Conference, Tampa, Florida, Dec. 2, 2011 (killer whales); Miller, P., Antunes, R., Alves, A.C., Wensveen, P., Kvadsheim, P., Kleivane, L., Nordlund, N., Lam, F.-P., van IJsselmuide, S., Visser, F., and Tyack, P., The 3S experiments: studying the behavioural effects of navy sonar on killer whales (*Orcinus orca*), sperm whales (*Physeter macrocephalus*), and long-finned pilot whales (*Globicephala melas*) in Norwegian waters, Scottish Oceans Institute Tech. Rep. SOI-2011-001, *available at* soi.st-andrews.ac.uk (killer whales). *See also, e.g.*, Fernández, A., Edwards, J.F., Rodríguez, F., Espinosa de los Monteros, A., Herráez, P., Castro, P., Jaber, J.R., Martín, V., and Arbelo, M., 'Gas and Fat Embolic Syndrome' Involving a Mass Stranding of Beaked Whales (Family Ziphiidae) Exposed to Anthropogenic Sonar Signals, *Veterinary Pathology* 42:446 (2005); Jepson, P.D., Arbelo, M., Deaville, R., Patterson, I.A.P., Castro, P., Baker, J.R., Degollada, E., Ross, H.M., Herráez, P., Pocknell, A.M., Rodríguez, F., Howie, F.E., Espinosa, A., Reid, R.J., Jaber, J.R., Martín, V., Cunningham, A.A., and Fernández, A., Gas-Bubble Lesions in Stranded Cetaceans, 425 *Nature* 575-576 (2003); Evans, P.G.H., and Miller, L.A., eds., Proceedings of the Workshop on Active Sonar and Cetaceans (2004) (European Cetacean Society publication); Southall, B.L., Braun, R., Gulland, F.M.D., Heard, A.D., Baird, R.W., Wilkin, S.M., and Rowles, T.K., Hawaiian Melon-Headed Whale (*Peponacephala electra*) Mass Stranding Event of July 3-4, 2004 (2006) (NOAA Tech. Memo. NMFS-OPR-31).

[142] Madsen, P.T., Marine mammals and noise: Problems with root-mean-squared sound pressure level for transients, *Journal of the Acoustical Society of America* 117:3952-57 (2005).

et al. (2002) and Møhl et al. (2003), which involves applying -3 dB end points relative to the wave form envelope.[143]

Second, it is not self-evident that using a single representative or average source level for large or small arrays is a reasonable and sufficiently conservative approach to BOEM's take analysis. As the DPEIS recognizes, the effective source levels of industry arrays may run considerably higher or lower than the one used in its modeling, up to or beyond 255 dB (zero-to-peak) for a large array (DPEIS at D-12). Given that impact areas grow exponentially with increases in source levels, the undercount that would result from excluding surveys with higher source levels could significantly exceed the overcount that would result from excluding surveys with lower source levels. For this reason, BOEM should conduct a sensitivity analysis to ensure that any representative source level, or levels, chosen for modeling do not negatively bias the analysis towards an undercount of take. If there is negative bias, the agency should modify the source level, or levels, and either rerun the model or use a conservative corrective factor to estimate take.

D. Failure to Adequately Assess Impacts on the North Atlantic Right Whale

In its consideration of potential environmental impacts, the DPEIS rightly pays special attention to the highly endangered North Atlantic right whale (*Eubalaena glacialis*), which is considered to be one of the most endangered species of large whales in the world. Indeed, as the National Marine Fisheries Service ("NMFS") has repeatedly stated, "the loss of even a single individual [North Atlantic right whale] may contribute to the extinction of the species" and "preventing the mortality of one adult female a year" may alter this outcome. 69 Fed. Reg. 30,857, 30,858 (June 1, 2004); *see also* 73 Fed. Reg. 60,173, 60,173 (Oct. 10, 2008); 72 Fed. Reg. 34,632, 34,632 (June 25, 2007); 66 Fed. Reg. 50,390, 50,392 (Oct. 3, 2001).

The affected planning areas contain both the majority of the right whale's migratory corridor and the species' only known calving ground. NMFS has characterized the latter as "a location vital to the population" and "a very high-risk area for pregnant females, new mothers, and calves."[144] Waters from the Altamaha River in Georgia (north of Brunswick) to San Sebastian Inlet in Florida (south of Melbourne) are federally-designated as critical habitat, specifically to protect it. *See* 59 Fed. Reg. 28,793, 28,803 (June 3, 1994). In addition, these and other waters in the southeast have been designated as special management areas to protect right whales from significant threats, such as ship-strikes and gillnet fishing. *See, e.g.*, 73 Fed. Reg. 60,173; 72 Fed. Reg. 34,632. In September 2009, several major conservation organizations petitioned NMFS to expand right whale critical habitat, to include the migratory corridor within 30 nautical miles of shore (from the southern border of Massachusetts to the border between North and

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[143] *Id. See also* Madsen, P.T., Møhl, B., Nielsen, B.K., and Wahlberg, M., "Male sperm whale behavior during exposures to distant seismic survey pulses," *Aquatic Mammals* 28:231–240 (2002); Møhl, B., Wahlberg, M., Madsen, P.T., Heerfordt, A., and Lund, A., "The monopulsed nature of sperm whale clicks," *Journal of the Acoustical Society of America* 114:1143–1154 (2003).

[144] NMFS, Final Environmental Impact Statement to Implement Vessel Operational Measures to Reduce Ship Strikes to North Atlantic Right Whales at 4-4 (Aug. 2008).

South Carolina) as well as additional calving areas adjacent to existing critical habitat, based on substantial new information about their biological importance.[145]

As discussed above, a single seismic source can significantly reduce right whale communication range on a population scale. Recent modeling from Cornell and NOAA shows the right whale to be particularly vulnerable to masking effects from airguns and other low-frequency noise given the acoustic and behavioral characteristics of its calls.[146] Seismic surveys in the Mid-Atlantic and South Atlantic planning areas would add cumulatively to the high levels of noise that right whales already experience from commercial shipping in their foraging grounds and along their migratory route, from LNG tanker traffic through their northeast critical habitat, and from Navy antisubmarine warfare training, which is expected to increase near their calving grounds with the construction of a new instrumented training range off Jacksonville, Florida. The advent of airgun noise on top of these other acoustic intrusions could significantly affect right whale vital rates over large scales. For example, modeling of right whale foraging in the Great South Channel, an area subject to high levels of ship traffic, has found that decrements in the whales' sensory range had a larger impact on food intake than even patch-density distribution, and are likely to compromise fitness in this endangered species.[147]

In addition to the threat of noise impacts to right whales, G&G surveying also poses the risk of increasing ship strikes, the leading cause of death for right whales. More than half (10 out of 14) of the post-mortem findings for right whales that died from significant trauma in the northwest Atlantic between 1970 and 2002 indicated that vessel collisions were a contributing cause of death (in the cases where presumed cause of death could be determined);[148] and these data are likely to grossly underestimate the actual number of animals struck, as animals struck but not recovered, or not thoroughly examined, cannot be accounted for.[149] Further, some types of anthropogenic noise have been shown to induce near-surfacing behavior in right whales, increasing the risk of ship-strike at relatively moderate levels of exposure, as noted in the next section below. It is possible that mid-frequency sub-bottom profilers and broadband airguns could produce the same effects, and both should be treated conservatively.

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[145] Center for Biological Diversity, Defenders of Wildlife, Humane Society of the United States, Ocean Conservancy, and Whale and Dolphin Conservation Society, Petition to Revise the Critical Habitat Designation for the North Atlantic Right Whale (*Eubalaena Glacialis*) under the Endangered Species Act (Sept. 16, 2009) (submitted to Commerce and NOAA Fisheries).

[146] Clark et al., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources; Clark et al., Acoustic masking in marine ecosystems: intuitions, analysis, and implication.

[147] Mayo, C.S., Page, M., Osterberg, D., and Pershing, A., On the path to starvation: The effects of anthropogenic noise on right whale foraging success, North Atlantic Right Whale Consortium: Abstracts of the Annual Meeting (2008).

[148] Moore, M. J., Knowlton, A.R., Kraus, S.D., McLellan, W.A., and Bonde, R.K., Morphometry, gross morphology and available histopathology in North Atlantic right whale (*Eubalena glacialis*) mortalities (1970-2002), *Journal of Cetacean Research and Management* 6:199-214 (2004).

[149] Reeves, R.R., Read, A., Lowry, L., Katona, S.K., and Boness, D.J., Report of the North Atlantic right whale program review, 13–17 March 2006, Woods Hole, Massachusetts (2007) (prepared for the Marine Mammal Commission).

While the DPEIS proposes two time-areas closures to reduce impacts on right whales, these measures are inadequate to address the impacts described here, for reasons discussed earlier in these comments Nor does the DPEIS provide any quantitative or even detailed qualitative analysis of masking effects or other cumulative, sub-lethal impacts on right whales. BOEM has again violated NEPA.

E. Failure to Consider Potential for Death and Serious Injury of Marine Mammals

While the DPEIS acknowledges the potential for injury, and indeed allows that some marine mammals will undergo permanent threshold shift as a result of the activity, it improperly dismisses the risk of mortality and serious injury from acoustic impacts.

First, the DPEIS fails entirely to consider the adverse synergistic effect that at least some types of anthropogenic noise can have on ship-strike risk. Mid-frequency sounds with frequencies in the range of some sub-bottom profilers have been shown to cause North Atlantic right whales to break off their foraging dives and lie just below the surface, increasing the risk of vessel strike.[150]

Second, as noted above (and contrary to representations in the DPEIS), a number of recent studies indicate that anthropogenic sound can induce permanent threshold shift at lower levels than anticipated.[151] Hearing loss remains a significant risk where, as here, the agency has not required aerial or passive acoustic monitoring as standard mitigation, appears unwilling to restrict operations in low-visibility conditions, and has not established seasonal exclusion areas for biologically important habitat other than designated critical habitat for right whales.

Third, the DPEIS wrongly discounts the potential for marine mammal strandings, even though at least one stranding event, the September 2002 stranding of beaked whales in the Gulf of California, is tightly correlated with geophysical survey activity; and even though high-intensity sounds in general have long been used by drive fisheries to force marine mammals ashore.[152]

Fourth, and finally, as noted above, the DPEIS makes no attempt to assess the long-term effects of chronic noise and noise-related stress on life expectancy, survival, and recruitment although proxies are available from the literature on terrestrial mammals and other sources. The need for

[150] Nowacek, D.P., Johnson, M.P., and Tyack, P.L., North Atlantic right whales (*Eubalaena glacialis*) ignore ships but respond to alerting stimuli, *Proceedings of the Royal Society of London, Part B: Biological Sciences* 271:227 (2004).

[151] Kastak, D., Mulsow, J., Ghoul, A., Reichmuth, C., Noise-induced permanent threshold shift in a harbor seal [abstract], *Journal of the Acoustical Society of America* 123: 2986 (2008); Kujawa, S.G., and Liberman, M.C., Adding insult to injury: cochlear nerve degeneration after "temporary" noise-induced hearing loss, *Journal of Neuroscience* 29:14077-14085 (2009).

[152] Brownell, R.L., Jr., Nowacek, D.P., and Ralls, K., Hunting cetaceans with sound: a worldwide review, *Journal of Cetacean Research and Management* 10: 81-88 (2008); Hildebrand, J.A., Impacts of anthropogenic sound, *in* Reynolds, J.E. III, Perrin, W.F., Reeves, R.R., Montgomery, S., and Ragen, T.J., eds., *Marine Mammal Research: Conservation beyond Crisis* (2006).

precautionary analysis in this regard is manifest, given BOEM's failure to commit to any substantial long-term monitoring program in the DPEIS – and the probability that even with an effective monitoring program, catastrophic declines in some Atlantic populations would remain likely to go unobserved.[153]

The DPEIS must be revised conservatively to account for potential mortality of marine mammals in the short- and long-term.

F. Failure to Adequately Assess Cumulative Impacts of the Activity

Here as elsewhere, the DPEIS analysis is anemic. The document makes no attempt to analyze the cumulative and synergistic effects of masking, energetic costs, stress, hearing loss, or any of the other impact mechanisms identified over the last several years,[154] whether for its own action alternatives or for the combined set of activities it identifies in its "cumulative impact scenario." Instead, for each of six sources of impacts, it strings a few unsupported and indeed baseless assumptions together – *e.g.*, that mitigation measures largely dependent on visual detection will eliminate "most" Level A takes, that "no significant noise impacts" would occur, that there is "no evidence of ambient noise levels approaching a threshold" where marine mammals might be significantly affected – and concludes that cumulative impacts would be "negligible" to "minor." *E.g.*, DPEIS at 4-62 to 4-65. This bare-bones approach disregards available information and analytical methodologies that are clearly relevant to an analysis of reasonably foreseeable impacts. 40 C.F.R. § 1502.22.

(1) Qualitative or detailed qualitative assessment.— Over the last several years, the scientific community has identified a number of pathways by which anthropogenic noise can affect vital rates and populations of animals. These conceptual models include the 2005 National Research Council study, which produced a model for the Population Consequences of Acoustic Disturbance; an ongoing Office of Naval Research program whose first phase has advanced the NRC model; and the 2009 Okeanos workshop on cumulative impacts.[155] The DPEIS employs none of these methods, and even in its qualitative analysis does not attempt to analyze any pathway of impact.

(2) Models of masking effects.— As noted above, bioacousticians at NOAA and Cornell have developed a quantitative model to assess loss of communication

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[153] Taylor, B.L., Martinez, M., Gerrodette, T., Barlow, J., and Hrovat, Y.N., Lessons from monitoring trends in abundance of marine mammals, *Marine Mammal Science* 23:157-175 (2007).

[154] National Research Council, Marine Mammal Populations and Ocean Noise: Determining When Noise Causes Biologically Significant Effects (2005); Wright, A.J. ed., Report on the workshop on assessing the cumulative impacts of underwater noise with other anthropogenic stressors on marine mammals: from ideas to action, proceedings of workshop held by Okeanos Foundation, Monterey, California, August 26-29, 2009 (2009).

[155] *Id*..

space over time from both commercial shipping and seismic exploration.[156] Incredibly, the DPEIS does not model for masking effects.

(3) Energetics.— Researchers have studied the impacts of various types of noise on the foraging success of killer whales and sperm whales. Both species were shown to experience significant decrements in foraging, of 18-19% and greater, within areas of obvious biological importance.[157] The DPEIS fails to consider the impacts of noise on foraging and energetics; indeed, despite its own recognition that animals who remain on their feeding grounds may suffer adverse impacts over time, it repeatedly characterizes "observed" impacts as minor and short-term. *E.g.*, DPEIS at 4-55. Based on the published evidence, for example, the DPEIS should conservatively assume that animals that are not evidently displaced from their feeding grounds nonetheless experience a significant decrement in foraging, of at least 20%, at received levels of 140 dB and greater.

(4) Chronic noise.— NOAA's Underwater Sound-Field Working Group has generated cumulative noise maps on ambient noise from ships around the world and on seismic surveys in the Gulf of Mexico, and noise maps covering individual seismic seismic surveys, military training exercises, and piledriving activity.[158] The draft EIS has not incorporated any of this quantitative information into its cumulative impact analysis.

(5) Stress.— Following from studies on terrestrial mammals, stress from ocean noise—alone or in combination with other stressors—may weaken a cetacean's immune system, interfere with brain development, increase the risk of myocardial infarctions, depress reproductive rates, cause malformations and other defects in young, all at moderate levels of exposure.[159] Because physiological stress response is highly

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[156] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10); Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., Van Parijs, S.M., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems: intuitions, analysis, and implication, *Marine Ecology Progress Series* 395: 201-222 (2009).

[157] Lusseau, D., Bain, D.E., Williams, R., and Smith, J.C., Vessel traffic disrupts the foraging behavior of southern resident killer whales *Orcinus orca*, *Endangered Species Research* 6: 211-221 (2009); Williams, R., Lusseau, D. and Hammond, P.S., Estimating relative energetic costs of human disturbance to killer whales (Orcinus orca), *Biological Conservation* 133: 301-311 (2006); Miller, P.J.O., Johnson, M.P., Madsen, P.T., Biassoni, N., Quero, M., and Tyack, P.L., Using at-sea experiments to study the effects of airguns on the foraging behavior of sperm whales in the Gulf of Mexico, *Deep-Sea Research I* 56: 1168-1181 (2009). *See also* Mayo, C.S., Page, M., Osterberg, D., and Pershing, A., On the path to starvation: the effects of anthropogenic noise on right whale foraging success, North Atlantic Right Whale Consortium: Abstracts of the Annual Meeting (2008) (finding that decrements in North Atlantic right whale sensory range due to shipping noise have a larger impact on food intake than patch-density distribution and are likely to compromise fitness).

[158] NOAA, Cetecean and Sound Mapping, *available at* www.st.nmfs.noaa.gov/cetsound (previewed at May NOAA symposium).

[159] *See, e.g.*, Chang, E.F., and Merzenich, M.M., Environmental Noise Retards Auditory Cortical Development, 300 *Science* 498 (2003) (rats); Willich, S.N., Wegscheider, K., Stallmann, M., and Keil, T., Noise Burden and the Risk of Myocardial Infarction, *European Heart Journal* (2005) (Nov. 24, 2005) (humans); Harrington, F.H., and Veitch,

conserved across species, it is reasonable to assume that marine mammals would be subject to the same effects, particularly if, as here, they are exposed repeatedly to noise from oil and gas exploration and other stressors.[160] Indeed, a recent New England Aquarium study of North Atlantic right whales, the closest relative of the bowhead whale, indicates that shipping noise alone can induce chronic stress in marine mammals.[161] The DPEIS, while acknowledging the potential for chronic stress to significantly affect marine mammal health, and while expecting that anthropogenic noise would induce physiological stress responses in marine mammals, does not incorporate chronic stress into its cumulative impact analysis, such as by using other species as proxies for lower life expectancies.

(6) Impacts from other sources.— While it lists numerous other reasonably foreseeable activities that stand to impact the same animal populations (DPEIS at 3-36 to 3-43), the DPEIS makes no attempt to incorporate their effects into its cumulative analysis. Perhaps most prominently, though it notes that naval activities will take increasing numbers of marine mammals in the region, BOEM nowhere accounts for the many millions of takes, including thousands of mortalities and serious injuries and hundreds of thousands of cases of threshold shift, that the Navy presently estimates will occur between January 2014 and January 2019 as a result of its Atlantic training and testing activities.[162] The lack of analysis is not supportable under NEPA.

The data already show that industrial noise can disrupt biologically significant behavior and shrink whale communication range on a region-wide scale. As Dr. Chris Clark (Cornell) postulated in a report of the International Whaling Commission's Scientific Committee, such repeated and persistent acoustic insults over the large areas affected by airgun surveys alone should be considered enough to cause population-level impacts in at least some species of marine mammals.[163] That analysis has since been underscored by additional quantitative analysis.[164]

A.M., Calving Success of Woodland Caribou Exposed to Low-Level Jet Fighter Overflights, *Arctic* 45:213 (1992) (caribou).

[160] A special issue of the International Journal of Comparative Psychology (20:2-3) is devoted to the problem of noise-related stress response in marine mammals. For an overview published as part of that volume, *see, e.g.,* A.J. Wright, N. Aguilar Soto, A.L. Baldwin, M. Bateson, C.M. Beale, C.Clark, T. Deak, E.F. Edwards, A. Fernández, A. Godinho, L. Hatch, A. Kakuschke, D. Lusseau, D. Martineau, L.M. Romero, L. Weilgart, B. Wintle, G. Notarbartolo di Sciara, and V. Martin, Do marine mammals experience stress related to anthropogenic noise? (2007).

[161] Rolland, R.M., Parks, S.E., Hunt, K.E., Castellote, M., Corkeron, P.J., Nowacek, D.P., Wasser, S.K., and Kraus, S.D., Evidence that ship noise increases stress in right whales, *Proceedings of the Royal Society B: Biological Sciences* doi:10.1098/rspb.2011.2429 (2012).

[162] Navy, Draft Environmental Impact Statement/ Overseas Environmental Impact Statement for Atlantic Fleet Training and Testing (2012).

[163] IWC Scientific Committee, Report of the 2004 Scientific Committee of the International Whaling Commission, Annex K: Report of the Standing Working Group on Environmental Concerns (2004).

[164] Clark, C.W., Ellison, W.T., Southall, B.L., Hatch, L., van Parijs, S., Frankel, A., and Ponirakis, D., Acoustic masking in marine ecosystems as a function of anthropogenic sound sources (2009) (IWC Sci. Comm. Doc. SC/61/E10); Clark, C., and Rice, A., Seismic airgun surveys and marine vertebrates (2012) (presentation given June 12, 2012 to the Mid-Atlantic Fishery Management Council); NOAA, Cetecean and Sound Mapping, *available at*

The DPEIS' summary conclusions to the contrary are made without support, and without even attempting to address data gaps through methods accepted within the scientific community.[165]

G. Failure to Adequately Define Impact Levels

For each resource, the DPEIS provides specific impact criteria, which are then used to determine whether the overall effect on the resource qualifies as "negligible," "minor," "moderate," or "major." DPEIS at 4-44, 4-50. Unfortunately, as the ultimate measure of potential effects, these descriptors, as stated and as applied, are problematic in the extreme. They do not incorporate all of the factors relevant to NEPA "significance" analysis; and insofar as they reflect standards embodied in other statutes, such as the Marine Mammal Protection Act and Endangered Species /Act, they are fundamentally misapplied.

(1) As BOEM states at the outset, the DPEIS is intended to provide the information necessary for agency compliance with the Marine Mammal Protection Act, Endangered Species Act, and other statutes, as well as the Outer Continental Shelf Lands Act and NEPA. DPEIS at vii. This approach comports with applicable caselaw. Courts have observed that, when an action is taken pursuant to a specific statute, not only do "the statutory objectives of the project serve as a guide by which to determine the reasonableness of objectives outlined in an EIS," but "the statutory objectives underlying the agency's action work significantly to define its analytic obligations." *Oregon Natural Desert Ass'n v. BLM*, 625 F3d 1092, 1109 (9th Cir. 2010). Indeed, agencies are required by NEPA to explain how alternatives in an EIS will meet requirements of "other environmental laws and policies." 40 C.F.R. § 1502.2(d). But that does not remove the obligation to evaluate significance according to the factors articulated in CEQ's regulations: e.g., "(3) "Unique characteristics of the geographic area," including "ecologically critical areas"; (4) the degree to which impacts "are likely to be highly controversial"; and (5) the degree to which potential impacts "are highly uncertain or involve unique or unknown risks. 40 C.F.R. § 1508.27. Although a defined threshold is particularly needed when an agency prepares an EA, it has consequences here given the programmatic nature of the analysis. BOEM and NMFS may later incorporate portions of the EIS by reference, and under such circumstances, it will be critical to understand the import of the analysis within the context of an established threshold. For that, incorporating the NEPA significance factors is essential.

(2) As noted above, NEPA regulations require agencies to explain how alternatives meet the requirements of other applicable statutes. 40 C.F.R. § 1502.2(d). And yet BOEM, while referencing elements of the MMPA's "negligible impact" standard, does not appear to apply the relevant OCSLA standard, "undue harm," anywhere in the DPEIS. *See* 43

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www.st.nmfs.noaa.gov/cetsound (previewed at May NOAA symposium, showing vast increase in equivalent noise level (L_{EQ}) of ambient noise from seismic in Gulf of Mexico, averaged over one year).

[165] 40 C.F.R. § 1502.22. *See also* Bejder, L., Samuels, A., Whitehead, H., Finn, H., and Allen, S., Impact assessment research: use and misuse of habituation, sensitization and tolerance in describing wildlife responses to anthropogenic stimuli, *Marine Ecology Progress Series* 395:177-185 (2009).

U.S.C. § 1340(a). The omission is puzzling given the DPEIS' ostensible aim of supporting permitting decisions made under OCSLA. DPEIS at vii. BOEM should consider "undue harm" into its analysis.

(3) The DPEIS, having incorporated the MMPA's "negligible impact" standard into its significance criteria, fails completely to apply it. In practice, the document does not provide, for example, the necessary information for determining whether any of the proposed alternatives will have a greater than negligible impact on any marine mammal stock. 16 U.S.C. § 1371(a)(5)(D)(i)(I). Instead, the DEIS offers qualitative conclusions, made without any apparent support or indeed any apparent attempt at assessing the cumulative impacts of the activity. For example, Level B takes are considered to result in only "moderate" impacts, even though the surveys "would affect a large number of individuals," since "it is presumed that exposure to elevated sound would be somewhat localized and temporary in duration." DPEIS at 4-55. Not only does this analysis make assumptions about behavioral response and take thresholds that are inconsistent with the available literature, it makes no attempt to translate short-term behavioral impacts into long-term impacts on populations – a failure that violates NEPA. 40 C.F.R. § 1508.7. The 2006 programmatic environmental assessment for seismic surveying in the Arctic incorporated the MMPA "negligible impact" standard by using "potential biological removal" to determine the number of harassed whales that could affect the population's rates of survival and recruitment.[166] The recent Draft Environmental Impact Report, by the California State Lands Commission, for seismic surveys off the Diablo Canyon nuclear reactor site develops another methodology for evaluating a project's cumulative Level A and Level B impacts against the MMPA standard.[167] BOEM must improve its analysis.

H. Failure to Analyze Impacts on Fish and Other Species of Concern

The activities considered in the DPEIS have potential to detrimentally affect multiple fish species, harm vital fish habitat, and conflict with multiple fisheries.

As an initial matter, the DPEIS's consideration of impacts does not give adequate weight to the effects of repeated seismic testing and other activities on the behavior of fish and invertebrates. For instance, the DPEIS dismisses temporary hearing loss in fish as a minor effect without considering whether the hearing loss may be permanent or whether even a temporary loss of hearing renders the fish vulnerable to predation, unable to locate food, or unable to locate a mate.[168] In addition, sublethal disturbance that causes fish to avoid key feeding or spawning

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[166] MMS, Final Programmatic Environmental Assessment, Arctic Outer Continental Shelf Seismic Surveys – 2006, OCS EIS/EA MMS 2006-038 at 36-37 (June 2006) (2006 PEA), *available at* http://www.alaska.boemre.gov/ref/EIS%20EA/Final_PEA/Final_PEA.pdf.

[167] California State Lands Commission, Draft Environmental Impact Report (EIR) for the Central Coastal California Seismic Imaging Project at Chap. 4.4 and App. H (2012) (CSLC EIR No. 758).

[168] *See* McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J., and McCabe, K., Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid (2000) (industry-sponsored study undertaken

areas could have a detrimental effect on the population of the species itself. For example, the DPEIS acknowledges that the activities it describes could disrupt feeding by Atlantic sturgeon, which is listed under the Endangered Species Act because its numbers are critically low. DPEIS at 4-131, 4-138. Yet it gives virtually no consideration to what effect disrupted feeding and effects benthic habitat will have when added to the species' ongoing struggle to survive in severely degraded, limited habitat. The DPEIS does not even consider the impacts such as masking, and silencing of fish vocalizations, may have on fish breeding success. For example, masking of black drum fish and toadfish choruses, which overlap with the low-frequency output of seismic airguns, could significantly impair breeding in those species.[169]

In the case of coastal pelagic species, also known as forage species, the action's adverse effects could ripple through the food chain. The DPEIS acknowledges that forage species are often very sensitive to sound and tend to avoid the sort of noise generated by G&G activities. DPEIS at 4-131. These species, such as herring, alewife, and others, comprise an important part of the diets of many predatory fish, including tuna and swordfish. Changes in aggregation behavior or movements of forage species could reduce the available food for predatory species, reducing their fitness and numbers and potentially causing them to shift their own movement patterns in response. Any such effects on predatory fish species would likely adversely affect the commercial and recreational fisheries that depend on them. Nor does the PDEIS assess the impact of G&G activities on invertebrates, such as cephalopods like squid and octopus, even though a number of studies have demonstrated that seismic and other low-frequency sound sources can disrupt, injure, and kill these taxa.[170]

Indeed, airgun surveys are known to significantly affect the distribution of some fish species, which can impact commercial and recreational fisheries and could also displace or reduce the foraging success of marine mammals that rely on them for prey. Indeed, as one study has noted, fishermen in various parts of the world have complained for years about declines in their catch rates during oil and gas airgun surveys, and in some areas have sought industry compensation for their losses.[171] Airguns have been shown experimentally to dramatically depress catch rates of some commercial fish species, by 40 to 80% depending on catch method, over thousands of

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by researchers at the Curtin University of Technology, Australia); McCauley, R., Fewtrell, J., and Popper, A.N., High intensity anthropogenic sound damages fish ears, *Journal of the Acoustical Society of America* 113: 638-642 (2003); *see also* Scholik, A.R., and Yan, H.Y., Effects of boat engine noise on the auditory sensitivity of the fathead minnow, *Pimephales promelas, Environmental Biology of Fishes* 63: 203-209 (2002).

[169] Clark, C., and Rice, A., Seismic airgun surveys and marine vertebrates (2012) (presentation given June 12, 2012 to the Mid-Atlantic Fishery Management Council).

[170] André, M., Solé, M., Lenoir, M., Durfort, M., Quero, C., Mas, A., Lombarte, A., van der Schaar, M., López-Bejar, M., Morell, M., Zaugg, S., and Houégnigan, L., Low-frequency sounds induce acoustic trauma in cephalopods, *Frontiers in Ecology and the Environment* 2011: doi:10.1890/100124 (2011); Guerra, A., and Gonzales, A.F., Severe injuries in the giant squid *Architeuthis dux* stranded after seismic explosions (2006) (paper presented at International Workshop on the Impacts of Seismic Survey Activities on Whales and Other Marine Biota, convened by German Federal Environment Agency, Sept. 6-7, 2006, Dessau, Germany); McCauley *et al.*, Marine seismic surveys: analysis and propagation of air-gun signals, and effects of air-gun exposure.

[171] McCauley *et al.*, Marine seismic surveys: analysis and propagation of air-gun signals, and effects of air-gun exposure.

square kilometers around a single array.[172] Large-scale displacement is likely to be responsible for the fallen catch rates: studies have shown both horizontal (spatial range) and vertical (depth) displacement in a number of other commercial species on a similar spatial scale.[173] Impacts on fisheries were found to last for some time beyond the survey period, not fully recovering within 5 days of post-survey monitoring.[174] Airguns also have been shown to substantially reduce catch rates of rockfish, at least to the distances (less than 5 km) observed in the experiment.[175] Yet the DPEIS – which acknowledging that displacement can increase the risk of predation, disrupt fish spawning and reproduction, alter migration routes, and impact feeding – appears to assume without support that effects on both fish and fisheries would be localized and "minor." PDEIS at 4-120.

In short, the DPEIS fails to recognize the scale of seismic survey impacts on commercial fish species, does not assess impacts of decreased prey availability on marine mammals, ignores the potential for acoustic impacts on Essential Fish Habitat – and, finally, fails to consider measures to mitigate these impacts, such as excluding surveys from spawning areas and other areas of biological importance to Arctic fish species. BOEM must improve its scant analysis.[176]

I. Failure to Adequately Consider Issues Related to Climate Change

The analysis related to the effects of climate change is faulty in a two key respects: (1) it fails to analyze the direct and indirect effects of the proposed action on climate change and ocean acidification, and (2) it fails to explain how the proposed action will impact the marine environment against the backdrop of ocean warming and acidification. Yet NEPA requires analysis of the direct and indirect effects of greenhouse gas ("GHG") emissions and their consequences for climate change. Indeed, proposed guidance by CEQ concludes that the NEPA

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[172] Engås, A., Løkkeborg, S., Ona, E., and Soldal, A.V., Effects of seismic shooting on local abundance and catch rates of cod (*Gadus morhua*) and haddock (*Melanogrammus aeglefinus*), *Canadian Journal of Fisheries and Aquatic Sciences* 53: 2238-2249 (1996); *see also* Løkkeborg, S., Ona, E., Vold, A., Pena, H., Salthaug, A., Totland, B., Øvredal, J.T., Dalen, J. and Handegard, N.O., Effects of seismic surveys on fish distribution and catch rates of gillnets and longlines in Vesterålen in summer 2009 (2010) (Institute of Marine Research Report for Norwegian Petroleum Directorate).

[173] Slotte, A., Hansen, K., Dalen, J., and Ona, E., Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast, *Fisheries Research* 67:143-150 (2004).

[174] Engås *et al*., Effects of seismic shooting.

[175] Skalski, J.R., Pearson, W.H., and Malme, C.I., Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes ssp*.), *Canadian Journal of Fisheries and Aquatic Sciences* 49: 1357-1365 (1992).

[176] Additionally, BOEM must consider the impacts of seismic surveys and other activities on invertebrates. *See, e.g.*, McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J., and McCabe, K., Marine seismic surveys: Analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid (2000); André, M., Solé, M., Lenoir, M., Durfort, M., Quero, C., Mas, A., Lombarte, A., van der Schaar, M., López-Bejar, M., Morell, M., Zaugg, S., and Houégnigan, L., Low-frequency sounds induce acoustic trauma in cephalopods, *Frontiers in Ecology and the Environment* doi:10.1890/100124 (2011); Guerra, A., and Gonzales, A.F., Severe injuries in the giant squid *Architeuthis dux* stranded after seismic explorations, *in* German Federal Environment Agency, International Workshop on the Impacts of Seismic Survey Activities on Whales and Other Marine Biota at 32-38 (2006);

process "should incorporate consideration of both the impact of an agency action on the environment through the mechanism of GHG emissions and the impact of changing climate on that agency action."[177]

First, BOEM must fully analyze the direct and indirect effects on climate change from the greenhouse gas emissions attributable to its G&G operations from vessels and other sources. While the DPEIS acknowledges that survey vessels and aircraft involved in G&G activities would emit greenhouse gas pollution, it never quantifies or evaluates the impact of those emissions. *See* DPEIS at 4-4. Additionally, the DPEIS cannot ignore the greenhouse gases that will be released in to the atmosphere as a result of the oil and gas produced as a result of the exploration activities authorized here. NEPA requires that agencies consider a proposed action's future indirect effects, which are those "caused by an action and are later in time or farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. § 1508.8(b). The stated need for the action is to determine the extent and location of oil and gas reserves to facilitate oil and gas development. DPEIS at 1-8. Accordingly, BOEM must calculate not only the greenhouse gas emissions from the vessels and activities used for the G&G operations, but the impacts of the greenhouse gases emitted from the produced oil and gas reserves.

Second, the DPEIS fails to explain how its G&G activities will impact marine species and ecosystems that are already compromised by rapid climate change and ocean acidification. The DPEIS' cursory description of climate change and ocean acidification, which concludes without analysis that the environmental effects are likely to be small, incremental, and difficult to discern from effects of other natural and anthropogenic factors (DPEIS at 3-43), falls short of the hard look required by NEPA. Moreover, simply stating, in the cumulative impacts section, that climate change is a broad cumulative impact is inadequate and does nothing to examine the relevance of the proposed action to that cumulative effect. *See, e.g.*, DPEIS at 4-21, 4-62, 4-85, 4-102, 4-122, 4-135, 4-150, 4-158, 4-164, 4-170, 4-183, 4-199, 4-212. For example, the analysis fails to evaluate the project in light of the increasing frequency and strength of hurricanes in the Atlantic, increasing sea level rise along the Atlantic seaboard, and stress to marine species from ocean warming and acidification that will be compounded by risks from oil and gas exploration and development.

1. Climate change impacts requiring analysis

Climate change is already resulting in warming temperatures, rising sea levels, and increases in the frequency of extreme weather events, particularly heat waves and extreme precipitation events.[178] The average temperature in the United States rose more than 2°F over the past 50 years; by the end of this century, it is expected to increase by 4 to 6.5°F under a lower emissions

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[177] Nancy Sutley, Chair, Council on Environmental Quality, Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions (Feb. 18, 2010).

[178] U.S. Global Change Research Program, Global Climate Change Impacts in the United States: A State of Knowledge Report from the U.S. Global Change Research Program (2009) (Cambridge University Press).

scenario and by 7 to 11°F under a higher emissions scenario.[179] The decade from 2000 to 2010 was the warmest on record,[180] and 2005 and 2010 tied for the hottest years on record.[181]

Global average sea level rose by roughly eight inches over the past century, and sea level rise is accelerating in pace.[182] Indeed, sea level is rising faster along the U.S. east coast now than at any other time during at least the past 2,000 years.[183] About 3.7 million Americans live within a few feet of high tide and risk being hit by more frequent coastal flooding in coming decades because of the sea level rise.[184] The most vulnerable state is Florida, followed by Louisiana, California, New York and New Jersey. Modeling indicates that the Atlantic is in danger of in danger of seeing historical extremes of sea level surges frequently surpassed in the coming few decades.[185] Studies that have attempted to improve upon the IPCC estimates have found that a mean global sea-level rise of at least 1 to 2 meters is highly likely within this century.[186] Others that have reconstructed sea-level rise based on the geological record, including oxygen isotope and coral records, have found that larger rates of sea-level rise of 2.4 to 4 meters per century are possible.[187]

As briefly mentioned in the DPEIS, sea turtles that nest on the Atlantic coast will be affected by rising and surging sea levels. The added pressure and displacement from their nesting and migration from the G&G program will further impact these threatened and endangered sea species. Additionally, critical habitat designation for the North Atlantic DPS of loggerhead sea turtles is imminent, and accordingly BOEM should evaluate the extent to which the proposed action will affect areas of potential marine and beach critical habitat. Other coastal wildlife species are also impacted by sea level rise, and these effects must also be evaluated.

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[179] *Id*.

[180] National Aeronautic Space Association, *NASA Research Finds Last Decade was Warmest on Record, 2009 One of the Warmest Years* (Jan. 21, 2010), www.nasa.gov/home/hqnews/2010/jan/HQ_10-017_Warmest_temps.html

[181] National Oceanic and Atmospheric Administration, *NOAA: 2010 Tied for Warmest Year on Record*, www.noaanews.noaa.gov/stories2011/20110112_globalstats.html

[182] U.S. Global Change Research Program, Global Climate Change Impacts, *supra*.

[183] Kemp, A.C., Horton, B.P., Donnelly, J.P., Mann, M.E., Vermeer, M., and Rahmstorf, S., Climate related sea-level variations over the past two millennia, *Proceedings of the National Academy of Sciences of the United States of America* 108: 11017-22 (2011).

[184] Strauss, B.H., Ziemlinski, R., Weiss, J.L., and Overpeck, J.T., Tidally adjusted estimates of topographic vulnerability to sea level rise and flooding for the contiguous United States, *Environmental Research Letters* 7(1): 014033. doi:10.1088/1748-9326/7/1/014033 (2012).

[185] Tebaldi, C., Strauss, B.H., and Zervas, C.E., Modelling sea level rise impacts on storm surges along US coasts, *Environmental Research Letters* 7(1): doi:10.1088/1748-9326/7/1/014032 (2012).

[186] Rahmstorf, S., A semi-empirical approach to projecting future sea-level rise, *Science* 315: 368-370 (2007); Pfeffer, W.T., Harper, J.T., and O'Neel, S., Kinematic constraints on glacier contributions to 21st-century sea-level rise, *Science* 321: 1340-1343 (2008); Vermeer, M., and Rahmstorf, S., Global sea level linked to global temperature, *PNAS* 2009: doi:10.1073/pnas.0907765106 (2009); Grinsted, A., Moore, J.C., and Jevrejeva, S., Reconstructing sea level from paleo and projected temperatures 200 to 2100 AD, *Clim. Dyn*. 2010: doi:10.1007/s00382-008-0507-2 (2010); Jevrejeva, S., Moore, J.C., and Grinsted, A., How will sea level respond to changes in natural and anthropogenic forcings by 2100? *Geophysical Research Letters* 37: doi:10.1029/2010GL042947 (2010).

[187] Milne, G.A., Gehreis, W.R., Hughes, C.W., Tamisiea, M.E., Identifying the causes of sea-level change, *Nature Geoscience* 2009: doi:10.1038/ngeo544 (2009).

Extreme weather events, most notably heat waves and precipitation extremes, are striking with increased frequency,[188] with deadly consequences for people and wildlife. In 2011 alone, a record 14 weather and climate disasters occurred in the United States, including droughts, heat waves, and floods, that cost at least $1 billion (U.S.) each in damages and loss of human lives.[189] Tropical cyclones in the Atlantic have already gotten stronger due to warmer waters, and on average storms in recent years have ramped up in severity more quickly than in the past.[190] Over the last 30 years the Atlantic coast has seen a significant increase in hurricane wave heights.[191] Models predict a doubling of severe category 4 and 5 hurricanes in the Atlantic within the century,[192] and the risks of oil and gas exploration and development increase during severe storms.

Recent studies on the impacts of climate change on biodiversity have demonstrated that current levels of greenhouse gases are already having significant impacts on species and ecosystems in all regions of the world, including changes in wildlife distribution, physiology, demographic rates, genetics, and ecosystem services, as well as climate-related population declines and extinctions.[193] Because greenhouse gas emissions to date commit the Earth to substantial climatic changes in the coming decades, and because climate change is occurring at an unprecedented pace with multiple synergistic impacts, climate change is predicted to result in catastrophic species losses during this century. The IPCC concluded that 20% to 30% of plant and animal species will face an increased risk of extinction if global average temperature rise

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[188] Coumou, D., and Rahmstorf, S., A decade of weather extremes, *Nature Climate Change* doi:10.1038/nclimate1452 (2012); IPCC, Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change (2012).

[189] National Oceanic and Atmospheric Administration, *Extreme Weather 2011*, http://www.noaa.gov/extreme2011/.

[190] Elsner, J.B., Kossin, J.P., and Jagger, T.H., The increasing intensity of the strongest tropical cyclones, *Nature* 455: 92-5 (2008); Kishtawal, C.M., Jaiswal, N., Singh, R., and Niyogi, D., Tropical cyclone intensification trends during satellite era (prepub.); Saunders, M.A., and Lea, A.S., Large contribution of sea surface warming to recent increase in Atlantic hurricane activity, *Nature* 451: 557-60 (2008).

[191] Komar, P.D., and Allan, J.C., Increasing hurricane-generated wave heights along the U.S. east coast and their climate controls," *Journal of Coastal Research* 242: 479-488 (2008).

[192] Bender, M.A., Knutson, T.R., Tuleya, R.E., Sirutis, J.J., Vecchi, G.A., Garner, S.T., and Held. I.M., Modeled impact of anthropogenic warming on the frequency of intense Atlantic hurricanes, *Science* 327: 454-8 (2010).

[193] Chen, I., Hill, J.K., Ohlemuller, R., Roy, D.B., and Thomas, C.D., Rapid range shifts of species associated with high levels of climate warming, *Science* 333: 1024-1026 (2011); Maclean, I.M.D., and Wilson, R.J., Recent ecological responses to climate change support predictions of high extinction risk, *Proceedings of the National Academy of Sciences of the United States of America* 108: 12337-12342 (2011); Parmesan, C., and Yohe, G., A globally coherent fingerprint of climate change impacts across natural systems, *Nature* 421: 37-42 (2003); Parmesan, C., Ecological and evolutionary responses to recent climate change, *Annu. Rev. Ecol. Evol. Syst.* 37: 637–669 (2006); Root, T.L., Price, J.T., Hall, K.R., Schneider, S.H., Rosenzweig, C., and Pounds, J.A., Fingerprints of global warming on wild animals and plants, *Nature* 421: 57-60 (2003); Walther, G., Post, E., Convey, P., Menzel, A., Parmesan, C., Beebee, T.J.C., Fromentin, J., Hoegh-Guldberg, O., and Bairlein, F., Ecological responses to recent climate change, *Nature* 416: 389-395 (2002); Walther, G.R., Berger, S., and Sykes, M.T., An ecological "footprint" of climate change, *Proceedings of the Royal Society B: Biological Sciences* 272: 1427-1432 (2002); Warren, R., Price, J., Fischlin, A., de la Nava Santos, S., and Midgley, G., Increasing impacts of climate change upon ecosystems with increasing global mean temperature rise, *Climatic Change* 106: 141-177 (2011).

exceeds 1.5°C to 2.5°C relative to 1980-1999 levels, with an increased risk of extinction for up to 70% of species worldwide if global average temperature exceeds 3.5°C relative to 1980-1999 levels.[194] Thomas et al. (2004) projected that 15%-37% of species will be committed to extinction by 2050 under a mid-level emissions scenario—a trajectory which the world has been exceeding.[195] Maclean and Wilson (2011) concluded that the harmful effects of climate change on species exceed predictions and that one in ten species could face extinction by the year 2100 if current rates of climate change continue unabated.[196] The updated IPCC Reasons for Concern reflect that current warming is already at a point where significant risks to species and ecosystems are occurring, and that these risks will become "severe" at a ~1°C rise above preindustrial levels.[197] A comprehensive literature review by Warren et al. (2011) found that significant species range losses and extinctions are predicted to occur at a global mean temperature rise below 2°C in several biodiversity hotspots and globally for coral reef ecosystems. At a 2°C temperature rise, projected impacts increase in magnitude, numbers, and geographic scope. Beyond a 2°C temperature rise, the level of impacts and the transformation of the Earth's ecosystems will become steadily more severe, with the potential collapse of some entire ecosystems, and extinction risk accelerating and becoming widespread.[198]

Contrary to the statements in the DPEIS, the impacts of climate change are happening within the next decade and are already occurring. For the North Atlantic, ocean warming has already been reported as contributing to ecosystem shifts.[199] Changes are seen from phytoplankton to zooplankton to fish and are modifying the dominance of species and the structure, diversity and function of marine ecosystems.[200] These changes in biodiversity, combined with other impacts from fishing, oil and gas exploration and development, and ocean acidification, can contribute to the decline or extinction of species and must be analyzed in the DPEIS.

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[194] IPCC, *Climate Change 2007: Synthesis Report-- An Assessment of the Intergovernmental Panel on Climate Change* (2007).

[195] Thomas, C.D., Cameron, A., Green, R.E., Bakkenes, M., Beaumont, L.J., Collingham, Y.C., Erasmus, B.F.N., Extinction risk from climate change, *Nature* 427: 145-148 (2004); Global Carbon Project, *Carbon Budget 2009*, (2010) (report available at http://www.globalcarbonproject.org/index.htm); Raupach, M.R., Marland, G., Ciais, P., Le Quéré, C., Canadell, J.G., Klepper, G., and Field, C.B., Global and regional drivers of accelerating CO2 emissions, *Proceedings of the National Academy of Sciences* 104: 10288 (2007).

[196] Maclean, I.M.D., and Wilson, R.J., Recent ecological responses to climate change support predictions of high extinction risk, *Proceedings of the National Academy of Sciences of the United States of America* 108: 12337-12342 (2011).

[197] Smith, J.B., Schneider, S.H., Oppenheimer, M., Yohe, G.W., Hare, W., Mastrandrea, M.D., Patwardhan, A., Assessing dangerous climate change through an update of the Intergovernmental Panel on Climate Change (IPCC) "reasons for concern," *Proceedings of the National Academy of Sciences of the United States of America* 106 (11): 4133-4137 (2009).

[198] Warren, R., Price, J., Fischlin, A., de la Nava Santos, S., and Midgley, G., Increasing impacts of climate change upon ecosystems with increasing global mean temperature rise, *Climatic Change* 106: 141-177 (2011).

[199] Beaugrand, G., Edwards, M., Brander, K., Luczak, C., and Ibanez, F., Causes and projections of abrupt climate-driven ecosystemshifts in the North Atlantic, *Ecology letters* 11: 1157-68 (2008).

[200] Beaugrand, G., Decadal changes in climate and ecosystems in the North Atlantic Ocean and adjacent seas, *Deep Sea Research Part II: Topical Studies in Oceanography* 56: 656-673 (2009); Kerr, L.A., Connelly, W.J., Martino, E.J., Peer, A.C., Woodland, R.J., and Secor, D.H., Climate change in the U.S. Atlantic affecting recreational fisheries, *Reviews in Fisheries Science* 17: 267-289 (2009).

2. Ocean acidification impacts requiring analysis

The oceans are becoming more acidic faster than they have in the past 300 million years, a period that includes four mass extinctions.[201] Friedrich et al. (2012) concluded that anthropogenic ocean acidification already exceeds the natural variability on regional scales and is detectable in many of the world's oceans, including Atlantic regions.[202] Observed trends over the last couple of decades off Bermuda indicate that aragonite saturation has declined -0.04 per decade—exceeding the last glacial termination by orders of magnitude.[203]

BOEM must examine the impacts of its proposed project on the marine environment in light of changes that are already occurring due to ocean acidification. Especially relevant to the proposed project is that the oceans are becoming noisier due to ocean acidification.[204] A 0.3 pH decrease causes of loss of ~40% sound absorption.[205] At levels of acidification predicted before the end of the century sound will travel 70% further in the ocean. The DPEIS must discuss the cumulative impacts of combined ocean acidification and the addition of noise to the marine environment from the proposed project.

Most marine animals respond negatively to ocean acidification, undermining calcification, growth, reproduction, metabolism, and survival.[206] Indeed, ocean acidification has already impacted Atlantic wildlife. For example, areas of the Chesapeake Bay have already been lost to oyster harvesting –[207] analogous to oyster die-offs in the Pacific Northwest that have now definitively been linked to ocean acidification.[208] Oyster populations in the bay are already at historically low levels, and an examination of 23 years of water quality data concluded that significant trends in acidity will have impacts on juvenile oyster growth and survival.[209] Already,

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[201] Honisch, B., Ridgwell, A., Schmidt, D.N., Thomas, E., Gibbs, S.J., Sluijs, A., Zeebe, R., The Geological Record of Ocean Acidification, *Science* 335: 1058-1063 (2012).

[202] Friedrich, T., Timmermann, A., Abe-Ouchi, A., Bates, N.R., Chikamoto, M.O., Church, M.J., Dore, J.E., Detecting regional anthropogenic trends in ocean acidification against natural variability, *Nature Climate Change* 2 (2): 1-5 (2012).

[203] *Id*.

[204] Hester, K.C., Peltzer, E.T., Kirkwood, W.J., and Brewer, P.G., Unanticipated consequences of ocean acidification: A noisier ocean at lower pH, *Geophysical Research Letters* 35: L19601 (2008).

[205] Brewer, P.G., and Hester, K.C., Ocean acidification and the increasing transparency of the ocean to low frequency sound, *Oceanography* 22 (4): 86–93 (2009).

[206] Kroeker, K.J., Kordas, R.L., Crim, R.N., and Singh, G.G., Meta-analysis reveals negative yet variable effects of ocean acidification on marine organisms, *Ecology Letters* 13: 1419-1434 (2010).

[207] Fincham, M.W., Who Killed *Crassostrea virginica*? The Fall and Rise of Chesapeake Bay Oysters (2012) (documentary film made for Maryland Sea Grant at the University of Maryland Center for Environmental Science, summary and excerpt available at www.mdsg.umd.edu/store/videos/oyster).

[208] Barton, A., Hales, B., Waldbusser, G.G., Langdon, C., and Feely, R.A., The Pacific oyster, *Crassostrea gigas*, shows negative correlation to naturally elevated carbon dioxide levels: Implications for near-term ocean acidification effects, *Limnol. Oceanogr.* 57: 698-710 (2012).

[209] Waldbusser, G.G., Voigt, E.P., Bergschneider, H., Green, M.A., and Newell, R.I.E., Biocalcification in the eastern oyster (*Crassostrea virginica*) in relation to long-term trends in Chesapeake Bay pH, *Estuaries and Coasts* 34(2): 1–11 (2010).

calcification of juvenile oysters is compromised by acidification. Waldbusser et al. (2011) conducted a study of eastern oyster under 4 levels of pH that encompass a range typical of the mesohaline waters of the Chesapeake Bay (7.2–7.9 on the NBS scale). They found that in as little as 2 weeks under various pH levels, shells began to dissolve even in waters that were not corrosive (7.9 pH). The treatments were not atypical for estuarine waters in the Chesapeake Bay and demonstrate that shell dissolution increases with declining pH, especially for fresh shells.[210]

Studies of Northwest Atlantic bivalves demonstrate that changes in ocean acidification and temperature can have significant negative consequences for these coastal animals, especially at larval stages. Eastern oyster and bay scallop are particularly sensitive to ocean acidification, while ocean acidification and temperature rise together impair the survival, growth, development, and lipid synthesis of hard clams and bay scallops.[211]

Not only do calcifying organisms suffer from an increasingly acidic ocean environment, but fish and fisheries are threatened as well. New science confirms the negative consequences of ocean acidification on Atlantic herring, Atlantic cod, and *Menidia beryllina*, a common Atlantic estuarine fish. In Atlantic cod, exposure to CO2 resulted in severe to lethal tissue damage in many internal organs, with the degree of damage increasing with CO2 concentration.[212] Larval survival and length of *M. beryllina* unambiguously decreased with increased carbon dioxide treatments.[213] Eggs exposed to high levels also had a higher rate of malformations, with larvae developing curved bodies. Increased carbon dioxide in the water also negatively affected Atlantic herring larvae.[214] Slower-growing larvae are more vulnerable to predation and decreased feeding success.[215] Since larval survival is critical to recruitment, ocean acidification has the potential to act as an additional source of natural mortality, affecting populations of already exploited fish stocks.[216]

Even now, ocean acidification is putting vulnerable marine animals at the threshold of their tolerance levels. Declines of plankton, shellfish, and fish will reverberate up the marine food web with impacts on entire ecosystems. The DPEIS must quantify and discuss the contribution of the proposed action to further acidification, and it must also evaluate the cumulative impacts of the G&G program on the marine environment, in combination with acidification.

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[210] Waldbusser, G.G., Steenson, R.A., and Green, M.A., Oyster shell dissolution rates in estuarine waters: Effects of pH and shell legacy, *Journal of Shellfish Research* 30: 659-669 (2011).

[211] Talmage, S.C., and Gobler, C.J., Effects of elevated temperature and carbon dioxide on the growth and survival of larvae and juveniles of three species of Northwest Atlantic bivalves, *PLoS ONE* 6(10): e26941.doi:10.1371/journal.pone.0026941 (2011).

[212] Frommel, A.Y., Maneja, R., Lowe, D., Malzahn, A.M., Geffen, A.J., Folkvord, A., Piatkowski, U., Reusch, T.B.H., and Clemmesen, C., Severe tissue damage in Atlantic cod larvae under increasing ocean acidification, *Nature Climate Change* 2: 1-5 (2011).

[213] Baumann, H., Talmage, S.C., and Gobler, C.J., Reduced early life growth and survival in a fish in direct response to increased carbon dioxide, *Nature Climate Change* 2: 6-9 (2011).

[214] Franke, A., and Clemmesen, C., Effect of ocean acidification on early life stages of Atlantic herring (*Clupea harengus L.*), *Biogeosciences* 8: 3697-3707 (2011).

[215] *Id.*; Baumann et al., Reduced early life growth and survival in a fish, *supra*.

[216] Frommel et al., Severe tissue damage in Atlantic cod larvae, *supra*.

V. COMPLIANCE WITH OTHER STATUTES

A number of other statutes and conventions are implicated by BOEM's permitting of G&G activities in the Atlantic. Among those that must be disclosed and addressed during the NEPA process are the following:

A. Marine Mammal Protection Act ("MMPA")

The MMPA prohibits citizens, including federal agencies, or those operating within the jurisdiction of the United States from "taking" marine mammals without first securing either an "incidental take" permit or an "incidental harassment" authorization. 16 U.S.C. § 1371(a); 50 C.F.R. §216.107. For most activities, "take" is broadly defined to include both the "potential to injure a marine mammal or marine mammal stock in the wild" ("Level A" harassment) and the potential to "disturb" them "by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering" ("Level B" harassment). 16 U.S.C. § 1362(18); 50 C.F.R. § 216.3.

In 1994, Congress amended the MMPA to add provisions that allow for the incidental harassment of marine mammals through incidental harassment authorizations ("IHAs"), but only for activities that result the "taking by harassment" of marine mammals. 16 U.S.C. § 1371(a)(5)(D)(i). For those activities that could result in "taking" other than harassment, interested parties must continue to use the pre-existing procedures for authorization through specific regulations, often referred to as "five-year regulations." 16 U.S.C. § 1371(a)(5)(A). Accordingly, NMFS' implementing regulations state that an IHA in the Arctic cannot be used for "activities that have the *potential* to result in serious injury or mortality." 50 C.F.R. § 216.107 (emphasis added). In the preamble to the proposed regulations, NMFS explained that if there is a potential for serious injury or death, it must either be "negated" through mitigation requirements or the applicant must instead seek approval through five-year regulations. 60 Fed. Reg. 28,379, 28,380-81 (May 31, 1995).

The caution exhibited by NMFS in promulgating the 1996 regulations is consistent with the MMPA's general approach to marine mammal protection. Legislative history confirms that at the time of the MMPA's original passage Congress intended to build in a "conservative bias" that would avoid adverse or irreversible effects "until more is known." H.R. Rep. 92-707, at 5 (1971) *reprinted in* 1972 U.S.C.C.A.N. 4144, 4148. The committee report that accompanied the House version of the 1994 amendments emphasizes that the IHA provisions were not intended to "weaken any of the existing standards which protect marine mammals and their habitats from incidental takes[.]" H.R. Rep. 103-439, at 37 (1994). Thus, the 1994 amendments preserved the existing five-year regulation process for those activities that risked the possibility of lethal or seriously injurious marine mammal take.

The risk of mortality and serious injury, discussed at section IV.E above, has implications for MMPA compliance. Here, in assessing their MMPA obligations, BOEM presupposes that industry will apply for IHAs rather than 5-year take authorizations and that BOEM will not apply to NMFS for programmatic rulemaking. DPEIS at 1-13, 5-9. But the potential for mortality and serious injury bars industry from using the incidental harassment process to obtain take authorizations under the MMPA. BOEM should therefore consider applying to NMFS for a programmatic take authorization, and revise its impact and alternatives analyses in the EIS on the assumption that rulemaking is required.

Additionally, we are concerned about BOEM's general statement that an IHA "may not be necessary" for certain HRG surveys if operators can demonstrate that they can effectively monitor out to the 160 dB isopleth, which BOEM construes as the threshold for Level B take. DPEIS at C-15. As noted above, we believe that BOEM has applied the incorrect threshold given (1) the potential for take from mid-frequency sources at received levels well below 160 dB (RMS); (2) the demonstrated sensitivity of some species, such as harbor porpoises and beaked whales, requiring far lower take thresholds; and (3) the virtually continuous acoustic output of some sub-bottom profilers, which suggests that a standard designed for transient sounds should not be used. It is not possible for operators to effectively monitor out to the impact distances implied by these conditions; indeed, it is highly unlikely that operators could monitor – with the 100% efficacy that would be necessary – the smaller distances that BOEM appears to contemplate here, especially if surveys occur at night and other times of low visibility.[217]

B. Endangered Species Act ("ESA")

The ESA requires that agencies give first priority to the protection of threatened and endangered species. *Tenn. Valley Auth. v. Hill*, 437 U.S. 153, 174 (1978) (Supreme Court found "beyond doubt" that "Congress intended endangered species to be afforded the highest of priorities."). Section 2(c) of the ESA establishes that it is "…the policy of Congress that all Federal departments and agencies shall seek to conserve endangered species and threatened species and shall utilize their authorities in furtherance of the purposes of this Act." 16 U.S.C. § 1531(c)(1).

The ESA defines "conservation" to mean "…the use of all methods and procedures which are necessary to bring any endangered species or threatened species to the point at which the measures provided pursuant to this Act are no longer necessary." 16 U.S.C. § 1532(3). Section 7(a)(2) of the ESA requires federal agencies to "insure that any action authorized, funded, or carried out by such agency… is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the adverse modification of habitat of such species… determined… to be critical…." 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a). To accomplish this goal, agencies must consult with the National Marine Fisheries Service or U.S. Fish and Wildlife Service, depending upon the species, whenever their actions "may affect" a listed species. 16 U.S.C. § 1536(a)(2); 50 C.F.R. § 402.14(a). Should they find that any listed species is likely to be adversely affected, the consulting agency must issue a biological opinion determining whether the action is likely to jeopardize the continued existence of the species or destroy or adversely modify critical habitat. If so, the opinion must specify reasonable and prudent alternatives that will avoid the likelihood of jeopardy or adverse modification and allow the action to proceed. 16 U.S.C. § 1536(b).

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[217] The limitations of real-time visual monitoring are well known, as observed at sections III.B.1 and III.C.10 above.

For its part, BOEM, as the action agency, has an ongoing, substantive duty to ensure that any activity it authorizes, funds, or carries out does not jeopardize a listed species or destroy or adversely modify its critical habitat. An action agency's reliance on an inadequate, incomplete, or flawed biological opinion cannot satisfy its duty to avoid the likelihood of jeopardy to listed species. *See, e.g., Florida Key Deer v. Paulson,* 522 F.3d 1133, 1145 (11th Cir. 2008); *Pyramid Lake Tribe of Indians v. U.S. Navy*, 898 F.2d 1410, 1415 (9th Cir. 1990); *Stop H-3 Ass'n. v. Dole*, 740 F.2d 1442, 1460 (9th Cir. 1984) (action agency must independently ensure that its actions are not likely to cause jeopardy).

The central purpose of the ESA is to recover species to the point where ESA protections are no longer necessary. 16 U.S.C. §§1531(b), 1532(3). The ESA's emphasis on recovery of species means that BOEM may not authorize or carry out actions that will significantly reduce the likelihood of either the survival *or the recovery* of a listed species. *See, e.g. National Wildlife Federation v. National Marine Fisheries Serv.*, 524 F.3d 917, 932 (9th Cir. 2008).

The DPEIS indicates that BOEM has begun the consultation process, and that a Biological Opinion, if issued, will be included as an appendix to the final document. To be sure, the consultation should include every listed marine mammal, sea turtle, fish, and seabird species in the region, but the agencies should spend particular attention on the North Atlantic right whale. Without substantial additional mitigation, NMFS cannot legally issue a no-jeopardy opinion for this species. As noted above, the right whale is so critically endangered that the loss of a single adult female could threaten its survival; it is particularly vulnerable to masking effects at far distances from low-frequency sound sources, to stress effects from anthropogenic noise, and to ship strikes especially in combination with certain types of sound; and sublethal effects that impair the individual whales' ability to feed, communicate, or travel, or otherwise disrupt normal behavior could compromise their overall fitness and reproductive success, diminishing the species' chances at survival and recovery over the long term. Significantly, the members of the population most vulnerable to the effects of the proposed action are mothers and calves – the individuals most vital to maintaining and rebuilding the population.[218]

In order to comply with the ESA, BOEM must select an alternative that sufficiently protects the right whale, its designated critical habitat, and all known migratory corridors, feeding areas, calving and nursery grounds. The seasonal exclusion proposed in Alternative A would not avoid jeopardy, nor would the additional exclusion (though superior) proposed in Alternative B.[219]

C. Coastal Zone Management Act ("CZMA")

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[218] *E.g.*, McCauley, R.D., Fewtrell, J., Duncan, A.J., Jenner, C., Jenner, M.-N., Penrose, J.D., Prince, R.I.T., Adhitya, A., Murdoch, J. and McCabe, K., Marine seismic surveys: analysis and propagation of air-gun signals, and effects of air-gun exposure on humpback whales, sea turtles, fishes, and squid (2000).

[219] *See* Comment letter from Dr. Scott Kraus, Vice-President for Research, New England Aquarium, to BOEM (Aug. 10, 2011) (concerning BOEM's Draft Mid-Atlantic Wind Energy Area EA, and noting the risk that acoustic sources will displace mothers and mother/calf pairs into "rougher and more predator-occupied waters, potentially reducing calf survival").

The CZMA requires that "[e]ach Federal agency activity within or outside the coastal zone that affects any land or water use or natural resource of the coastal zone shall be carried out in a manner which is consistent to the maximum extent practicable with the enforceable policies of approved State management programs." 16 U.S.C. § 1456(c)(1)(A). *See also California v. Norton*, 311 F.3d 1162 (9th Cir. 2002) (applying consistency requirement to activities well outside state waters). Under the law, BOEM must provide a consistency determination to the relevant State agency responsible for the State's CZM program at least 90 days before final approval of the federal activity. 16 U.S.C. § 1456(c)(1)(C); 15 C.F.R. § 930.36(b)(1). The State must provide its concurrence with or objection to the consistency determination within 60 days of receiving the determination and supporting information; otherwise, the federal agency may presume that the State concurs with its consistency determination. 15 C.F.R. § 930.41(a). If the State determines that the federal agency has not provided sufficient information to support the consistency determination, as required by 15 C.F.R. § 930.39(a), it must notify the federal agency of the deficiency and the 60-day clock will not commence until the State receives the necessary information. *Id.*

If the State objects to the consistency determination, the federal agency must work with the State to attempt to resolve their differences before the 90-day notice period expires. After that time expires, the federal may only proceed with the activity over the State's objection if the agency determines that federal law requirements prevent the activity from achieving full consistency with enforceable state management program policies or the agency concludes, despite the State's objection, that the activity is fully consistent with such enforceable policies. *Id.* § 930.43(d). In the alternative, a State may issue a conditional concurrence that states the conditions that must be satisfied in order to ensure consistency with specific enforceable polies of the State's CZM program. The agency must modify the proposed plan or application to include the State's conditions or notify the State that it refuses to do so, in which case the State's conditional concurrence will be treated as an objection. *Id.* § 930.4(a)-(b). More specifically:

(1) Importantly, the consistency requirement applies to multiple phases of OCS activities. When BOEM develops a plan to direct the agency's future OCS actions, such as the plan of activities considered in the DPEIS, the agency must provide a consistency determination and seek each State's concurrence that the activities covered by the plan are consistent to the maximum extent practicable with the enforceable policies of the State's coastal zone management program. 15 C.F.R. § 930 Subpart C. This phase of planning and consistency review helps set the stage for future permitting and licensing decisions regarding OCS activities being carried out pursuant to the plan, but does not take the place of subsequent consistency determinations. Activities carried out by private entities that require a permit or license, such as a G & G permit, and all federal license or permit activities described in an OCS plan, must be determined to be fully consistent with the affected State's enforceable coastal zone management policies. 15 C.F.R. § 930 Subparts D, E. The DPEIS acknowledges the multi-stage nature of consistency review under the CZMA, but does not indicate that BOEM will undergo review at the present stage. *See* 5-8 to 5-9. BOEM must.

(2) The CZMA and its regulations broadly define the "may affect" trigger for consistency review. An activity that occurs outside the coastal zone still crosses the threshold if it affects resources within the coastal zone, or if it affects resources (such as whales and fish) that regularly come within the coastal zone but are outside the zone at the time of impact. This definition has significant implications for the high-intensity noise produced by airgun exploration, since a survey occurring tens or even hundreds of miles offshore can still affect coastal resources due to its enormous propagation footprint and its impact on wide-ranging species. *See NRDC v. Winter*, No. 8:07-cv-00335-FMC-FMOx, 2007 WL 2481037 (C.D. Cal. Aug. 7, 2007), *aff'd in rel. part*, 508 F.3d 885 (9th Cir. 2007), *rev'd in part on other grounds sub nom. Winter v. NRDC*, 129 S.Ct. 365 (2008). Perhaps most pressingly, BOEM must include New Jersey – which is omitted from the DPEIS' distribution list (DPEIS at 5-6) – among the affected coastal states. Further, BOEM must acknowledge the full scope of activity that would affect coastal resources under the Act, for purposes of satisfying this important provision at both the planning and permitting stages.

(3) Finally, it is crucial that BOEM provide a thorough analysis of the proposed action's effects on the myriad coastal resources that State programs are designed to protect. Without such a thorough analysis, it is impossible for the states to assess the validity of any consistency determination BOEM issues – particularly in light of the short period of time the states have to object to a consistency determination. In addition, the states need full information to inform their own citizens and give those citizens a meaningful opportunity to comment on the proposed action, as required by 15 C.F.R. § 930.2. As written, however, the DPEIS glosses over many important impacts to coastal resources and, aside from the seasonal restrictions targeted at North Atlantic right whales and loggerhead sea turtles, fails to present reasonable alternatives necessary to protect those resources, including other marine mammals and fisheries. In its final PEIS, BOEM must present these missing alternatives and information, and give State CZM programs sufficient time to assess the information and the proposed actions' consistency with their enforceable policies.

D. Magnuson-Stevens Fishery Conservation and Management Act

The Magnuson-Stevens Fisheries Conservation and Management Act, 16 U.S.C. § 1801 et seq., requires federal agencies to "consult with the Secretary [of Commerce] with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken" that "may adversely affect any essential fish habitat" identified under that Act. 16 U.S.C. § 1855 (b)(2). In turn, the Act defines essential fish habitat as "those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity." 16 U.S.C. § 1802 (10). As discussed above, BOEM's Atlantic study area contains such habitat, and geological and geophysical operations have the significant potential to adversely affect at least the waters, and possibly the substrate, on which fish in these areas depend. Accordingly, and as the DPEIS anticipates, BOEM must consult with the Secretary of Commerce through NMFS and the Mid-Atlantic and South Atlantic Fisheries Management Councils. DPEIS at 5-9.

E. National Marine Sanctuaries Act

The National Marine Sanctuaries Act requires agencies whose actions are "likely to injure a sanctuary resource" to consult with the Office of National Marine Sanctuaries ("ONMS"). 16 U.S.C. § 1434(d). As the DPEIS recognizes, the agency does not need to conduct the activity itself, since any federal agency action, including permitting or licensing, can trigger the requirement; nor must the activity occur within the sanctuary, so long as the resource is likely to be injured. DPEIS at 1-17; 16 U.S.C. § 1434(d). ONMS may also request that the agency initiate the consultation process.[220] Under the consultation scheme, BOEM is required to prepare a Sanctuary Resource Statement; if ONMS determines that the statement is complete and that injury is indeed likely, it must prepare recommended alternatives to the proposed action, which may include relocation, rescheduling, or use of alternative technologies or procedures.[221]

To ensure compliance with the consultation provision, BOEM should keep several critical points in mind.

First, ONMS in its regulations defines the term "sanctuary resource" quite broadly, to the extent that it includes "virtually every living and nonliving component of the sanctuary ecosystem";[222] these include any resource "that contributes to the conservation, recreation, ecological, historical, research, educational, or aesthetic value of the Sanctuary." 15 C.F.R. § 922.182. Consistent with this approach, ONMS defines the term "injure" to mean "change adversely, either in the short or long term, a chemical, biological, or physical attribute of, or the viability of." 15 C.F.R. § 922.3. The DPEIS appears to interpret these provisions narrowly. *See* DPEIS at 5-9 to 5-10. Yet there can be no question, under these definitions, that an activity that degrades the acoustic habitat of a National Marine Sanctuary, even temporarily, or impinges on the sanctuary's value for scuba diving or other recreational activities, injures a sanctuary resource. Thus BOEM should not consider itself subject to consultation only if its permitting activities physically injure a marine animal within sanctuary boundaries. The permitting of any seismic survey likely to degrade the acoustic environment of the Monitor or Gray's Reef NMS, or (given the best available science on scuba diver aversion to low-frequency sound) raise noise levels within the sanctuaries above 145 dB (SPL), is subject to consultation under the Act.

Second, we strongly encourage BOEM to tier consultation with the sanctuaries. As it stands, the agency plans to undertake consultation only with respect to the issuance of survey-specific permits. DPEIS at 1-17. But this approach only risks greater conflict down the line, since BOEM will have less latitude to accept some types of recommended alternatives, such as restricting a survey from certain areas, when the action turns to individual surveys; and it fails to benefit from any streamlining that a tiered process would afford.[223] BOEM should undertake

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[220] NOAA Office of National Marine Sanctuaries, Overview of conducting consultation pursuant to section 304(d) of the National Marine Sanctuaries Act (16 U.S.C. 1434(d)) at 4 (2009).

[221] *Id*. at 8.

[222] *Id*. at 5.

[223] For example, if, as a result of consultation, BOEM establishes a time-area closure around the sanctuaries, its need to consult on individual permitting activities could diminish.

consultation now on its proposed programmatic alternatives and renew the process, if necessary, for individual permits.

F. National Ocean Policy

The National Ocean Policy ("NOP") is a "stewardship" plan for our coast and ocean, including BOEM's area of interest. Under NOP, it is the policy of the federal government to "protect, maintain, and restore the health and biological diversity of ocean, coastal, and Great Lakes ecosystems and resources"; "to improve the resiliency of ocean, coastal, and Great Lakes ecosystems, communities, and economies"; "to respect and preserve our Nation's maritime heritage, including our social, cultural, recreational, and historical values"; "to use the best available science and knowledge to inform decisions affecting the ocean, our coasts, and the Great Lakes"; and "to foster a public understanding of the value of the ocean, our coasts, and the Great Lakes to build a foundation for improved stewardship. Exec. Order No. 13547, 75 Fed. Reg. 43023 (July 22, 2010).

Taken together, the intrusion of oil and gas exploration into the communities of the Atlantic Coast will seriously impact the economies of clean ocean uses. Unlike other regions, where oil and gas operations permeate coastal zone activities, the Atlantic Ocean has been oil and gas industry-free for decades, and has built a clean ocean economy that depends on thriving fisheries, whales to drive ecotourism, and safe, swimmable beaches. The proposed action will lead to the direct displacement of commercial and recreational fishermen and will likely impact long-term ecotourism and coastal cultural values. The President's Executive Order, which directs all agencies to "take such action as necessary to implement the policy set forth in section 2 of this order and the stewardship principles and national priority objectives," does not exempt BOEM from any of its provisions. Therefore, BOEM has the responsibility to protect the economies and ecosystems of the Atlantic Ocean under a program of improved understanding, stakeholder engagement, and science-based decisionmaking. This DPEIS does not achieve any of these goals, does not represent good ocean governance, and does not represent the use of good science. Until it does so, BOEM is in violation of the President's declared policies for the protection of our ocean's ecosystems and resources.

VI. CONCLUSION

For the above reasons, we urge BOEM first and foremost to adopt Alternative C as its preferred alternative, and next to seriously consider the recommendations we have made to improve analysis and mitigate the far-reaching impacts of the proposed activity.

We would welcome the opportunity to meet with you, your staff, and other relevant offices at any time to discuss these matters. Given the swift timeline BOEM has set for finalizing the DPEIS and producing a record of decision, we would urge you to contact us at the earliest opportunity. For further discussion, please contact Michael Jasny of NRDC (mjasny@nrdc.org).

Very truly yours,

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EXHIBIT 3

OCEANA | Protecting the World's Oceans

MEMORANDUM

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May 7, 2014

Via Federal e-Rulemaking Portal
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Re: Final Programmatic Environmental Impact Statement for Geological and Geophysical Activities in the Outer Continental Shelf Waters of the Atlantic Coast in Support of Oil and Gas Exploration and Development, 79 Fed. Reg. 13,074 (March 7, 2014), ID# *BOEM-2014-0028-0001*

Dear Mr. Goeke:

Oceana and the International Fund for Animal Welfare (IFAW) thank you for the opportunity to submit comments on the above-captioned final programmatic environmental impact statement ("PEIS") concerning high-intensity seismic surveys in the Atlantic Ocean. This PEIS is important because sound is a fundamental element of the marine environment, but the seismic surveys would include airgun blasts that will harm marine mammals. The sound from airguns can travel hundreds to thousands of miles underwater and across entire ocean basins.[1] Studies have documented the harm from airgun blasts. For example, humpback and fin whales stopped vocalizing in a 100,000 square mile area[2] during airgun activity. Evidence shows that blasts cause baleen whales to abandon habitats over a similar spatial area.[3] Yet even though the proposed action is an activity with significant potential impacts on the marine environment along nearly the entire East Coast of the United States, the PEIS fails to take a hard look at its impacts.

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[1] Nieukirk, S.L., Stafford, K.M., Mellinger, D.K., Dziak, R.P., and Fox, C.G., (2004). Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean, *Journal of the Acoustical Society of America* 115: 1832-1843.
[2] Clark, C.W., and Gagnon, G.C., (2006). Considering the temporal and spatial scales of noise exposures from seismic surveys on baleen whales (IWC Sci. Comm. Doc. IWC/SC/58/E9).
[3] MacLeod, K., Simmonds, M.P., and Murray, E., (2006).Abundance of fin (*Balaenoptera physalus*) and sei whales (*B. Borealis*) amid oil exploration and development off northwest Scotland, *Journal of Cetacean Research and Management* 8: 247-254.

The PEIS is fatally flawed because

1) The Bureau of Ocean Energy Management ("the Bureau") had, but did not consider, information from a Cornell study on the extent of right whales' presence in the Atlantic Ocean.
2) The Bureau failed to consider a full range of alternatives in light of the information published in the Cornell study. As a result, the preferred alternative mitigation measure will not adequately protect right whales.
3) The Bureau had, but did not consider, information on acoustic thresholds for marine mammals that shows that marine mammals suffer harm at much lower decibel levels than is assumed in the PEIS.
4) The Bureau had, but did not consider, information on the possible indirect impacts of Level B Takes, including the possibility of Level B Takes resulting in mass mortality events.
5) The baseline against which the Bureau measured environmental impacts is inaccurate for several reasons, resulting in inadequate consideration of the impacts of the proposed action.
6) The Bureau failed to take a hard look at environmental impacts on essential fish habitat ("EFH").

For these six reasons, the PEIS is fatally flawed, and therefore the Bureau cannot rationally adopt the preferred alternative in the Record of Decision ("ROD"). In order to proceed with a proposal for geological and geophysical ("G&G") activities in the Outer Continental Shelf ("OCS") waters of the Atlantic coast, the Bureau must develop an adequate PEIS that considers the best available science, analyzes a full spectrum of reasonable and feasible alternatives, and takes a hard look at the impacts on marine life, especially protected marine mammals.

I. THE BUREAU HAD, BUT DID NOT CONSIDER, INFORMATION FROM A CORNELL STUDY ON THE EXTENT OF RIGHT WHALES' PRESENCE IN THE ATLANTIC OCEAN.

The Bureau had, but did not consider, information from a study by Cornell University's Bioacoustics Research Program, regarding the extent of right whales' presence in the Atlantic Ocean. Under Council of Environmental Quality ("CEQ") regulations promulgated under the National Environmental Policy Act ("NEPA"), an agency's evaluation of environmental consequences, in an environmental impact statement ("EIS"), must be based on "accurate" and "high quality" scientific information.[4] Therefore EISs "must present accurate and complete information to decision-makers to allow informed decisions."[5] The Bureau did not base the PEIS

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[4] 40 C.F.R. § 1500.1(b).
[5] *N.C. Wildlife Fed'n v. N.C. Dept. of Transp.*, 677 F.3d 596 (4th Cir. 2012), *cited by* David R. Mandelker, NEPA Law and Litigation § 10:33:20 (2013 ed.). "[Environmental] impact statement[s] must contain an adequate compilation of relevant data and information…." *Id.*, *citing N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067 (9th Cir. 2011); *Sierra Club v. U.S. Army Corps of Eng'rs*, 701 F.2d 1101 (2d Cir. 1983); *Native Ecosystems Council v. Weldon*,

on either accurate or complete scientific information by failing to include data from a study performed by researchers at Cornell on the distribution of the right whale, an endangered species within the Atlantic OCS area where seismic surveys are proposed.[6]

In the PEIS, the Bureau listed alternatives to the proposed action. The preferred Alternative mitigation measure (named "Alternative B" in the PEIS) contains the most protective measures for the endangered right whales. This alternative includes a time-area closure extending 20 nautical miles from shore from Delaware Bay to the southern edge of the area of interest ("AOI"), running from November 15 to April 15 within the right whale's critical habitat, and a closure within the Mid-Atlantic and Southeast U.S. Seasonal Management Areas ("SMAs") from November 1 to April 30.[7]

In developing the preferred alternative mitigation measure, the Bureau relied on historical sighting data of right whales from the National Marine Fisheries Service ("the Service") and an assumption that approximately 83% of right whales occur within 20 nautical miles of the coast.[8] While shipboard and aerial sighting surveys are important, they are also highly limited because they are constrained to daylight hours and favorable weather, spotting whales only when they surface. Some sighting data is recorded by the public and can suffer from a near-shore bias. Long-term passive acoustic monitoring networks, in combination with sighting survey data, provide a much more accurate assessment of right whale distribution in the mid and south Atlantic.

The Cornell study shows that critically endangered North Atlantic right whales are present throughout the year off the Virginia coast.[9] By using marine autonomous recording units

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848 F.Supp. 2d 1207 (D. Mont. 2012); *Border Power Plant Working Grp. v. Dep't of Energy*, 467 F.Supp. 2d 1040 (S.D. Cal. 2006); *Fund for Animals v. Norton*, 365 F. Supp. 2d 394 (S.D. N.Y. 2005); *Nat'l Wildlife Fed'n v. Norton*, 332 F. Supp. 2d 170, 183 (D.D.C. 2004).

[6] Aaron Rice, ET. AL., *Acoustic Ecology of North Atlantic Right Whales off the Virginia Coast: Data Quality and Initial Right Whale Presence Results*, Cornell University Bioacoustics Research Program (Oct. 2013). The study was partially funded by and prepared for Oceana and the International Fund for Animal Welfare. Dr. Rice presented the results to Brian Hooker and other staff in the Bureau's Office of Renewable Energy Programs in Herndon, VA on Thursday, Nov. 14, 2013.

[7] *See* Bureau of Ocean Energy Mgmt., Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement, Vol. I Summary, Time-Area Closure for North Atlantic Right Whales for HRG surveys at xxvii (2014).

[8] *See* Bureau of Ocean Energy Mgmt., Atlantic Outer Continental Shelf Proposed Geologic and Geophysical Activities Mid and South Atlantic Planning Areas Draft Programmatic EIS, Vol I. Chapter 2.2.21, Expanded Time-Area Closure for North Atlantic Right Whales at 2-28 (2012).

[9] Aaron Rice, ET. AL., *Acoustic Ecology of North Atlantic Right Whales off the Virginia Coast: Data Quality and Initial Right Whale Presence Results*, Cornell University Bioacoustics Research Program (Oct. 2013). The study was partially funded by and prepared for Oceana and the International Fund for Animal Welfare. Dr. Rice presented the results to Brian Hooker and other staff in the Bureau's Office of Renewable Energy Programs in Herndon, VA on Thursday, Nov. 14, 2013.

("MARUs") to record right whale vocalizations, Cornell researchers assessed right whale presence in five locations off the Virginia coast. Researchers used MARUs in two separate deployments to provide acoustic coverage from June 3, 2012, to June 13, 2013. All five of the MARUs detected right whale presence at varying distances from shore: 16, 30, 38, 48, and 63 nautical miles. The results indicate a year-round presence of right whales with peak concentrations occurring from mid-January 2013 through late March 2013. This information is not considered in the PEIS, which assumes a mostly seasonal presence. Moreover, the vast majority of right whale detections occurred outside the bounds of the time-area closure proposed by the Bureau as the preferred alternative mitigation measure in the draft EIS.[10] Therefore, the preferred alternative mitigation measure will not adequately protect endangered right whales.

On December 6, 2013, Oceana and IFAW not only sent Secretary Jewell a letter describing the Cornell study's findings,[11] but also met with Bureau leadership to discuss re-scoping the draft EIS in light of the relevant scientific information.[12] The Bureau then failed to include the relevant information from the study in the PEIS.

The Bureau had this information but did not consider it in the PEIS. The assumptions under which the PEIS analyzed impacts, proposed alternatives, and adopted mitigation measures are not justified, and therefore the Bureau cannot rationally adopt the preferred alternative in the PEIS for the ROD.[13] Accordingly, it is now necessary for the Bureau to re-scope the issue and alternatives, and develop a new draft EIS for public comment prior to advancing further with the Atlantic seismic exploration program.

II. IN LIGHT OF NEW INFORMATION, THE PREFERRED ALTERNATIVE MITIGATION MEASURE WILL NOT ADEQUATELY PROTECT RIGHT WHALES AND THEREFORE THE PEIS IS INADEQUATE BECAUSE IT LACKS AN ALTERNATIVE WHICH WOULD ADEQUATELY PROTECT RIGHT WHALES.

In light of the information published in the Cornell study, the preferred alternative mitigation measure will not adequately protect right whales, so the PEIS is inadequate because it fails to consider a complete range of alternatives. Under NEPA, EISs must include an analysis of "all

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[10] *See* Bureau of Ocean Energy Mgmt., Atlantic OCS Proposed Geological and Geophysical Activities Mid-Atlantic and South Atlantic Planning Areas Final Programmatic Environmental Impact Statement, Vol. I Chapter 2.2.2.1., Expanded Time-Area Closure for North Atlantic Right Whales for Alternative B at 2-36 (2014).
[11] Letter from Oceana and IFAW to Sec'y Sally Jewell, Dep't of Interior (Dec. 6, 2013) (attached) (Re: Significant New Information Requires a New Programmatic Environmental Impact Statement for Atlantic Geological and Geophysical Activities).
[12] Meeting between Walter Cruickshank, Deputy Director, the Bureau, *et al.*, and Jackie Savitz, Vice Pres., Oceana, *et al.* (Dec. 6, 2013). At this meeting, Bureau staff raised the issue that this study is not yet published; however, we explained that research used in these contexts is normally not published. Since this information is of the type normally relied on by scientists in this context, the Bureau cannot postpone considering this information until after the completion of the PEIS.
[13] 40 C.F.R. § 1502.9.

reasonable alternatives" to the proposed action.[14] The new information published in the Cornell study mentioned above shows a larger spectrum of the potential effects than is included in the PEIS.

Prior to the Cornell study, Alternative B may have seemed to prevent blasts within the temporal and geographic range where whales would be present. However, as discussed above, the Cornell study shows an expanded geographic and temporal range for the presence of whales. On December 6, 2013, Oceana and IFAW sent a letter to, and met with, the Bureau to discuss the Cornell study's findings.[15] However, the findings were not incorporated into the PEIS.

Therefore, the preferred alternative mitigation measure does not offer adequate protection of right whales, because it does not consider the right whales' actual geographic and temporal range. Consequently the PEIS is inadequate because it does not consider a full range of alternatives to mitigate the impacts on right whales. Alternative B can be kept as a mid-range alternative, but a new alternative is needed, that will coincide with the correct temporal and geographic range in which whales will be present. Without a new alternative, the PEIS is fatally flawed, and the Bureau cannot rationally rely on it because the EIS does not contain a full spectrum of alternatives to the project.

When re-developing an adequate PEIS, the Bureau should, at a minimum, expand the time area closures to at least 63 miles, where MARUs recorded significant numbers of right whales. A failure to expand the mitigation measures will needlessly threaten the right whale and will increase the proposed numbers of injuries and disturbances of this critically endangered species.

III. THE BUREAU HAD, BUT DID NOT CONSIDER, INFORMATION ON THE ACOUSTIC THRESHOLDS OF MARINE MAMMALS.

The Bureau had, but did not consider, data on the threshold levels for acoustic activity that harms marine mammals—in other words, data that show the decibel levels at which noise becomes too loud and therefore harmful to marine mammals. An EIS must be based on accurate and complete scientific information.[16] The Bureau relied on outdated information and therefore failed to include years of available scientific data. The new information is important because the data show that the impacts from the sound of seismic testing cover a much larger geographic range than originally thought. A larger geographic range of effects would affect a larger number of marine mammals that are not protected by the preferred alternative mitigation measure and are not considered as affected in the PEIS. By failing to consider available data that the Bureau was (1) given and (2) was aware of because of its incorporation in the Draft Guidance, [17] the Bureau failed to base the PEIS on either accurate or complete scientific information.

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[14] 40 C.F.R. § 1502.14(a).
[15] *See supra* notes 11, 12.
[16] 40 C.F.R. § 1500.1(b).
[17] *See* NOAA, *NOAA's Marine Mammal Acoustic Guidance, available at*: http://www.nmfs.noaa.gov/pr/acoustics/guidelines.htm

On July 2, 2012, Oceana and other parties informed the Bureau of the inadequacy of the acoustic threshold data used in the draft EIS.[18] Our communication included dozens of studies concerning acoustic-threshold data that should have been included in the draft EIS.[19] On January 8, 2014, four members of the U.S. House of Representatives sent a letter to the Department of the Interior ("Interior") urging the agency to use the best available acoustic-threshold data before approving any seismic activity.[20] On February 20, 2014, a coalition of 102 scientists sent President Obama a letter urging that the best available science be used for acoustic-threshold data before permitting seismic surveys in the Atlantic.[21] On February 26, 2014, nine members of the U.S. Senate sent a letter to Interior urging the agency to use the best available science for acoustic-threshold data in the PEIS.[22] Despite several notifications of the updated scientific information available, the Bureau failed to consider the current data. Moreover, the Bureau must have been aware of the data because the Service used this data while formulating the new Draft Guidance. In order to accurately assess the scope of marine mammal impacts from proposed seismic airgun surveys, the Service must include all relevant scientific data.

IV. THE BUREAU HAD, BUT DID NOT CONSIDER, INFORMATION REGARDING THE POSSIBILITY OF LEVEL B TAKES CAUSING MASS MORTALITY EVENTS AND OTHER SERIOUS INJURIES.

The Bureau had, but did not consider, information regarding the potential of Level B takes to cause mass mortality events. An EIS must be based on accurate and complete scientific information.[23] The Bureau had, but failed to include, data from a mass mortality event in Madagascar. Therefore, the Bureau did not base the PEIS on either accurate or high quality scientific information.

The high number of Level B takes authorized in the PEIS requires the Bureau to address the severity of the impacts that Level B takes can have, particularly when examining an AOI that contains six species of endangered cetaceans. Level B takes, or disturbances in behavior, have indirect effects, such as behavior alterations, that can change the dynamics of a population and influence stock size.

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[18] Oceana, *et al.*, Comments on the Draft PEIS for Atlantic G&G Activities at 37-45 (July 2, 2012) (attached).
[19] *See id.*
[20] Letter from Rep. Peter DeFazio, Rep. Frank Pallone, Jr., Rep. Rush Hold, Rep. Joe Carcia to Sec'y Sally Jewell, Dep't of the Interior (Jan. 8, 2014) (attached) (Letter concerning the impacts of offsore oil and gas exploration and development activities on living marine resources).
[21] Letter from Matthew Huelsenbeck, *et al.*, to Pres. Obama (Feb. 20, 2014) (attached) (Re: Use the Best Available Science before Permitting Seismic Surveys for Offshore Oil and Gas in the Mid- and South-Atlantic).
[22] Letter from Sen. Cory Booker, Sen. Edward Markey, Sen. Brian Schatz, Sen. Maria Cantwell, Sen. Barbara Mikulski, Sen. Sheldon Whitehouse, Sen. Robert Menendez, Sen. Benjamin Cardin, Sen. Barbara Boxer to Sec'y Sally Jewell, Dep't of the Interior (Feb. 26, 2014) (attached) (Letter concerning the PEIS on seismic airgun testing for offshore oil and gas exploration in the Atlantic Ocean.
[23] 40 C.F.R. § 1500.1(b).

One example of the potential for deadly impacts from Level B takes is the stranding of over 75 melon-headed whales off the coast of Madagascar. An Independent Scientific Review Panel (ISRP) examined the conditions surrounding this stranding to determine plausible cause for the unusual events. This scientific expert panel concluded that the most plausible explanation was the use of a multibeam echosounder, another technology that causes acoustic disturbance in the marine environment.[24] The use of this echosounder caused the melon headed whales to divert from their original location, to a bay farther inshore, otherwise known as a behavioral disturbance or Level B take. This diversion caused the whales to enter shallow water, which led to a mass stranding, followed by emaciation, dehydration, and eventually death. This study is a primary example of how Level B takes, or a simple behavioral disturbance, can ultimately lead to harm greater than a Level B take. Two additional instances of airgun use have been linked to beaked whale strandings in the Gulf of California and the Galapagos. While no scientific report was published as in the Madagascar study, U.S. courts required the seismic activity to stop until further investigation was completed.[25,26] Especially when considering endangered populations, mortalities of this magnitude can have serious population-level consequences.

Additionally, there are other studies of marine mammal populations that examine the effects of behavioral disturbance on survival of marine mammals as well as the possible consequences for population levels. One study of behavioral disturbance to a fin whale pod found that seismic activity caused a migratory diversion. This is classified as a Level B take although it is thought to have implications for the breeding season and fecundity of this population, as it may have caused them to lose a year of calves.[27] Literature reviews of the effects of seismic surveys have found potential serious long-term consequences due to chronic exposure to seismic activity. These reviews have also found that populations can be adversely affected by the behavioral disturbances that constitute a Level B take, such as alteration of feeding, orientation, hazard avoidance, migration or social behavior.[28]

On January 8, 2014, four members of the U.S. House of Representatives sent a letter to the Bureau informing the agency of the mass stranding event in Madagascar and the study that

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[24] Southall, B.L., Rowles, T., Gulland, F., Baird, R.W., and Jepson, P.D. 2013. Final report of the Independent Scientific Review Panel investigating potential contributing factors to a 2008 mass stranding of melon-headed whales (*Peponocephala electra*) in Antsohihy, Madagascar.
[25] Malakoff, D. 2003. Suit ties whale deaths to research cruise. Science 298: 722-723.
[26] Gentry, R.L. 2002. Mass Stranding of Beaked Whales in the Galapagos Islands, April 2000. http://www.nmfs.noaa.gov/prot_res/PR2/Health_and_Stranding_Response_Program/Mass_Galapagos_Islands.htm.
[27] Castellote, M., Clark, C. W., and Lammers, M. O. 2010. Potential negative effects in the reproduction and survival on fin whales (Balaenoptera physalus) by shipping and airgun noise. Int. Whal. Comm. Working Pap. SC/62 E, 3.
[28] Gordon, J.C.D., Gillespie, G., Potter, J., Frantzis, A., Simmonds, M.P., Swift, R., Thompson, D. 2003. A review of the effects of seismic survey on marine mammals. Marine Technology Society Journal 37(4): 14-32.

connected the strandings to seismic activity.[29] Despite being aware of the information, the Bureau failed to include the information in the PEIS.

V. THE BASELINE AGAINST WHICH THE BUREAU MEASURED ENVIRONMENTAL IMPACTS IS INACCURATE FOR SEVERAL REASONS, CAUSING A FATAL FLAW IN THE PEIS ANALYSIS OF ENVIRONMENTAL IMPACTS.

The baseline against which the Bureau measured environmental impacts is inaccurate for several reasons. The baseline is inaccurate because (1) the Bureau relied on outdated stock assessments; (2) the Bureau did not consider the unusual mortality event ("UME") occurring for bottlenose dolphins in the Atlantic; (3) the Bureau did not consider the impacts of Hurricane Sandy; and (4) the Bureau did not consider the impacts of the 2010 British Petroleum ("B.P.") oil-spill disaster in the Gulf of Mexico.

Before the Bureau can claim that the impacts of the proposed G&G activities will have a moderate, rather than major, impact on marine mammals, the Bureau must use updated population information and complete baseline data. The Marine Mammal Protection Act ("MMPA") requires that marine-mammal stocks be assessed every five years; however 80 percent of marine mammal stocks in U.S. Atlantic waters have not been assessed in the past five years. Of the 46 stocks that have not been recently assessed, two are considered endangered under the Endangered Species Act ("ESA"), and five are considered depleted under the MMPA.[30] This stock abundance information must be updated if it is to form the baseline data used by the Bureau to determine possible population effects of seismic activity in the Atlantic.

Furthermore, this baseline data does not take into account the UME that occurred along the Atlantic coast. Beginning in 2013, the Service designated a UME for bottlenose dolphins in the Mid-Atlantic ranging from New York to Florida.[31] Bottlenose dolphins are estimated to be killed or injured in large numbers during this seismic activity, but the PEIS does not address the unusual mortality event and the population level effects this may have. As the mortality event is so recent, it has not yet been incorporated into the Service population data, which again invalidates the underlying baseline population estimates, particularly for bottlenose dolphins.

In addition, the Bureau did not consider the impacts of Hurricane Sandy in determining the baseline, as urged by a coalition of parties in a December 3, 2012, letter to Interior.[32] Finally, the

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[29] Letter from Rep. Peter DeFazio, *et al.*, at 2.
[30] Waring, G.T., Josephson, E., Maze-Foley, K., and Rosel, P.E. 2013. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments: 2012. U.S. Department of Commerce, NOAA Technical Memorandum p. 419.
[31] "2013-2014 Bottlenose Dolphin Unusual Mortality Event in the Mid-Atlantic". NOAA Fisheries. 25 March 2014, *available at*: http://www.nmfs.noaa.gov/pr/health/mmume/midatldolphins2013.html
[32] Letter from Clean Ocean Action, *et al.*, to Sec'y Ken Salazar, Department of Interior (Dec. 3, 2012) (attached) (Re: Request for Postponement of Proposed Geological and Geophysical Survey Decisions for Atlantic Ocean Offshore Oil and Gas Energy Development).

Bureau did not consider the impacts of the 2010 B.P. oil-spill disaster, as urged by four members of the U.S. House of Representatives in a January 8, 2014, letter to Interior.[33]

Under CEQ regulations, any agency must explain when necessary information is missing or incomplete.[34] If the missing or unavailable information is "essential," then the agency must include the information in the EIS.[35] However, if the costs of obtaining the information "are exorbitant or the means to obtain it are not known,"[36] the agency must: (1) state that the information is unavailable or incomplete; (2) state the relevance of the information to the impacts discussed in the EIS; (3) summarize the relevant, existing scientific evidence; and (4) evaluate the impacts based on generally accepted theoretical approaches or methods.[37]

The Bureau failed to include data from a current stock assessment, the UME, Hurricane Sandy, and the B.P. disaster, all of which are essential to the PEIS's baseline. Because that information is essential, the Bureau must include it in the PEIS, or follow the four steps listed just above, either of which the Bureau failed to do in the PEIS. Therefore the Bureau cannot rationally adopt the preferred alternative in the PEIS. Basic population assessments for marine mammal stocks in the Atlantic must be updated before the Bureau can accurately analyze potential impacts of seismic activity on these populations.

VI. THE BUREAU FAILED TO TAKE A HARD LOOK AT THE ENVIRONMENTAL IMPACTS ON ESSENTIAL FISH HABITATS (EFH).

The Bureau failed to take a hard look at the impacts on EFH. Agencies must take a "hard look" at environmental impacts "likely to result" from the action considered.[38] The Bureau must take a hard look at impacts to EFH, as well as the commercial fisheries that rely on these managed species.[39] The PEIS merely states that impacts from active acoustic sound sources, such as airguns, would range from minor to moderate.[40]

The available science states that acoustic disturbances of the same magnitude as acoustic surveys can cause physical damage, and disrupt essential behaviors necessary for life functions of fish stocks. Research described below indicates that seismic surveys, and other anthropogenic noises at similar intensities, can impact fish physiology as well as behavior. One study found that direct

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33 Letter from Rep. Peter DeFazio, *et al.*, at 2, 3.
34 40 C.F.R. § 1502.22.
35 *Id*. at (a).
36 *Id.* at (b).
37 *Id*. at (b)(1).
38 *Town of Orangetown v. Gorsuch*, 718 F.2d 29, 35 (2d Cir. 1983), *cert. denied*, 465 U.S. 1099 (1984).
39 As discussed in Section VII, part of taking a hard look is consulting with the Service regarding "any" action "that may affect EFH." 50 C.F.R. § 600.920(a)(1).
40 *See* Bureau of Ocean Energy Mgmt., Atlantic Outer Continental Shelf Proposed Geologic and Geophysical Activities Mid and South Atlantic Planning Areas Draft Programmatic EIS, Vol I. Table 2-4, Comparison of Impact Levels for Alternatives A,B, and C at Tables-11 (2014).

mortality from seismic airguns is limited, in some species, to a range of 5 meters from airguns. [41] This same study notes that seismic surveys should be avoided in areas of spawning or fish migration.[42] Additional studies show that fish exposed to airguns from geological survey exhibit damaged sensory epithelia, with no evidence of repair two months after seismic airgun exposure.[43] Physical damage from airguns must be assessed in the context of potential population level effects.

Acoustic impacts detailed in the literature can affect important fish behaviors. There can be economic consequences to these changes in behavior. For example, one study found a 50% reduction in catch of haddock and cod using longlines and trawls in the area of seismic blasting, with significant effects noted over the entire study area of 40 x 40 nautical miles.[44] Rockfish studies showed CPUE decline by over 50% on average in areas of geophysical surveys with economic losses averaging 49%.[45] Slotte *et al.* illustrate that the large-scale distribution of both herring and blue whiting systematically showed lower abundances after periods of seismic activity.[46] While there is little data available for commercially important species that are not finfish, captive squid showed a strong startle response to nearby air-gun start up and evidence suggests that they would significantly alter their behavior at an estimated 2-5 km from an approaching large seismic source.[47] These behavioral impacts are not addressed in this EIS, and there is no mention of potential population-level effects that could emerge due to repeated behavioral alterations. Qualitative categorization of impacts encompassing such a broad range of impacts from minor to moderate is insufficient detail to satisfy the requirements of NEPA regarding authorization of activities that can be potentially harmful to EFH.

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[41] Dalen, J., and Knutsen, G. M. 1987. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. *Progress in Underwater Acoustics*: 93-102. Springer US.

[42] Dalen, J., and Knutsen, G. M. 1987. Scaring effects in fish and harmful effects on eggs, larvae and fry by offshore seismic explorations. *Progress in Underwater Acoustics*: 93-102. Springer US.

[43] McCauley, R., Fewtrell, J., and Popper, A.N. 2003. High intensity anthropogenic sound damages fish ears. *Journal of the Acoustical Society of America* 113: 638-642.

[44] Engås, A., Løkkeborg, S., Ona, E., & Soldal, A. V. 1996. Effects of seismic shooting on local abundance and catch rates of cod ((*Gadus morhua*) and haddock)(*Melanogrammus aeglefinus*). *Canadian Journal of Fisheries and Aquatic Sciences* 53(10): 2238-2249.

[45] Skalski, J. R., Pearson, W. H., & Malme, C. I. 1992. Effects of sounds from a geophysical survey device on catch-per-unit-effort in a hook-and-line fishery for rockfish (*Sebastes* spp.). *Canadian Journal of Fisheries and Aquatic Science* 49(7): 1357-1365.

[46] Slotte, A., Hansen, K., Dalen, J., & Ona, E. 2004. Acoustic mapping of pelagic fish distribution and abundance in relation to a seismic shooting area off the Norwegian west coast. *Fisheries Research* 67(2): 143-150.

[47] McCauley, R., Duncan, A., Penrose, J., & McCabe, K. 2003. Marine seismic surveys: analysis and propagation of air-gun signals; and effects of air-gun exposure on humpback whales, sea turtles, fishes and squid.

VII. CONCLUSIONS

In sum, the Bureau should not move forward with permitting seismic activity off of the Mid- and South-Atlantic coasts. The PEIS is fatally flawed, and therefore the Bureau cannot rationally adopt the preferred alternative in the ROD, nor can it commence the proposed activity. In order to proceed with G&G activities in the OCS waters of the Atlantic coast, the Bureau must first develop an adequate PEIS that considers the best available science, analyzes a full spectrum of reasonable and feasible alternatives, and takes a hard look at the impacts. We appreciate the opportunity to provide input and thank you for your time. We will continue to be engaged in this process moving forward.

Sincerely,

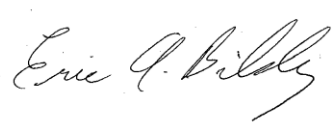

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EXHIBIT 4

Annual Level A Take Estimates from Seismic Airgun Sources Using Southall et al. (2007) Criteria for Marine Mammal Species during the Project Period

Order Cetacea	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	**Total by Species**
Baleen Whales										
Common Minke Whale	0	0	0.083	0.161	0.017	0.067	0.047	0.022	0.024	0.421
Sei Whale	0	0	0.208	0.402	0.047	0.17	0.121	0.061	0.068	1.077
Bryde's Whale	0	0	0.632	1.237	0.144	0.714	0.535	0.364	0.173	3.799
Blue Whale	0	0	0.831	1.622	0.18	0.908	0.672	0.443	0.215	4.871
Fin Whale	0	0	0	0	0	0	0	0	0	0
North Atlantic Right Whale	0	0	0.036	0.071	0.008	0.045	0.034	0.024	0.009	0.227
Humpback Whale	0	0	3.046	5.931	0.674	3.102	2.279	1.415	0.848	17.295
Toothed Whales, Dolphins, Porpoises										
Short-beaked Common Dolphin	0	0	116.584	225.454	18.848	96.111	64.095	28.714	23.101	572.907
Pygmy Killer Whale	0	0	0.161	0.312	0.061	0.158	0.129	0.082	0.091	0.994
Short-Finned Pilot Whale	0	0	11.616	22.498	74.416	55.161	93.694	123.153	153.571	534.109
Long-Finned Pilot Whale	0	0	59.577	117.528	13.886	79.691	61.042	45.685	14.791	392.2
Risso's Dolphin	0	0	370.55	731.439	87.14	501.58	385.115	290.103	92.466	2458.393
Northern Bottlenose Whale	0	0	0.004	0.007	0.001	0.003	0.002	0.001	0.001	0.019
Pygmy Sperm Whale	0	0	0	0	0.081	0.041	0.08	0.083	0.138	0.423
Dwarf Sperm Whale	0	0	2.819	5.564	1.326	4.2	3.676	3.169	2.01	22.764
Atlantic White-sided Dolphin	0	0	1.347	2.659	0.522	1.965	1.659	1.415	0.768	10.335
Fraser's Dolphin	0	0	0.208	0.402	0.032	0.161	0.105	0.041	0.04	0.989
Sowerby's Beaked Whale	0	0	0	0	0.006	0.004	0.007	0.009	0.012	0.038
Blainville's Beaked Whale	0	0	1.459	2.816	0.225	1.126	0.731	0.282	0.282	6.921
Gervais' Beaked Whale	0	0	1.459	2.816	0.225	1.126	0.731	0.282	0.282	6.921
True's Beaked Whale	0	0	1.459	2.816	0.225	1.126	0.731	0.282	0.282	6.921
Killer Whale	0	0	0.052	0.1	0.033	0.054	0.052	0.04	0.056	0.387
Melon-Headed Whale	0	0	0.161	0.312	0.061	0.158	0.129	0.082	0.091	0.994
Harbor Porpoise	0	0	2.064	3.995	0.655	1.913	1.509	0.963	1.012	12.111
Sperm Whale	0	0	0.095	0.184	0.015	0.076	0.05	0.021	0.019	0.46
False Killer Whale	0	0	0.155	0.3	0.126	0.194	0.204	0.186	0.224	1.389
Pantropical Spotted Dolphin	0	0	135.938	263.432	35.378	127.155	96.513	61.914	53.839	774.169
Clymene Dolphin	0	0	64.945	125.855	16.902	60.749	46.109	29.58	25.722	369.862
Striped Dolphin	0	0	527.416	1020.455	157.93	486.916	383.424	258.754	256.777	3091.672
Atlantic Spotted Dolphin	0	0	771.308	1496.301	201.604	741.31	564.738	369.59	303.44	4448.291
Spinner Dolphin	0	0	0.611	1.184	0.159	0.571	0.434	0.278	0.242	3.479
Rough-Toothed Dolphin	0	0	0	0	0.036	0.023	0.043	0.061	0.075	0.238
Bottlenose Dolphin	0	0	14.775	28.936	21.683	28.545	34.819	39.072	42.117	209.947
Cuvier's Beaked Whale	0	0	10.213	19.709	1.577	7.883	5.119	1.972	1.972	48.445
TOTAL	**0**	**0**	**2099.812**	**4084.498**	**634.223**	**2203.006**	**1748.628**	**1258.143**	**974.758**	13003.07
									13003.07	

Annual Level A Takes Estimates from Seismic Airgun Sources Uing 180-dB Criteria for Marine Mammal Species during the Porject Period

Order Cetacea	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	**Total by species**
<u>Baleen Whales</u>										
Common Minke Whale	0.000	0.000	0.342	0.666	0.101	0.364	0.285	0.196	0.144	**2.098**
Sei Whale	0.000	0.000	1.965	3.855	0.648	2.473	2.009	1.567	0.925	**13.442**
Bryde's Whale	0.000	0.000	1.948	3.820	0.642	2.445	1.986	1.548	0.918	**13.307**
Blue Whale	0.000	0.000	2.182	4.274	0.700	2.653	2.139	1.632	1.000	**14.580**
Fin Whale	0.000	0.000	4.400	8.638	1.507	5.679	4.657	3.705	2.180	**30.766**
North Atlantic Right Whale	0.000	0.000	1.162	2.290	0.611	1.757	1.595	1.464	0.858	**9.737**
Humpback Whale	0.000	0.000	5.897	11.542	1.853	7.071	5.671	4.275	2.632	**38.941**
<u>Toothed Whales, Dolphins, Porpoises</u>										
Short-beaked Common Dolphin	0.000	0.000	3,121.383	6,146.553	1,114.258	4,282.933	3,551.165	2,919.887	1,611.226	**22,747.405**
Pygmy Killer Whale	0.000	0.000	2.253	4.410	0.705	2.708	2.170	1.635	0.997	**14.878**
Short-Finned Pilot Whale	0.000	0.000	2,354.300	4,631.133	840.256	3,170.157	2,627.151	2,145.343	1,224.552	**16,992.892**
Long-Finned Pilot Whale	0.000	0.000	297.400	582.360	96.845	362.017	292.887	224.439	139.821	**1,995.769**
Risso's Dolphin	0.000	0.000	1,619.672	3,180.466	551.169	2,095.819	1,717.190	1,367.649	796.896	**11,328.861**
Northern Bottlenose Whale	0.000	0.000	0.127	0.250	0.043	0.174	0.143	0.116	0.061	**0.914**
Pygmy Sperm Whale	0.000	0.000	2.371	4.592	0.559	2.140	1.562	0.872	0.770	**12.866**
Dwarf Sperm Whale	0.000	0.000	14.844	29.005	4.264	16.955	13.300	9.592	5.939	**93.899**
Atlantic White-sided Dolphin	0.000	0.000	4.668	9.152	1.467	5.795	4.657	3.573	2.063	**31.375**
Fraser's Dolphin	0.000	0.000	0.242	0.468	0.055	0.210	0.151	0.079	0.076	**1.281**
Sowerby's Beaked Whale	0.000	0.000	0.203	0.397	0.060	0.233	0.184	0.134	0.085	**1.296**
Blainville's Beaked Whale	0.000	0.000	39.568	77.313	11.835	45.464	35.978	26.232	16.739	**253.129**
Gervais' Beaked Whale	0.000	0.000	39.568	77.313	11.835	45.464	35.978	26.232	16.739	**253.129**
True's Beaked Whale	0.000	0.000	39.568	77.313	11.835	45.464	35.978	26.232	16.739	**253.129**
Killer Whale	0.000	0.000	1.965	3.843	0.602	2.309	1.839	1.363	0.852	**12.773**
Melon-Headed Whale	0.000	0.000	2.523	4.942	0.818	3.098	2.505	1.924	1.168	**16.978**
Harbor Porpoise	0.000	0.000	7.054	13.798	2.245	8.376	6.733	5.072	3.235	**46.513**
Sperm Whale	0.000	0.000	158.828	309.723	44.502	173.124	134.518	93.561	62.258	**976.514**
False Killer Whale	0.000	0.000	2.801	5.491	0.930	3.501	2.848	2.218	1.334	**19.123**
Pantropical Spotted Dolphin	0.000	0.000	446.741	876.082	145.967	559.932	454.020	352.985	208.113	**3,043.840**
Clymene Dolphin	0.000	0.000	207.184	406.191	67.382	258.155	209.054	161.919	96.038	**1,405.923**
Striped Dolphin	0.000	0.000	2,038.848	3,993.224	650.891	2,483.607	2,000.683	1,526.327	928.896	**13,622.476**
Atlantic Spotted Dolphin	0.000	0.000	2,978.964	5,847.582	988.880	3,813.267	3,105.692	2,446.233	1,406.107	**20,586.725**
Spinner Dolphin	0.000	0.000	1.949	3.821	0.634	2.429	1.967	1.523	0.903	**13.226**
Rough-Toothed Dolphin	0.000	0.000	13.755	26.888	4.279	16.048	12.821	9.510	6.112	**89.413**
Bottlenose Dolphin	0.000	0.000	5,977.039	11,748.210	2,090.846	7,908.443	6,521.887	5,266.486	3,022.262	**42,535.173**
Cuvier's Beaked Whale	0.000	0.000	276.973	541.189	82.842	318.247	251.849	183.622	117.174	**1,771.896**
TOTAL	**0.000**	**0.000**	**19,668.687**	**38,636.794**	**6,732.066**	**25,648.511**	**21,043.252**	**16,819.145**	**9,695.812**	**138,244.267**
									138,244.267	

Annual Level B Take Estimates (160-dB criteria) from Airgun Surveys for Marine Mammal Species during the Project Period

Order Cetacea	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	**Total by species**
Baleen Whales										
Common Minke Whale	0.000	0.000	33.522	65.282	9.857	35.718	27.956	19.257	14.116	**205.708**
Sei Whale	0.000	0.000	192.625	377.801	63.466	242.395	196.917	153.588	90.689	**1,317.481**
Bryde's Whale	0.000	0.000	190.896	374.359	62.904	239.608	194.649	151.692	89.980	**1,304.088**
Blue Whale	0.000	0.000	213.901	418.875	68.622	259.980	209.629	159.949	98.045	**1,429.001**
Fin Whale	0.000	0.000	431.204	846.583	147.732	556.574	456.478	363.111	213.637	**3,015.319**
North Atlantic Right Whale	0.000	0.000	113.846	224.490	59.848	172.225	156.298	143.499	84.052	**954.258**
Humpback Whale	0.000	0.000	577.964	1,131.230	181.646	692.987	555.789	419.002	257.919	**3,816.537**
Toothed Whales, Dolphins, Porpoises										
Short-beaked Common Dolphin	0.000	0.000	305,926.755	602,423.698	109,208.426	419,770.312	348,049.714	286,178.116	157,916.298	**2,229,473.319**
Pygmy Killer Whale	0.000	0.000	220.776	432.193	69.105	265.443	212.700	160.267	97.713	**1,458.197**
Short-Finned Pilot Whale	0.000	0.000	230,744.930	453,897.344	82,353.473	310,707.070	257,487.079	210,265.101	120,018.336	**1,665,473.333**
Long-Finned Pilot Whale	0.000	0.000	29,148.152	57,077.138	9,491.739	35,481.323	28,705.807	21,997.239	13,703.882	**195,605.280**
Risso's Dolphin	0.000	0.000	158,744.009	311,717.478	54,020.063	205,411.212	168,301.811	134,043.314	78,103.785	**1,110,341.672**
Northern Bottlenose Whale	0.000	0.000	12.462	24.544	4.259	17.031	13.994	11.395	6.003	**89.688**
Pygmy Sperm Whale	0.000	0.000	232.353	450.073	54.784	209.782	153.072	85.460	75.450	**1,260.974**
Dwarf Sperm Whale	0.000	0.000	1,454.885	2,842.740	417.949	1,661.508	1,303.577	940.144	582.097	**9,202.900**
Atlantic White-sided Dolphin	0.000	0.000	457.481	896.987	143.826	567.919	456.474	350.144	202.187	**3,075.018**
Fraser's Dolphin	0.000	0.000	23.717	45.882	5.427	20.593	14.819	7.782	7.470	**125.690**
Sowerby's Beaked Whale	0.000	0.000	19.910	38.905	5.903	22.874	18.068	13.148	8.286	**127.094**
Blainville's Beaked Whale	0.000	0.000	3,878.016	7,577.415	1,159.902	4,455.915	3,526.252	2,570.966	1,640.602	**24,809.068**
Gervais' Beaked Whale	0.000	0.000	3,878.016	7,577.415	1,159.902	4,455.915	3,526.252	2,570.966	1,640.602	**24,809.068**
True's Beaked Whale	0.000	0.000	3,878.016	7,577.415	1,159.902	4,455.915	3,526.252	2,570.966	1,640.602	**24,809.068**
Killer Whale	0.000	0.000	192.589	376.649	59.002	226.289	180.233	133.567	83.546	**1,251.875**
Melon-Headed Whale	0.000	0.000	247.240	484.381	80.135	303.674	245.516	188.604	114.448	**1,663.998**
Harbor Porpoise	0.000	0.000	691.367	1,352.385	219.996	820.894	659.933	497.063	317.088	**4,558.726**
Sperm Whale	0.000	0.000	15,566.706	30,355.996	4,361.663	16,967.893	13,184.100	9,169.873	6,101.896	**95,708.127**
False Killer Whale	0.000	0.000	274.527	538.213	91.113	343.104	279.084	217.358	130.741	**1,874.140**
Pantropical Spotted Dolphin	0.000	0.000	43,785.058	85,864.840	14,306.228	54,878.902	44,498.535	34,596.047	20,397.152	**298,326.762**
Clymene Dolphin	0.000	0.000	20,306.091	39,810.739	6,604.129	25,301.751	20,489.358	15,869.727	9,412.707	**137,794.502**
Striped Dolphin	0.000	0.000	199,827.536	391,375.882	63,793.815	243,418.330	196,086.989	149,595.327	91,041.146	**1,335,139.025**
Atlantic Spotted Dolphin	0.000	0.000	291,968.246	573,121.475	96,920.094	373,738.318	304,388.840	239,755.284	137,812.574	**2,017,704.831**
Spinner Dolphin	0.000	0.000	191.026	374.513	62.127	238.022	192.750	149.292	88.549	**1,296.279**
Rough-Toothed Dolphin	0.000	0.000	1,348.103	2,635.268	419.376	1,572.892	1,256.603	932.059	599.076	**8,763.377**
Bottlenose Dolphin	0.000	0.000	585,809.587	1,151,442.029	204,923.786	775,106.463	639,210.107	516,168.326	296,211.886	**4,168,872.184**
Cuvier's Beaked Whale	0.000	0.000	27,146.110	53,041.902	8,119.316	31,191.403	24,683.766	17,996.764	11,484.217	**173,663.478**
TOTAL	**0.000**	**0.000**	**1,927,727.622**	**3,786,792.119**	**659,809.515**	**2,513,810.234**	**2,062,449.401**	**1,648,444.397**	**950,286.777**	**13,549,320.065**
									13,549,320.065	

Annual Level A Take Estimtes from All Non-Airgun High-Resolution Geophysical Surveys Using Southall et al. (2007) Criteria for Marine Mammal Species during the Project Perio

Order Cetacea	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	**Total by Species**
Baleen Whales										
Common Minke Whale	0.0003	0.0004	0.0004	0.0004	0.0004	0.0003	0	0	0	**0.0022**
Sei Whale	0.002	0.0024	0.0024	0.0024	0.0024	0.0021	0.0004	0	0	**0.0141**
Bryde's Whale	0.0023	0.003	0.003	0.003	0.003	0.0027	0.0007	0	0	**0.0177**
Blue Whale	0.0002	0.0005	0.0005	0.0005	0.0005	0.0005	0.0003	0	0	**0.003**
Fin Whale	0.0155	0.0208	0.0208	0.0208	0.0208	0.0185	0.0053	0	0	**0.1225**
North Atlantic Right Whale	0.0021	0.0026	0.0026	0.0026	0.0026	0.0022	0.0005	0	0	**0.0152**
Humpback Whale	0	0	0	0	0	0	0	0	0	**0**
Toothed Whales, Dolphins, Porpoises										
Short-beaked Common Dolphin	4.0936	5.2235	5.2235	5.2235	5.2235	4.546	1.1299	0	0	**30.6635**
Pygmy Killer Whale	0.0004	0.001	0.001	0.001	0.001	0.0009	0.0006	0	0	**0.0059**
Short-Finned Pilot Whale	0.0053	0.0106	0.0106	0.0106	0.0106	0.0106	0.0053	0	0	**0.0636**
Long-Finned Pilot Whale	0	0	0	0	0	0	0	0	0	**0**
Risso's Dolphin	1.863	2.2287	2.2287	2.2287	2.2287	2.0205	0.3658	0	0	**13.1641**
Northern Bottlenose Whale	0	0	0	0	0	0	0	0	0	**0**
Pygmy Sperm Whale	0.0048	0.0064	0.0064	0.0064	0.0064	0.0059	0.0016	0	0	**0.0379**
Dwarf Sperm Whale	0.0145	0.0192	0.0192	0.0192	0.0192	0.0178	0.0047	0	0	**0.1138**
Atlantic White-sided Dolphin	0	0	0	0	0	0	0	0	0	**0**
Fraser's Dolphin	0.0001	0.0003	0.0004	0.0004	0.0004	0.0003	0.0003	0	0	**0.0022**
Sowerby's Beaked Whale	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0	0	0	**0.0012**
Blainville's Beaked Whale	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0	0	0	**0.0012**
Gervais' Beaked Whale	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0	0	0	**0.0012**
True's Beaked Whale	0.0002	0.0002	0.0002	0.0002	0.0002	0.0002	0	0	0	**0.0012**
Killer Whale	0.0025	0.0061	0.0061	0.0061	0.0061	0.0058	0.0036	0	0	**0.0363**
Melon-Headed Whale	0.0001	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0	0	**0.0023**
Harbor Porpoise	0.0005	0.0007	0.0007	0.0007	0.0007	0.0006	0.0002	0	0	**0.0041**
Sperm Whale	0.0008	0.0009	0.0009	0.0009	0.0009	0.0008	0.0001	0	0	**0.0053**
False Killer Whale	0.0001	0.0004	0.0004	0.0004	0.0004	0.0003	0.0003	0	0	**0.0023**
Pantropical Spotted Dolphin	0.4477	0.5868	0.62	0.62	0.62	0.5432	0.1677	0.0287	0.0287	**3.6628**
Clymene Dolphin	0.2139	0.2803	0.2962	0.2962	0.2962	0.2595	0.0801	0.0137	0.0137	**1.7498**
Striped Dolphin	0.5954	0.7674	0.8121	0.8121	0.8121	0.7114	0.2107	0.0386	0.0386	**4.7984**
Atlantic Spotted Dolphin	5.3991	6.9574	7.3614	7.3614	7.3614	6.4414	1.898	0.3397	0.3397	**43.4595**
Spinner Dolphin	0.002	0.0026	0.0028	0.0028	0.0028	0.0024	0.0008	0.0001	0.0001	**0.0164**
Rough-Toothed Dolphin	0.0099	0.0145	0.0145	0.0145	0.0145	0.0134	0.0047	26.1283	0	**26.2143**
Bottlenose Dolphin	1.2977	2.1422	2.3608	2.3608	2.3608	1.9922	1.04	0.1955	0.1955	**13.9455**
Cuvier's Beaked Whale	0.0013	0.0015	0.0015	0.0015	0.0015	0.0013	0.0003	0	0	**0.0089**
TOTAL	**13.9759**	**18.2814**	**18.9981**	**18.9981**	**18.9981**	**16.6017**	**4.9222**	**26.7446**	**0.6163**	**138.1364**
									138.1364	

Annual Level A Take Estimates from All Non-Airgun High-Resolution Geophysical Surveys Using 180-dB Criteria for Marine Mammal Species during the Project Period

Order Cetacea	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	**Total by Species**
Baleen Whales										
Common Minke Whale	0.0002	0.0003	0.0003	0.0003	0.0003	0.0003	0.0002	0.0001	0.0004	**0.0024**
Sei Whale	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0012	0.0008	0.0024	**0.0074**
Bryde's Whale	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0012	0.0008	0.0024	**0.0074**
Blue Whale	0.0007	0.001	0.0011	0.0011	0.0011	0.0011	0.0015	0.0009	0.0026	**0.0111**
Fin Whale	0.0012	0.0016	0.0017	0.0017	0.0017	0.0018	0.0031	0.0019	0.0055	**0.0202**
North Atlantic Right Whale	0.002	0.0025	0.0025	0.0025	0.0025	0.0027	0.0051	0.0031	0.0089	**0.0318**
Humpback Whale	0.0025	0.0034	0.0035	0.0035	0.0035	0.0034	0.0037	0.0022	0.0066	**0.0323**
Toothed Whales, Dolphins, Porpoises										
Short-beaked Common Dolphin	1.2187	1.4589	1.4946	1.4946	1.4946	1.5087	2.0876	1.3143	3.8682	**15.9402**
Pygmy Killer Whale	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0011	0.0008	0.0024	**0.0073**
Short-Finned Pilot Whale	0.0132	0.0166	0.0171	0.0171	0.0171	0.1358	1.2475	0.805	2.3163	**4.5857**
Long-Finned Pilot Whale	0.0027	0.0033	0.0033	0.0033	0.0033	0.0153	0.1295	0.0932	0.2808	**0.5347**
Risso's Dolphin	0.0913	0.1118	0.1118	0.1118	0.1118	0.1826	0.8666	0.5861	1.7367	**3.9105**
Northern Bottlenose Whale	0	0	0	0	0	0	0.0001	0	0.0001	**0.0002**
Pygmy Sperm Whale	0.0011	0.0015	0.0015	0.0015	0.0015	0.0014	0.0007	0.0005	0.0017	**0.0114**
Dwarf Sperm Whale	0.0034	0.0046	0.0046	0.0046	0.0046	0.0046	0.0057	0.0038	0.0119	**0.0478**
Atlantic White-sided Dolphin	0	0.0001	0.0001	0.0001	0.0001	0.0002	0.0017	0.0014	0.0044	**0.0081**
Fraser's Dolphin	0.0004	0.0006	0.0007	0.0007	0.0007	0.0006	0.0003	0.0001	0.0002	**0.0043**
Sowerby's Beaked Whale	0	0	0	0	0	0	0.0001	0.0001	0.0002	**0.0004**
Blainville's Beaked Whale	0	0	0	0	0	0.0013	0.0134	0.0104	0.032	**0.0571**
Gervais' Beaked Whale	0	0	0	0	0	0.0013	0.0134	0.0104	0.032	**0.0571**
True's Beaked Whale	0	0	0	0	0	0.0013	0.0134	0.0104	0.032	**0.0571**
Killer Whale	0.0005	0.0007	0.0007	0.0007	0.0007	0.0007	0.001	0.0007	0.0021	**0.0078**
Melon-Headed Whale	0.0004	0.0005	0.0005	0.0005	0.0005	0.0006	0.0014	0.0009	0.0029	**0.0082**
Harbor Porpoise	0.0016	0.0018	0.0018	0.0018	0.0018	0.0019	0.0031	0.0023	0.0068	**0.0229**
Sperm Whale	0.0002	0.0002	0.0002	0.0002	0.0002	0.0041	0.043	0.0377	0.1213	**0.2071**
False Killer Whale	0.0004	0.0006	0.0006	0.0006	0.0006	0.0007	0.0016	0.001	0.0029	**0.009**
Pantropical Spotted Dolphin	0.3036	0.4453	0.4509	0.4509	0.4509	0.4381	0.3559	0.161	0.4798	**3.5364**
Clymene Dolphin	0.145	0.2127	0.2154	0.2154	0.2154	0.2088	0.1643	0.0729	0.217	**1.6669**
Striped Dolphin	0.3964	0.5755	0.5831	0.5831	0.5831	0.6088	0.9086	0.5299	1.5825	**6.351**
Atlantic Spotted Dolphin	3.4607	4.9269	4.9955	4.9955	4.9955	4.7511	3.0827	1.2151	3.5657	**35.9887**
Spinner Dolphin	0.0013	0.0019	0.002	0.002	0.002	0.0019	0.0015	0.0007	0.002	**0.0153**
Rough-Toothed Dolphin	0.0057	0.0074	0.0075	0.0075	0.0075	0.0073	0.008	0.0052	0.0164	**0.0725**
Bottlenose Dolphin	0.9382	1.4056	1.465	1.465	1.465	1.6672	3.8323	2.2521	6.4434	**20.9338**
Cuvier's Beaked Whale	0.0002	0.0002	0.0002	0.0002	0.0002	0.009	0.0939	0.0726	0.2243	**0.4008**
TOTAL	**6.5928**	**9.187**	**9.3677**	**9.3677**	**9.3677**	**9.5644**	**12.8944**	**7.1984**	**21.0148**	**94.5549**
									94.5549	

Annual Level A Take Estiamtes from All Non-Airgun High-Resolution Geophysical Surveys Using 160-dB Criteria for Marine Mammal Species during the Project Period

Order Cetacea	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*	**Total by Species**
Baleen Whales										
Common Minke Whale	0.0225	0.0287	0.03	0.03	0.03	0.0282	0.02	0.0135	0.0419	**0.2448**
Sei Whale	0.0358	0.0476	0.0511	0.0511	0.0511	0.0557	0.1152	0.0784	0.2328	**0.7188**
Bryde's Whale	0.0355	0.047	0.0505	0.0505	0.0505	0.0553	0.1169	0.079	0.2338	**0.719**
Blue Whale	0.0659	0.098	0.1037	0.1037	0.1037	0.1048	0.1448	0.0871	0.2568	**1.0685**
Fin Whale	0.1153	0.1598	0.1665	0.1665	0.1665	0.1722	0.3083	0.1847	0.5384	**1.9782**
North Atlantic Right Whale	0.1945	0.2461	0.2491	0.2491	0.2491	0.269	0.5016	0.3002	0.8702	**3.1289**
Humpback Whale	0.2454	0.3285	0.3444	0.3444	0.3444	0.3313	0.3597	0.2189	0.6492	**3.1662**
Toothed Whales, Dolphins, Porpoises										
Short-beaked Common Dolphin	119.444	142.9833	146.4839	146.4839	146.4839	147.8699	204.6009	128.8144	379.127	**1562.291**
Pygmy Killer Whale	0.0345	0.0494	0.0494	0.0494	0.0494	0.0549	0.1097	0.0759	0.237	**0.7096**
Short-Finned Pilot Whale	1.292	1.6287	1.6711	1.6711	1.6711	13.3054	122.2637	78.8942	227.0254	**449.4227**
Long-Finned Pilot Whale	0.2621	0.3201	0.3267	0.3267	0.3267	1.4975	12.6893	9.1359	27.5252	**52.4102**
Risso's Dolphin	8.9444	10.9577	10.9577	10.9577	10.9577	17.8981	84.9354	57.4417	170.2112	**383.2616**
Northern Bottlenose Whale	0	0	0	0	0	0.0006	0.0063	0.0041	0.0118	**0.0228**
Pygmy Sperm Whale	0.1119	0.1503	0.1503	0.1503	0.1503	0.141	0.0732	0.0472	0.1675	**1.142**
Dwarf Sperm Whale	0.3358	0.4508	0.4508	0.4508	0.4508	0.4557	0.5592	0.3686	1.1655	**4.688**
Atlantic White-sided Dolphin	0.0027	0.0055	0.0055	0.0055	0.0055	0.0208	0.168	0.1357	0.4275	**0.7767**
Fraser's Dolphin	0.0345	0.0568	0.0637	0.0637	0.0637	0.0575	0.0304	0.0098	0.0183	**0.3984**
Sowerby's Beaked Whale	0.0023	0.0026	0.0026	0.0026	0.0026	0.003	0.0073	0.0056	0.0175	**0.0461**
Blainville's Beaked Whale	0.0023	0.0026	0.0026	0.0026	0.0026	0.1259	1.3153	1.0167	3.14	**5.6106**
Gervais' Beaked Whale	0.0023	0.0026	0.0026	0.0026	0.0026	0.1259	1.3153	1.0167	3.14	**5.6106**
True's Beaked Whale	0.0026	0.0032	0.0032	0.0032	0.0032	0.1265	1.3156	1.0167	3.14	**5.6142**
Killer Whale	0.0509	0.0642	0.0678	0.0678	0.0678	0.068	0.0952	0.0667	0.2021	**0.7505**
Melon-Headed Whale	0.0361	0.0525	0.0525	0.0525	0.0525	0.0604	0.1362	0.0921	0.2839	**0.8187**
Harbor Porpoise	0.1543	0.1717	0.1812	0.1812	0.1812	0.1894	0.299	0.2206	0.6643	**2.2429**
Sperm Whale	0.0182	0.0215	0.0215	0.0215	0.0215	0.4051	4.2127	3.6965	11.8913	**20.3098**
False Killer Whale	0.0389	0.0582	0.0582	0.0582	0.0582	0.0674	0.1524	0.0959	0.2885	**0.8759**
Pantropical Spotted Dolphin	29.7529	43.6445	44.1968	44.1968	44.1968	42.9366	34.8805	15.7818	47.022	**346.6087**
Clymene Dolphin	14.2145	20.8513	21.1152	21.1152	21.1152	20.46	16.1068	7.1416	21.2706	**163.3904**
Striped Dolphin	38.8529	56.4013	57.1529	57.1529	57.1529	59.6638	89.0555	51.9312	155.0979	**622.4613**
Atlantic Spotted Dolphin	339.1818	482.888	489.6133	489.6133	489.6133	465.651	302.1377	119.089	349.4761	**3527.264**
Spinner Dolphin	0.1306	0.1899	0.1924	0.1924	0.1924	0.1862	0.1484	0.0672	0.2001	**1.4996**
Rough-Toothed Dolphin	0.5554	0.7281	0.7355	0.7355	0.7355	0.7138	0.7853	0.5128	1.6114	**7.1133**
Bottlenose Dolphin	91.9501	137.76	143.5851	143.5851	143.5851	163.3981	375.6071	220.7238	631.5169	**2051.711**
Cuvier's Beaked Whale	0.0158	0.0181	0.0181	0.0181	0.0181	0.881	9.2072	7.1172	21.9798	**39.2734**
TOTAL	**646.1387**	**900.4186**	**918.1559**	**918.1559**	**918.1559**	**937.38**	**1263.78**	**705.4814**	**2059.682**	**9267.348**
									9267.348	

EXHIBIT 5

Reichert, Christina

To: Reichert, Christina
Subject: FW: Notification: Receipt of Applications for Multiple IHAs in the Atlantic Ocean
Attachments: 7-27-15_Notice of receipt of multiple IHA apps for Atlantic activities_as filed.pdf

Subject: FW: Notification: Receipt of Applications for Multiple IHAs in the Atlantic Ocean

From: Craig Woolcott - NOAA Federal [mailto:craig.woolcott@noaa.gov]
Sent: Monday, July 27, 2015 4:22 PM
To: Craig Woolcott - NOAA Federal <craig.woolcott@noaa.gov>
Cc: Meagan Dunphy-Daly - NOAA Federal <meagan.dunphy-daly@noaa.gov>
Subject: Notification: Receipt of Applications for Multiple IHAs in the Atlantic Ocean

Good afternoon colleagues -

NOAA has received four Incidental Harassment Authorization (IHA) requests under the Marine Mammal Protection Act (MMPA) for proposed oil and gas geophysical survey activity in the Atlantic Ocean. The filed notification of receipt is attached to this email, and I have included additional background information below. Once the notification is published in the Federal Register, there will be an initial public review comment period of 30 days. This initial public review period is not typical for the issuance of IHAs, but it is required for more complex actions authorized through a different section of the statute.

Please feel free to contact me with any questions at
Craig.Woolcott@noaa.gov
or 202-482-
7940
.

Regards,
Craig

Background information:

- Under the MMPA, NOAA Fisheries is charged with the conservation and protection of marine mammals, including the appropriate authorization of incidental take.
    - NOAA Fisheries works with applicants to produce adequate and complete applications before publishing notice of the proposed authorizations for public comment. We then consider input from the public, make our final determinations, and issue or deny the authorization.
    - Typically, this process takes six to nine months, but may take longer for projects that are more complex.
    - NOAA Fisheries' responsibility is to consider the anticipated effects of the action to individual marine mammals in a population-level context and determine whether those consequences reflect a negligible impact on the relevant stocks. NOAA Fisheries may authorize the incidental taking

of "small numbers" of marine mammals if the taking will have no more than a negligible impact on the species/stock.
    - Behavioral disturbance of individual marine mammals by seismic surveys is well-documented, meaning that an MMPA authorization is required. The potential impacts to marine mammal populations grow with the scale of the proposed survey activity. It is difficult to document population level effects, but recent science has demonstrated connections between disturbance and energetic costs that can affect vital rates and, ultimately, population.
- This group of actions is not typical as the proposed surveys are very large in scale and complicated.
    - The scale of the proposed surveys is unprecedented in U.S. waters, with some surveys involving multiple source vessels and occurring year-round throughout a broad section of the Atlantic Ocean.
    - These proposed surveys are much larger than the typical academic seismic survey and involve much larger acoustic sources that produce more noise.
    - NOAA has been working diligently with the applicant companies to produce adequate applications and to address fundamental MMPA issues.
- This initial public review period is not typical for the issuance of IHAs, but it is required for more complex actions authorized through a different section of the statute.
    - NOAA Fisheries believes a public comment period will be productive in identifying information that should be considered in the decision-making process for these complex proposed surveys.
    - This public comment period does not represent additional time in the process; the public will gain an extra review period while the proposed authorizations are concurrently in development.
    - The regular public comment period will occur when we publish the proposed authorizations (targeted for September 2015).
- NOAA Fisheries is committed to careful review and to ensuring appropriate use of the best available information in satisfying the requirements of the MMPA and NOAA Fisheries' implementing regulations for these proposed surveys.

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EXHIBIT 6

April 21, 2015

Mary Colligan
Assistant Regional Administrator
NMFS Protected Resources Division
Greater Atlantic Regional Office
55 Great Republic Drive
Gloucester, MA 01930

RE: Endangered and Threatened Species; Critical Habitat for Endangered North Atlantic Right Whale

Dear Ms. Colligan,

I am writing on behalf of the International Fund for Animal Welfare (IFAW), the Natural Resources Defense Council (NRDC), Oceana, Inc., and millions of our concerned supporters on the proposed rule to expand the critical habitat for the endangered North Atlantic right whale. We are very supportive of the proposed rule to expand the critical habitat for North Atlantic right whales with two new areas – approximately 29,945 nm^2 of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1) and off the Southeast U.S. coast (Unit 2). It is our request that the National Marine Fisheries Service also

1. Include the mid-Atlantic migratory corridor and the southernmost portion of the current critical habitat in the right whale critical habitat expansion; and

2. Increase right whale protection measures to provide the protection necessary to allow for the recovery and long-term survival of right whales, including

    a. Expanding Seasonal Management Areas that reduce ship strikes to include all portions of the proposed critical habitat in the northeast and critical habitat in the mid-Atlantic migratory corridor out to 30 nms as well as areas in the Southeast Atlantic;

    b. Protect right whales from gear entanglement through expanded SMAs and expanding entanglement regulations to encourage the use of gear innovations such as sinking or neutrally buoyant line to reduce and prevent entanglement, and to promote science-based catch quotas; and

    c. Protecting right whales from proposed oil and gas exploration and development in the Atlantic Ocean through rules that prevent or limit the seismic airgun activity.

Conservation of North Atlantic right whales is imperative. With a population of about only 500, it is paramount that necessary precautions are taken to ensure species growth and prohibit further detriment to their existence. The most recent NMFS draft stock assessment for North Atlantic right whales, puts the species' annual Potential Biological Removal (PBR) level at 0.9 individuals, but for the period of 2008 through 2012, the minimum rate of annual human-caused mortality and serious injury to right whales averaged 4.75 per year, with incidental fishery entanglement reports at 3.85 per year, and ship strike records at 0.9 per year.[1] This level of mortality and serious injury is four times greater than the species' PBR. This means there are no unnatural right whale mortalities that can be deemed "insignificant" to their endangered population. NOAA is the United States agency responsible for protecting and recovering endangered marine species, and therefore, it is your duty to provide the protection required to safeguard this critically endangered population.

We Support Proposed Rule to Expand Critical Habitat for North Atlantic Right Whale

We applaud the National Marine Fisheries Service's (NMFS) efforts towards expanding North Atlantic right whale critical habitat. The designation and protection of critical habitat is one of the primary ways in which the fundamental purpose of the ESA, "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved," is achieved.[2] When designating critical habitat, NMFS considers the following characteristics: (1) space for individual and population growth, and for normal behavior; (2) food, water, air, light, minerals, or other nutritional or physiological requirements; (3) cover or shelter; (4) sites for breeding, reproduction, rearing of offspring, germination, or seed dispersal; and (5) habitats that are protected from disturbance or are representative of the historic geographical and ecological distributions of species.[3] Right whale critical habitat has not been revised since 1994 and since that time, our understanding of their seasonal habitat use has grown exponentially. Now that it is widely known that right whale critical habitat is much broader than originally believed, it is only right that the critical habitat boundaries reflect that modernized knowledge and the best science available.

In 1994, at the time when the North Atlantic right whale critical habitat was designated, right whale foraging grounds were thought to be solely located in the Great South Channel and the Cape Cod Bay. Now various studies and analysis of right whale sightings data in U.S. northwest Atlantic waters indicate foraging habitat important to the conservation of right whales is much more extensive than originally perceived. In fact, a study conducted in 2008 found that there is no statistically significant difference between the Sightings Per Unit Effort (SPUE) of right whales inside the current Cape Cod Bay critical habitat and the areas to the east (P=0.669).[4] Instead of two essential feeding grounds, six areas in the region are now understood to be seasonally important for right whale foraging purposes: Cape Cod Bay (January-April), Great South Channel (April-June), the western Gulf of Maine (April-May and July-October), the northern edge of Georges Bank (May-July), Jordan Basin (August-October), and Wilkinson Basin (April-July).

Jordan and Wilkinson Basins are also essential for right whales because they serve as overwintering areas for their prey, copepods. Right whales can be found foraging in these Basins year-round, but they

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[1] Waring *et al*. 2014 Draft Marine Mammal Stock Assessment Reports. Retrieved from: http://www.nmfs.noaa.gov/pr/sars/pdf/atl2014_draft.pdf

[2] 16 U.S.C. § 1536(a)(2).

[3] 50 C.F.R. § 424.12(b)(1)–(5).

[4] Nichols, O. C., Kenney, R. D., & Brown, M. W. (2008). Spatial and temporal distribution of North Atlantic right whales (Eubalaena glacialis) in Cape Cod Bay, and implications for management. Fishery Bulletin, 106(3), 270-280. Retrieved from http://0-web.ebscohost.com.library.colgate.edu/ehost/detail?sid=84ec6e2f-a35a-4c65-a80e-369c291643f9%40sessionmgr115&vid=1&hid=128&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=aph&AN=34474673

feed in especially high numbers during the fall and early winter months.[5] For example, right whale surveys conducted in Jordan Basin during the winter of 2004-2005 reported up to 24 foraging whales at a time[6] and in the winter of 2008, NOAA's Northeast Fisheries Science Center (NEFSC) observed 44 individual right whales on December 3rd and 41 on December 14th – about 14% of the total estimated population at the time.[7] After the overwintering period is over, the copepods in these Basins distribute to the other aforementioned areas in abundance and become the right whales food source throughout their foraging habitat. Right whale foraging activity is triggered by these high concentrations of copepods and a standard analysis of metabolic needs suggests that they require these dense patches to survive.[8] It is essential that all of the areas within the Gulf of Maine and Georges Bank region are included in the expansion as proposed so the dense copepod concentrations needed for right whale survival cannot be easily disturbed by harmful activities. Each of the listed areas make up North Atlantic right whale foraging habitat and are crucial to the long-term survival of right whales; because of this, these areas should be designated as critical habitat to right whales as proposed according to the Endangered Species Act (ESA).

The best science currently available also indicates that the existing North Atlantic right whale critical habitat boundaries in the southeast Atlantic Ocean are underrepresenting vital right whale habitat necessary to their species' conservation. As the location of the only calving grounds for right whales, this region is paramount to their population's growth and ultimate survival. Recent studies indicate that the current critical habitat boundaries need to be expanded to include areas farther offshore and substantially further north off the coast of Georgia.[9] As stated by the NMFS, southern North Carolina waters are a "substantial and core portion of the right whale calving area".[10] This expanse includes suitable average environmental conditions and has a high predicted sightings rate of calving right whales. Also by using a developed model to mean sea surface temperature (SST) throughout December-March, with right whale sightings per unit effort (SPUE) averaged across years, one study predicted suitable calving habitat for right whales over much of the continental shelf south of Cape Fear, North Carolina. It is clearly evident that right whale critical habitat should be expanded to encompass the proposed expansion. [11]

Therefore, the proposed expanded critical habitat for right whales represents important foraging, calving, and reproduction areas.

<u>Inclusion of the Mid-Atlantic Migratory Corridor and the Southernmost Portion of the Current Critical Habitat in the New Right Whale Critical Habitat Expansion</u>

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[5] Pace RM III, Merrick RL. (2008.) Northwest Atlantic Ocean Habitats Important to the Conservation of North Atlantic Right Whales (Eubalaena glacialis). Northeast Fish Sci Cent Ref Doc. 08-07; 24 p. Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd0807/

[6] Ibid.

[7] Dawicki, Shelley. (January 2009). High numbers of right whales seen in Gulf of Maine. NOAA National Marine Fisheries Service. Retrieved from http://www.eurekalert.org/pub_releases/2009-01/nnmf-hno010209.php

[8] Pace, R.M. and Merrick, R.L. (April 2008). Northwest Atlantic Ocean habitats important to the conservation of North Atlantic right whales (*Eubalaena glacialis*). Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd0807/crd0807.pdf

[9] Keller, C.A., Garrison, L., Baumstark, R., Ward-Geiger, L.I., and Hines, E. (2012). Application of a habitat model to define calving habitat of the North Atlantic right whale in the southeastern United States. Endangered Species Research, doi: 10.3354/esr00413. Retrieved from http://www.int-res.com/articles/esr_oa/n018p073.pdf

[10] NMFS (2012). U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments –North Atlantic right whale. Retrieved from http://www.nmfs.noaa.gov/pr/sars/pdf/ao2012.pdf

[11] Keller, C.A., Garrison, L., Baumstark, R., Ward-Geiger, L.I., and Hines, E. (2012). Application of a habitat model to define calving habitat of the North Atlantic right whale in the southeastern United States. Endangered Species Research, doi: 10.3354/esr00413. Retrieved from http://www.int-res.com/articles/esr_oa/n018p073.pdf

While we are very pleased with the proposed critical habitat expansion, we request that you consider including the mid-Atlantic migratory corridor and the entire currently designated critical habitat in the southeast in the proposal as well. As mentioned above, when designating critical habitat, NMFS considers space for normal behavior and sites for breeding and reproduction.[12] Here, the mid-Atlantic migratory corridor represents an area of normal species behavior because whales use the corridor to move between the species' southern calving sites and northern foraging sites. Further, the southernmost portion of the current critical habitat is essential for breeding and reproduction. Thus, NMFS should include both the mid-Atlantic migratory corridor and the southernmost portion of the current critical habitat in the expanded right whale critical habitat.

The mid-Atlantic migratory corridor connects both essential habitats and is traversed by the most important and vulnerable members of the population – mothers and calves. It is crucial that these essential foraging and calving grounds receive the increased protection and special management consideration necessary to allow the North Atlantic right whales devastatingly low population to recover. Including this area in the expansion would help to safeguard their migratory route and ensure that mothers and calves are able to access their calving and foraging grounds. If this area is not included, detrimental activities could take place in the corridor and put mothers and calves at an increased risk of injury and mortality. Complete protection of mothers and calves is crucial to population growth. It is already apparent that NMFS acknowledges right whale use of this high risk area by allotting Seasonal Management Areas (SMAs) out to 20 nautical miles from mid-Atlantic ports. As a known, necessary area to right whales it should be included in the critical habitat expansion.

Also, in order to provide the best possible protection, the southern tip of the existing Southeast Atlantic critical habitat should not be decreased or narrowed as proposed. The safety of calving habitat is crucial to right whale success and should not be downsized by any means if we are to provide right whales with the best protection possible. At their current endangered status, the right whale population is not at a point where protection should be decreased for their species. By including the existing southern tip in the proposed critical habitat boundaries, as previously indicated, 91% of analyzed sightings would be included in the expansion. This would provide right whales with nearly full habitat coverage.

Therefore, NMFS should include the mid-Atlantic migratory corridor because the species normally uses it to move between the southern calving sites and northern foraging sites. And NMFS should include the southernmost portion of the current critical habitat because this area is essential for breeding and reproduction.

<u>Expanding Protective Measures to Strengthen Right Whale Protection within the Newly Designated Critical Habitat</u>

We request that NMFS expand protective measures within existing and newly designated critical habitat to strengthen whale protection. NMFS also states that critical habitat provides a benefit to species by focusing federal, state, and private conservation and management efforts in areas designated critical habitat.[13] Recovery efforts can then address special considerations needed in critical habitat areas,

[12] 50 C.F.R. § 424.12(b)(1)–(5).
[13] *See Palila v. Hawaii Department of Land and Natural Resources*, 852 F. 2d 1106 (9th Cir. 1988).

including conservation regulations to restrict private as well as federal activities.[14] Therefore, to provide the necessary protections for right whales, NMFS should

1. Expand Seasonal Management Areas (SMAs) that reduce ship strikes to include all portions of the proposed critical habitat in the northeast and critical habitat in the mid-Atlantic migratory corridor out to 30 nms as well as areas in the Southeast Atlantic;

2. Protect right whales from gear entanglement through expanded SMAs and expanding entanglement regulations to encourage the use of gear innovations such as sinking or neutrally buoyant line to reduce and prevent entanglement, and to promote science-based catch quotas; and

3. Protect right whales from proposed oil and gas exploration and development in the Atlantic Ocean through rules that prohibit or limit seismic airgun activity.

First, NMFS should expand SMAs[15] that reduce ship strikes to include all portions of the proposed critical habitat in the northeast. Ship strikes currently remain one of the greatest known causes of North Atlantic right whale mortality.[16] Many of their physiological tendencies, such as swimming slowly, living in near-shore waters, and spending extended periods of time near the surface, put them in extreme jeopardy of being struck by a traversing vessel. Given the vulnerability of the right whale population, the loss of even one whale reduces the species chance of long-term survival.

The feeding behavior of pregnant or breeding females and their calves put them at a particularly high risk of vessel collision. Surface intervals for calves and females with calves average 5.69 minutes, whereas surface intervals for all other individuals, excluding the pregnant female, average 3.13 minutes. Pregnant females have the highest average surface interval at 11.08 minutes.[17] Therefore, ships are most likely to hit the individuals most essential in reviving the population. Females have an average lifetime calf production total of 5.25 calves; killing a reproductive female has a potentially critical impact on the population's recovery.[18]

Considering right whale vulnerability to ship strikes and their critically endangered status, SMAs should be expanded to include all portions of the proposed critical habitat in the northeast. Also, in the mid-Atlantic SMAs should be extended out to at least 30 nm as whales have been detected further offshore than current regulations reach. Reduced ship speeds of 10 knots or lower have proven to decrease the likelihood of ship strikes to right whales. In fact, since the Ship Speed Rule went into effect in 2008, none of the 5 reported ship strike serious injury and mortalities of North Atlantic right whales in U.S. waters occurred in SMAs. Modeling studies indicate that in these areas, the probability of fatal vessel

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[14] *Id.*

[15] SMAs should include both restrictions on vessel speed and restrictions on the use of fishing gear that can interact with and entangle North Atlantic right whales.

[16] Recovery Plan for the North Atlantic Right Whale, (August 2004); Prepared by the National Marine Fisheries Service Department of Commerce; page IG-1

[17] Baumgartner, M.F., Mate, B.R. (2003). Summertime foraging ecology of North Atlantic right whales. Mar Ecol Prog Ser. 264:123–135. Retrieved from http://ir.library.oregonstate.edu/xmlui/bitstream/handle/1957/27353/SummertimeForagingEcologyOf.pdf?sequence=1

[18] Kraus, S. D., Brown, M. W., Caswell, H., Clark, C. W., & al, e. (2005). North atlantic right whales in crisis. *Science, 309*(5734), 561-2. Retrieved from http://search.proquest.com/docview/213603412?accountid=10207

strikes to right whales has been reduced by 80 to 90 percent.[19] On the contrary, though fewer vessel strike mortalities have occurred inside active SMAs, their prevalence has increased outside of these areas, meaning that more area should be protected to reduce vessel strike mortalities. Specifically, about 32% of pre-Ship Speed Rule right whale vessel strike mortalities occurred outside of SMAs during their active times, showing that the spatial extent of SMAs is insufficient in certain seasons.[20] Dynamic Management Areas (DMAs)[21] may pop up where there are multiple right whale sightings outside of SMAs, but relying on this measure alone in such prevalent right whale habitat provides inadequate protection to this endangered species. DMAs are only subject to voluntary speed restrictions and unfortunately receive low compliance. They may have had some tacit benefit in raising awareness of mariners to the problem of right whale vulnerability to ship strikes, but when measured by vessels either avoiding an area or restricting speed within it, the DMA program has likely had little or no impact in reducing ship strike occurrences.[22] Studies suggest that due to a large number of right whale observations that have occurred incidentally outside SMAs – like in Jordan Basin where at least 3 DMAs were issued in 2009,[23] at least 5 in 2010,[24] at least 3 in 2011,[25] and finally at least 1 in 2012 [26] – consideration should be given to either expanding the sizes of the SMAs to encompass a large portion, if not all, of the recurring DMAs or to establishing new SMAs. In order to fully take advantage of the effectiveness of this protection measure, SMAs need to be expanded to include larger portions of right whale habitat.

As the migratory corridor between the right whale calving grounds in the southern Atlantic and their feeding grounds in the north, the mid-Atlantic should not only be included in the proposed critical habitat expansion, but also deserves ship speed regulations to be expanded there as well. Analysis indicates that SMAs only cover a small portion of essential right whale habitat, a fact that is also made evident by the proposed rule to expand their critical habitat extensively. By expanding the existing SMAs in the mid-Atlantic migratory corridor out to 30 nm instead of 20 nm, an additional 15,453 km^2 of protection would be allotted to this critically endangered species.[27] Studies have shown that in the mid-Atlantic a 20 nm buffer from each port typically picks up less than half the sightings that pass the ports'

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[19] NOAA (2013). NOAA proposal extends rule reducing risk of whale ship strikes along U.S. East Coast. Retrieved from http://www.noaanews.noaa.gov/stories2013/20130605_rightwhale.html

[20] van der Hoop, J. M., Vanderlaan, A. S. M., Cole, T. V. N., Henry, A. G., Hall, L., Mase-Guthrie, B., Wimmer, T. and Moore, M. J. (2015), Vessel Strikes to Large Whales Before and After the 2008 Ship Strike Rule. Conservation Letters, 8: 24–32. doi: 10.1111/conl.12105. Retrieved from http://onlinelibrary.wiley.com/doi/10.1111/conl.12105/full

[21] Areas where voluntary speed restrictions are adopted in response to aggregations of Atlantic Right Whales outside of SMAs.

[22] Ibid p. 35

[23] Khan, C, Cole, T, Duley, P, Glass, A, Gatzke, J. (2010). North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS) 2009 Results Summary. US Dept Commer, Northeast Fish Sci Cent Ref Doc. Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd1007/crd1007.pdf

[24] Khan, C, Cole, T, Duley, P, Henry, A, Gatzke, J. (2011). North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS) 2010 Results Summary. US Dept Commer, Northeast Fish Sci Cent Ref Doc. Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd1105/1105.pdf

[25] Khan C, Cole T, Duley P, Henry A, Gatzke J, Corkeron. (2012). North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS) 2011 Results Summary. US Dept Commer, Northeast Fish Sci Cent Ref Doc. Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd1209/

[26] Gatzke J, Khan C, Henry A, Cole T, Duley P. (2013). North Atlantic Right Whale Sighting Survey (NARWSS) and Right Whale Sighting Advisory System (RWSAS) 2012 Results Summary. US Dept Commer, Northeast Fish Sci Cent Ref Doc. Retrieved from http://www.nefsc.noaa.gov/publications/crd/crd1308/

[27] Schick, R. S., Halpin, P. N., Read, A. J., Slay, C. K., Kraus, S. D., Mate, B. R., & ... Clark, J. S. (2009). Striking the right balance in right whale conservation. Canadian Journal Of Fisheries & Aquatic Sciences, 66(9), 1399-1403. doi:10.1139/F09-115. Retrieved from http://0-web.ebscohost.com.library.colgate.edu/ehost/detail?sid=53199adf-1de7-4fde-bcd8-2b53e9af1cc6%40sessionmgr111&vid=1&hid=128&bdata=JnNpdGU9ZWhvc3QtbGl2ZQ%3d%3d#db=aph&AN=44183936

entrances. With a 25 nm buffer, over 50% of right whale sightings are included at five of the nine ports. At 30 nm, only the Delaware Bay port, which has few sightings, includes less than 50% of sightings. The other eight ports include between 55% and 94% of all sightings and 80% of tagged animal sightings at this inclusion distance. At 35 nm, sighting inclusion is close to 100% at all nine ports.[28] The mid-Atlantic migratory corridor has the highest right whale ship strike incidence and mortality density.[6]

Therefore, it is paramount that ship speed regulations be applied more extensively to this area and buffers at least extend out to 30 nm in order for the SMAs to be effective.

Second, NMFS should expand protections against entanglement to fully safeguard the right whale population so they may achieve long-term survival. Entanglement is another leading cause of right whale mortality, with nearly three-quarters of all known North Atlantic right whales inflicted with scars from past entanglements with commercial fishing gear[29]. North Atlantic right whales' migratory route and foraging and calving habitats coincide with a variety of fisheries, putting them in grave danger of entanglement. Similar to ship strikes, entanglements are most likely to occur with calves, juveniles, and pregnant females – vulnerable members of the population that are essential to growth.[30]

Several measures can be taken to help prevent entanglement occurrences. These measures include regulating or prohibiting in SMAs the use of fishing gear that interact with and lead to entanglement of North Atlantic right whales. Appropriate measures also include promoting, and as appropriate, requiring adoption of gear innovations like sinking or neutrally buoyant line, and encouraging science-based catch quotas, which can promote efficiency, productivity, and profit, while minimizing unintended threats and "bycatch" of marine species.

Entanglements are inhibiting the North Atlantic right whale population from reaching the Marine Mammal Protection Act's (MMPA) mandate to reach the Zero Mortality Rate Goal (ZMRG) and the ESA recovery mandate 16 U.S.C. § 1531(b). According to NMFS over half of all identified right whale deaths have been caused by entanglement in commercial fishing gear.[31] Also, it is estimated that more than 75% of North Atlantic right whales have been entangled at some time in their lives[32] – a percentage that has risen considerably from 57% in 1990,[33] 61.6% in 1998,[34] and may have even risen again within the past few years. Fishermen take advantage of the biological productivity and advantageous conditions found within right whale habitat the same as the whales do, creating a potentially harmful co-occurrence of right whale presence and fishing gear.

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[28] Knowlton, A.R., Ring, J.B., Russell, B. (July 2002). Right whale sightings and survey effort in the mid Atlantic region: migratory corridor, time frame, and proximity to port entrances. Report submitted to NMFS ship strike working group. Retrieved from http://www.greateratlantic.fisheries.noaa.gov/shipstrike/ssr/midatanticreportrFINAL.pdf

[29] Knowlton, A.R., Marx, M.K., Pettis, H.M., Hamilton, P.K., & Kraus, S.D. (February 2005). Analysis of scarring on North Altantic Right Whales (Eubalaena Glacialis): Monitoring rates of entanglement interaction: 1980-2002. Retrieved from http://docs.lib.noaa.gov/noaa_documents/NOAA_related_docs/Analysis_Scarring_North_Atlantic_Right_Whales.pdf

[30] Knowlton, A. R., Hamilton, P. K., Marx, M. K., Pettis, H. M., and Kraus, S. D. (2012). Monitoring North Atlantic right whale (*Eubalanena glacialis)* entanglement rates: a 30 yr retrospective. Marine Ecology Progress Series, 466, 293-302.

[31] NMFS (2012). U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments –North Atlantic right whale. Retrieved from http://www.nmfs.noaa.gov/pr/sars/pdf/ao2012.pdf

[32] Knowlton, A.R., M.K. Marx, H.M. Pettis, P.K. Hamilton and S.D. Kraus. (2005). Analysis of scarring on North Atlantic right whales (Eubalaena glacialis): monitoring rates of entanglement interaction 1980-2002. National Marine Fisheries Service. Contract #43EANF030107. Final Report.

[33] National Marine Fisheries Service. (2013). Draft Recovery Plan for the North Pacific Right Whale (Eubalaena japonica). National Marine Fisheries Service, Office of Protected Resources, Silver Spring, MD. (citing Kraus, S.D. 1990. Rates and potential causes of mortality in North Atlantic right whales. Marine Mammal Science 6(4):278-291).

[34] Hamilton, P.K., M.K. Marx, and S.D. Kraus. (1998). Scarification analysis of North Atlantic right whales (Eubalaena glacialis) as a method of assessing human impacts. Northeast Fisheries Science Center. Contract No. 4EANF-6-0004. Final Report.

Therefore, NFMS should expand entanglement regulations, including through SMAs and through gear technology requirements, to more effectively mitigate entanglement incidences.

Third, NMFS should protect right whales from the proposed expansion of oil and gas development in the Atlantic Ocean through rules that limit the sonic impact from seismic activity. The Bureau of Ocean Energy Management (BOEM) has proposed to authorize geological and geophysical activities to support its oil and gas development, renewable energy, and marine minerals programs in the Federal waters of the mid- and south Atlantic Outer Continental Shelf – completely engulfing right whale calving grounds and the mid-Atlantic migratory corridor.[35] Their Environmental Impact Statement (EIS) discusses strategies to minimize right whale takes, but with such a small population size, no right whale death can be deemed insignificant to the population's survival. Accordingly, NMFS should look to the best available science, including the acoustic guidelines currently under development, in developing protective regulations to prohibit in critical habitat damaging sonic impacts from seismic exploration. These regulations might include buffer zones distancing seismic activity outside of critical habitat to make sure that the noise level inside critical habitat is not too high, or other appropriate science-based protections tailored to the particular kind of threat posed by different seismic activities.

Therefore, to fully protect the right whale within existing and newly designated critical habitat, NMFS should

1. Expanding Seasonal Management Areas that reduce ship strikes to include all portions of the proposed critical habitat in the northeast and critical habitat in the mid-Atlantic migratory corridor out to 30 nms as well as areas in the Southeast Atlantic;

2. Protect right whales from gear entanglement through expanded SMAs and expanding entanglement regulations to encourage the use of gear innovations such as sinking or neutrally buoyant line to reduce and prevent entanglement, and to promote science-based catch quotas; and

3. Protecting right whales from proposed oil and gas exploration and development in the Atlantic Ocean through rules that prevent or limit seismic airgun activity.

Conclusion

We are in full support of the proposed rule to expand North Atlantic right whale critical habitat and also respectfully requests that you consider

1. Including the mid-Atlantic migratory corridor and the southernmost portion of the current critical habitat in the right whale critical habitat expansion; and

2. Increasing right whale protection measures to provide the protection necessary to allow for the recovery and long-term survival of right whales, including

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[35] BOEM (2012). Proposed geological and geophysical activities – mid-Atlantic and south Atlantic planning areas – biological assessment. Retrieved from http://www.boem.gov/uploadedFiles/BOEM/Oil_and_Gas_Energy_Program/GOMR/Biological_Assessment_finalforwebposting_wcover_5-24-12.pdf

a. Expanding Seasonal Management Areas that reduce ship strikes to include all portions of the proposed critical habitat in the northeast and critical habitat in the mid-Atlantic migratory corridor out to 30 nms as well as areas in the Southeast Atlantic;

b. Protect right whales from gear entanglement through expanded SMAs and expanding entanglement regulations to encourage the use of gear innovations such as sinking or neutrally buoyant line to reduce and prevent entanglement, and to promote science-based catch quotas; and

c. Protecting right whales from proposed oil and gas exploration and development in the Atlantic Ocean through rules that prevent or limit seismic airgun activity.

In order to safeguard the right whale population, we must protect them and limit disturbances from current and future threatening implications to the best of our abilities. On behalf of our organizations, we thank you for considering our views and recommendations.

Sincerely,

Margaret Cooney
Campaigns Officer
International Fund for Animal Welfare

Taryn Kiekow Heimer
Senior Policy Analyst
Natural Resources Defense Council

Claire Douglass
Campaign Director, Climate and Energy
Oceana, Inc.

EXHIBIT 7

North Atlantic Right Whale Critical Habitat: Southeast Atlantic

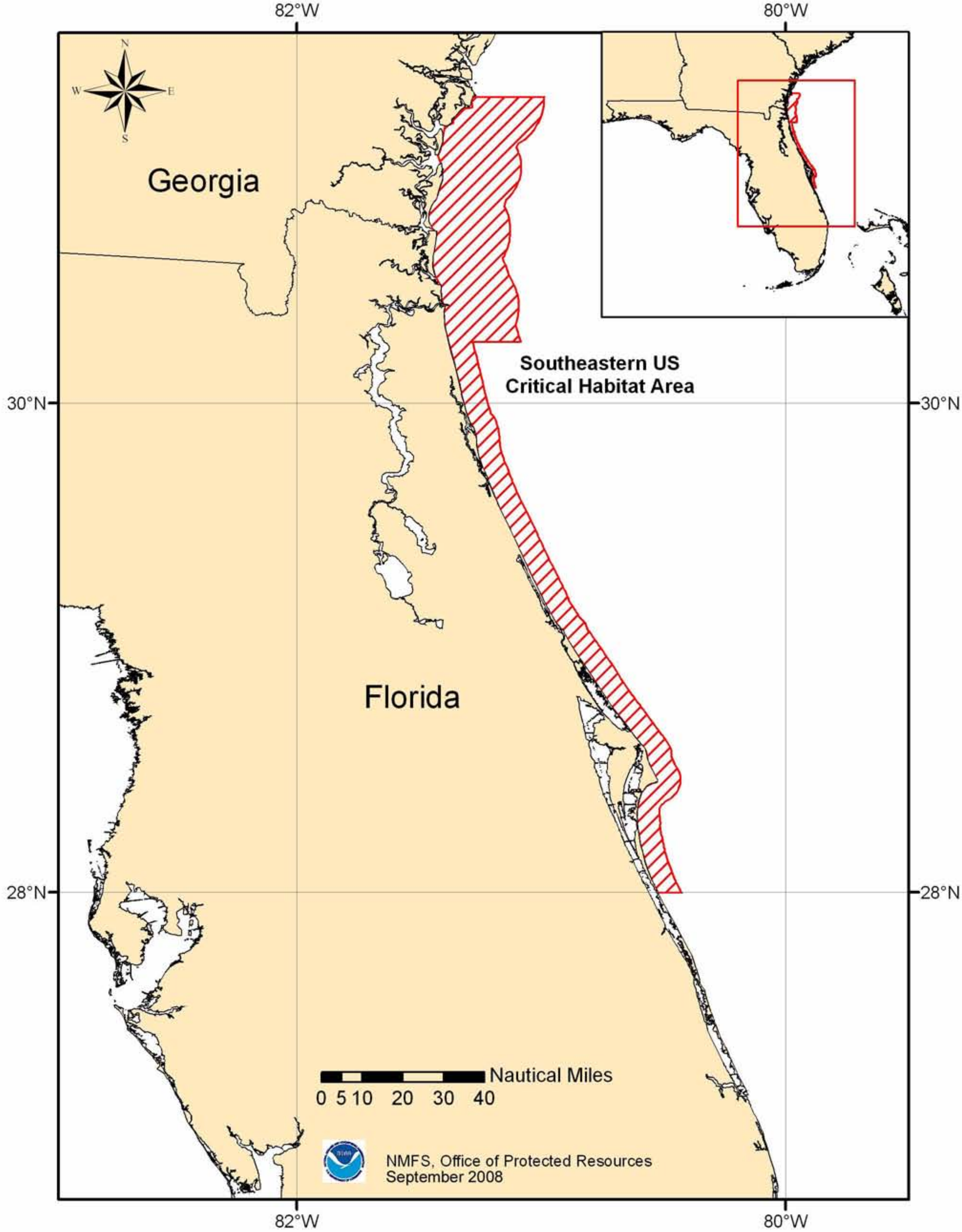

EXHIBIT 8

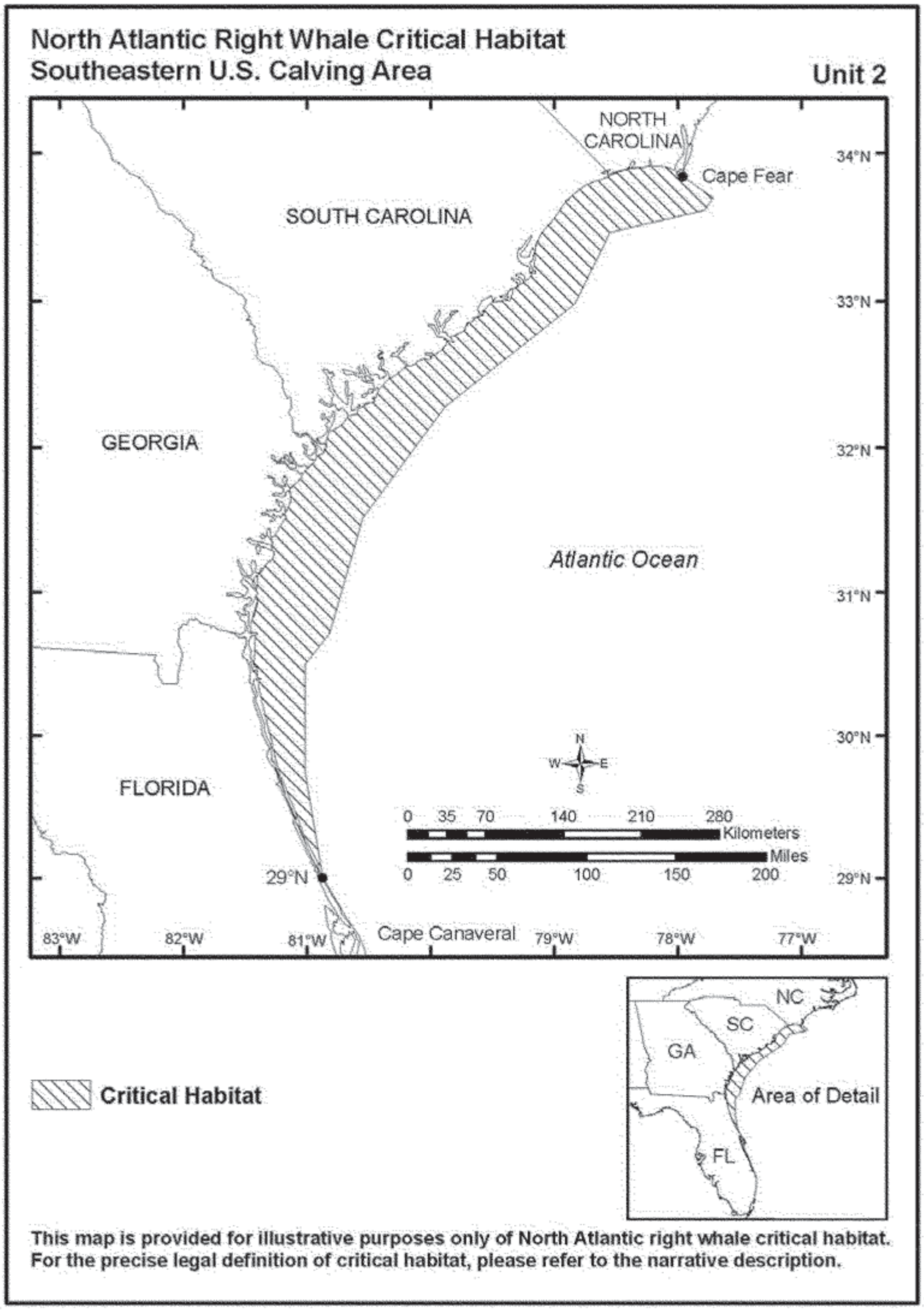

Figure 2. Area considered for designation as North Atlantic right whale southeastern calving critical habitat.

OCEAN CONSERVATION RESEARCH

Science and technology serving the sea

Mr. Gary D. Goeke, Chief, April 30, 2014
Regional Assessment Section,
Office of Environment (MS 5410),
Bureau of Ocean Energy Management,
Gulf of Mexico OCS Region,
1201 Elmwood Park Boulevard,
New Orleans,
Louisiana 70123–2394

Cc: Jill Lewandowski, USDOI

Re: Comments on the Final PEIS for Atlantic G&G Activities

Dear Mr. Goeke,

We appreciate this opportunity to submit our comments on the Final Programmatic Environmental Impact Statement on the Atlantic OCS Proposed Geological and Geophysical Activities (hereinafter Atlantic G&G PEIS). In this document we will comment on how and if our original comments on the 2012 Draft Environmental Impact Statement were addressed, and to the extent that we can, comment on the changes made in the document reflecting the comments of the public and industry.

As in our original comments we will attempt to be thorough and informative in our review. We will also be focusing the bulk of our comments on the acoustical impacts of the proposed actions because this is our area of expertise.

In our conversations with colleagues about this "final" PEIS the fact continuously arises that Draft EIS on acoustical guidelines was recently submitted by NOAA for public review[1] (hereinafter "NOAA Acoustical Guidelines"). While these guidelines represent an incremental improvement over previous noise exposure guidelines, we found them lacking due to the paucity of data establishing auditory thresholds across marine mammal species, and with the submission of new data which puts the whole concept of "Temporary Threshold Shift" into question.[2, 3] (We have attached our critique of the guidelines to this letter.)

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[1] 78 Fed. Reg. 78822 "Draft Guidance for Assessing the Effects of Anthropogenic Sound on 13 Marine Mammals" (Dec. 27, 2013)
[2] Kujawa, S.G., and M.C. Liberman. 2009. Adding insult to injury: Cochlear nerve degeneration after "temporary" noise-induced hearing loss. The Journal of Neuroscience 29:14077-2
[3] Lin, H.W., A.C. Furman, S.G. Kujawa, and M.C. Liberman. 2011. Primary neural degeneration in the guinea pig cochlea after reversible noise-induced threshold shift. Journal of the Association for Research in Otolaryngology 12:605-616.

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Given that the Atlantic G&G PEIS depends on the most up-to-date scientific information it stands to reason that a final decision on the plan cannot be issued until the noise guidelines are amended, approved, and used as guidelines for the Atlantic G&G PEIS.

It appears that BOEM had anticipated this, and why what is known as "Southall 2007" [4] was cited so extensively in the Atlantic G&G Draft PEIS. So while using the Southall guidelines in parallel with the legacy guidelines presaged the issuance and review of the NOAA Acoustical Guidelines, we believe that there are too many shortcomings in the acoustical guidelines to even approximate impacts indicated in the literature which has been published since the Southall 2007 paper. (e.g. Roland et.al.[5], 2012 and Costellote et.al 2012 [6])

So while we will put effort into our review, we believe in the end that a final "Final PEIS" will need another review using a revised set of acoustical guidelines.

From an editorial perspective it is clear that "Alternative B, the preferred action" is a paean to the fossil fuel industry. One of the deepest concerns of conservationists about the Atlantic G&G plan is that choosing the wrong alternative will be a tacit gateway for fossil fuel development on the Eastern Seaboard. In light of all we know about the severe impacts of fossil fuel on global climate, and the risks that fossil fuel extraction – particularly deepwater exploration and production on local and regional marine habitat, continuing to subsidize the hydrocarbon industry with the opportunities cleared by Alternative B is reckless and irresponsible.

Political, social, economic, and environmental threats posed by higher-energy climate conditions, sea level rise, and dependence on politically volatile non-renewable fossil fuel have been well detailed. Continuing to place the future of our civilization in the hands of private global energy interests is the epitome of madness. For these reasons alone it should be clear that the only realistic alternative would be Alternative C – the no action alternative which promotes the development of offshore wind and tidal energy resources. Choosing this alternative will send a clear message to the world that the US government is finally taking a stand on the climate disaster that is currently and rapidly unfolding.

Regarding some of the specific aspects of BOEM responses to our 2012 comments to the Draft PEIS,[7] we appreciate the time that went into reviewing and in a number of cases revising the "Final" PEIS in response to many of our (collective) concerns, although there remain some issues that we either did not express clearly enough, or the issue was not

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[4] Southall, B.L., A.E. Bowles, W.T. Ellison, J.J. Finneran, R.L. Gentry, C.R. Greene Jr., D. Kastak, D.R. Ketten, J.H. Miller, P.E. Nachtigall, W.J. Richardson, J.A. Thomas, and P.L. Tyack. 2007. Marine mammal noise exposure criteria: Initial scientific recommendations. Aquatic Mammals 33(4):411-521.

[5] Rosalind M. Rolland, Susan E. Parks, Kathleen E. Hunt, Manuel Castellote, Peter J. Corkeron, Douglas P. Nowacek, Samuel K. Wasser and Scott D. Kraus. 2012 "Evidence that ship noise increases stress in right whales" Proc. R. Soc. B

[6] Manuel Castellote, Christopher W. Clark, Marc O. Lammers 2012 "Acoustic and behavioural changes by fin whales (*Balaenoptera physalus*)in response to shipping and airgun noise" Biological Conservation 147 (2012) 115–122

[7] Found in BOEM-2014-001-v3 Table 6: NGO-E-4 comments 0.01 through 0.31

resolved due to established regulatory guidelines – some of which we believe are regulatory shortcomings.

In response to our comment NGO-E-4-0.07 about hearing damage in fish, we believe that there is still too little known about fish hearing to make the broad assumption that "fishes are not likely to ever become permanently deaf."[8] We dismissed the Smith 2006 paper because the study was on goldfish – not representative of marine fish, and while Lombarte and Popper, (1994)[9] indicate high densities of hair cells in the saccule, there is no clear correlation that these high densities result in increased (or even what humans might consider "good") hearing sensitivity. While Mann et.al., (2009) do correlate increased hearing sensitivity in other gadiformes[10] correlated with age (or size of the saccular otolith and associated sensory epithelia of the inner ear) the effect of the increase in saccule size and number of hair cells does not clearly point to the same relationship between quantity of hair cells to hearing acuity (or hearing damage) found in humans and other terrestrial vertebrates. Thus I would not rely on hair cell density, or even "self repair" to be a proxy for hearing health or acuity.

Furthermore McCauley et al., (2003)[11] does not indicate hair cell repair as indicated in the Atlantic G&G PEIS section 4.2.5.1.4; rather the paper indicated intermediate and long-term damage through "blebbing" and holes developing in the sensory epithelia. The paper also included the statement that "impact of exposure on ultimate survival of the fish is not clear. Fishes with impaired hearing or vestibular senses would have reduced fitness, potentially leaving them vulnerable to predators." This is an important factor that the Atlantic G&G PEIS continues to overlook – whether it is in fish or in marine mammals: That when animal's sensory systems are compromised they become less fit. Even if the compromise is "temporary," the animals will become more subject to predation, less capable of locating food, navigating, and sensing its surrounding for any survival purpose. McCauley et al., (2003) noted serious physiological compromise after 58 days. This is a long time to not hear well. And the very cage that prevented the fish from dispersing (used as a dismissive argument in the PEIS) may have also protected them from predation. (There was no later histologies performed on these subjects tracking degradation or recovery.)

Regarding the comment about caged fish not being able to escape from the noise; sedentary fish will not necessarily disperse when under assault, but may be predisposed to diving down and "sheltering in place."[12] This response is likely an adaptation to escape predation rather than to escape noise. In McCauley 2000 squid swam closer to the surface when exposed to noise where low frequency noise levels would be attenuated by the

[8] Atlantic G&G PEIS section 4.2.5.1.4
[9] Lombarte, A. and A.N. Popper. 1994. Quantitative analyses of postembryonic hair cell addition in the otolithic endorgans of the inner ear of the European hake, (*Merluccius merluccius*). Journal of Comparative Neurology 345:419-428
[10] David A. Mann, Christopher D. Wilson, Jiakun Song & Arthur N. Popper . 2009 "Hearing Sensitivity of the Walleye Pollock" Transactions of the American Fisheries Society Volume 138, Issue 5, pp 1000-1008
[11] McCauley, R. D., Fewtrell, J, and Popper, A. N. (2003). High intensity anthropogenic sound damages fish ears. J. Acoust. Soc. Am., 113:638-642
[12] Lise Doksæter, Nils Olav Handegard, and Olav Rune Godø, Petter H. Kvadsheim and Nina Nordlund. 2011 "Behavior of captive herring exposed to naval sonar transmissions (1.0–1.6kHz) throughout a yearly cycle." Acoust. Soc. Am. V.131:2

Lloyd mirror effect.[13] If the caged fish attempted to escape the noise they may have sensed the quieter boundary area near the surface and sheltered there. This provides an additional perspective on the cage issue from McCauley et. al., (2003) which also casts a shadow (or sheds light) on the BOEM response to our comment NGO-E-4-0.08, so our comments still stands, paraphrased in this and the previous paragraph. So the phrase "No mortality or injury is expected because there has been no observation of direct physical injury or death to fishes from airguns" should be pulled from the Atlantic G&G PEIS Summary page xviii

There is an ongoing assumption that fish will successfully disperse from areas they find unsuitable, represented in the BOEM comment "…adult fish exposed to elevated sound levels would be able to leave the area most severely impacted by the survey noise" made in the section 4.2.5.1. "Summary of Fish and Invertebrate Hearing Capabilities." This statement is pure speculation and is not consistent with what we know about sedentary and non-migratory fish. This assumption should not be used as a mitigation strategy and should be pulled from the EIS.

The fact stated in section 4.2.5.1.4 that "there is no evidence in fishes for permanent hearing loss" can also as factually be rephrased to "there is no evidence in fishes that permanent hearing loss does not occur." To substantiate this point; fish deafened "temporarily" in lab settings would typically be dissected to perform a histology of the inner ear. Deaf fish in their native habitat would likely be eaten – leaving no evidence of their hearing impairment.

As we have indicated in our 2012 comments, an absence of evidence does not indicate an absence of harm, and given the overwhelming evidence that human enterprise is significantly compromising marine habitat it becomes incumbent upon us to apply the precautionary principal when there is an absence of evidence of possible harm from habitat compromise.[14]

We also continue to stand behind our comments that "The DEIS treats invertebrates very lightly - almost dismissively" because we find the following summary statement in Appendix D:

> "At present very little is known about the response to invertebrates to sound exposure and it is not possible to specify levels of sound exposure that are safe for invertebrates. There are few, if any, data suggesting that exposure to seismic airguns produce immediate mortality for invertebrates. A more important issue for invertebrates is likely to be the induction of sub-lethal effects that may impact life functions without causing death."

[13] McCauley, R.D., J. Fewtrell, A.J. Duncan, C. Jenner, M.-N. Jenner, J.D. Penrose, R.I.T. Prince, A. Adhitya, J. Murdoch, and K. McCabe. 2000. Marine seismic surveys: Analysis of airgun signals and effects of air gun exposure on humpback whales, sea turtles, fishes and squid. Report from Centre for Marine Science and Technology, Curtin University, Perth, Western Australia, for Australian Petroleum Production Association, Sydney, NSW.

[14] "Precautionary Tools for Reshaping Environmental Policy" MIT Press 2005 Edited by Nancy Myers and Carolyn Raffensperger

This is the convener's synthesis of Dr. Jerry Payne's presentation to the "Effects of Noise on Fish, Fisheries, and Invertebrates in the U.S. Atlantic and Arctic from Energy Industry Sound" workshop cited in the PEIS as Normandeau (2012) [15] This comment was found in the "Gap Analysis" section of the report – which substantiates the fact that there is little known about the impacts of seismic impulses, or any other noise on marine invertebrates.

It is important to establish here that while marine invertebrates are not specifically protected under an agency such as the Marine Mammal Commission (MMC), and that any regulatory oversight on the general health of any given species falls under the Department of Commerce (DOC)[16] which predicates regulatory guidelines on the commercial importance of the species. Thus abalone, clams, and lobsters are regulated, but sea pens and zooplankton are not. Because these "lesser creatures" do not have a "front line" regulatory status, there is little incentive to understand their natural history (no funding for research). As a consequence we know very little about the impacts of chemical pollution, over-harvesting, or industrial noise on these building-block species - and do not have a regulatory framework or mitigation guidelines to protect them.[17]

But many species that are protected under the DOC depend on these unregulated and unprotected species. If we use the "no evidence of harm" argument to justify disrupting their habitat we are setting a bad precedent of opening a gateway for potential habitat disruption that will have impacts on species of concern which are protected under our regulatory regimes.

Regarding the use of Appendix J for any guidance on impact s on fish, it appears as though Dr. Popper arrives at similar conclusion that we have; that with all of the uncertainty it is hard to predict, especially in broad terms, what impact noises will have on fish. Representative of some of his comments:

> "The data obtained to date on effects of sound on fishes are very limited both in terms of the number of well-controlled studies and in the number of species tested. Moreover, there are significant limits in the range of data available for any particular type of sound source."
>
> "Because of the limited ways in which behavior of fishes in these studies were "observed" (often by doing catch rates, which tell nothing about how fishes really react to a sound), there really are no data on the most critical questions regarding behavior."
>
> "Long-term rises in sound level are not likely to result in death or physiological effects (though it is possible that there may be long-term changes in stress levels

[15] Normandeau Associates, Inc. 2012. "Effects of noise on fish, fisheries, and invertebrates in the U.S. Atlantic and Arctic from energy industry sound-generating activities." A literature synthesis for the U.S. Dept. of the Interior, Bureau of Ocean Energy Management.
[16] National Oceanographic and Atmospheric Administration (NOAA) over National Marine Fisheries Service (NMFS) are under the Department of Commerce.
[17] In Normandeau 2012 Dr. Payne states "These laboratory studies should focus on deriving dose-response relationships, including those for chronic sound exposure, for both commercially important species as well as keystone zooplankton species such as *Calanus*".

> and immune response), but they could also produce hearing impairment, masking, and/or behavioral effects"
>
> "There are very few data documenting effects of any intense sound source on eggs and larvae in the open ocean. Far more data are needed before any preliminary conclusions can be reached on the effects of sound on eggs and larvae, and studies need to include, in addition to mortality, effects on growth and body tissues."

Using Dr. Popper's synthesis of existing literature, and citing his expressed need for more data, we submit that the Atlantic Seaboard should not be used as a makeshift lab for studies on the impacts of anthropogenic noise on fish and invertebrates.

Regarding BOEM response to our propagation models (NGO-E-4-0.10) we found that the models used in Appendix D were even more simplistic than our models – reverting back to either spherical or cylindrical spreading. We stand by our comments:

One assumption [made in the Atlantic G&G PEIS, Appendix D is that sound will propagate in a hemispherical pattern away from the source until the acoustical energy encounters a boundary. The 'broad brush' attenuation formula for this is: $20\log_{10}(r_1/r_2)$ where r_1 is the reference distance (usually 1 meter) and r_2 is the subject distance for evaluation.

Once the energy hits the seafloor the energy tends to spread in a cylindrical pattern wherein the attenuation formula is $10\log_{10}(r_1/r_2)$. Because the first boundary encountered is the seafloor, the sound levels at a distance within the depth of the ocean directly beneath the source will be more in line with attenuation at 20dB $\log_{10}$ of r. Far field will be more in line with $10\log_{10} r$. But there is some continuum between these attenuation conditions, so depending on the distance between the receiver and the source the attenuation factor may be closer to 17 in the "nearish field" and 13 in the far field.

Additionally, while it is not mentioned anywhere in the DEIS there is a secondary transmission path in the "mixed layer" above the marine thermocline that behaves as a "surface duct." While the propagation in this transmission path is dependent on the wavelength of the source, the angle of incidence, the depth of the mixed layer, and the surface conditions, the attenuation characteristics are more in consistent with the cylindrical model of $10\log_{10} r$. (see Urick 1983)[18]

Transmission in the surface duct, along with the far-field cylindrical propagation highlights concerns in the "nearish" field pertaining to both required "exclusion zones" and the efficacy of marine mammal observers (MMO). It is already impractical to expect MMOs to effectively spot marine mammals at distances over 1000 meters in calm seas during the day. In these conditions a large airgun array with a source level of 229 dB re:1μPa @ 1m[(FN.19)] would require 10km to attenuate to 180dB re:1μPa exposure level.

[18] Urick, R. J. 1983. Principles of Underwater Sound. (3rd Edition). McGraw-Hill Book Company, New York, NY. Chapter 6

[19] 235 dB (from Appendix D Table-22) – 6dB to accommodate for directionality of the array.

$$229dB - 180dB = 41dB \rightarrow 10\log_{10}(1/13000) = -41dB$$

MMO effectiveness over these ranges is not just impractical, it is improbable. So it is clear that in most situations a large capacity survey cannot avoid subjecting any marine mammal within 10km to Level A harassment exposures from either the surface ducting or the cylindrical propagation of acoustical energy.

If you add the “second hit” from the reflected sound off of the sea bottom, and the direct noise from the hemispherical propagation, the receiver is hit with at least three distinct wave fronts from multi-path sources (all three transmission paths have differing geometrical lengths as well as different transmission speeds due to temperature, pressure, and salinity factors). These three paths need to be integrated into the Sound Exposure Level (SEL) metric in the near-to-intermediate field.

Additionally, due to the various transmission artifacts there may be situations in the far field in which the noise from the surveys are not heard as distinct pulses, but as a continuous noise due to reverberation and multipath effects.[20,21,22,23] Because the noise would be continuous it should be mitigated under the 120dB “continuous noise” exposure threshold, particularly since the surveys will likely be occurring around the clock anyway.

These considerations preclude the use of large capacity seismic surveys if Level A harassment conditions are to be avoided.

Regarding the mitigation strategy of separating the survey vessels by more than 40 km: While the model was not clearly articulated it appears that the DEIS used the hemispherical attenuation factor of $20\log_{10} r$ to derive the 40km “mitigation” strategy.

A more accurate model for this setting is to determine what the exposure level would be at the midpoint (20km) between the two survey vessels. We assume that a source level of 235 dB (convergence in the far field is not influenced by the directivity of the array).

Using the hemispherical propagation model:

$$20\log_{10}(1/20000) = 86dB \rightarrow 235dB - 86dB = 149dB \text{ re:}1\mu Pa$$

Each survey would contribute 149dB to the system, which at the mid-point between them would yield 152dB (adding two equal sound levels increases the overall level by 3dB). But as we know, far field propagation is not hemispherical, rather it is more cylindrical. Using exclusively the cylindrical model:

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[20] Guerra, M., Thode, A.M., Blackwell, S.B., Macrander, A.M. (2011) “Quantifying seismic survey reverberation off the Alaskan North Slope., J. Acoustical Society of America 130:5 3046-3058

[21] Nieukirk, S.L., Mellinger, D.K., Moore, S.E., Klinck, K., Dziak, R.P., Goslin, J. (2012) “Sounds from airguns and fin whales recorded in the mid-Atlantic Ocean, 1999-2009, J. Acoustical Society of America 131:1102- 1112

[22] Nieukirk, S.L., Stafford, K.M., Mellinger, D.K., Dziak, R.P., and Fox, C.G.(2004)”Low-frequency whale and seismic airgun sounds recorded in the mid-Atlantic Ocean” J. Acoustical Society of America 115: 1832-1843

[23] Roth, E.H., Hildebrand, J.A., Wiggins, S.M., and Ross, D. (2012). “Underwater ambient noise on the Chukchi Sea continental slope” J. Acoustical Society of America 131:104-110

$$10\log_{10}(1/20000) = 43dB \rightarrow 235dB - 43dB = 192dB\ re{:}1\mu Pa$$

Each survey would contribute 192dB to the system, which at the mid-point between them would combine to add +3dB yielding 195dB – well above the 180dB exclusion zone. (These levels would also be significantly beyond the visual reach of MMOs.)

Of course the attenuation factor is somewhere between these two models, but this − like the surface ducting transmission path, is not accounted for in the DEIS. Additionally, while convergence zones as an artifact of propagation are mentioned in Appendix D, there is no evidence that this propagation characteristic is used in calculating exposure levels in marine mammals that are well beyond the visual reach of Marine Mammal Observers or even the acoustical reach of passive acoustic monitors.

Regarding BOEM response to our comment NGO-E-4-0.15 on fuel spills. We appreciate that the DEIS text has been revised to not include speculative text about marine mammal "avoidance behavior" of toxic oil spills it nonetheless continues to treat fuel oil spills lightly – speculating that "lighter, volatile components of the fuel would evaporate to the atmosphere almost completely in a few days. Evaporation rate may increase as the oil spreads because of the increased surface area of the slick. Rougher seas, high wind speeds, and high temperatures also tend to increase the rate of evaporation and the proportion of oil lost by this process" citing an American Petroleum Industry (1999) document which all seems rather innocuous. But it is a well-known practice that once ships are beyond the regulatory reach of the coastal states that they burn filthier and much thicker bunker fuel.

If I were writing this section I would balance the "lighter" fuel impacts discussion with an equally weighted comment on bunker fuel – and perhaps not cite a document published by one of the leading US petroleum industry propaganda organizations.[24]

We know from aerial photographs of dolphins and whales surfacing through oil slicks, and dramatically increased mortality rates of marine mammals in the Gulf of Mexico as a consequence of the 2010 BP-Macondo rig blowout, treating any fossil fuel spill lightly both flies in the face of the facts, and ignores the high probability of oil spills occurring, and marine mammal habitat compromise resulting from spills of any size. And while the scope of the Atlantic G&G PEIS does not cover Oil and Gas Exploration and Production (E&P) (as we have indicated above) if the wrong action alternative is selected this PEIS will serve as a gateway for Oil and Gas E&P – dramatically increasing the probability of both catastrophic as well as chronic oil spills – and the toxic compromise of protected species.

Regarding our comments NGO-E-4-0.18 on considering the increased impacts of a complex array of simultaneous signals: BOEM response that "The complexity of the integrated sound field or "soundscape" referred to in this comment is not feasible or

[24] It is ironic that BOEM response to our comment includes the statement "However, BOEM and NOAA cite the best available information available" e.g.: American Petroleum Institute. 1999. "Fate of spilled oil in marine waters: Where does it go? What does it do? How do dispersants affect it?" API Publication No. 4691. 57 pp.

appropriate to model in a programmatic document since there are so many different possibilities of equipment combinations to be used for various surveys" misses our point that while the DEIS and PEIS evaluate each noise as an autonomous event, these noises are often concurrent with other noises, all of which contribute to a "soundscape." It would be difficult (and not particularly helpful) to characterize each possible assemblage of equipment to their unique contribution to the soundscape. But it is important to state that no survey will have any particular noise from which the exposure impacts will supersede others (if louder) or will be negated by louder noises if quieter. Rather the entire compliment of noise will contribute to the overall impact.

There is currently no metric for the behavioral impacts of complex soundfields composed of multiple antagonistic noises, but it stands to reason (as in the "common sense"[25] approach to "ramp-up" as a mitigation practice stands to reason) that a juggernaut of banging, screeching, chirping, thrashing, and jangling noises from a moving soundsource will induce higher stress in exposed animals than a single banging, or screeching, or chirping noise from the same moving source. The call here is not to deconstruct and model each scenario considering a full complement of equipment; rather it is to state that the impacts complex soundfields need to be considered in their own complexity – with the understanding that additional complexity increases the uncertainty of any anticipated behavioral responses - tending toward higher impact, rather than a lower impact that would be derived from simple cumulative impact metrics.

If simple metrics are to be used for complex soundfields, then all of the noises running simultaneously – including any vessel propulsion system - would qualify as a continuous sound source and be subject to the 160dB mitigation criteria. We understand from BOEM response to our comment NGO-E-4-0.24 that vessel propulsion noise is not currently regulated by BOEM. We are not sure how this exclusion became set in (or was omitted from) the regulations, but given that the vessels under consideration in the PEIS are soundsource platforms with large compliments of acoustical stimulus, communication, and control signals, it might be time to look at the entire soundfield generated by these acoustical platforms in a regulatory context (as indicated above).

Additionally thruster-stabilized drilling platforms that would be used in COST well drilling are not technically "vessels underway;" rather they are stationary noise sources being used for activities that are under BOEM purview and should be regulated as such. This foregoing comment also applies to BOEM response to our comment NGO-E-4-0.25. Thruster-stabilized operating platforms are increasingly becoming a feature in offshore operations and we appreciate that "BOEM will consider the acoustic effects from these activities in site/permit-specific evaluations of individual survey applications," and that "Text has been added to the section to note noise attenuation conditions, approximate radial distance, and the fact that BOEM will evaluate project-specific noise sources, as necessary."

Regarding BOEM response to our comment NGO-E-4-0.29 that "Prohibiting all survey operations at night is not feasible based on the operational requirements for broad scale surveys that may require months of 24 hour days to complete" precisely illustrates our

[25] See BOEM response to our comment NGO E-4-0.06

point. If it is not feasible to shut down operations at night when opportunities for preventing impacts are reduced, then operations should not continue at all.

This entire Environmental Impact Statement exercise is not designed to drop regulations when it is not convenient to adhere to them, it is designed to safeguard marine protected species and marine habitat from undue impacts. This is particularly the case during the night – a time when our already limited knowledge of marine mammal behavior is at its lowest. To blithely exempt seismic operations from established mitigation procedures because “it is not feasible” is a nadir of hubristic thinking.

Seismic surveys are an integral part of the entire offshore fossil fuel industry. This industry is incredibly profitable (as any pension fund manager will concur). One reason it is so profitable is that the industry has been able to externalize their costs – often by way of not paying for the damage their operations exact on the environment. Seismic surveys are very expensive, but this is the cost of doing business. If it is more costly to shut down an operation when it is not able to adhere to the law, then that cost of shutting down will need to be assumed into the cost of doing business – not foisted on marine animals that otherwise do not benefit in any way from the suppositions that inflicting “limited damage” to their populations is somehow “OK.”

All of our other forgoing comments aside, the BOEM statement about the ‘infeasibility of shutting down seismic surveys at night’ is really all that is needed to rule out both Action Alternatives A or B. But to summarize the other shortcomings of the Atlantic G&G PEIS:

1) The PEIS should be reevaluated in the context of the most up-to-date NOAA Acoustic Guidelines. These guidelines have just recently been reviewed by the public and stakeholders whose comments will need to be addressed in what will become the final NOAA Acoustic Guidelines. As we found many shortcomings with the guidelines we don’t expect the final guidelines to align with the comparisons made in the Atlantic G&G PEIS referencing Southall 2007.[26]
2) Not enough is known about fish hearing to make the broad assumption that the proposed action alternatives will not either damage physically, or disrupt behaviorally commercially or biologically important fish.
3) No enough is known about fish hearing to assume that any temporary damage or displacement will not adversely impact individual fishes, or the fitness of any fish species populations.
4) BOEM statements in 4.2.5.1. “Summary of Fish and Invertebrate Hearing Capabilities” about fish dispersing from a survey area is speculative and should not be implied as a mitigation strategy.
5) The statement in section 4.2.5.1.4 that “there is no evidence in fishes for permanent hearing loss” can also as factually be rephrased to “there is no evidence in fishes that permanent hearing loss does not occur.” This is one of many places in the PEIS where statements about the absence of evidence does not perfect the argument for the absence of harm.[27]

[26] “Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals” OCR Comments (attached to this document).
[27] See Colin Macilwain (2014) “Beware of backroom deals in the name of 'science'” Nature v.508:7496 on “lack on evidence” being used to substantiate industry arguments of “no harm.”

6) Very little is known about impacts of seismic and other survey signals on marine invertebrates. This dearth on knowledge should not be a reason for proceeding under the assumption that there will be no harm to species that - while not protected, may nonetheless be important elements in the trophic fabric of animals that are protected.
7) Our current state of knowledge about fish and invertebrate responses to chemical, electromagnetic, seismic survey, and other survey signals is very sketchy. The proposed action alternatives should not be used to find out "the hard way" what fish and invertebrates can endure.
8) Propagation models used in the PEIS Appendix D remain simplistic, only considering cylindrical and hemispherical spreading and only mentioning, but not modeling surface ducting,[28] leaving propagation models used in calculating exclusion zones only speculative.
9) While 'convergence zones' are mentioned in the PEIS there no evidence that this propagation characteristic is used in calculating exposure levels in marine mammals that are well beyond the visual reach of Marine Mammal Observers or even the acoustical reach of passive acoustic monitors.
10) PEIS Sections 2.1.3.2 and 4.2.2.3 discussion on fuel oil spills should be expanded to include a realistic discussion about fuels that will be used, not just lighter, more volatile, and faster dispersing fuels.
11) Because survey platforms are increasingly being fitted with various acoustical signal generators, the produced soundfield impacts should be considered in its entirety, not as a composite of individual signals.
12) Because the complex soundfields produced by survey vessels are a product of many overlapping sounds, the resulting soundfield should be considered as continuous and subject to the 160dB (re:1µPa) mitigation threshold and exclusion zone guidelines.
13) Thruster-stabilized drilling platforms that used in COST well drilling are not "vessels underway;" rather they are stationary noise sources being used for activities that are under BOEM purview and should be regulated as such.
14) Finally, precluding regulatory constraints on seismic survey vessels at night because "it is not feasible" is the strongest argument for prohibiting their implementation. Laws and guidelines – regardless of how simplistic, incomplete, or inconvenient are nonetheless a product of many years of research and deliberation by many dedicated, thoughtful, and informed people. Dismissing them for the sake of expediency is both unlawful and sets a dangerous precedent.

Even if BOEM satisfactorily addresses our above concerns we still believe that Action Alternatives A and B should be disallowed. Unfortunately it seems almost a foregone conclusion that Atlantic Geophysical and Geological plan will include the seismic survey regulatory framework necessary to advance oil and gas exploration and production on the Eastern Seaboard. And this would be a shame, because we know without question that the global environmental consequences of promoting a fossil fuel-based economy are killing the planet – by way of atmospheric CO_2 as well as all of the chemical and materials products of that industry which are poisoning our water, and littering the ocean and terrestrial landscapes with "cheap" and thus disposable plastic products.

[28] See: Ivan Tolstoy "Ocean Acoustics: Theory and Experiment in Underwater Sound" p. 181-185 American Institute of Physics.

If we are to assure an acceptable life quality in the future for ourselves as well as our future generations this must stop.

But it is clear that despite over 30 years of discussing the deleterious impacts of fossil fuel on the global environment we cannot muster the political will to have the industry account for the costs of exploration, production, and use of their products – rather we continue to find ways to subsidize the industry by exempting them from environmental laws, making provisional allowances for "take authorizations," suggesting that damaging our environment is acceptable and necessary for "our national security," and even sending our youth out to secure fossil fuel resources in foreign countries – many losing their lives and killing others to do so. This is madness.

But herein lies an opportunity: While we have not, and likely will not find the political will to change our global energy strategy (and hopefully save the planet), we do have the regulatory framework to shift our global energy priorities from fossil fuel over to wind, tidal, wave, and solar power. Making the right decision on the Atlantic G&G PEIS could be a watershed toward turning the fossil fuel juggernaut around.

Due to the foregoing arguments, Action Alternatives A and B should be disallowed. The "No Action Alternative C" should be the preferred action.

Thank you for this opportunity to review and comment on the proposed actions.

Sincerely,

Michael Stocker
Director

Appendix

OCR Comments on NOAA Acoustical Guidelines

February 26, 2014

Chief, Marine Mammal and Sea Turtle Conservation Division,
Office of Protected Resources,
National Marine Fisheries Service,
1315 East-West Highway,
Silver Spring,
MD 20910-3226

Re: Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals

To Whom it May Concern;

It is clear that much work and consideration has been put into the "Draft Guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammals" (hereinafter "Draft Guidance document"), gathering together and including many of the studies that have been executed, reviewed, and published over the past decade. The guidelines represent a significant improvement over the broad-brush threshold guidelines that have been used to date and as such should more accurately represent potential noise induced physiological impacts of noise exposures on marine mammals. The preparers should be applauded for their work.

I am also encouraged that the Draft Guidance document has provisions for updating the thresholds as new data become known, reflecting the best available science.[29] It is important in this context to assure that all of the best available science is considered when updating the guidelines.

Even with all of the work that has been put into achieving a greater understanding of marine mammal acoustical sensory systems, there remains many shortcomings in what we know, how we frame our inquiries, and our assumptions about the impacts of noise on these animals. Our concerns are outlined in the following body of this letter.

The paucity of data:

Establishing Temporary Threshold Shift exposure levels the document relies heavily on so few subjects, and many tests on these few animals from the SPAWARS studies.[30] This dependence is also woven into the fabric of the main reference studies used to substantiate the Draft Guidance document (Finneran and Jenkins; 2012 and Southall et. al. 2007) wherein the mature (13 – 20 y.o.) to old (35 – 40 y.o.) animals are used to examine auditory performance. The Draft Guidance document also relies heavily on the University of Hawaii studies of the hearing responses of one captive born Atlantic bottlenose dolphin. (Mooney et.al. 2009, Nachtigall et. al. 2003, 2004)

[29] Draft Guidance document section IV
[30] Finneran, J.J. 2011; Finneran and Schlundt 2009; Finneran and Schlundt 2010; Finneran and Schlundt 2011; Finneran and Schlundt 2013; Finneran et.al. 2000; Finneran et.al. 2002; Finneran et.al. 2005; Finneran et.al. 2007; Finneran et.al. 2010a; Finneran et.al. 2010b

All of the SPARWAR subjects and the University of Hawaii subject have been systematically exposed to noise studies for many years. The dolphin and beluga whale subjects of these studies have lived in a busy environment full of anthropogenic noise, and continuously exposed to noise testing, so it is highly likely that they have been habituated to the test environment. It is clear that these animals do not represent approximately 125 different species of wild marine cetaceans in their own environment.

This paucity of data from a limited number of subjects discussed in the Draft Guidance document text,[31] but because there are so many ingrown layers of these references through Finneran and Jenkins 2012, and Southall et. all. 2007, and that these studies are used to conjecture the hearing performance of "Low Frequency" cetaceans, are all facts that should be clearly established as significant caveats in interpreting the guidelines. These interpretations should be founded on the precautionary principal that lacking data to prove otherwise, an assumption of harm should direct actions with unknown impacts.[32]

For the record, all cetacean TTS models – including the models for the "Low Frequency cetaceans are based on six bottlenose dolphins (five from SPAWAR, one from Univ. of Hawaii) three belugas (two from SPAWAR, one from Popov et. al. 2011b) two harbor porpoises (one from Kastelein et. al. 2012a, and one from Lucke et. al. 2009) and two Yangtze finless porpoises (Popov et.al. 2011a). Additionally all pinniped thresholds are derived from only four individual animals, two California sea lions (aged between 12 and 21 years), three harbor seals (one from Long Marine Lab, the other two from SEAMARCO), and a northern elephant seal (Kastak et.al 1999, Kastak et.al.2005). The California sea lions were mature to old, aged 12 - 21 years in the two cited studies,[33] the domesticated harbor seal (named "Sprouts") from Long Marine Lab had been inadvertently exposed to damaging airborne construction noise at four years of age [34] which may have had long term impacts on its hearing sensitivities,[35] the two harbor seals from SEAMARCO were captive bred, and a young (4 – 7 years) elephant seal whose provenance was not articulated in the citations.

All data are taken from captive animals:

All of these animals – cetaceans and pinnepeds, are captive so we can assume a few things about them: With the exception of the captive bred harbor seals from SEAMARCO, they were likely rescued and thus either suffered some trauma or were not as fit as their wild kin. Additionally their captive habitat is not fraught with predation, nor are they taxed with the necessity of locating their own food supplies, so it is possible that these animals are less alert due their provenance and to habituating to these less stimulating (sensory-deprived relative to their natural habitat) circumstances. Although it is not surprising that the

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[31] Section 1.1 directly under the introductory paragraph of the Draft Guidance document.
[32] "Precautionary Tools for Reshaping Environmental Policy" MIT Press 2005 Edited by Nancy Myers and Carolyn Raffensperger
[33] Schusterman, Ronald J., Brandon Southall, David Kastak and Colleen Reichmuth Kastak "Age-related hearing loss in sea lions and their scientists" J. Acoust. Soc. Am. 111, 2342 (2002)
[34] Kastak, David and Ronald J. Schusterman (1996) "Temporary threshold shift in a harbor seal (*Phoca vitulina*) J. Acoust. Soc. Am. 100 (3)
[35] Lin, H.W., A.C. Furman, S.G. Kujawa, and M.C. Liberman. 2011. Primary neural degeneration in the guinea pig cochlea after reversible noise-induced threshold shift. Journal of the Association for Research in Otolaryngology 12:605-616

captive bred harbor seals had significantly lower auditory thresholds[36] and lower onset of TTS[37] than the Long Marine Lab harbor seal given their "cushy" captive life and not having been acoustically traumatized and an early age.

It should also be noted that the three species of pinnipeds are species that are commonly found in coastal mid-latitudes in close proximity to high concentrations of human activity. It would be hard to determine how this proximity to what is now noisy habitat is reflected in their physiology as opposed to the polar seals. We know behaviorally that the polar seals are extremely songful, which is not found in the harbor seal, the elephant seal, or the California sea lion. It would stand to reason that the polar seals have different, if not more complex acoustical adaptations than the two captive phocid species.

Natural protective hearing mechanisms are not included in the threshold model:

Model inaccuracies due to habituation to captivity may be compounded by the fact that the test animals may employ biological protections to prepare them for their tests – protections akin to the "wincing" that visual animals use to protect their eyes from damage. Terrestrial animals have a mechanism, like "wincing" in their middle ears that protect them from damaging sounds. This mechanism is a tightening of the tensor tympani muscles around the middle ear ossicles, protecting the hearing organ from physical damage. While this mechanism is fast acting in response to unexpected stimulus, once terrestrial animals are habituated to expect loud noise, the system is activated by the expectation. In humans the mechanism kicks in when noise levels reach 75dB SL (re: 20µPa)[38] – about 10dB SL below where OSHA guidelines for TTS-level noise exposures occur in humans, and about 50dB SL below where PTS occurs.

The middle ear structure of marine mammals differs significantly from the middle ears of terrestrial animals. We are learning about how environmental sounds are conveyed into the odontocete's inner ears. This mechanism seems to include the lipid channels in their lower jaws,[39] and the mobility of the bulla (the bone envelope that houses the cochlea and semicircular canals). While this mechanism does include the same middle ear ossicles of terrestrial mammals, these bones in cetaceans can be rigidly attached to each other and connected differently (by way of ligaments) to the tympanic membrane.[40] While the ears of the odontocetes or mysticetes do not have the same tensor tympani found in terrestrial mammals, it is probable that these hearing specialist animals would have an analogous system to protect their inner ears from

[36] Kastelein,Ronald A., Paul J. Wensveen1, Lean Hoek, Willem C. Verboom and John M. Terhune. (2009) "Underwater detection of tonal signals between 0.125 and 100kHz by harbor seals (*Phoca vitulina*)" J. Acoust. Soc. Am. 125, 1222
[37] Kastelein, R.A., R. Gransier, L. Hoek, A. Macleod, and J.M. Terhune. (2012b). Hearing threshold shifts and recovery in harbor seals (Phocina vitulina) after octave-band noise exposure at 4 kHz. Journal of the Acoustical Society of America 132:2745-2761
[38] Pierre Buser and Michel Imbert "Audition" 1992. MIT Press. p. 110 - 112.
[39] Heather Koopman, Suzanne Budge, Darlene Ketten, Sara Iverson "The Influence of Phylogeny, Ontogeny and Topography on the Lipid Composition of the Mandibular Fats of Toothed Whales: Implications for Hearing" 2003 Paper delivered at the Environmental Consequences of Underwater Sound conference, May 2003.
[40] G.N. Solntseva, "The auditory organ of mammals"1995 p. 455 in "Sensory Systems of Aquatic Mammals" R.A. Kastelein, J.A. Thomas and P.E. Nachtigall eds. De Spil press.

periodic or occasional sound levels that would otherwise damage their organs of hearing.[41] In fact it stands to reason that echolocating odontocetes would necessarily have some form of "automatic gain control" (AGC) because they need to discriminate bio-sonar return signals much quieter than their outgoing signal. If they did not have some form of AGC their own outgoing signal might induce a temporary threshold shift that would defeat their receiving sensitivity, given that outgoing clicks of *tursiops* can be as loud as $227dB_{(peak)}$ re: 1µPa[42] and TTS for continuous signals in MF cetaceans is $224dB_{(peak)}$. If this assumption is correct, then the "sound test" habituated odontocetes [43] would obviously yield much higher thresholds for TTS than their wild, un-habituated counterparts – given that they will always "prepare" for acoustical assaults when asked to perform in a given testing situation.[44]

Lab data are derived from signals that are not representative of exposure signals:

In terms of the range of impact relative to signal amplitude, Kastelein and Rippe (2000) studied younger animals (harbor porpoise *Phocena phocena*) [45] with more appropriate test signals yielded significantly different results than what was found in the much older, test-habituated subjects. These animals demonstrated an aversion to more complex signals in the frequency range of the proposed sonars and at 130dB re: 1µPa@1m. (Animals used in the Kastelein and Rippe study had been recently taken into captivity and approximately three years old at the time of the study.)

It should also be noted that all non-impulsive signals used in the citations upon which the thresholds are established are sinusoids or sinusoidal-derived band-limited 'pink' noise.[46] While these signals do lend consistency to audiometric testing, they do not necessarily reflect the characteristic signals being introduced into the sea. We are particularly concerned with the exponential proliferation of acoustical communication signals being used in underwater multimodal communication networks for control and monitoring of autonomous and remotely operated equipment for resources extraction, scientific research, and industrial exploration.

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[41] This system might involve thermo-regulating the viscosity, and thus the acoustical compliance of the lipids through regulating blood circulation around the organs – thereby attenuating or accentuating acoustical transfer through the organ as needed.

[42] Aroyan JL, McDonald MA, Webb SC, Hildebrand JA, Clark D, Laitman JT, Reidenberg JS (2000) "Acoustic Models of Sound Production and Propagation." In: Au WWL, Popper AN, Fay RR (eds), *Hearing by Whales and Dolphins.* New York: Springer-Verlag, pp. 409-469.

[43] e.g. J. J. Finneran, C. E. Schlundt, D. A. Carder, J. A. Clark, J. A. Young, J. B. Gaspin, S. H. Ridgway Auditory and behavioral responses of bottlenose dolphins (*Tursiops truncatus*) and a beluga whale (*Delphinapterus leucas*) to impulsive sounds resembling distant signatures of underwater explosions. J. Acoustical Soc. of America. V.108(1) July 2000.

[44] Nachtigall, Paul E., and Alexander Ya. Supin (2013) "False killer whale reduces its hearing sensitivity when a loud sound is preceded by a warning" J. Exp. Biology 216, 3062-3070

[45] R.A, Kastelien, H.T. Rippe " The Effects of Acoustical Alarms on the Behavior of Harbor Porpoises (*Phocena phocena*) in a floating pen" Marine Mammal Science 16(1) p. 46 – 64. January 2000

[46] Band limited "Pink Noise" is typically derived from Fourier Transfer derived Gaussian noise constructed from sine waves without any coherent time-domain component.

These communication signals include characteristically rapid rise-times either in set frequencies such as square waves or other high "crest factor"[47] signals which are not sinusoidal, or they include signals that are rapid rise time in frequency switching of sinusoids such as "Frequency Shift Key" (FSK) and spread spectrum frequency hopping schemes such as Orthogonal Frequency-Division Multiplexing (OFDM), Trellis Coded Modulation (TCM), and Time Domain Multiplexing (TDM). Many of these schemes, when used in short to intermediate distance acoustic communication technologies (1km – 10km) operate in the 10kHz – 100kHz ranges that overlap all of the marine mammal hearing groups. Furthermore due to the need for well-defined leading edges required for reliable state-change detection, the signals read more like impulsive signals and are characterized by high kurtosis in amplitude and frequency variability over time.

Kurtosis (β) describes the shape of a probability distribution on an x-y graph. It is equated with the "peakedness" of the curve as a product of the distribution of observed data around the mean:

$$\beta = \frac{1}{N} \sum_{\infty}^{N} \left(\frac{X_i - \overline{X}}{S} \right)^4$$

Where:

N = the number of elements in the distribution.
S = Standard deviation
X= are the discreet peaks in data stream (for sound, the pressure/time waveform) over some interval of time.

Kurtosis then is an expression weather the data are peaked or flat relative to a Gaussian distribution. This matters because noise impacts from high kurtosis signals induce significantly higher hearing losses than exposures from sinusoidal signals[48] and is associated with "unpleasantness" or aggravating characteristics of sound.[49] This characteristic is only taken into consideration in Draft Guidance document relative to impulsive sounds and the Equal Energy Hypothesis (EEH) (Danielson et al. 1991; Hamernik et al. 2003; Henderson and Hamernik 1986; Henderson et al. 1991).

Unfortunately there is a dearth of data on the physiological impacts of high kurtosis continuous signals or tone bursts on hearing systems, but avoidance behavior which is a proxy for self-protection is clearly influenced by sound quality characterized by high kurtosis signals.[50,51]

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[47] Crest factor is the ration of peak to RMS value of a signal. Pure sinusoidal waves have a crest factor of .707; pure "square waves have a crest factor of 1; repetitive impulse sounds have a crest factor greater than 1.

[48] Hamernik, R. P., Qiu, W., and Davis, B. (2003). "The effects of the amplitude distribution of equal energy exposures on noise-induced hearing loss: "The kurtosis metric," J. Acoust. Soc. Am. 114, 386–395

[49] Sukhbinder Kumar, Helen M. Forster, Peter Bailey, Timothy D. Griffiths (2008) "Mapping unpleasantness of sounds to their auditory representation" J. Acoust. Soc. Am. 124: 6

[50] R.A. Kastelien, D. Goodson, L. Lein, and D. de Haan. "The effects of acoustic alarms on Harbor Porpoise (*Phocena phocena*)" 1997 P.367-383 in A.J. Read, P.R. Wiepkema, and P.E. Nachigall eds. "The Biology of Harbor Porpoise" de Spil publishers, Woerned, The Netherlands.

The Verboom and Kastelein (2005) study extrapolates a TTS level for these animals at 150 dB(*w*) re:1µPa@1m for the harbor seal, and 137dB(*w*) re:1µPa@1m[52] for the harbor porpoise. These levels are significantly lower than the TTS levels of 160dB SEL_{CUM} for HF Cetaceans and 183dB SEL_{CUM} for Phocids suggested in Draft Guidance document Table 6. The paper also goes on to suggest that hearing injury – PTS, will occur in the Harbor seal at 190dB – Less than half the energy of the 197dB level found in Draft Guidance document Table 6. While this is just one paper, it evaluates various responses to different sounds and is one of the earlier papers to suggest segregating species into their various hearing function groups. As such the paper should be included and brought into consideration in the Draft Guidance document.

The foregoing also suggests that noise exposure guidelines should include a metric for sound quality, not just instantaneous, periotic, or cumulative exposure amplitude as suggested in the Draft Guidance document table 6b. We need a metric that expresses actual signal quality, not merely exposure profile. And while we do not have enough data to derive a precise "quality" metric, we do have enough information to know that not all signals inflict equal impact and that if signals are anything other than sinusoidal-derived continuous signals or tone bursts that the exposure should be reviewed on a case-basis (as provided for in Draft Guidance document section 2.3 "TTS and PTS Onset Acoustic Threshold Levels.")

For example: when digital communication signal exposures are subject to impact assessment, the thresholds should be established using data from Kastelein et.al (2005) and Kastelein et.al (2006) where actual communication signals were used. In these studies it was found that discomfort thresholds in Harbor porpoise were at 103 – 104 dB for Direct Sequence Spread Spectrum signals, and 111 – 112 dB for Modulated Frequency Shift Key signals (all re: 1µPa, frequency range: 6.3kHz – 18kHz). In a similar study with Harbor seals it was found that the discomfort thresholds were all around 107 (dB re: 1µPa) for all communication signal types.[53]

While "discomfort thresholds," are not a defined term in the Draft Guidance document, they are indicative of pain and avoidance behavior well below the TTS levels suggested in the Draft Guidance document. Kastelein et.al were not measuring TTS in these studies, but there is a probable correlation between avoidance behavior and physiologically damaging (TTS inducing) sound types (not just sound levels).

It is noted in the Draft Guidance document that there are no data on PTS in marine mammals, but the estimated PTS levels used in the DEIS, like the PTS figures from the Verboom and Kastelein (2005) study are extrapolations – extrapolating from behavioral responses to noise exposure of young, healthy marine mammals against known human and terrestrial mammal auditory responses. The disparity between the TTS

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[51] W.C. Verboom and R.A. Kastelein. "Some examples of marine mammal 'discomfort thresholds' in relation to man-made noise." June 22, 2005. Proceedings from the 2005 Undersea Defense Technology conference 2005, Sponsored by TNO, P.O. Box 96864, 2509 JG The Hague, The Netherlands.

[52] "dB(*w*) re: 1µPa@1m" is not a standard metric but was an attempt by the authors to weight broadband noise for the inverse shape of the relevant audiogram. Not equal energy but equal perceived loudness for the subject, so direct comparison to dB SEL_{CUM} is not precise, but approximate (time dimension notwithstanding).

[53] Kastelein et.al. (2006) Continuously varying frequency sound, Direct Sequence Spread Spectrum, frequency sweep, and Modulated Frequency Shift Key signals.

figures used by Verboom and Kastelein (2005) and the numbers used in the DEIS indicate a high degree of scientific uncertainty in the models and extrapolation methods used in both sets of assumptions. I am more inclined to accept the Verboom and Kastelein (2005) data because they are inherently more precautionary in that they examine the thresholds of behavioral response, not the upper limits of physiological response.

PTS Thresholds based on terrestrial and hearing generalist species:

Regarding the estimation of PTS onset relative to TTS levels used in the DEIS, I find the statement that TTS extrapolation for PTS onset "based on data from humans and terrestrial mammals"[54] a bit troubling. Firstly because beyond this cursory statement there is no explanation of the way the relationship was derived. Due to its historic use throughout the NMFS DEIS's over the years[55] I presume they are linear regressions adapted from the W.D. Ward et. al. (1960) papers [56] (also cited in the Draft Guidance document). Ward's data were all taken from human subjects – highly visually adapted terrestrial mammals. Ward's research indicates a threshold of PTS by examining the maximum recoverable TTS in human and finds that humans can recover from a TTS of 50dB without permanently damaging their hearing. The Ward studies are "conservatively" tempered in the legacy DEIS's (see ref. 19) by incorporating a study of cats by Miller et.al. (1963)[57] that indicates that cat's threshold of PTS is at 40dB recoverable TTS.[58]

The cat is also a highly visually adapted terrestrial animal, though it is more dependent on aurality than humans.[59] One correlation that can be deduced here is that animals that are more dependent of sound cues are less able to recover from extreme TTS. Thus if there is a 10 dB disparity in recovery levels between humans (50dB difference on onset of TTS and PTS) and cats (40dB difference on onset of TTS and PTS), it might reasonably follow that cetaceans who rely almost exclusively on acoustical cues would be even less likely to recover from extreme TTS. While we don't know what these differences are between these onset thresholds, it is appropriate to bear in mind that this framing again calls in the precautionary principal; inasmuch as we should assume harm where data does not exist.

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[54] Draft Guidance document section 2.3.4 "Development of TTS and PTS Onset Acoustic Threshold Levels" item #6

[55] e.g. "Gulf of Alaska Navy Training Activities Preliminary Final Environmental Impact Statement/ Overseas Environmental Impact Statement." March 2011. Section 3.8-88–92 "Relationship between TTS and PTS, and "Overseas Environmental Impact Statement/Environmental Impact Statement. Undersea Warfare Training Range." October 2005. 4.3.3.2 Relationship Between TTS and PTS

[56] e.g.: Ward, W.D. "Recovery from high values of temporary threshold shift." J. Acoust. Soc. Am., 1960. Vol. 32:497–500.

[57] Miller, J.D., C.S. Watson, and W.P. Covell. 1963. "Deafening effects of noise on the cat."Acta Oto-Laryngologica Supplement Vol. 176:1–91.

[58] The Gulf of Alaska DEIS states further that "A variety of terrestrial mammal data sources point toward 40 dB as a reasonable estimate of the largest amount of TS that may be induced without PTS" though no citations are provided to substantiate this statement. The Undersea Warfare Training Range DEIS cites Kryter et al. (1966) stated: "A TTS that approaches or exceeds 40 dB can be taken as a signal that danger to hearing is imminent." Then the DEIS speculates: "These data indicate that TSs up to 40 to 50 dB may be induced without PTS, and that 40 dB is a reasonable upper limit for TS to prevent PTS."

[59] Ralph E. Beitel "Acoustic pursuit of invisible moving targets by cats" JASA – 1996. Vol.105(6) p.3449 This paper indicates that cats will follow acoustic cues without needing to visually identify the cue, unlike humans, who will use an auditory cue to help localize a source of noise which they will then "look for the source."

The threshold difference between TTS and PTS vary in the Draft Guidance document tables, depending on whether the exposures are weighted or un-weighted, which demonstrate a more thorough evaluation of the literature than what had been used in the legacy guidelines. In the threshold tables the level difference between onset of TTS and onset of PTS thresholds are 15dB for impulsive noise exposure, and 20dB for non-impulsive noise exposure (14dB for the pinnepeds) in all frequency classes of animals.

While we appreciate that the extrapolations used to derive onset of PTS from onset of TTS are much more conservative than what has been used in the legacy guidelines, they are based on assumptions that are still of questionable validity inasmuch as they are based on extrapolated models that meld terrestrial, highly visual animals with (mostly) old, test-weary odontocetes. I feel that these assumptions provide a poor stand-in for a diverse variety of wild marine mammals, in their own habitat, being subjected to extreme levels of noise that they are not biologically adapted to or trained to expect.

Current data on long-term neural damage from "TTS" not included in the DEIS:

Additionally, while the Draft Guidance document does allude to the Kujawa and Liberman (2009) [60] and Lin et. al. (2011)[61] findings to the that "temporary" threshold shift is a predictor of a longer-term permanent damage to the inner hair cell ganglion, these findings are "soft-pedaled" in the document for wont of more data.[62] This position flies in the face of the precautionary principal – particularly in light of the knowledge that TTS is NOT "temporary" and thus TTS is a "Level A take" We should be confident that there is true recoverability of compromised hearing which does not cause long-term synaptic damage before we abuse these animals − to later find that the abuse causes irreversible harm. I suspect than once any of the SPAWARS subjects dies, a histology of their auditory nervous system will tell us volumes about the TTS and PTS assumptions that have been made using these animals.

SEL_{CUM} accumulation period modeled for convenience but not substantiated by the literature:

Regarding setting the baseline for the SEL_{CUM} metric (Draft Guidance document 2.3.1.1 Recommended Baseline Accumulation Period), while helpful for modeling simplification, we find this whole section troubling. Using a 24 hour accumulation window is only a convenience which only has meaning in terms of how we set our watches; exposed animals do not "clear the stack" after 24 hours and start anew. Accumulation of sound form the purposes of SEL_{CUM} should continue as long as the sound continues. This is particularly germane as the noises we are using in the ocean are increasingly becoming continuous – from the "around the clock" seismic surveys, to the increasing array of autonomous vehicles and stationary equipment, to the continuously operating communication and navigation beacons.

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[60] Kujawa, S.G., and M.C. Liberman. 2009. Adding insult to injury: Cochlear nerve degeneration after "temporary" noise-induced hearing loss. The Journal of Neuroscience 29:14077-2

[61] Lin, H.W., A.C. Furman, S.G. Kujawa, and M.C. Liberman. 2011. Primary neural degeneration in the guinea pig cochlea after reversible noise-induced threshold shift. Journal of the Association for Research in Otolaryngology 12:605-616.

[62] Draft Guidance document section 3.2.1 Temporary Threshold Shift Acoustic Threshold Levels: "It is not known whether smaller levels of TTS would lead to similar changes. NOAA acknowledges the complexity of noise exposure on the nervous system, and will re-examine this issue as more data become available."

"Avoidance behavior" used as an exposure mitigation strategy:

We also find it troubling that this section is loosely hinged on the idea of "avoidance behavior" being a mitigating factor in the exposure. With the understanding that the Draft Guidance document is specifically about MMPA "Level A Takes" and not behavioral impacts Castellote et.al. (2010) notes that seismic survey noise disrupted an entire migration season of fin whales. In this case the avoidance behavior was at cause for a loss of entire breeding year (which is not strictly physical damage to the organism but does have a profound bearing on survival). That this "avoidance behavior" occurred at hundreds of kilometers from the airgun source points to a fallacy in the assumption that animals can escape the impacts of noise by moving out of the noise field. It may be that case that animals would avoid the most direct physiological impacts of noise by moving away from the source, although this is not always the case as commonly seen in dolphins that gambol in the bow waves of ships and in the "diner bell" effect of net predator pinnipeds[63] that for one reason or another have elected not to avoid noise exposure. Thus "avoidance behavior" cannot be relied upon as a mitigation strategy and should not be incorporated into any exposure models.

This brings forth a larger concern about framing. It is well known that behavioral responses to any stimulus are dependent on situations and circumstances; courting animals will be less disturbed by alien noises than resting animals; net predator animals will even be attracted to noises designed to harass them if they know that food is available for the mere cost of their suffering.[cit.35] Regulators like clear guidelines, but by viewing all animals mechanistically we are assuming that all animals will predictably respond, or be impacted similarly. Segregating animals into frequency groups is an improvement – expressing our deeper understanding of marine mammal bioacoustics derived over the past decade of research, but given the paucity of quality data the guidelines remain a very blunt gauge to measure our impacts on the marine acoustic habitat.

In summary, while we find the Draft Guidance document a significant improvement over the previous guidelines and we welcome its final implementation, as it is currently written there remain many shortcomings. We are pleased that the document includes provisions and a schedule for revising as more data become available, because it is clear that much data is lacking and significant revisions will be required.

The following points have been detailed in the foregoing review:

- Where data are lacking, assume harm until the data clearly indicates otherwise.
- All models for TTS depend on very few animals and thus are incomplete.
- The animals from which the TTS data are derived are captive and test-regime habituated and thus are a poor proxy for their wild counterparts.
- The four species of captive odontocetes are a data-poor approximation of the 125+ species of all cetaceans.
- The two species of phocids found in the Draft Guidance document are commonly found in close proximity to human population centers and are not good stand-ins for Arctic and Antarctic seals.

[63] Jefferson, T. A. and B. E. Curry, 1996, "Acoustic methods of reducing or eliminating marine mammal-fishery interactions: do they work?" Ocean and Coastal Management 31:41–70

- Captive animal's provenance further segregates them from wild animals due to their differing survival tactics relative to food provision and predator awareness.
- Signals used in auditory test regimes are not representative of typical exposure signals found in the field and this are inadequate models for actual exposure impacts.
- Where there is a disparity in TTS onset thresholds, the lower thresholds should be used, not cast out as "outliers." (Draft Guidance document App. B Section 2.2 III)
- Currently there is no metric to express various sound qualities that do have bearing on impacts (e.g. rise time, kurtosis).
- Extrapolating PTS from TTS by way of terrestrial, visually dominant animals (from Ward et.al. 1960 and Miller e.al. 1963) requires a deeper discussion and a precautionary approach.
- Findings by Kujawa and Liberman (2009) and Lin et.al. (2011) indicate that TTS is not temporary, but is an injury and should be classified as a MMPA "Level A Take." This data has been excluded from the Draft Guidance document because there are no equivalent data on marine mammals and lower TTS levels. It should be included.
- SEL_{CUM} accumulation period should not "dump and reset" after 24 hours (for complex models) or integrate over 1 hour (for simple models); rather accumulation should continue for the entire duration of the exposure.
- Avoidance behavior of an exposed animal should not be incorporated into any mitigation model.

There is a larger philosophical discussion here that while our focus on regulatory thresholds does drive the very reason we are engaged in this exercise, in attempting to find clear numeric guidance we sometimes lose track of our relationship with our mutually inhabited marine (and terrestrial) habitats. The noise exposure guidelines we have in place for our own neighborhoods are not based on physiological damage to our neighbor; rather they are based on annoyance. Our neighbor's "ability to recover their hearing sensitivity" from acoustical assault is not an acceptable threshold for our less-than-neighborly noise-making behavior. So why should we believe it is acceptable to expose clearly sentient marine animals to noises that compromise their sensory systems?

This is not just sentimentality, because as we understand the interdependence of all life on our planet it is becoming increasingly clear that as we compromise the habitats of other life forms on the planet we are also compromising our own habitat, and that without a healthy and robust natural environment no amount of money or oil will improve the quality of our own civilization or our engagement with the natural world upon which we depend.

Sincerely,

Michael Stocker
Director
Ocean Conservation Research

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The Cornell Lab of Ornithology

Acoustic Ecology of North Atlantic Right Whales off of the Virginia Coast:

Data Quality and Initial Right Whale Presence Results

October 1, 2013

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Deployment and Recovery Information

6 marine autonomous recording units (MARU's) were used in two separate deployments to provide acoustic coverage ranging from June 3, 2012 – June 13, 2013. See Table 1 and 2 for deployment information including drop coordinates, recording start/end time and recording bandwidth. For the first deployment, (June – November 2012), 5 of the 6 units were successfully recovered (Table 1). For the second deployment (November 2012 – June 2013), 4 of the six units were recovered (Table 2), and of those 4 recovered, 3 experienced some unexpected data loss (Table 3).

See Figures 1 for a map of MARU locations. Table 3 outlines any hardware and recording malfunctions that occurred. Note all times are in Eastern Standard Time (EST).

Table 1: MARU deployment information for Deployment 01.

MARU #	Site #	Bandwidth (Hz)	Latitude Decimal Degrees	Longitude Decimal Degrees	Record Start Date/Time YYYY-MM-DD HH:MM:SS (EST)	Record End Date/Time YYYY-MM-DD HH:MM:SS (EST)
PU190	1	2000	36.8640400	-75.6652167	2012-05-31 15:09:53	2012-11-10 14:31:32
PU153	2	2000	36.9340933	-75.4249150	2012-05-31 15:00:43	2012-11-10 14:30:33
PU168	3	2000	36.8679350	-75.2749583	2012-05-31 15:14:55	2012-11-10 14:31:10
PU136	4	2000	36.9213933	-75.1036950	2012-05-31 15:18:37	2012-11-10 14:32:30
PU191	5	2000	36.9184917	-74.8384283	2012-05-31 15:22:12	2012-11-10 14:33:13
PU218	6	2000	36.9170000	-74.4786200	2012-05-31 15:27:44	Unit not recovered.

Table 2: MARU deployment information for Deployment 02.

MARU #	Site #	Bandwidth (Hz)	Latitude Decimal Degrees	Longitude Decimal Degrees	Record Start Date/Time YYYY-MM-DD HH:MM:SS (EST)	Record End Date/Time YYYY-MM-DD HH:MM:SS (EST)
PU195	1	2000	36.86475	-75.66588	2012-11-09 12:47:56	2013-05-26 07:05:54
PU193	2	2000	36.94466	-75.42702	2012-11-09 12:42:00	Unit not recovered.
PU163	3	2000	36.86773	-75.27485	2012-11-09 12:37:02	2013-06-04 21:27:10
PU130	4	2000	36.92127	-75.10345	2013-05-13 19:03:06	2013-06-08 07:53:09
PU217	5	2000	36.91748	-74.83757	2012-11-09 12:24:45	2012-06-13 16:57:41
PU227	6	2000	36.90081	-74.47935	2012-11-09 12:18:45	Unit not recovered.

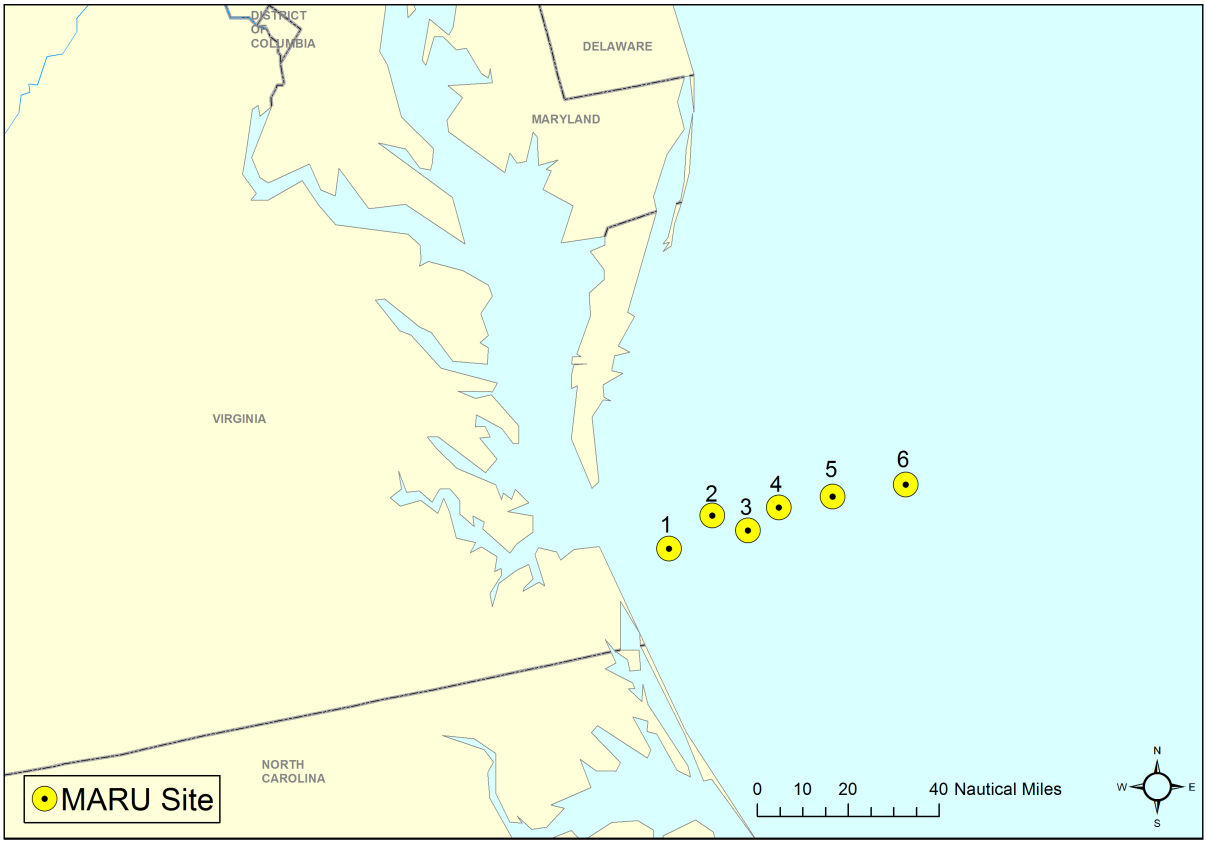

Figure 1: Deployment Site Map. For deployment 01 (June 3 – November 9, 2012), no data were available for MARU Site 6. For deployment 02 (November 10, 2012 – June 13, 2013), no data were available for MARU Site 2 and 6.

Hardware and Recording Failures:

During the course of the recording period, six MARU's experienced hardware and or recording failures. See Table 3 for a summary of each unit's issue.

Table 3: MARU hardware and recording failures.

MARU #	Site #	Hardware Issue
PU218	6 Dep 01	MARU was not recovered.
PU195	1 Dep 02	MARU stopped recording early on 2013-05-26.
PU193	2 Dep 02	MARU was not recovered.
PU163	3 Dep 02	MARU stopped recording properly on 2013-06-04.
PU130	4 Dep 02	MARU failed to record properly from 2012-11-09 through 2013-05-13. Data coverage for this unit is only from 2013-05-13 through 2013-06-08.
PU227	6 Dep 02	MARU was not recovered.

North Atlantic Right Whale Presence - Initial Data Analysis

Methods:

Daily presence of North Atlantic right whales (*Eubalaena glacialis*) was determined by the detection and verification of their contact calls (Morano et al., 2012a), the most commonly produced right whale call (Parks & Tyack 2005; Parks & Clark 2007). Analysis was performed on 9,024 hours of sound, from 376 days using an automated signal detection algorithm designed to detect contact calls (Urazghildiiev & Clark 2007; Urazghildiiev et al. 2009). Human analysts visually confirmed or rejected every detection event, resulting in no false positives and a low false negative rate. Every true positive upcall was verified by a human analyst and tabulated to be displayed in various daily and hourly plots.

Results:

North Atlantic right whales were found throughout the year, with an increased daily presence from mid-January 2013 through late March 2013. See Figure 2A and 2B for daily presence results.

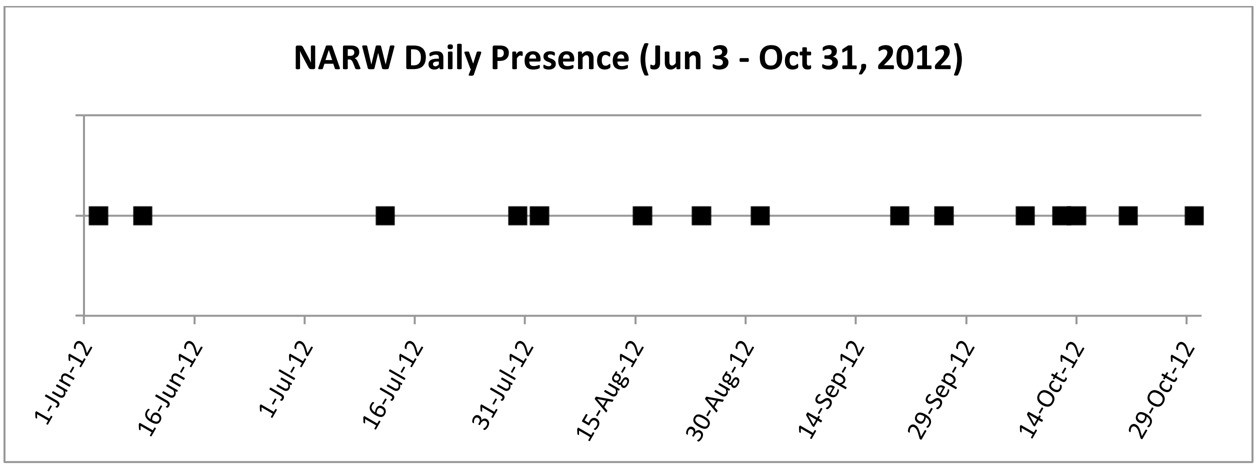

Figure 2A: Daily North Atlantic right whale presence for June 3, 2012 – October 31, 2012. Black squares represent right whale presence for that day.

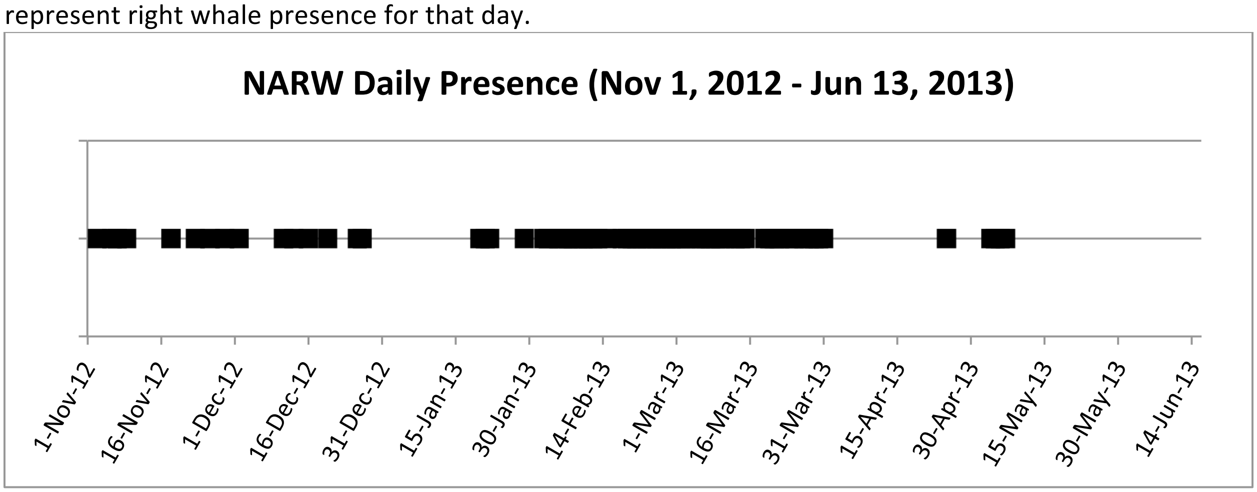

Figure 2B: Daily North Atlantic right whale presence for November 1, 2012 – June 13, 2013. Black squares represent right whale presence for that day.

Right whale presence was compared across MARU sites to give insight into the relative location of calling activity in the area. During the peak season of right whale daily and hourly presence from late January to late March, a significant portion of the upcalls were found at MARU sites 3 and 5, with a smaller percent found at MARU site 1. This differs with the rest of the year, where right whales were found to be randomly distributed across all MARU sites. See Figures 3A and 3B for daily presence based on MARU site location.

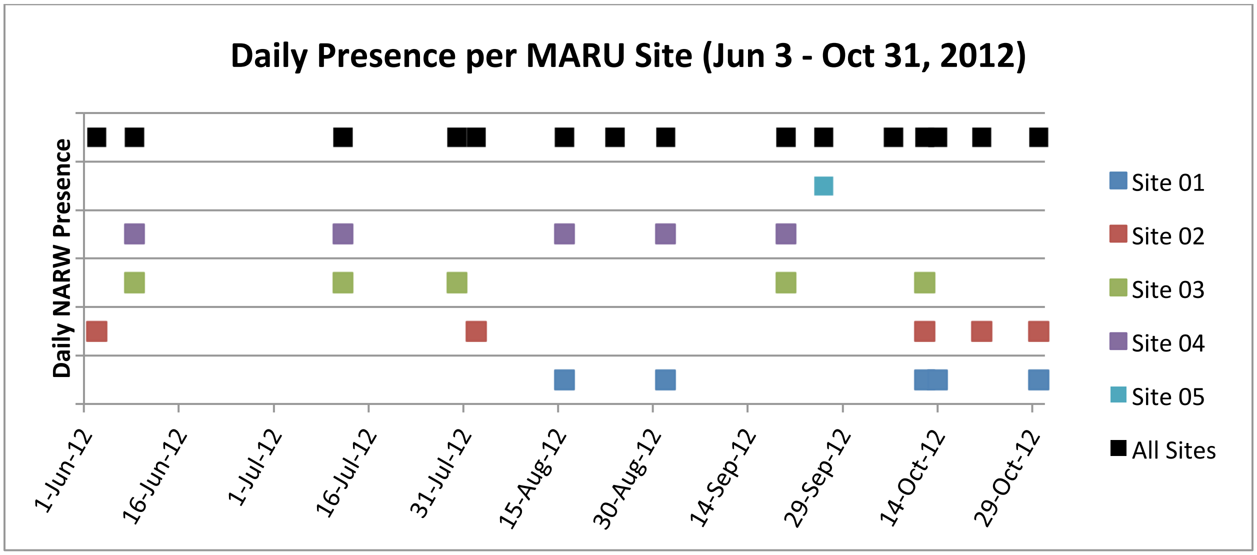

Figure 3A: Daily presence per MARU site from June 3 – October 31, 2012.

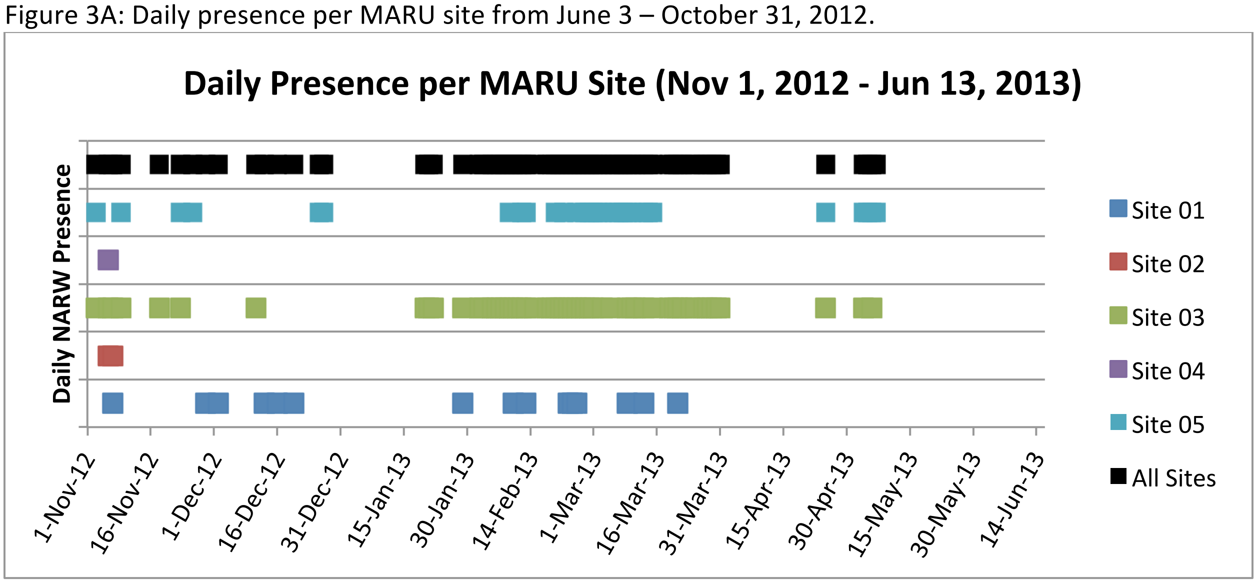

Figure 3B: Daily presence per MARU site from November 1, 2012 – June 13, 2013.

Increasing the resolution of analysis to consider hourly presence, a similar increase in hours containing North Atlantic right whale upcalls can be seen for the mid-January to late March time period. This illustrates a higher abundance of upcalls during this period as well. See Figure 3A and 3B for hourly presence results.

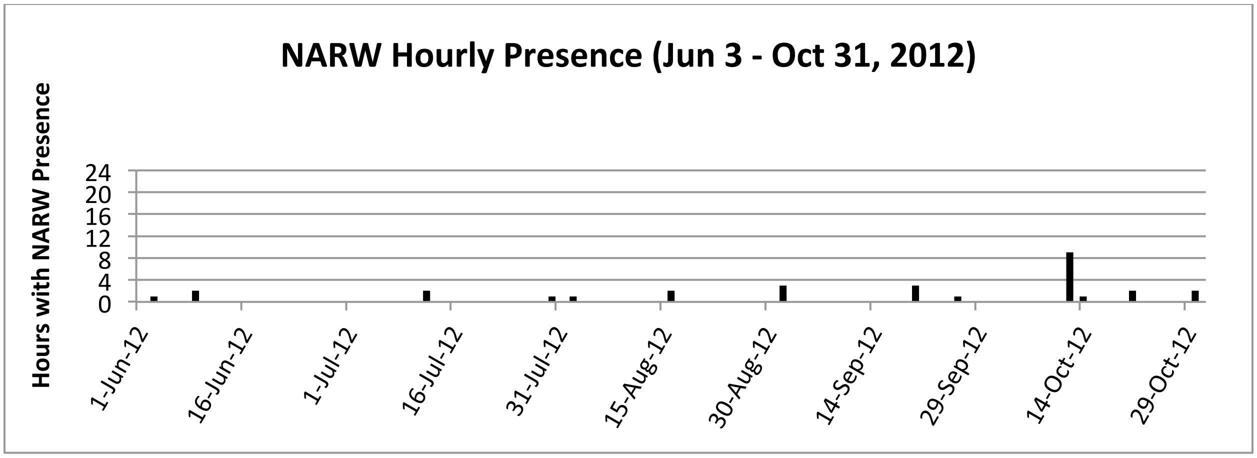

Figure 4A: Hourly North Atlantic right whale presence for June 3, 2012 – October 31, 2012. Total number of hours with right whale presence is represented on the y-axis.

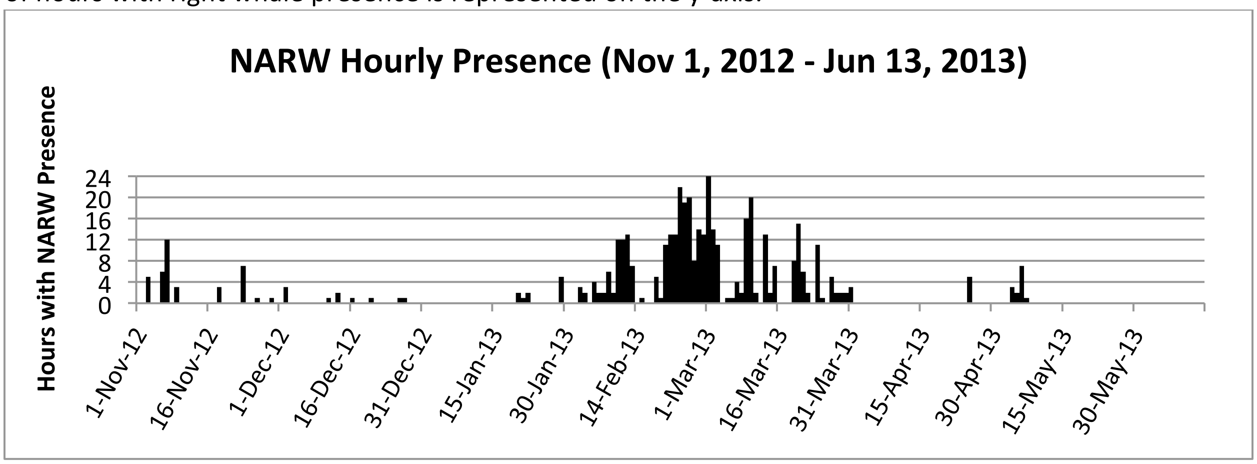

Figure 4B: Hourly North Atlantic right whale presence for November 1, 2012 – June 13, 2013. Total number of hours with right whale presence is represented on the y-axis.

Daily patterns of calling activity were determined by totaling the number of right whale upcalls per hour across the entire sample period. This confirmed that similar to patterns observed in Massachusetts Bay and Cape Cod Bay (Morano et al. 2012), the majority of calling activity occurs in the evening from 17:00 – 21:00 hours. See Figure 5.

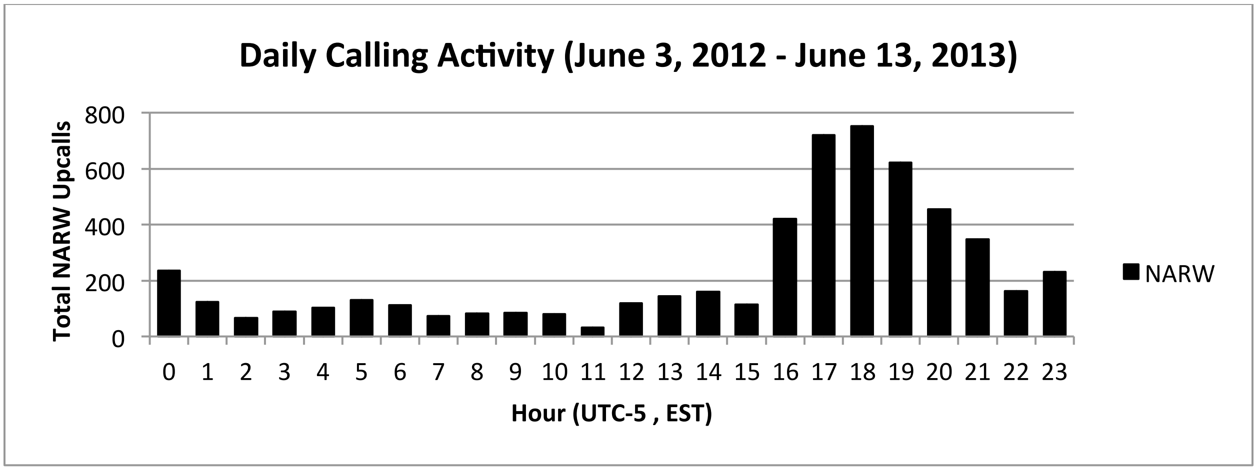

Figure 4: Daily pattern of right whale calling activity. All verified upcalls were totaled for each hour of the day throughout the entire recording period of June 3, 2012 – June 13, 2013.

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The documents cited in *Exhibit 2*, except for *Nowacek et al. (in press),* which is not yet published, were compiled on a thumb drive and were delivered by mail to Jolie Harrison, Chief, Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service, 1315 East-West Highway, Silver Spring, MD 20910. Publication of *Nowacek et al. (in press)* is expected next week and will be submitted shortly after publication.

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Dear Mr. President:

We, the undersigned, are marine scientists united in our concern over the introduction of seismic oil and gas exploration along the U.S. mid-Atlantic and south Atlantic coasts. This activity represents a significant threat to marine life throughout the region.

To identify subsea deposits, operators use arrays of high-volume airguns, which fire approximately every 10-12 seconds, often for weeks or months at a time, with sound almost as powerful as that produced by underwater chemical explosives. Already nine survey applications covering the entirety of the region several times over have been submitted within the past six months, including multiple duplicative efforts in the same areas. In all, the activities contemplated by the Interior Department would result in more than 20 million seismic shots.

Airgun surveys have an enormous environmental footprint. For blue and other endangered great whales, for example, such surveys have been shown to disrupt activities essential to foraging and reproduction over vast ocean areas. Additionally, surveys could increase the risk of calves being separated from their mothers, the effects of which can be lethal, and, over time, cause chronic behavioral and physiological stress, suppressing reproduction and increasing mortality and morbidity. The Interior Department itself has estimated that seismic exploration would disrupt vital marine mammal behavior more than 13 million times over the initial six-to-seven years, and there are good reasons to consider this number a significant underestimate.

The impacts of airguns extend beyond marine mammals to all marine life. Many other marine animals respond to sound, and their ability to hear other animals and acoustic cues in their environment are critical to survival. Seismic surveys have been shown to displace commercial species of fish, with the effect in some fisheries of dramatically depressing catch rates. Airguns can also cause mortality in fish eggs and larvae, induce hearing loss and physiological stress, interfere with adult breeding calls, and degrade anti-predator response: raising concerns about potentially massive impacts on fish populations. In some species of invertebrates, such as scallops, airgun shots and other low-frequency noises have been shown to interfere with larval or embryonic development. And threatened and endangered sea turtles, although almost completely unstudied for their vulnerability to noise impacts, have their most sensitive hearing in the same low frequencies in which most airgun energy is concentrated.

The Interior Department's decision to authorize seismic surveys along the Atlantic coast is based on the premise that these activities would have only a negligible impact on marine species and populations. Our expert assessment is that the Department's premise is not supported by the best available science. On the contrary, the magnitude of the proposed seismic activity is likely to have significant, long-lasting, and widespread impacts on the reproduction and survival of fish and marine mammal populations in the region, including the critically endangered North Atlantic right whale, of which only 500 remain.

Opening the U.S. east coast to seismic airgun exploration poses an unacceptable risk of serious harm to marine life at the species and population levels, the full extent of which will not be understood until long after the harm occurs. Mitigating such impacts requires a much better understanding of cumulative effects, which have not properly been assessed, as well as strict, highly precautionary limits on the amounts of annual and concurrent survey activities, which have not been prescribed. To proceed otherwise is simply not sustainable. Accordingly, we respectfully urge you, Mr. President, to reject the Interior Department's analysis and its decision to introduce seismic oil and gas surveys in the Atlantic.

Sincerely,

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